Version 8.0

User's Guide

Eventus®

Version 8.0

Software for Event Studies

and CRSP Data Retrieval

http://www.eventstudy.com/

User's Guide

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Standard Edition 2.1
January 2007

Notice Concerning Use of Eventus Software

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Introduction

Eventus® performs event studies using CRSP stock databases or user-collected data. Eventus can also retrieve raw returns, and raw or split-adjusted prices, bid and ask quotations, trading volume, number of trades and shares outstanding from the CRSP database. The raw data retrieval features use an event study-like query format, making them ideal for research that deals with similar events occurring at different times, such as security issuances. Eventus also includes utility features to convert calendar dates to CRSP trading day numbers, convert CUSIP identifiers to CRSP permanent numbers, and output cumulative or compounded abnormal returns for use in further analysis.

Eventus provides user control over estimation periods and cumulation or compounding windows (from very short to very long). The user has a choice of benchmarks such as comparison period mean returns, market returns, the market model, the Fama-French model, custom factor models and companion portfolios. Simple statements allow the researcher to run a complete event study, from reading the CRSP stock database to displaying and storing results, with a program as short as four lines. Volume event studies are available also.

Eventus 8.0 includes several new features, but is compatible with Eventus 7.x with the exception of one existing feature. In previous versions, the `EVTSTUDY` statement option `FACTORS=` was associated only with the event parameter approach. Therefore, if you specified the option without also specifying `SUR` or `ITSUR`, Eventus 7.x estimated an OLS event parameter model. The `FACTORS=` option now has an expanded role. To perform a similar function in Eventus 8.0 as `FACTORS=` in previous versions, specify the option combination `OLSPARAM FACTORS=`. Also, before Eventus 8.0, the

option referred to the number of factors including the market index. It now specifies the number of factors in addition to the market index.

This *Guide* is not intended to be a textbook on event study methods, although citations to relevant literature are provided. For an overview of event study methods, please see Peterson (1989), Binder (1998), and MacKinlay (1997). For a rigorous justification of conventional event-study procedures under certain conditions, see Prabhala (1997).

Please visit our Web site, `www.eventstudy.com`, for additional usage examples, frequently asked question lists (FAQs), upgrade announcements, documentation, software license sales and technical support.

Eventus is analytical software and does not include data. While Eventus can deal with all the CRSP stock data products mentioned in this *Guide*, your organization may not subscribe to all of them. If not, some database-specific features of Eventus may not be of use to you. However, as explained in Section 3.3, you can supply stock and index returns from non-CRSP sources and take advantage of all Eventus analytical features.

The symbols that appear in the statement descriptions in this *Guide* have the following meanings. In syntax descriptions, a vertical bar (|) indicates that only one of the words it joins may be chosen. Anything within square brackets ([]) is optional. **Boldface type** indicates that you enter the word exactly as it appears in the statement description. Replace a word or symbol set in *slanted Roman type* with a word or numeral of your choice. An ellipse (. . .) indicates that you can continue with additional specifications. In the text, Eventus statement names and variable names are set in a `fixed width font`. Names of statements that are part of Eventus typically appear in upper case, but are not case-sensitive in practice. Thus, `EVENTUS` refers to the statement of that name, whereas Eventus refers to the software package as a whole. Statement and option names in the text may be hyphenated for formatting purposes, but no statement or option name actually includes a hyphen. Variable names often appear in lower or mixed case in this *Guide* and are not case-sensitive in practice. The terms "variable" and "column" are used interchangeably, as are the terms "line" and "row" in reference to a file or data set.

The term "listing output" refers to results that, by default, appear in the SAS Output window or in a text file with a `.lst` extension. Previous editions of this *Guide* used the term "printed output" for listing output.

Chapter 2

Event Studies: The Essentials

> *"Much has been learned from the body of research based on event study methodology.... As one moves forward, it is expected that event studies will continue to be a valuable and widely used tool in economics and finance."* MacKinlay (1997, p. 38)

2.1 A Simple Program

Eventus offers many options to tailor its operation. As an introduction to Eventus event studies, this chapter presents a program in the simplest possible form, without options.

Figure 2.1 shows the minimum set of statements to run an event study using daily CRSP data. An event study using non-CRSP data is similar, but the user must prepare a mini-database and add related specifications to the Eventus statements. Section 3.3 describes the differences.

The user can type the statements into the SAS Editor window for interactive submission or create and save a separate program file (plain text but with a `.sas` extension) for command-line submission. Statements are not case sensitive, with the possible exception of text inside quotation marks.

Figure 2.1
The Simplest Eventus Event Study Program.

```
filename request 'F:\Any Folder\Filename.extension';
Eventus;
 Request;
 Evtstudy;
```

Figure 2.2
Request File: PERMNOs and Dates.

```
11983 20030623
13100 20050225
14322 20041117
32379 20050309
62324 20031109
69163 20030924
76101 20040813
76238 20030204
77284 20041210
78752 20050118
79910 20050126
81064 20030220
82843 20030708
86259 20050418
86447 20040715
88275 20050615
```

The `filename request` statement points to the *request file*.[1] The request file is a separate file that the researcher creates to define the sample for the study. Each line of the request file contains a five digit PERMNO identifier and a date in the form YYYYMMDD. The date in the request file is the event date on which the event study is centered, "day 0". Spacing is unimportant as long as at least one blank separates the PERMNO and date. Figure 2.2 displays an example of a text request file. The request file need not be sorted.

The `EVENTUS` statement gets the package started. Here, the statement

[1] `filename` is a base SAS statement. A SAS file shortcut, also known as a fileref, is a short reference label associated with a file not in a format exclusive to SAS, such as a text file. The user can define a SAS file shortcut using a `filename` statement, or in the SAS Explorer window of interactive SAS.

Figure 2.3
Eventus Listing Output: First Page.

```
          Eventus (R) Software from Cowan Research, L.C.


Eventus (R) software is produced by Cowan Research, L.C.
http://www.eventstudy.com/


ESTIMATION PERIOD:  Ends 46 days before the event date;
                        255 days in length.

TOTAL EVENTS IN REQUEST FILE:                              16

EVENTS DROPPED:                                             1
EVENTS WITH USEABLE RETURNS:                               15


MINIMUM RETURN DATA REQUIRED FOR ESTIMATION:                   3


STATISTICAL SIGNIFICANCE LEVELS:  1 tailed


NOTE:  Useable returns means all nonmissing returns except the
      first day after a missing estimation period return.
```

consists simply of the word `EVENTUS` and a semicolon. Later chapters describe options that can be added. The `REQUEST` statement in the next line tells Eventus to read the request file. In the last line, `EVTSTUDY` launches the event study.

2.2 Listing Output

After the user runs the four statements, the results appear in the Output window of interactive SAS, or the listing file (`*.lst`) produced by a command-line run. Figures 2.3 and following present the results for the above request file and Eventus statements. The first page of output summarizes the sample and some default settings. The second page presents a listing of the sample, reporting how many daily returns are available for each event. The issuer name comes from the name history array of the CRSP database and is the name in effect on the event date. If a share class letter exists in the database, it is reported at the end of the name in the sample listing.

Figure 2.4
Eventus Listing Output: Data Availability Report.

Eventus (R) Software from Cowan Research, L.C.

Results of Daily Security Return Data Input

PERMNO	Name on Event Date	Event Date	Estimation Period Returns <=255	Event Period Returns <=61	Reason if no useable returns
11983	BIOGEN INC	06/23/2003	253	61	
13100	MAY DEPARTMENT STORES CO	02/25/2005	255	61	
14322	SEARS ROEBUCK & CO	11/17/2004	255	61	
32379	GREAT LAKES CHEM CORP	03/09/2005	255	61	
62324	Not checked or unavailable.	11/09/2003	*	*	Market closed on 11/09/2003
69163	ALBERTO CULVER COA	09/24/2003	255	61	
76101	VARCO INTERNATIONAL INC DEL	08/13/2004	255	61	
76238	NUEVO ENERGY CO	02/04/2003	255	61	
77284	NEXTEL COMMUNICATIONS INCA	12/10/2004	255	61	
78752	CEDARA SOFTWARE CORP	01/18/2005	41	61	
79910	MAGNUM HUNTER RESOURCES INC	01/26/2005	255	61	
81064	SPORTS AUTHORITY INC	02/20/2003	255	61	
82843	ROADWAY CORP	07/08/2003	255	61	
86259	ELECTRONICS BOUTIQUE HLDGS CORP	04/18/2005	255	61	
86447	CAESARS ENTERTAINMENT INC	07/15/2004	255	61	
88275	INTEGRATED CIRCUIT SYSTEMS INC	06/15/2005	255	61	

* No useable returns found.

The third page presents sample mean and median statistics of returns and estimated benchmark model parameters for each security-event. By default, Eventus uses the market model, estimated by ordinary least squares with data from a 255 trading-day estimation period ending 46 trading days before the event date. In Figure 2.5, the alpha, beta and residual standard deviation are the estimated market model intercept, slope and root mean squared error, respectively.

The final pages present the event study results. The event period is defined by default as 30 trading days before through 30 trading days after the event date. By default, Eventus reports one parametric test statistic (the Patell test) and one nonparametric test statistic (the generalized sign test). Figure 2.6 presents the first page of event study results. The daily results continue on the next page, not displayed here. Figure 2.7 shows the final page of output, where the results for the windows appear. By default,

Figure 2.5
Eventus Listing Output: Parameter Estimates and Estimation Period Statistics.

Eventus (R) Software from Cowan Research, L.C.

Parameter Estimates and Estimation Period Statistics

---------- Market Index=Equal ----------

PERMNO	Event Date	Mean Total Return	% of Raw Returns >0	Alpha	Beta	Market Model Residuals>0	Total Return Variance	Residual Standard Deviation	Autocorrelation*
76238	04FEB2003	0.00054	47.45%	0.00010	1.13	48.24%	0.00095	0.02852	-0.0837
81064	20FEB2003	0.00297	47.45%	0.00251	2.01	45.88%	0.00272	0.04793	-0.0389
11983	23JUN2003	-0.00148	49.41%	-0.00144	1.67	52.17%	0.00097	0.02567	0.0337
82843	08JUL2003	0.00131	47.06%	0.00099	1.33	42.35%	0.00102	0.02871	0.0504
69163	24SEP2003	0.00113	52.94%	0.00036	0.48	49.02%	0.00014	0.01090	-0.0683
86447	15JUL2004	0.00229	53.73%	0.00028	1.05	49.41%	0.00030	0.01554	-0.0732
76101	13AUG2004	-0.00011	46.67%	-0.00123	0.72	48.24%	0.00049	0.02145	-0.1512
14322	17NOV2004	0.00003	48.63%	-0.00088	1.10	49.80%	0.00030	0.01522	0.1211
77284	10DEC2004	0.00128	54.90%	-0.00032	1.74	50.98%	0.00043	0.01609	-0.0242
78752	18JAN2005	0.00339	46.34%	0.00424	-0.53	39.02%	0.00056	0.02379	-0.0639
79910	26JAN2005	0.00189	56.08%	0.00097	1.17	47.45%	0.00054	0.02157	-0.0556
13100	25FEB2005	0.00035	49.80%	-0.00050	0.95	47.45%	0.00029	0.01548	-0.1166
32379	09MAR2005	0.00042	47.45%	-0.00098	1.51	46.67%	0.00036	0.01549	-0.1206
86259	18APR2005	0.00170	52.94%	0.00074	1.60	48.63%	0.00058	0.02119	0.0113
88275	15JUN2005	-0.00129	46.67%	-0.00172	1.73	51.37%	0.00049	0.01878	0.0236
MEAN		0.00096	49.83%	0.00021	1.18	47.78%	0.00068	0.02175	-0.0371
MEDIAN		0.00113	48.63%	0.00010	1.17	48.24%	0.00049	0.02119	-0.0556

* First order autocorrelation of market model abnormal returns

Eventus uses three windows for abnormal return cumulation: the pre-event period, trading days −30 through −2; days −1 and 0, a period commonly investigated for the immediate impact of the event; and the post-event period, days +1 through +30.

The Patell Z test is an example of a standardized abnormal return approach, which estimates a separate standard error for each security-event and assumes cross-sectional independence. The generalized sign test adjusts for the fraction of positive abnormal returns in the estimation period instead of assuming 0.5. Appendix A presents further details of the tests. The next chapter describes alternative tests and benchmark methods that the user can select.

2.3 The SAS Log: Notes, Warnings and Errors

When you run Eventus, the SAS log window or log file reports the completion of data steps and procedures that Eventus executes internally. Most Eventus users will find that many of these details have little meaning for them. However, it is a good idea to briefly scan the SAS log for messages that begin with `NOTE`, `WARNING`, or `ERROR`. Eventus occasionally generates informative notes and important warnings. Other notes and warnings, generated automatically by SAS in response to routine internal Eventus operations, are less likely to require user attention.

Log messages marked as errors, however, are nearly always critical. If an error message in the SAS log is not self-explanatory, please send an e-mail to `support@eventstudy.com` for help. Please attach the entire log window contents, or *.log file, resulting from one attempted Eventus run that generated the error. In some cases, we will ask for more information, but the log is a good starting point for diagnosis. WRDS web interface users should contact WRDS support for help; Cowan Research LC does not provide direct support for the web interface.

Figure 2.6
Eventus Listing Output: Daily Results.

Eventus (R) Software from Cowan Research, L.C.

Market Model, Equally Weighted Index

Day	N	Mean Abnormal Return	Positive: Negative	Patell Z	Generalized Sign Z
-30	15	-0.28%	9:6	-0.321	0.948
-29	15	-0.04%	7:8	0.072	-0.086
-28	15	-0.06%	6:9	0.139	-0.603
-27	15	2.24%	10:5)	4.259***	1.465$
-26	15	-0.12%	6:9	-0.468	-0.603
-25	15	0.40%	7:8	1.170	-0.086
-24	15	-1.01%	4:11(	-1.639$	-1.637$
-23	15	0.89%	8:7	1.342$	0.431
-22	15	-0.86%	5:10	-1.290$	-1.120
-21	15	-0.43%	7:8	-0.488	-0.086
-20	15	-0.21%	7:8	-0.421	-0.086
-19	15	-1.12%	6:9	-2.314*	-0.603
-18	15	-1.17%	6:9	-1.716*	-0.603
-17	15	0.19%	6:9	0.190	-0.603
-16	15	-0.24%	5:10	0.133	-1.120
-15	15	0.87%	10:5)	1.779*	1.465$
-14	15	0.37%	8:7	0.589	0.431
-13	15	-0.82%	8:7	-0.371	0.431
-12	15	0.02%	7:8	-0.320	-0.086
-11	15	-0.06%	6:9	-0.642	-0.603
-10	15	-0.90%	5:10	-1.435$	-1.120
-9	15	0.43%	7:8	1.263	-0.086
-8	15	1.52%	7:8	4.304***	-0.086
-7	15	-0.20%	5:10	-0.785	-1.120
-6	15	0.77%	10:5)	1.198	1.465$
-5	15	-0.36%	7:8	-0.963	-0.086
-4	15	1.04%	10:5)	2.173*	1.465$
-3	15	-0.02%	7:8	-0.198	-0.086
-2	15	-0.27%	7:8	-0.035	-0.086
-1	15	1.53%	8:7	3.531***	0.431
0	15	10.06%	11:4>	17.438***	1.981*
+1	15	0.56%	7:8	0.627	-0.086
+2	15	0.02%	8:7	0.426	0.431
+3	15	-0.32%	7:8	-0.844	-0.086
+4	15	-0.26%	7:8	-0.028	-0.086

The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01 and 0.001 levels, respectively, using a 1-tail test. The symbols (,< or),> etc. correspond to $,* and show the significance and direction of the generalized sign test.

Figure 2.7
Eventus Listing Output: Window Results.

Eventus (R) Software from Cowan Research, L.C.

Market Model, Equally Weighted Index

Days	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Generalized Sign Z
(-30,-2)	15	0.57%	2.61%	9:6	0.966	0.948
(-1,0)	15	11.59%	10.53%	12:3>>	14.827***	2.498**
(+1,+30)	15	0.61%	0.90%	9:6	0.328	0.948

The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01 and 0.001 levels, respectively, using a 1-tail test. The symbols (,< or),> etc. correspond to $,* and show the significance and direction of the generalized sign test.

Chapter 3

Event Studies: The Options

Eventus lets you configure many details of its operation to suit your needs. Eventus uses option keywords, some with arguments and some without. Each statement accepts multiple options. Options can appear in any order after the statement name and before the semicolon, separated by one or more blank spaces or line breaks. This *Guide* typically presents statement and option names in upper case, but the user can specify them in upper, lower or mixed case. This chapter describes many common options for event studies. The complete list of options appears in Appendix B.

3.1 Event Studies Centered on a Single Event Date

The typical event study analyzes returns around one event date. If you need to cumulate or compound returns between two paired event dates, when the number of days or months between them varies across security-events, continue with section 3.2 after reading this section. Figure 3.1 displays the Eventus statements to run an event study with a single event date.

The `EVENTUS` statement

Use options on the `EVENTUS` statement to make non-default selections regarding the CRSP or non-CRSP data source and supplemental data. By default, Eventus tries to read stock and market return data from a daily CRSP U.S.

Figure 3.1
Eventus Statements for an Event Study Centered around a Single Date, with Selected Options.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS [**MONTHLY**] [**ESTINTER=DAY**|**MONTH**]
[**FFF=***libname.member*] [**VOLUMEINDEX=***libname.member*]
[**MYFACTORS=***libname.member*]
[**MYCOMPANIONIDX=***libname.member*
PORT1DS=*libname.member*]**;**

[**TITLE** '*text*'**;**]

[**TITLE2** '*text*'**;**]

REQUEST [**INSAS=***libname.member*]
[**CUSIPERM**] [**AUTODATE**[**=BACK**]]
[**ID=***variable* **IDFMT=***format*] [**GROUP=***variable* [**GRWEIGHT**]]
[**DATEFMT=MMDDYY**|**YYMMDD**|**DDMMYY**|**...**|**CRSP**]
[**SIZEINDX**[**=CRSPACCESS**|**OWNMARKET**|**CAPBASED**|**SP500**]
|**COMPOSIT**|**BETAINDEX**|**STDINDEX**|**COMPANION**]
[**NODIVIDX**] [**EST=**−*value*| +*value*] [**POOL**]
[**ESTLEN=***n*] [**MINESTN=***n*] [**SHORT**]**;**

[**WINDOWS** *(begin,end)* [*(begin,end) ...*]**;**]

EVTSTUDY [**NONAMES**|**NOPLIST**|**SIC**] [**PLOT**]
[**DETAIL**|**DETAIL=FULL**] [**RAW**] [**CP**] [**MAR**] [**NOMM**]
[**FACTORS=***n*] [**MEDIAN**] [**BUYHOLD**]
[**VALUE**|**BOTH**] [**SW**|**GARCH**|**EGARCH**]
[**VOLUME**] [**MAXMISS=***n*]
[**PRE=***periods*] [**POST=***periods*] [**OVERLAP**]
[**PATELL**] [**STDCSECT**] [**EGLS**] [**CDCSI**] [**SERIAL**]
[**TRANSNORM**] [**CDA**] [**CSECTERR**] [**CALENDARTIME**]
[**RANKTEST**] [**JACKKNIFE**] [**WSR**] [**BOOT**]
[**FAMAFRENCH** [**MOMENTUM**]] [**IRATS**|**TWOSTEP**]
[**TAIL=1**|**2**] [**BTAIL=1**|**2**]
[**OUTWIN=***libname.member*|**FILEWIN=***file shortcut or name*]**;**

stock database. Event studies using monthly CRSP data, or using the SAS-NONCRSP input method (section 3.3) for other data sources, are similar.

MONTHLY To select a monthly CRSP stock database instead of the default daily, or to indicate that non-CRSP input data are monthly, specify MONTHLY on the EVENTUS statement. For example,

```
EVENTUS MONTHLY;.
```

FFF This option points to the data set containing Fama-French and momentum factor returns, needed only if the EVTSTUDY statement option FAMAFRENCH, described below, is present.

VOLUMEINDEX= This option points to the data set containing market volume index returns, needed only if the EVTSTUDY statement option VOLUME, described below, is present.

MYFACTORS= This option points to the data set containing user-provided factor returns, needed only if the EVTSTUDY statement option combination TWOSTEP FACTOR=*n* is present.

MYCOMPANIONIDX= **and** PORT1DS= These options point to SAS data sets containing companion portfolio returns and mappings between security identifiers and portfolio numbers. The companion portfolio data are used only if the REQUEST statement option COMPANION is present. Please see page 105 for details.

ESTINTER By default, Eventus uses the same return frequency for the estimation period and event period. The ESTINTER option selects a different return frequency for the estimation period. For example, to run a daily return event study (the default) using market model parameters estimated from monthly returns instead of daily, specify ESTINTER=MONTH. When using CRSP data, Eventus uses the CRSP environment variables to locate the daily and monthly stock databases installed on your system. See Handa, Kothari and Wasley (1989) for a discussion of the relation between the parameter estimation interval and measured beta.

The REQUEST statement and request file

The REQUEST statement processes the trading calendar of the input database and processes the user's request file. The statement accepts options that control the processing of these inputs, define the estimation period, determine which market indexes or benchmark portfolios are available to the event study, and select special handling of input returns.

By default, the request file is expected to be a text file; optionally, it can be a SAS data set. Use it to list the PERMNO or alternative security identifiers, event dates, and depending on the options used in the event study (see below), possibly other security-event-specific information. Chapter 2 presents an example of a basic text request file.

If the request file is a text file, the SAS file shortcut `request` must point to it. If the request file is a SAS data set, specify its two-part name using the INSAS=*libname.membername* option. In the simplest case, a SAS data set request file includes a numeric variable (column) named PERMNO containing the five-digit CRSP permanent issue number and a SAS date variable named `eventdat` representing day 0. Page 130 summarizes the other columns that Eventus recognizes in a SAS data set request file, some of which are described in this section.

For monthly event studies, the dates in a text request file can be any day of the month; in a SAS data set request file, use the first of the month. For weekly event studies, use the last trading day of the week in either a text request file or SAS data set, or specify any day up to the last trading day and use the AUTODATE option described below.

Option to convert CUSIPs to PERMNOs

To search a CRSP stock database by CUSIP instead of the default PERMNO, use CUSIP instead of PERMNO in the request file and specify the CUSIPERM option on the REQUEST statement. Eventus matches each CUSIP to the corresponding CRSP PERMNO, then uses the PERMNO to locate stock data in the database. When using CRSP data, each CUSIP must be exactly eight characters long. A six-character CUSIP identifies only the issuer, not a unique issue in the database. A nine-character CUSIP includes a check digit that CRSP does not use. If the request file is a SAS data set, use CUSIP as the name of the column containing the CUSIP; the variable length in the data set properties should be eight. To build a new copy of the request file that contains the PERMNOs

Eventus finds, please see Chapter 7.

The `CUSIPERM` option works properly only if the program `Update PERMNO-CUSIP Conversion Database.sas` is run during Eventus installation (the Eventus for Windows setup program does this automatically) and after each annual, quarterly or monthly update of the CRSP stock database. Only CUSIPs present in the CRSP database are matched.

Including an identification variable

Each row of the request file can include an optional variable to identify the security-event uniquely. Use the option `ID=` to specify the desired (text request file) or actual (SAS data set) name of the optional identification variable. The variable can have almost any valid SAS name (letters, digits and underscores, with the first character a letter or underscore), but don't use the name of the active security issue key (e.g. `PERMNO`). Use `IDFMT` to specify the SAS format for reading and displaying the identification variable. `IDFMT=4.0` means a 1–4 digit integer; `IDFMT=$4.` means a four character string. Other lengths and other SAS formats are permitted. In a text request file, the identification variable, when used, must follow the dates on each line of the file.

Grouping variables and group weights

When you specify `GROUP=`*variable name*, Eventus looks for a grouping variable in the request file. Replace *variable name* with a valid SAS name, for example `GroupNum`. The grouping variable should follow the event date, and the `ID` variable if there is one, on each line of a text request file. If the request file is a SAS data set, the *variable name* column must contain the grouping variable. The grouping variable must be numeric. Rows with the same grouping variable value need not be contiguous in either type of request file.

When two or more observations have the same grouping variable value, Eventus combines the observations into a portfolio and uses the portfolio return, as if it were a single security's return, in the event study. The portfolio is aligned in event time, not calendar time. For example, the portfolio return for trading day 0 is the mean, across securities with the same grouping variable value, of the respective day 0 returns, without regard to whether the

Figure 3.2
A Text Request File Configured for the GROUP and GRWEIGHT options.

```
56899 19851016 01 85 .16666
60038 19851016 05 85 .16666
28804 19851016 09 85 .16666
42083 19851016 13 85 .16666
18817 19851016 17 85 .16666
44740 19851016 21 85 .1667
56899 19870206 03 87 .20
60038 19870206 07 87 .20
28804 19870206 11 87 .20
42083 19870206 15 87 .20
18817 19870206 19 87 .20
56899 19940131 00 94 .08333
60038 19940131 04 94 .08333
28804 19940131 08 94 .08334
42083 19940131 12 94 .25
18817 19940131 16 94 .25
44740 19940131 20 94 .25
56899 19960206 02 96 .20
60038 19960206 06 96 .20
28804 19960206 10 96 .20
42083 19960206 14 96 .20
18817 19960206 18 96 .20
```

calendar dates differ across securities. Any market index, factor or companion portfolio return receives similar treatment.

By default, the observations with a common grouping variable value receive equal weights in the group portfolio. To specify unequal weights, use the GRWEIGHT option. Each row of the request file then must contain a within-group weight. In a text request file, the weight must appear immediately after the grouping variable value. In a SAS data set request file, the column name must be GRWEIGHT. The weights should sum to one across the rows of each group.

For example, suppose a researcher specifies this REQUEST statement:

```
request id=Event group=GROUP grweight;
```

The request file in Figure 3.2 provides the required information. Following the security identifier and event date, each line lists the identification number EVENT, the group number GROUP, and the weight for the observation within its group. Event 00 is part of GROUP 94 and receives weight .08333, while Events 04, 08, 12, 16 and 20 in the same group receive weights of .08333, .08333, .25, .25, and .25 respectively. Other observations are part of other groups. The number of members can vary from group to group, as it does

here. If the GRWEIGHT option is absent, Eventus does not recognize or use the weight information in the request file.

The example happens to have several repeated PERMNOs, but it could just as well have all different PERMNOs. The example also features event dates that are the same across the security-events within each group. This is not a requirement, but if the dates vary within a group, any market model or multi-factor model results should be interpreted with caution.

Short positions

Each security-event normally has a positive weight in the event-time portfolio. To indicate that some security-events should enter the portfolio as if they are sold short, specify SHORT on the REQUEST statement. In a text request file, place either an S or an L as the last item of each line to indicate short or long. In a SAS data set request file, include a character variable of length one named SL. When S appears, Eventus reverses the sign of each estimation-period and event-period security return for the security-event. The sign reversal occurs just after the return is read from the input database and verified as non-missing. The same security can be held short in one event and long in another; Eventus re-reads the security returns from the input database for each row of the request file, even if both the security identifier and event date are the same as another row, and reverses the sign only for S security-events.

After performing the sign reversal, Eventus makes no further distinction between S and L security-events, except in calculating buy-and-hold compounded returns. In Eventus 8.0, the buy-and-hold abnormal return of an S security-event is the negative of the buy-and-hold abnormal return if the security were held long over the same holding period, not the compounded value of the sign-reversed daily or monthly returns.

Eventus makes no explicit adjustment to portfolio weights as a result of the SHORT option. The event study calculations still treat the sample as an equally weighted portfolio of securities held long; the negative weights of shorted securities are implied by the sign reversal discussed above.[1] This allows the researcher to create an arbitrage portfolio by specifying a short position for half the security-events and a long position for the other half. The portfolio weights sum to zero in an arbitrage portfolio.

[1] Replace "equally weighted" by "precision-weighted" in the case of standardized abnormal return tests, or "value-weighted" if the valueweightsample option is active.

Studies of insider trading often use combinations of short and long positions in abnormal return tests. For examples, see Rozeff and Zaman (1988) and Arshadi and Eyssell (1991).

Options for processing dates

The following `REQUEST` statement options select how Eventus handles the dates in the request file.

The `DATEFMT=` option

Calendar dates If the request file is a SAS data set, the event date variable `eventdat` (or `eventda1` and `eventda2` for a two event-date (twin) event study; see section 3.2) must be a SAS date variable, not an integer date. In a text request file, list calendar dates in any conventional format. The default is YYMMDD, which automatically accommodates both eight digit (four digit year) and six digit (two digit year) dates. Besides MMDDYY, DDMMYY and so on, you can use the style expected by the SAS informat DATE.[2]

CRSP and similar dates Eventus internally converts calendar dates to sequential trading day or month numbers (called CRSP dates generically, but applicable to mini-databases, discussed in Section 3.3, as well as CRSP databases). However, if you already have CRSP dates, you can use them in the request file. Specify `DATEFMT=CRSP` on the `REQUEST` statement to indicate that the request file dates are CRSP dates. If the request file is a SAS data set, name the date variable `crspday` (or `crspda1` and `crspda2` when the `TWIN` option is in effect).

`AUTODATE` By default, in an Eventus run with daily data, event dates on which the market is closed are dropped from the analysis and reported as such in the data availability listing. Specifying `AUTODATE` on the `REQUEST` statement causes Eventus to convert non-trading days to trading days. Non-trading days are converted to the following trading day; for example, a Saturday in the United States markets would be changed to the following Monday,

[2] An example of a date in DATE style is 19OCT2006.

or Tuesday if Monday were a holiday. To convert non-trading dates to the previous trading day instead of the next, specify `AUTODATE=BACK`.

Market index options

`NODIVIDX` Eventus normally uses the returns including dividends of the basic equally weighted and value-weighted indexes in the CRSP or other input database. Specify `NODIVIDX` to use the index returns excluding dividends.

`SP500|COMPOSIT` The CRSP NYSE-AMEX-Nasdaq stock database reports the Standard and Poor's 500 Composite Index and the Nasdaq Composite Index in addition to CRSP-defined indexes. Specify `SP500` to use the Standard and Poor's index return or `COMPOSIT` to use the Nasdaq Composite return. These options refer to stock database indexes, not the *CRSP Indices Database and Security Portfolio Assignment Module*, an add-on to the stock database. If the `BOTH` option is active, an index selected by one of these options replaces the value-weighted index.

`SIZEINDX` This option allows the use of size-portfolio returns.[3] Eventus reads the size (capitalization) portfolio membership information from the CRSP database, as of the event date, to determine which size portfolio return to use. All tests described in this *Guide* are conducted as they would normally be, except that the index return is a size portfolio return instead of the return on a broader market index.[4]

Subscribers to the *CRSP Indices Database and Security Portfolio Assignment Module* (an add-on to the stock database) can use several of its stock capitalization decile indexes and cap-based portfolios. To use the size-decile portfolio returns based on rankings of the entire CRSP universe of NYSE, Nasdaq, and AMEX stocks, specify `SIZEINDX=CRSPACCESS`.

To use NYSE-only, AMEX-only and Nasdaq-only size-decile portfolios as replacement market indexes for NYSE, AMEX and Nasdaq stocks, respectively, specify `SIZEINDX=OWNMARKET`. Eventus matches each stock in the sample to a market and size decile using the CRSP-reported exchange and decile number as of the event date (day or month 0). `SIZEINDX=OWNSYSTEM` (not shown in

[3]This option is not supported for the `SASNONCRSP` input mode. Instead, use the companion index method; see the `mycompanionidx` option on page 105.

[4]Portfolio 1 contains the stocks with the smallest capitalization; portfolio 10, the largest.

Figure 3.1) is similar to `OWNMARKET` except that it matches combined NYSE-AMEX size-decile portfolios to NYSE and AMEX stocks.

The following two options, not shown in Figure 3.1, select size-decile portfolios from a specific market system, regardless of the trading location of the stocks in the sample. To use NYSE-AMEX-only size-decile portfolios, specify `SIZEINDX=NYSEAMEX`. To use Nasdaq-only size-decile portfolios, specify `SIZEINDX=NASDAQ`. To use the monthly CRSP Cap-Based Portfolios containing stocks from the entire CRSP universe (NYSE, Nasdaq, and AMEX) with decile breakpoints based on NYSE stocks only, specify `SIZEINDX=CAPBASED`.

If the size-portfolio returns come from a file generated by the `SizBuild` statement, specify the `SIZEINDX` option without an argument. In this case, the SAS file shortcut `sizeindx` must point to the size-portfolio index file.[5]

For all flavors of the option, the size-decile assignment is fixed as of the event date. If some days or months fall in different years than day 0, when the stock could belong to a different decile, this is not taken into account. The returns provided in place of market index returns are still those of the decile to which the stock is assigned as of day or month 0. For example, if day 0 is in 2004 and day +30 is in 2005, the size decile portfolio return for day +30 is the return on the decile to which the stock is assigned in 2004. All returns correspond to the correct respective days or months; only the decile number, to determine which size portfolio's return to use, is fixed.

`BETAINDEX` and `STDINDEX` These options select the use of NYSE-AMEX risk decile-portfolio returns when the *CRSP Indices Database and Security Portfolio Assignment Module* is available. Eventus reads the risk decile assignment codes, as of the event date, from the CRSP database to determine which beta or standard deviation decile-portfolio return to use. Event studies are conducted as they would be otherwise, except that the selected type of risk decile-portfolio return substitutes for the return on a broader market index. These options are available only with daily returns. For variant forms of the options, please see the reference documentation beginning on pages 127 (`BETAINDEX`) and 136 (`STDINDEX`). As with size deciles, the decile assignment is fixed as of day 0.

[5] In an Eventus-generated binary size-index file, the date expressed as a YYYYMMDD integer occupies the first four bytes of each record. The ten size portfolio returns for the date follow in the next 40 bytes, each represented as a four-byte real value.

`COMPANION` Substitutes the matched companion portfolio return for the default market-wide index return. This requires the `EVENTUS` statement options `MYCOMPANIONIDX` and `PORT1DS` to point to the companion portfolio data. The companion portfolio facility enables the user to provide a set of benchmark portfolio returns, which Eventus matches to each security based on user-determined characteristics. Please see page 105 for details. To run an event study where the abnormal return is defined as the security return minus the companion portfolio return, use the `COMPANION` option and also the `MAR` option of the `EVTSTUDY` statement.

Using an outside market index You can provide a market index return separately instead of using one from the CRSP database. Please see the reference documentation of the `EVENTUS` statement option `MYVWINDEX=` on page 106 for details.

Continuously compounded returns

To analyze returns in continuously compounded form, specify `LOG` on the `REQUEST` statement. Eventus then transforms each security and index return r_{jt} to $\log_e(1 + r_{jt})$ as it is read from the database. By default, Eventus does not make the log transformation.

Selecting the benchmark estimation period

The estimation period is the period used for running market model or factor model regressions, computing comparison period mean returns, and so on. All event study approaches in this chapter except the Ibbotson RATS method and calendar-time portfolio regression use an estimation period.

`EST=` and `POOL` By default, Eventus determines the estimation period for each security-event by subtracting 46 trading days (13 months in monthly event studies) from the event date in the request file. The resulting date becomes the last day of the estimation period. To have the estimation period end 91 trading days before the event date, specify `EST=-91`. To use an estimation period following the event date, specify a positive number. For example, `EST=+61` (the plus sign is optional) selects an estimation period

that begins on trading day +61.[6]

EST has no effect on the length of the estimation period.

To split the estimation period between pre- and post-event periods, specify POOL on the REQUEST statement. Eventus will chop your estimation period into equal halves. For example,

```
REQUEST ...  EST=50 POOL;
```

gets you an estimation period of which the first half ends with day −50, and the second half begins on day +50.

ESTLEN= The ESTLEN option selects the estimation period length in trading days, months, etc. By default, the estimation period is 255 trading days long when using daily data and 52 weeks or 60 months long when using weekly or monthly data. Optionally, select the estimation period length with ESTLEN. The largest number allowed is 999 and the smallest is 3. Eventus interprets the argument of EST= as months for a monthly event study, days for a daily event study, etc.

MINESTN= Specify MINESTN=*n* to remove an observation from the sample if the stock has fewer than *n* days or months of return data in the estimation period. For example, MINESTN=60 means that if a security-event has fewer than 60 usable stock returns in the estimation period, it will be dropped and reported as such in the data availability listing. By default, the only constraint on estimation-period data is the requirement of one plus the number of linear model coefficients (two if no market or factor model is in use).

The WINDOWS statement

The WINDOWS statement is optional. Use it to specify ranges of trading days relative to day 0 — "windows" — over which Eventus reports cumulative or compounded abnormal returns and associated test statistics. Each window specification requires a *begin* and *end*, which can be the same if desired. For example, (−3,0) specifies a four-day or four-month window ending with the event date; (2,2) specifies a one-day or one-month window containing the second day or month after the event date.

[6] It is also possible to specify the estimation period by calendar date or trading day or month number; see EST=SPECIFIC on page 129 in Appendix B.

When *begin* and *end* are equal, no cumulation or compounding occurs, but the one-day or one-month window appears in the window section of the listing output and in the output data set or file if the `OUTWIN=` or `FILEWIN=` option appears on the `EVTSTUDY` statement. If the `WINDOWS` statement is omitted, Eventus reports three windows: (−`PRE`,−2), (−1,0) and (+1,+`POST`).

The `EVTSTUDY` statement

The `EVTSTUDY` statement is required for an event study. Options are available to adjust the event period, limit the number of missing returns in the event period, select benchmark methods and test statistics, select buy-and-hold compounding for windows, adjust how much listing output appears and its format, save results in a SAS data set or text file and more.

Selecting the amount of listing and graphics output

`EVTSTUDY` normally produces a report of data availability after searching the CRSP or other database for your sample. The report lists the security identifier (such as PERMNO), identification variable and event date from the request file, together with the name of the issuer from the database. The report also tells, for each security, how many returns Eventus finds in the estimation period and in the event period. The report describes problems detected in the sample, such as a requested date outside the range of data for the security. If you prefer not to have Eventus produce this report, specify `NONAMES` on the `EVTSTUDY` statement.

When a two-step linear model benchmark method is used (default market model or `TWOSTEP` option), unless you specify `NOPLIST` on the `EVTSTUDY` statement, you also receive a list of the estimation-period return statistics for each observation and the mean and median for the sample. The report includes linear model parameter estimates and residual standard deviations, fraction of residuals positive, and additional statistics.

The last section of listing output contains the event period results. For each benchmark, the default report lists the sample mean abnormal return (mean cumulative abnormal return for windows), test statistics, number positive and negative, and significance levels, for each date in the event period and for each window defined by the `WINDOWS` statement or default windows.

To display window cumulative or compounded abnormal returns and standardized cumulative abnormal returns (when compatible with active options)

for every security-event, specify DETAIL on the EVTSTUDY statement. To display window results and also complete daily or monthly abnormal returns and standardized abnormal returns (when compatible with active options) for each security-event, specify DETAIL=FULL. Full detail can produce a large amount of listing output.

The DETAIL option displays results at the security-event level, in the SAS output window or listing file, formatted for viewing. To save such results to a file for further analysis, use the OUTWIN=*libname.membername* option or the FILEWIN=*file shortcut or name* option (page 33).

To see plots of the abnormal returns and cumulative or compounded abnormal returns, include the PLOT option on the EVTSTUDY statement.

Performing a volume event study

To run an event study on relative trading volume, specify the VOLUME option. This requires a market volume index data set, which Eventus for Windows includes a software tool, in the Start menu folder for Eventus, to build from the CRSP stock database. Eventus for WRDS users have access to pre-installed volume index data sets; other current annual subscribers may be able to download them from www.eventstudy.com. Appendix B describes the data set format in detail (see page 110).

If the SASNONCRSP input mode is active, a volume event study requires mini-database components corresponding to the EVENTUS statement options INDEXDS (for calendar purposes), VOLUMEDS and SHAREDS, described in Section B.4.

The volume event study is conducted much like any other, according to the options specified; the main difference is that log-transformed relative volume replaces the return. Eventus computes the log-transformed relative volume for each security in the sample as described by Campbell and Wasley (1996).

Specifying a benchmark model

Models for two-step procedures If the user specifies no benchmark or test option, Eventus computes market model abnormal returns. To select Fama-French (1993) three-factor model returns (see below), specify FAMA-FRENCH TWOSTEP on the EVTSTUDY statement. To select Fama-French (1993) plus momentum four-factor model returns (see below), specify FAMAFRENCH

MOMENTUM TWOSTEP on the EVTSTUDY statement. For market adjusted or comparison period mean adjusted returns, specify MAR or CP, respectively, on the EVTSTUDY statement. For total unadjusted, or "raw", returns, specify RAW. (Unadjusted returns are considered a form of "abnormal return" in Eventus event studies. To obtain raw return data without running an event study, see Chapter 5).

Certain benchmark options can be run at the same time. For example, CP MAR MM selects comparison period mean adjusted returns, market adjusted returns and market model abnormal returns. A multi-factor model must be run separately from other benchmarks.

Fama-French model Fama and French (1993) present a time-series model of the evolution of excess security returns (relative to a risk-free rate) as a function of excess market returns, a high-minus-low market-to-book ratio factor, and a small-minus-big market capitalization factor. To use this model as the benchmark, specify the FAMAFRENCH option.

To use Fama-French factors, the EVENTUS statement option FFF must point to a SAS data set containing the needed risk-free rate, excess market return, and factor return data. Eventus for WRDS users have access to pre-installed factor return data sets. Users of locally installed copies of Eventus under an active annual site subscription can download pre-built factor data sets from www.eventstudy.com. Eventus 8 for Windows for all license types includes a software tool, found in the Eventus start menu folder, to download the factors from Professor French's web site and install them in the required SAS data set format. The factor data set is further described in Appendix B (see page 104).

To use the Fama-French model as a benchmark in the traditional two-step event study approach, where model parameters are estimated using data from outside the event period, specify the option pair FAMAFRENCH TWOSTEP. In the two-step application, the risk-free rate is not deducted from stock and market returns nor otherwise included in the model. Eventus supports two additional applications of the Fama-French model: calendar-time portfolio regressions and Ibbotson RATS, neither of which uses a separate estimation period.

The default application of the Fama-French model, and the four-factor and custom factor models discussed below, is the calendar-time portfolio regression. In this approach, securities are formed into portfolios by event

month or event day. A single regression is run where the dependent variable is the time series of calendar portfolio excess returns and the explanatory variables, in the Fama-French three-factor case, are the returns of the excess market factor, the small-minus-big capitalization factor, and the high-minus-low book-to-market factor. The intercept represents the mean monthly or daily abnormal return in the event period. The default test statistic for the calendar-time method is the OLS test of the null hypothesis that a particular parameter is zero. To select a weighted least squares test, where each trading day or month is weighted by the number of securities in the calendar-time portfolio corresponding to the period, specify the `WLS` option. To select a generalized method of moments test, specify the `GMM` option.

To add the momentum factor, suggested by Carhart (1997), to either a two-step or calendar-time portfolio event study specify the additional option `MOMENTUM`.

The Fama-French calendar-time test differs from the calendar-time approach for other benchmarks described in the statistical tests section below unless you specify the explicit option combination `FAMAFRENCH TWOSTEP CALENDARTIME`. The description of the RATS procedure covers the `FAMAFRENCH IRATS` option combination.

Any `WINDOWS` statement is ignored with the calendar-time portfolio regression approach because there is no abnormal return estimated for a particular event day or month, only a mean across the event period.

Custom factor models Eventus allows you to define your own linear multi-factor model. Use the `TWOSTEP FACTORS=`*n* option combination to select custom factor model mode and specify the number of factors in addition to the market index (or suppress the market index by adding the `NOMARKET` option). Supply the factor returns in a SAS data set pointed to by the `MYFACTORS=`*libname.membername* option of the `EVENTUS` statement. The columns of the data set must include the calendar date (SAS date variable `CalDt`) and the factor returns (sequentially numbered variables starting with `Factor1`). The custom factor model interacts with the presence or absence of event study options `TWOSTEP`, `CALENDARTIME` and `IRATS` in a manner similar to the `FAMAFRENCH` option. The market index, if not suppressed, is the same one that would be used if the `FACTORS` option were not specified; it depends on other `REQUEST` and `EVTSTUDY` statement options.

Ibbotson RATS (Ibbotson, 1975) develops the Returns Across Time and Securities (RATS) approach. In the event-study application of this approach, security returns are regressed on market index returns cross-sectionally for each month in event time, and the estimated intercept represents the abnormal return for the month. To select this approach for any frequency of returns, specify the `IRATS` option.

The RATS method can be combined with the Fama-French model by specifying both the `IRATS` and `FAMAFRENCH` (and possibly `MOMENTUM`) options. In the combined method, excess security returns (relative to the risk-free rate) are regressed on excess factor returns cross-sectionally for each period in event time, and the estimated intercept represents the abnormal return for the period.

Specification of a market index

By default, when a CRSP US stock database is the source of returns, Eventus uses the CRSP equally weighted market index as the market return for the market-model, market-adjusted and two-step multi-factor benchmark methods. When the `SASNONCRSP` input mode is active, Eventus by default uses the corresponding index from the mini-database. Specify `VALUE` to change to the value-weighted index or `BOTH` to produce a set of results using each. `VALUE` has no effect with the calendar-time portfolio regression method, which includes the case where the `FAMAFRENCH` option is specified without `TWOSTEP`. When the `FAMAFRENCH TWOSTEP` option pair is active, `VALUE` affects the market factor only; it does not change the weighting of the other factors.

Scholes-Williams and GARCH market model estimation

Eventus reports market model results using both ordinary least squares and Scholes-Williams (1977) beta estimation when you specify `SW`.

When you specify the `GARCH` option, Eventus estimates the market model assuming a GARCH(1,1) error structure. For exponential GARCH, or EGARCH(1,1), specify the `EGARCH` option. With either the `GARCH` or `EGARCH` option, maximum likelihood estimates using the dual quasi-Newton algorithm are produced. Eventus reports the alpha and beta estimates as it does for ordinary least squares, but does not report the estimated parameters of the conditional error variance model. No more than 250 iterations will be performed for each stock. In general, convergence will be better the longer

the estimation period (ESTLEN) and better with the EGARCH(1,1) than the GARCH(1,1) model.

The SW, GARCH and EGARCH options are not available for multi-factor models.

Campbell and Wasley (1993) and Cowan and Sergeant (1996) report that event study test specification and power are insensitive to the use of Scholes-Williams versus OLS estimation when used with daily data and short event windows. Corhay and Tourani Rad (1996) and Brockett, Chen and Garven (1999) discuss the potential benefits of GARCH estimation in event studies. Bollerslev, Chou and Kroner (1992) provide an overview of GARCH, EGARCH and related models in finance.

Selecting the number of days or months in the event period

EVTSTUDY computes and reports abnormal returns for the event period, which is defined by default as days or weeks −30 through +30, or months −12 through +12. Optionally, specify the number of days before and after on the EVTSTUDY statement, using PRE and POST. The options can be used singly or in combination. For example, PRE=60 means that the abnormal returns are to start with day −60; unless POST= is also specified, the latter retains its default value.

If you specify PRE= or POST=, you may need to change the estimation period from the default. To change the estimation period, specify EST= on the REQUEST statement. Eventus stops and write an error message to the SAS log if the event period defined by PRE and POST overlaps the default or specified estimation period. To override overlap checking and allow the estimation period and the event period to have dates in common, specify OVERLAP on the EVTSTUDY statement.

Dropping observations with missing event period returns

Specifying MAXMISS=*n* on the EVTSTUDY statement causes Eventus to exclude from the analysis any security-event that has more than *n* missing returns in the event period (−PRE,+POST). To keep only those observations with no missing event period returns, specify MAXMISS=0.

Reporting median abnormal returns

To report median abnormal returns, specify `MEDIAN` on the `EVTSTUDY` statement.

Computing buy-and-hold compounded window returns

To select buy-and-hold abnormal returns for windows, specify `BUYHOLD` on the `EVTSTUDY` statement. Eventus computes buy-and-hold abnormal returns by compounding successive daily (or other period) raw returns and any market index, factor or companion portfolio returns, then adjusting the raw returns according to the benchmark used. Comparison period mean returns, market model alphas and two-step factor model intercept terms are adjusted for the window length. The Eventus output labels the mean buy-and-hold window returns "Mean Compounded Abnormal Return," whereas the default additive window abnormal returns appear as "Mean Cumulative Abnormal Return."

Selecting statistical tests

When using two-step benchmark procedures (not calendar-time portfolio regression or RATS), you can select up to six statistical tests. If no test statistic option is specified with the market model, market adjusted, comparison period and raw return benchmarks, Eventus reports the Patell and generalized sign tests. The Patell test is not defined for multi-factor models, for which the time-series standard deviation method is the default. When the `BUYHOLD` option is active, there is no default parametric test and the Patell test is not available. If at least one parametric (nonparametric) test option is specified, the default parametric (nonparametric) test is omitted.

Parametric tests

Patell test The test that Patell (1976) describes is selected by the `PATELL` option. The option has no effect with multi-factor models and benchmarks that do not use a separate estimation period, or when the `BUYHOLD` option is active.

Standardized cross-sectional test The `STDCSECT` option selects the standardized cross-sectional test. This extension of the Patell test was introduced by Boehmer, Musumeci and Poulsen (1991). The standardized cross-sectional test compensates for a possible variance increase on an event date by incorporating a cross-sectional variance adjustment. The option has no effect with multi-factor models and benchmarks that do not use a separate estimation period, or when the `BUYHOLD` option is active. The `SERIAL` option below is activated automatically by the `STDCSECT` option.

Serial dependence adjustment The `SERIAL` option applies primarily to the Patell test. By default, the Patell test statistics for abnormal returns cumulated over windows defined in the `WINDOWS` statement are not adjusted for serial dependence. Mikkelson and Partch (1988) and others perform such a correction on cumulative returns. The `SERIAL` option causes Eventus to apply the correction. Karafiath and Spencer (1991) and Cowan (1993) report simulation evidence of the properties of the corrected and uncorrected Patell test statistics.

Note that the serial dependence that the `SERIAL` option corrects is not due to any presumed dependence in the true market model error term, but occurs because all of the abnormal return estimators being cumulated are functions of the same estimators of the market model parameters. The derivation of the corrected standard error used by Mikkelson and Partch (1988) requires that the abnormal return be interpreted as a forecast error.

Time-series standard deviation test The `CDA` option selects the time-series standard deviation test. The standard error for this test is computed from the time series of portfolio mean abnormal returns during the estimation period. Brown and Warner (1980, 1985) refer to the procedure as the "crude dependence adjustment".[7]

Calendar-time test The `CALENDARTIME` option selects a calendar-time test similar to that of Jaffe (1974) and Mandelker (1974). In this approach, securities are formed into portfolios by event date. A portfolio standard deviation is estimated from the time series of portfolio abnormal returns in

[7] See Chandra, Moriarity, and Willinger (1990) for further discussion and analysis of cross-sectional dependence in event studies.

the estimation period and used to standardize the portfolio return. A cross-sectional t-test is then performed on the standardized portfolio abnormal returns. When the `BUYHOLD` option is in effect, Eventus does not standardize portfolio abnormal returns; the calendar-time test with `BUYHOLD` is the simpler one described by Lyon, Barber and Tsai (1999, section V.B.2).

To perform the Jaffe-Mandelker test with Fama-French factors, specify the option combination `FAMAFRENCH TWOSTEP CALENDARTIME`. There also is a Fama-French calendar time portfolio regression method, commonly used for long-horizon event studies, that works a bit differently; see page 25 for details.

Skewness-corrected test The `TRANSNORM` option selects the skewness-corrected transformed normal test derived by Hall (1992), who denotes the statistic T1. Hall argues, and reports supporting simulation evidence, that the test improves upon a related test derived by Johnson (1978). Lyon, Barber and Tsai (1999) analyze the Johnson test in the context of long-horizon event studies. They report that the test as presented by Johnson is misspecified in simulation, but its nonparametric bootstrap analog exhibits correct specification.[8] Hall (1992) shows that Johnson's derivation of the test is flawed, and that the correctly derived T1 performs well in Monte Carlo simulation. This test is eligible for Eventus bootstrapping; see the `BOOT` option.

Cross-sectional test The `CSECTERR` option selects the cross-sectional test. The standard error for this test for each date (or window) in event time is computed across securities, not across time. For an example, see Pilotte (1992).

EGLS and Collins-Dent tests The `EGLS` and `CDCSI` options select the generalized least squares test and Collins-Dent test assuming cross-sectional independence, respectively. These tests are discussed in detail by Sanders and Robins (1991). The `EGLS` and `CDCSI` options automatically activate the `SERIAL` option. The options have no effect with multi-factor models and benchmarks that do not use a separate estimation period, or when the `BUYHOLD` option is active.

[8] See Barber and Lyon (1997) and Cowan and Sergeant (2001) for additional analysis of skewness in long-horizon event studies.

Nonparametric tests

Generalized sign test The generalized sign test statistic (Cowan, 1992) is selected by the `GENSIGN` option. The generalized sign test controls for the normal asymmetry of positive and negative abnormal returns in the estimation period.

Rank test The `RANKTEST` option selects the nonparametric rank test introduced by Corrado (1989).[9]

Jackknife test The `JACKKNIFE` option selects the jackknife test developed by Giaccotto and Sfiridis (1996).

Wilcoxon test The `WSR` option selects the Wilcoxon signed-rank test. Unlike the rank test, which is based upon ranking estimation-period and event-period abnormal returns security by security, the `WSR` option applies the Wilcoxon signed-rank test cross-sectionally.

Bootstrapping The `BOOT` option of the `EVTSTUDY` statement performs nonparametric bootstrapping to determine the p-values of certain parametric tests. Eventus performs bootstrap tests only for the windows, not each individual day or month. However, you can obtain bootstrap tests for an individual day or month by specifying a window (on the `WINDOWS` statement) with the same beginning and ending date. The bootstrap p-values appear in a separate section of the listing output after the regular parametric and nonparametric test results.

The Patell, standardized cross-sectional, time-series standard deviation, skewness-corrected transformed normal, and cross-sectional tests are eligible for the bootstrap. Only tests which are selected by the appropriate option specifications (or the Patell test if no parametric test is explicitly specified) are bootstrapped. If the Patell test is used, the `SERIAL` option is implied by the `BOOT` option. That is, when the bootstrap is selected, the Patell test is adjusted for serial dependence in both parametric and bootstrap results.

[9] See Campbell and Wasley (1993) for additional analysis and discussion of the rank test.

By default, the resampling ratio is 0.25 and the bootstrap significance level is one- or two-tailed according to the `TAIL` option. The `RESAMPLE=`*ratio* and `BTAIL=1|2` options are available to override the defaults.

Kramer (2001) and Lyon, Barber and Tsai (1999) discuss the bootstrap method in event studies. For a comprehensive introduction to the bootstrap method in econometrics, see Horowitz (2001).

Reporting one- instead of two-tailed tests

Eventus reports one-tailed significance levels by default. `TAIL=2` changes to two-tailed tests.

Saving results to a data set or text file

To save CARs or BHARs for each security-event for each window, specify the SAS data set in which to save them using the `OUTWIN=`*libname.membername* option. The *libname* part of the two-part name can be `work` for a temporary data set that exists only until SAS terminates, or a user-defined SAS library name (also called a libref) that points to a folder or directory in which to save the data set. In either case, the data set is created if it does not exist already, or replaced if it does exist. Alternatively, you can save the results in a text file using the `FILEWIN=`*file shortcut or name* option. The file shortcut or name should be either an unquoted SAS file shortcut name (as previously defined by a SAS `filename` statement or interactively in the SAS Explorer) or a quoted file name.

The SAS data set or text file contains window cumulative or compound abnormal returns. When the default `PATELL` or optional `STDCSECT`, `EGLS` or `CDCSI` options are specified, the file also includes weighted least squares weights (ready for the SAS REG procedure) and standardized cumulative abnormal returns. Please see page 40 for a discussion of the weights and their relation to standardized abnormal returns.

3.2 Paired Events: The `TWIN` Option

The `TWIN` option computes cumulative or compounded abnormal returns over periods that vary in length from one security-event to another. The statements in Figure 3.3 run a `TWIN` event study. The options common to both single-date and twin event studies are omitted. The differences

Figure 3.3
Eventus Statements and Options Specific to Event Studies Cumulating or Compounding Returns between Two Firm-Specific Event Dates.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS TWIN *other options*;

[**TITLE** '*text*';]

[**TITLE2** '*text*';]

REQUEST [**NDAYS=***n*] *other options*;

WINDOWS [**EVENT1=***event_label_1* **EVENT2=***event_label_2*];

EVTSTUDY *options*;

are the option `TWIN` on the `EVENTUS` statement and the specification of the `WINDOWS` statement. Specify event date labels of up to 64 characters using the `EVENT1=` and `EVENT2=` options of the `WINDOWS` statement. Eventus uses the labels to identify the two event dates in the output. If a label contains one or more blanks, enclose it in a SAS `%str` function, for example, `event1=%str(Merger Announcement)`. Event date labels must contain only letters, numbers, blanks and underscores.

If the request file is a text file, it must contain a pair of event dates, separated by one or more blank spaces, following the PERMNO or other security identifier. If the request file is a SAS data set, it must contain SAS date variables named `eventda1` and `eventda1`, or variables `crspda1` and `crspda2` containing CRSP trading day or month numbers. Alternatively, to run a twin event study where the event period length is constant across security-events, specify the total number of trading days or months using the `REQUEST` statement option `NDAYS` and include only the beginning event date in the request file (as `eventda1` if the request file is a SAS data set).

3.3 Event Studies Using Data Sources Other than CRSP

While the CRSP database is the only data source from which, using the native database format, Eventus automatically retrieves and assembles data, you can run an Eventus event study with other data. This section describes how to conduct an event study where Eventus reads stock return data from any source. If your data source provides prices but not returns, you will need to calculate returns as Eventus does not do this.

Datastream users can automate most of the process using the EventStream package from Cowan Research, L.C. EventStream accepts Eventus-like options and request files, generates ready-to-run DSWindows macros for use with the *Datastream* DSWindows program, pre-processes downloaded data, builds a mini-database, and generates Eventus statements. Please visit `www.eventstudy.com` for details.

Required contents of a database for the `SASNONCRSP` method

The mini-database for the `SASNONCRSP` method consists of SAS data sets created by the user. The `EVENTUS` statement option `INDEXDS` option points to a data set containing at least two columns: `CalDt`, a SAS date variable containing the calendar date of the observation, and one or more columns of market index returns. When the mini-database frequency is daily, only days when the market is open should be included. Dates on which the market is closed, such as weekends and holidays, are omitted, not represented by a zero or missing return. However, dates on which the market is open, but the researcher does not have the index return, should not be omitted when they fall between the earliest and latest dates the researcher wants to include in the mini-database. On dates when the market is open but the researcher does not have the index return, place a SAS missing value code in the index return column(s).[10] The index data set serves as the master calendar for the mini-database, and therefore all dates in the security returns data set (or other individual security data) must also appear in the index data set.

The name of an index return column is *?*`wret`*?*, where the first *?* is

[10]The basic SAS missing value code is a decimal point character (dot) separated from other data by at least one leading and one trailing blank. In an Excel file to be imported into SAS, enter a single apostrophe immediately before the dot.

replaced by `e` for an equally weighted index or `v` if the index is value-weighted. The second *?* is replaced by `d` if the index return includes dividends or `x` if it excludes them. By default, Eventus looks for `ewretd`. To use a column name that ends in `x`, specify `NODIVIDX` on the `REQUEST` statement. To use a column name that begins with `v`, specify `VALUE` on the `EVTSTUDY` statement.

The second data set is pointed to by the `EVENTUS` statement option `RETURNDS`. It contains three columns: the date `CalDt`, the security identifier, and the rate of return `ret`. The security identifier can be a numeric or character variable. Its name and format are defined by the `REQUEST` statement specifications `ISSUEKEY` and `ISSUEFMT` respectively. Each row of the data set contains the rate of return for one issue for a single day, month, etc. For each security, the data set need contain only dates from the first available return to the last available return for the security. Within that range, however, there should be a one-to-one correspondence between dates in the return data set for the security and dates in the index data set. Code a missing return as a SAS missing value in the return column.

Statements

Figure 3.4 displays the statements and options that have specific interactions with the use of non-CRSP data in event studies. All non-database-specific event study options described in this *Guide* are available with the `SASNONCRSP` method described in this section.

The `EVENTUS` statement

The `SASNONCRSP` option must appear on the `EVENTUS` statement to use non-CRSP data. The `SASNONCRSP` option indicates that the data source for the event study is a user-constructed mini-database. The contents and format details appear under the `REQUEST` statement below.

`MONTHLY|WEEKLY|QUARTERLY|ANNUAL` With non-CRSP data, these options tell Eventus the frequency of data in the input data set. Eventus does not select a different data set depending on the frequency as it does with CRSP data; the user is responsible for verifying the data frequency. If no data frequency option is specified, Eventus expects the mini-database to contain daily data.

Figure 3.4
Eventus Statements and Selected Options Specific to a Non-CRSP Event Study Centered around a Single Date.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS SASNONCRSP
[**MONTHLY**|**WEEKLY**|**QUARTERLY**|**ANNUAL**]
[**INDEXDS**=*libname.marketmembername*
RETURNDS=*libname.returnmembername*];

[**TITLE** '*text*';]

[**TITLE2** '*text*';]

REQUEST [**NAME**] [**INSAS**=*libname.requestmembername*]
[**ISSUEKEY**=*name*] [**ISSUEFMT**=*SAS format*];

[**WINDOWS** *(begin,end)* [*(begin,end) ...*];]

EVTSTUDY *options*;

`INDEXDS RETURNDS` These parameters are required when using the `SASNONCRSP` option. The next subsection describes them further. Additional options can be used to specify other kinds of `SASNONCRSP` input data. Additional reference documentation on the `EVENTUS` statement is in Appendix Section B.4.

The `REQUEST` statement

If the request file is a text file, the SAS file shortcut `request` must point to it.

Including issuer names To have Eventus show security issuer names in the listing output, specify the `NAME` option on the `REQUEST` statement. The name is retrieved from the name history array of the database, described on page 107.

The WINDOWS statement

The WINDOWS statement is optional and has no special interaction with non-CRSP data input.

The EVTSTUDY statement

The EVTSTUDY statement is required for an event study. In the SASNONCRSP method, all EVTSTUDY features and options in this chapter, and all other event study-related features and options in this *Guide* except those that are specific to CRSP data, are available.

3.4 The EXTRACT Statement

This section describes the EXTRACT statement. The statement is not often needed starting with Eventus 8.0. Its function is duplicated more simply using the OUTWIN= or FILEWIN= options of the EVTSTUDY statement.

The EXTRACT statement, like OUTWIN= and FILEWIN= selects and organizes window cumulative or compounded abnormal returns for each security-event, and creates a data file useful for cross-sectional analysis. The difference is that OUTWIN= and FILEWIN= are options of the EVTSTUDY statement, whereas EXTRACT uses results saved by a previous EVTSTUDY statement with the option OUTSAS=.

Figure 3.5 displays the Eventus statements needed to use this older method of extracting and cumulating CAARs or compounding BHARs from saved event study results.

The EVENTUS Statement

A new EVENTUS statement is required only if the EXTRACT run is not being submitted immediately after the corresponding EVTSTUDY run, in the same SAS session, command-line run or rsubmit block.

The WINDOWS Statement

Use the WINDOWS statement to specify one or more intervals, or "windows", of days, weeks or months (the data frequency that the event study used). The cumulative or compounded abnormal return for each window is calculated

Figure 3.5
`EXTRACT` Statement Syntax.

EVENTUS ;

WINDOWS *(begin,end)* [*(begin,end)* ...]**;**

EXTRACT INSAS=*libname.membername*
[**VPREFIX**=*prefix*]
[**WPREFIX**=*prefix*]
[**MM**] [**SW**] [**MAR**] [**RAW**] [**CP**] [**FF**] [**FFM**] [**CMF**]
[**TYPE**=[**CP**|**RAW**|**MAR**|**SW**|**FF**|**FFM**|**CMF**]]
[**VALUE**|**BOTH**] [**EXTEND**[=*n*]] [**TEXT**|**HTEXT**]
[**OUTSAS**=*libname.membername*|**EXTFILE**=*fileref*]**;**

and stored for each firm. You can list up to 200 windows on the `WINDOWS` statement. The windows must be within the `PRE` and `POST` limits of the original event study. Within the limits, the windows need not be the same as those listed in the `WINDOWS` statement, if any, that preceded the `EVTSTUDY` statement. When the saved data are from a `TWIN` event study, omit the `WINDOWS` statement. Otherwise, exactly one `WINDOWS` statement must immediately precede the `EXTRACT` statement.

The `EXTRACT` Statement

Identifying the saved event study data set

Use `INSAS` to tell Eventus where to find the saved event study data. The *libname* and *membername* should match the `OUTSAS` specification of the original `EVTSTUDY` statement. (See page 33.)

Selecting a stored identification variable

If the `EVTSTUDY` program that saved the data included `ID` and `IDFMT` on the `REQUEST` statement, the identification variable is included in the `OUTSAS` data set or the `EXTFILE` file created by `EXTRACT`.

Naming the window variables and selecting weights

The VPREFIX option selects a prefix for the variable names under which the window cumulative or buy-and-hold abnormal returns are stored in the OUTSAS data set. The prefix can be up to 29 characters long, of which all must be letters, digits or underscores and the first must be a letter or underscore. Eventus completes the variable name by appending an integer from 1 to 200 indicating the position of the window on the WINDOWS statement. For example, if you specify VPREFIX=CumulativeAR and

```
WINDOWS (−1,0) (−2,2);,
```

the OUTSAS data set includes a variable named CumulativeAR1 containing the days (−1,0) cumulative abnormal return for each firm. The cumulative abnormal return for the second window, (−2,2), will be a variable named CumulativeAR2, and so on. The default is VPREFIX=WINAR.

The WPREFIX option includes a weight variable in the output file or data set, and gives the prefix for the weight variable name. The weight variable is the reciprocal of the variance of the cumulative abnormal return. Running a weighted least squares regression, with the weight variable specified in the WEIGHT statement of PROC REG, is equivalent to estimating an ordinary least squares regression with all the variables (including the vector of ones used for the intercept) multiplied by the square root of the weight.[11] Weighted least squares regression, and analogous statistical tests such as a weighted analysis of variance (using PROC GLM, for example), fulfills the intent of tests sometimes seen in the literature, on standardized abnormal returns or standardized cumulative abnormal returns (SCAR). When heteroskedasticity is a concern, specifying an OLS regression with the SCAR on the left hand side will not produce best linear unbiased estimates (BLUE). If the nonzero elements of the (diagonal) weight matrix are proportional to the reciprocal of variance for each observation, weighted least squares estimation using the original abnormal return or CAR on the left hand side does produce BLUE. Under the assumptions of the Patell and standardized abnormal return tests, the weights produced by the WPREFIX option are proportional to reciprocals of variance. The WPREFIX option is available if the EVTSTUDY run that created the data set used as input to EXTRACT included the Patell or other standardized abnormal return test.

[11] See Draper and Smith (1981), Section 2.11; or Neter, Wasserman and Kutner (1983), pp. 171–172.

When saving cumulative abnormal returns in a text file, omit `VPREFIX`. However, if WLS weights are desired, it is still necessary to specify `WPREFIX=W` (the argument is arbitrary), even though the weight prefix will not appear in the output text file. The cumulative or compounded abnormal returns for the first security-event appear on one line of the output text file, continuing onto additional lines as needed. Then the weights for the first firm appear on a new line, or more than one line if necessary. The returns for the second firm then start on a new line, and so on.

Selecting the type of abnormal return to extract

By default, market model returns are extracted if available. Alternatively, specify an option, for example, `FF`, `RAW`, `MAR` or `SW` to extract abnormal returns created by other benchmarks, for example Fama-French three-factor, raw, market adjusted, or Scholes-Williams-adjusted returns. The `EVTSTUDY` run that created the input SAS data set must have included the specified type of abnormal return. `EXTRACT` considers `RAW` to be a type of abnormal return. To extract raw returns, the `EVTSTUDY` statement in the event study program must include the `RAW` option.

Extending a window to make up for missing days

If you specify the `EXTEND` option, Eventus will attempt to make up for missing returns within the window. For example, suppose you want to output a two-day window for a sample of takeover targets, some of which experienced trading halts on day -1 or 0, or both. You could specify `EXTEND=3` to attempt to obtain 2 days' worth of abnormal returns for each firm. In this case, if one of days -1 and 0 were missing, Eventus would extend the window to day $+1$. If day $+1$ were also missing, the window would be extended to day $+2$ for that firm. Eventus keeps trying to extend the window until it has obtained the "normal" number of returns for the window, or until it has exhausted the n days following the window. Specifying `EXTEND` without `=`n is equivalent to specifying `EXTEND=1`. You may want to consider the use of weighted least squares regression with abnormal returns generated using this option.

Selecting the Output Format

The EXTRACT statement produces no listing output. By default, the extracted data are written to a text file, named userdata.dat, in the current working folder or directory. To change the location or name of the text file to be written, define a file shortcut using a SAS filename statement or the SAS Explorer window, and use the EXTRACT statement option EXTFILE= to specify the shortcut. To direct the output to a SAS data set instead of a text file, use the option OUTSAS= to specify a two-level SAS data set name.

The default text file format uses one line for each combination of secondary stock-event, window specification and market index. For example, if the sample contains 50 observations, the WINDOWS statement specifies 3 windows, and the creating EVTSTUDY statement includes the BOTH option, there are 300 lines. The HTEXT option produces an alternative "horizontal" format in which all windows appear on the same line. In the above example, the number of lines would be reduced to 100 if there were no WPREFIX specification. The default text format includes the weight after the cumulative abnormal return on the same line. The horizontal format includes a separate line for the weights immediately below the cumulative abnormal return. Both formats list the windows in the order specified on the WINDOWS statement that immediately precedes the EXTRACT statement.

Usage Example

Figure 3.6 displays the Eventus statements to perform an event study with daily CRSP data. In this example, no WINDOWS statement happens to appear before the EVTSTUDY statement; therefore, Eventus generates default windows as explained in Chapter 3. The EVTSTUDY statement includes two option specifications to save needed data in a SAS data set. The option OUTSAS=WORK.INTERMEDIATE names the SAS data set to be created. Using WORK as the first part of a two part data set name specifies a temporary data set. A temporary data set ceases to exist after the user closes an interactive SAS session, or after execution completes in a command-line run. Eventus currently requires the two part name, but WORK.INTERMEDIATE and the one part name INTERMEDIATE are completely interchangeable in ordinary SAS language and procedures. A permanent data set could be specified instead, by replacing WORK with a SAS library name previously defined in a libname statement or the Add New Library dialog.

Figure 3.6
Example of EXTRACT Statement Usage.

```
filename request 'F:\Any Folder\Filename.extension';
eventus;
 title 'US Targets of Canadian Acquirers 1997-1998';
 request;
 evtstudy outsas=work.intermediate;

 windows (-30,-2) (-1,0);
 extract type=MM vprefix=wincar wprefix=weight
   insas=work.intermediate outsas=work.abnormalreturns;
```

A new WINDOWS statement must come between the EVTSTUDY and EXTRACT statements, whether or not there is a WINDOWS statement before EVTSTUDY. The windows listed on the new WINDOWS statement can be different from those on any preceding WINDOWS statement.

The EXTRACT statement includes options to specify the type of abnormal return benchmark to use (market model), the prefix (wincar) to use in building variable names for the cumulative abnormal returns (CARs), the prefix for variable names for the WLS weights (weight), the name of a SAS data set previously built by an EVTSTUDY statement (work.intermediate), and the name of the output SAS data set to create (work.abnormalreturns).

Figure 3.7 displays the contents of work.abnormalreturns produced by the SAS statements proc print data=abnormalreturns; id permno;. The _Weight_ variable has the value Equal for all observations in the example because only the event study use the default equally weighted market index. Had the BOTH option appeared on the EVTSTUDY statement, there would have been two observations in work.abnormalreturns for each PERMNO, one with _Weight_ of Equal and one with Value. The CAR-WLS weight pair wincar1, weight1 corresponds to the first window listed on the last WINDOWS statement, $(-30,-2)$ in the example, and the second pair corresponds to the second window. To conform to the requirements of the weight statement in SAS regression procedure, for example PROC REG, the weights are reciprocals of variance, not portfolio weights.

Assume that the researcher creates a SAS data set explanatory, with one observation for each firm in the sample of various explanatory variables, identified by PERMNO. The researcher can then merge the two data sets and estimate a cross-sectional regression with statements like the following,

Figure 3.7
Contents of SAS Data Set `abnormalreturns` Produced by Figure 3.6 Code.

US Targets of Canadian Acquirers 1997-1998

PERMNO	_weight_	wincar1	weight1	wincar2	weight2
10506	Equal	0.56738	5.777	-0.03257	83.88
10914	Equal	0.13304	55.647	0.41793	807.09
36150	Equal	0.20945	91.579	0.19949	1331.05
67652	Equal	0.29229	46.506	0.44130	675.01
72100	Equal	-0.08272	21.992	0.81411	319.29
75111	Equal	0.52603	37.952	0.10444	552.85
75241	Equal	-0.04506	88.500	-0.04199	1241.09
76263	Equal	0.03851	209.194	-0.02503	3045.64
76369	Equal	-0.01549	2.847	1.34032	41.35
76754	Equal	0.49761	30.693	0.14292	438.04
77142	Equal	0.10692	41.911	0.06721	600.09
77170	Equal	0.54004	6.870	-0.35172	100.62
77446	Equal	-0.08327	19.854	0.22735	290.88
77833	Equal	-0.07545	13.418	0.22582	191.68
79739	Equal	0.10539	44.350	0.39443	644.39
83447	Equal	0.29044	27.797	-0.08052	396.70

```
data regression_variables;
 merge abnormalreturns explanatory;
  by permno;
proc reg data=regression_variables;
 model wincar2=regressors;
 weight weight2;
```

where the word `regressors` is replaced by the name of one or more explanatory variables. The `weight` statement can be omitted for ordinary least squares regression. The procedure allows many additional options, including hypothesis tests using a heteroskedasticity consistent covariance matrix (White, 1980). Please see SAS documentation for further details.

Figure 3.8
Eventus Statements for Merging Saved Event Studies.

EVENTUS ;

[**TITLE** '*text*';]

[**TITLE2** '*text*';]

WINDOWS [*(begin,end) (begin,end) ...*];

OLDSTUDY INSAS*n*=*libname.membername*
[**INSAS2=***libname.membername*]
...
[**INSAS10=***libname.membername*];

3.5 Combining Saved Event Studies with the OLDSTUDY Statement

The EVTSTUDY statement allows you to save abnormal returns in a SAS data set with the OUTSAS option. The OLDSTUDY statement lets you merge two or three event studies from saved EVTSTUDY SAS data sets.

Figure 3.8 lists the statements and options used in an OLDSTUDY program. Most of the options can be used in EVTSTUDY runs, and are described in Section 3.1 above. The options have a similar meaning here, but placement and usage differ in certain instances. For example, the ID= option goes on the OLDSTUDY statement and specifies the name of the original identification variable.

No option is needed on the EVENTUS statement. The windows specified on the WINDOWS statement need not be those used with the original EVTSTUDY program(s), except TWIN event studies.

The INSAS*n* specifications on the OLDSTUDY statement tell Eventus where to find saved event study SAS data sets. The *libname* and *membername* parameters should match those on the OUTSAS= options of the original EVTSTUDY statement(s). (See page 33.) The event studies to be merged all should have the same security identifier name (e.g. PERMNO), return frequency, PRE,

Figure 3.9
Sample Eventus Program Using OLDSTUDY to Merge Two Saved Event Studies.

If you create and save data sets with the following programs...

```
Eventus;                          |  Eventus;
 Request ...;                     |   Request ...;
 Evtstudy outsas=mylib.res1;      |   Evtstudy outsas=yoursas.res2;
```

...you can merge the two portfolios and print the combined event study with a third:

```
Eventus;
 title  'text';
 title2 'text';
 Windows (-45,-2) (+1,+5);
 Oldstudy insas=mylib.res1 insas2=yoursas.res2;
```

POST and abnormal return method options in the original programs. If the original programs specified different variable names for ID=, or incompatible identification variable formats (such as numeric and character), omit the ID= option from the OLDSTUDY statement.

The OLDSTUDY statement detects the abnormal return methods used in the original event study and uses them as the defaults.

Figure 3.9 displays a sample Eventus program to merge two event studies. Do not use a REQUEST statement with OLDSTUDY.

Chapter 4

Event Studies Using the Event Parameter Approach

In the conventional two-step approach, the market model or other benchmark parameters are estimated over a period that excludes the event dates to be tested. The abnormal returns on the event dates then are estimated in a second stage. In the event parameter approach, the market model is augmented by adding dummy variables for event days or months, allowing the joint estimation of the market model parameters and abnormal returns. Karafiath (1988) provides a tutorial on the event parameter approach. Malatesta (1986) and Ingram and Ingram (1993) present simulation evidence on the event parameter approach using joint generalized least squares (also known as SUR) estimation.

Eventus implements the event parameter approach by including a dummy variable for each trading day or month in the event period. Hypotheses about windows listed on the `WINDOWS` statement are tested as linear hypotheses on the component dummy variables.

Figure 4.1 displays the Eventus statements to run a single-event date event parameter study. The options that are specific to the event parameter approach are described below.

The `EVENTUS` statement

The `EVENTUS` statement selects the input database and data frequency as described in Chapter 3.

Figure 4.1
Commonly Used Statements for an Event Parameter Study.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS [**SASNONCRSP**] [**MONTHLY**]
[*SASNonCRSP mode options*];

[**TITLE** '*text*';]

[**TITLE2** '*text*';]

REQUEST [**INSAS**=*libname.membername*] [**CUSIPERM**]
[**ID**=*variable* **IDFMT**=*format*]
[**DATEFMT=MMDDYY|YYMMDD|DDMMYY|DATE**]
[**EST**=−*value*| +*value*] [**POOL**] [**ESTLEN**=*n*] ;

WINDOWS (*begin,end*) [(*begin,end*) ...];

EVTSTUDY [**NONAMES**] **OLSPARAM|SUR|ITSUR**
[**FACTORS**=*n*] [**VALUE**]
[**PRE**=*periods*] [**POST**=*periods*];

The `REQUEST` statement

The `REQUEST` statement is required for an event parameter study. Please see Chapter 3 for a detailed explanation of the request file and `REQUEST` statement options to process dates, specify an optional identification variable, set up the estimation period, and so on. In the event parameter approach, the estimation period has no role separate from that of the event period, although it contains no event dates. Specifically, Eventus joins the estimation and event periods into a single time series to estimate the augmented market model. The estimation and event periods are still specified separately; Eventus does not check whether they are contiguous.

The `WINDOWS` statement

The `WINDOWS` statement is required for the event parameter approach. Use it to specify ranges of dates — "windows" — relative to the base date (day or month 0), over which Eventus is to compute abnormal return parameters

and statistical significance tests. For example, with daily returns, the window (−2,+2) defines a five-trading day period, from two days before through two days after day 0. Up to 200 windows can be specified. Single-date windows can be defined by repeating the relative date. For example, (3,3) establishes a window containing only day +3.

The EVTSTUDY statement

The EVTSTUDY statement is required for an event parameter study. Its options permit you to change the default event period, limit listing output, and select a market index and estimation method. For details not specific to the event parameter approach, please see Chapter 3. In the event parameter approach, the event period and estimation period are joined into a single time series for model estimation and testing. The series is not necessarily continuous in calendar time. If you want to make it continuous, specify the REQUEST statement option EST= with a negative argument equal to $-(pre + 1)$ or a positive argument equal to $post + 1$, where *pre* and *post* are the specified arguments or default values of the EVTSTUDY statement options of the respective names.

Specifying additional return-generation factors

The default benchmark model, to which dummy variables are added, is the single-factor market model. To customize the benchmark model, use the custom factor model facility described on page 26 and in Appendix B.

Selecting an estimation method

To invoke the event parameter method, specify one of the EVTSTUDY statement options OLSPARAM, SUR, or ITSUR. The options indicate estimation using ordinary least squares, seemingly unrelated regressions (also called joint generalized least squares), or iterated seemingly unrelated regressions methods respectively.

Chapter 5

Retrieving Returns, Prices, Volume and Other Data from a CRSP Stock Database

Eventus can retrieve selected stock and index returns, stock prices, cash distributions, bid and ask quotes, trading volume, number of trades and other data from a CRSP database for later analysis by the user. This group of features uses a request file format and statement syntax that are similar to those for event studies, facilitating rapid retrieval of data aligned with respect to an event date. The data retrieved are saved in a SAS data set or a text file.

5.1 The EVENTUS Statement

The option GETDATA must appear on the EVENTUS statement preceding any RETURNS, PRICES or VOLUME statement.

The default data frequency is daily. To use an installed monthly CRSP database, specify MONTHLY on the EVENTUS statement. For example,

```
EVENTUS MONTHLY;
```

Figure 5.1
Eventus Statements to Retrieve Stock Returns from a CRSP Database.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS GETDATA [**MONTHLY**];

REQUEST [**INSAS**=*libname.membername*]
[**ID**=*variable* **IDFMT**=*format*]
[**DATEFMT=MMDDYY|YYMMDD|DDMMYY|...|CRSP**]
[**AUTODATE**[=**BACK**]] [**NDAYS**=*n*] [**NODIVIDX**]
[**SIZEINDX**[=**CRSPACCESS|OWNMARKET|CAPBASED**]
|SP500|COMPOSIT|BETAINDEX|STDINDEX];

RETURNS [**VSAS|HSAS**] [**INDEX**]
[**VALUE|BOTH**] [**SIC**] [**SHRCODE**] [**EXCHCODE**]
[**EXTFILE**=*fileref*|**OUTSAS**=*libname.membername*];

5.2 The REQUEST Statement and Request File

The REQUEST statement is required immediately before a RETURNS, PRICES or VOLUME statement. It reads the request file, which contains the PERMNO or CUSIP security identifiers and beginning and ending dates of data to retrieve, and optionally can contain other items described below. To use a SAS data set request file, specify its two-part name using the INSAS=*libname.membername* option; see page 130 for further explanation. If the request file is a text file, the SAS file shortcut `request` must point to it.

Each row of the request file for a RETURNS, PRICES or VOLUME program should contain the following items: security identifier (PERMNO by default), starting date of data to retrieve, ending date of data to retrieve, and identification variable value if any. Omit the ending date if you specify NDAYS=, explained below, on the REQUEST statement. With a monthly database and a text request file, the dates can be any day of the month; if the request file is a SAS data set, use the first of the month.

Figure 5.2
Eventus Statements to Retrieve Stock Prices from a CRSP Database.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS GETDATA [**MONTHLY**];

REQUEST [**INSAS**=*libname.membername*]
[**ID**=*variable* **IDFMT**=*format*]
[**DATEFMT=MMDDYY**|**YYMMDD**|**DDMMYY**|**...**|**CRSP**]
[**AUTODATE**[=**BACK**]] [**NDAYS**=*n*];

PRICES [**VSAS**|**HSAS**] [**SIC**] [**SHRCODE**]
[**EXCHCODE**] [**SHARES**] [**DISTRIB**]
[**NOMINUS**] [**BIDASK** [**NOCLOSE**]]
[**NMS** [**TRADES**]] [**SPLITADJ**]
[**EXTFILE**=*fileref*|**OUTSAS**=*libname.membername*];

Including an identification variable

Each line of the request file can include an optional variable to identify uniquely the requested combination of security and date range. If the option is specified, the optional variable appears in the data availability report and output data set or file. Use the option `ID=` to specify the desired (text request file) or actual (SAS data set request file) name of the identification variable. The variable can have almost any valid SAS name, but don't use the name of the active security issue key (e.g. `PERMNO`). Use `IDFMT` to specify the SAS format for reading and displaying the identification variable. `IDFMT=4.0` means a 1–4 digit integer; `IDFMT=$4.` means a four character string. Other lengths and other SAS formats are permitted. In a text request file, the optional identification variable, when used, must follow the dates on each line.

Options for processing dates

The following `REQUEST` statement options select how Eventus handles the dates in the request file.

Figure 5.3
Eventus Statements to Retrieve Trading Volume Data from a CRSP Database.

[**filename request 'G:\Some Folder\Filename.extension';**]

EVENTUS GETDATA [**MONTHLY**];

REQUEST [**INSAS**=*libname.membername*]
[**ID**=*variable* **IDFMT**=*format*]
[**DATEFMT=MMDDYY|YYMMDD|DDMMYY|...|CRSP**]
[**AUTODATE**[=**BACK**]] [**NDAYS**=*n*];

VOLUME [**VSAS|HSAS**] [**SIC**] [**SHRCODE**] [**EXCHCODE**]
[**SHARES**] [**TRADES**] [**SPLITADJ**]
[**EXTFILE**=*fileref*|**OUTSAS**=*libname.membername*];

The `DATEFMT=` option

Calendar dates If the request file is a SAS data set, the request date variables `eventda1` and `eventda2` (the latter is not needed if the `NDAYS` option is specified) must be a SAS date variable, not an integer date. List calendar dates in a text request file in any conventional format. The default is YYMMDD, which automatically accommodates both eight digit (four digit year) and six digit (two digit year) dates. Besides MMDDYY, DDMMYY and so on, the style expected by the SAS informat DATE is allowed.[1]

CRSP dates When using a CRSP database, Eventus internally converts calendar dates to CRSP day or month numbers (CRSP dates). However, if you already have CRSP dates, you can use them in the request file. Specify `DATEFMT=CRSP` on the `REQUEST` statement to indicate that the request file dates are CRSP dates. If the request file is a SAS data set, name the date variable `crspda1` (and `crspda2` if the `NDAYS` option is not specified).

`AUTODATE` If some of the calendar dates in the request file may not be trading days, you can specify `AUTODATE` on the `REQUEST` statement. `AUTODATE`

[1] An example of DATE style is 29DEC2006.

tells Eventus to convert automatically all calendar dates to trading days. Non-trading days are converted to the following trading day, or the previous trading day if `AUTODATE=BACK` is specified. For example, using data from U.S. markets, Eventus changes a Sunday to the following Monday, or Tuesday if Monday is a holiday. The `AUTODATE` option is ignored with monthly data and when `DATEFMT=CRSP` appears.

`NDAYS=` Specify `NDAYS=`*n* when you want the same, fixed number of trading days or months of returns, prices or volume data for every row of the request file. Omit the ending date column from the request file if you specify this option. The valid range of values for *n* is from 1 to 9999.

Two additional date processing options, `SHIFT1=` and `SHIFT2=`, are available. These options shift the dates from the request file by a specified number of days. See page 134 in Appendix B for further details.

Market index options

The options in this section apply when the `INDEX` option appears on the `RETURNS` statement.

`NODIVIDX` Eventus normally retrieves the returns including dividends on the equally weighted and value-weighted (if the `VALUE` or `BOTH` option is specified) indexes from a CRSP database. Specify `NODIVIDX` to use index returns excluding dividends.

`SP500|COMPOSIT` `SP500` selects the return on the Standard and Poor's 500 Composite Index. `COMPOSIT` selects the return on the Nasdaq Composite Index. These options select the CRSP stock database indexes, not indexes from the additional CRSP indexes subscription. Therefore, the returns may be without dividends, regardless of whether `NODIVIDX` is specified; see CRSP documentation for the definitions of the index returns.

`SIZEINDX`[=*specification*] This option selects size-portfolio returns. Eventus uses the size (capitalization) portfolio membership information on the CRSP database as of the starting request date to match the market capitalization decile to the stock. The size-portfolio return replaces the broader

market return in the output file. The decile portfolio number for each request is fixed at the starting request date. If the requested time series extends past a calendar year end, the decile assignment is not updated. If the same stock appears on more than one row of the request file, each appearance is a separate security-event with its own starting request date and is handled independently.

Subscribers to the *CRSP Indices Database and Security Portfolio Assignment Module* (an add-on to the stock database) can select several of its stock capitalization decile indexes and cap-based portfolios. To obtain size-decile portfolio returns based on rankings of the entire CRSP universe of NYSE, Nasdaq, and AMEX stocks, specify `SIZEINDX=CRSPACCESS`. For NYSE-only, AMEX-only and Nasdaq-only size-decile portfolios as replacement market indexes for NYSE, AMEX and Nasdaq stocks, respectively, specify `SIZEINDX=OWNMARKET`. `SIZEINDX=OWNSYSTEM` (not shown in the figures) is similar to `OWNMARKET` except that it matches combined NYSE-AMEX size-decile portfolios to NYSE and AMEX stocks. The following two options, not shown in the figures, select size-decile portfolios from a specific market system. To use NYSE-AMEX-only size-decile portfolios, specify `SIZEINDX=NYSEAMEX`. To use Nasdaq-only size-decile portfolios, specify `SIZEINDX=NASDAQ`. Size decile returns from the specified market will be provided regardless of the market on which the individual stock trades.

To select the monthly CRSP Cap-Based Portfolios containing stocks from the entire CRSP universe (NYSE, Nasdaq, and AMEX) with decile breakpoints based on NYSE stocks only, specify `SIZEINDX=CAPBASED`. Eventus matches each stock in the sample to a market and size decile using the CRSP-reported exchange and decile number as of the starting request date.

If the size-portfolio returns come from the `sizeindex.sas` program distributed with Eventus, specify the `SIZEINDX` option without an argument. In this case, the SAS file shortcut `sizeindx` must point to the size-portfolio index file.

`BETAINDEX` **and** `STDINDEX` These options select the use of risk decile-portfolio returns when the `INDEX` option appears on the `RETURNS` statement and the *CRSP Indices Database and Security Portfolio Assignment Module* is available. Eventus uses the risk portfolio membership information from the CRSP database to match the beta or standard deviation decile to the stock. The appropriate risk decile-portfolio return replaces the return on a market in-

dex in the output file. As with size decile returns, a stock's decile portfolio assignment is fixed as of the starting request date (for a given row of the request file) and not updated if later dates in the time series fall beyond the initial calendar year.

5.3 The RETURNS, PRICES and VOLUME Statements

Use only one of the `RETURNS`, `PRICES` or `VOLUME` statements in a single program. The following options are available.

Selecting an output file format

Available output formats include text, horizontal text, vertical SAS data set, and horizontal SAS data set. The vertical and horizontal SAS data sets can be read only by SAS procedures and data steps. In a vertical data set, data are stored under a single variable name, `Return`, `Price`, or `Volum` (no "e"), with one SAS observation per trading day or month per firm. In a horizontal format data set, there is a separate variable for each trading day or month, so that there is one SAS observation per firm. (See Appendix B, pages 123 and following for more detailed descriptions of the formats.)

Reporting market index returns with stock returns

These options are valid only on the `RETURNS` statement. No market index return is included with the stock return unless the `INDEX` option is present. By default, the index is the CRSP equally weighted index. To select value weighted or both equally and value-weighted index returns, also specify `VALUE` or `BOTH`. The Standard and Poor's index return or Nasdaq Composite Index return is provided when `SP500` or `COMPOSIT` appears on the `REQUEST` statement; these index selections are mutually exclusive of each other and the value-weighted index.

Retrieving SIC codes

The `SIC` option retrieves SIC (industry classification) codes from the CRSP database and includes them in any output SAS data set being created (see the `OUTSAS` option below), as the numeric variable `SICCode`. The CRSP database

includes a history of SIC codes for many stocks. The `SIC` option retrieves the code for the last reporting date on or before the starting date in the current row of the request file. An exception occurs when the earliest reporting date follows the starting date of time-series data; then the earliest SIC code is provided. See the latest CRSP *Data Description Guide* for more information about the SIC code data.

Retrieving share type and exchange codes

To include the CRSP two-digit share type code or stock exchange code in an output SAS data set being created, specify the `SHRCODE` option or `EXCHCODE` option, respectively. Normally the share or exchange code reported by Eventus is the last code reported on the CRSP database that is dated on or before the starting date on the current request file line. In rare cases, the earliest code reporting date for a stock can be later than the starting date of data to retrieve. In this case, Eventus uses the earliest share or exchange code. Please see the latest CRSP *Data Description Guide* for further details on the share type and exchange codes.

Dropping signs from negative prices

CRSP uses a negative price to flag a bid-ask average recorded when no closing trade price is available. To have Eventus suppress the sign and report the absolute value, specify the `NOMINUS` option.

Selecting bid and ask or intraday high and low prices

The `BIDASK` option, valid only on the `PRICES` statement, reads the secondary price variables — *Bid or Low Price* and *Ask or High Price* — from the CRSP stock database. CRSP documentation indicates that these prices may be either closing bid and ask prices, or intraday high and low transaction prices. Eventus does not distinguish between the two types of data when executing a `PRICES BIDASK` statement. However, the source of the secondary prices can be inferred from the sign of the primary price variable when using daily data, if the `NOMINUS` option is not used. When the primary price is negative, the secondary price variables are closing bid and ask price quotes. When the primary price is positive, the secondary price variables are the lowest and highest transaction prices during the day.

The secondary price data are stored in variables named `BidLo` and `AskHi` if you specify `VSAS`, or `bidl1`–`bidl`*nnnn* and `askh1`–`askh`*nnnn* if you specify `HSAS`. In the default text output format, each stocks's secondary prices follow its primary prices on separate lines identified by the words `BIDLO` and `ASKHI`.

The `NMS` option on the `PRICES` statement causes Eventus to read the Supplemental Nasdaq Data Arrays of the CRSP database, which report closing bid and ask quotes and number of trades. When you specify both the `BIDASK` and `NMS` options, Eventus attempts to supply as many true bid and ask quotations instead of intraday high and low transaction prices as possible. Eventus reports bid and ask prices from the Supplemental Nasdaq Data Arrays when they exist, and secondary price data from the main time-series arrays otherwise. Nasdaq stock-date combinations not represented in the Supplemental Nasdaq Data Arrays typically have closing bid and ask quotations in the main time-series arrays. If the sample contains both Nasdaq and NYSE-AMEX stocks, the `BIDASK NMS` option combination is likely to result in a mixture of bid-ask quotations and intraday high-low transaction prices.

To prevent Eventus from reading the closing transaction (primary) prices in addition to the secondary prices, specify `NOCLOSE` on the `PRICES` statement. Thus, the option combination `BIDASK NOCLOSE` reports only secondary prices from the main time-series arrays. An additional feature of the `NOCLOSE` option is that, when combined with the `NMS` option, it disables the mixing of Supplemental Nasdaq bid and ask quotations with secondary prices. Instead, Eventus reports both bid and ask prices from the Supplemental Nasdaq Data Arrays and secondary prices from the main time-series structures, *as four separate variables,* when you specify `BIDASK NMS NOCLOSE`.

Reporting the number of shares outstanding with stock prices or volume

The `SHARES` option is valid only on the `PRICES` and `VOLUME` statements. The `SHARES` option tells Eventus to store the number of shares outstanding, in thousands, along with the share price or trading volume.

In the default text output file, the number of shares appears after the price or volume, on the same line. In a `VSAS` or `HSAS` output file the number of shares is a variable named `Shares`.

Retrieving cash distributions

The DISTRIB option on the PRICES statement retrieves dividends and other cash distributions from the CRSP distribution structure. Daily or monthly per-share cash distributions are reported, with zero reported on any non-ex-dividend date. If the SPLITADJ option is in effect, distributions are split-adjusted in the same manner as the price. In a VSAS or HSAS output data set, the cash distribution amount is a variable named DivAmt, and the CRSP distribution code is a variable named DistCode. If there are multiple cash distributions on the same date, the sum of distribution amounts is reported and the distribution code is replaced by MULT.

Retrieving the number of trades for Nasdaq stocks

The TRADES option is valid on the PRICES and VOLUME statements. Eventus reads the number of trades from the Supplemental Nasdaq Data Arrays of the CRSP database. With the PRICES statement, you must also specify the NMS option for TRADES to work.

In a VSAS output file the number of trades is a variable named Trades; in an HSAS file the variable names are trad1–trad*nnnn*.

Retrieving Nasdaq-specific data items

NASDINFO retrieves the trading status trait code, the National Market System indicator and the number of market makers from the Nasdaq information array of the CRSP database when the HSAS or VSAS option also appears on the VOLUME statement. The variable names in the SAS data set are Trait, NMS and Makers. The NASDINFO data are not available in a text output file. The NASDINFO option is valid only on the VOLUME statement and only when the SHARES option is valid; NASDINFO automatically activates the SHARES option.

Adjusting for splits and other stock distributions

By default, in a raw data retrieval run, Eventus does not adjust stock prices, bid and ask quotations, trading volume, or shares outstanding for stock splits and stock dividends. (Returns on the CRSP stock database already are adjusted.) You can specify SPLITADJ on the PRICES or VOLUME statement to

adjust for any stock splits or stock dividends that occur between the first and last dates of data. For example, suppose that a 2-for-1 stock split occurs on the fiftieth of 100 days of data. Without the `SPLITADJ` option, Eventus reports the actual data for each of the 100 days. With the `SPLITADJ` option, the trading volume and shares outstanding for the second 50 days are divided by 2, and the prices and bid-ask quotations for the second 50 days are multiplied by 2.

Selecting an output file location

Text or ASCII binary output is directed by default to the file to which the SAS file shortcut `userdata` points. If the shortcut is undefined, a file named `userdata.dat`, is created in the current working folder or directory. To designate the file in which to store the data, use a `filename userdata` statement, before the `EVENTUS` statement, to give the path and name of the file to be created. To use a SAS file shortcut other than `userdata`, specify the shortcut with the `EXTFILE` option.

Vertical and horizontal SAS data sets require a SAS library name to point to the folder or directory where the data set should go. If you specify the `VSAS` or `HSAS` option, also specify the two part SAS data set name (*libname.membername*), using the `OUTSAS` option. For a temporary data set (which will no longer exist after the user closes SAS or after the command-line run completes), use the SAS library name `work`. For a permanent data set, use a `libname` statement, before the `EVENTUS` statement, to point the library name to the folder or directory.

Chapter 6

Converting Calendar Dates to CRSP Trading Day or Month Numbers Using DATECONV

DATECONV is an Eventus statement that converts calendar dates to CRSP style trading period numbers (CRSP dates). It is not necessary to use DATECONV in preparation for a routine Eventus run; Eventus automatically converts calendar dates to CRSP trading day numbers. Only researchers who want to manipulate CRSP dates directly need DATECONV.

Figure 6.1 lists the Eventus statements needed to use DATECONV. The options are described below.

6.1 The EVENTUS Statement

If you are converting pairs of dates for each PERMNO, specify TWIN. If you are converting dates for use with a monthly or weekly database, specify MONTHLY or WEEKLY on the EVENTUS statement. Eventus uses the CRSP database's calendar to determine the association between calendar dates and CRSP dates.

6.2 The DATECONV Statement

The DATECONV statement instructs Eventus to read the request file, which by default is expected to be a text file, containing PERMNO identifiers, dates,

Figure 6.1
Eventus Statements for Converting Calendar Dates to CRSP Trading Day or Month Numbers.

[**filename request 'G:\Some Folder\Filename.extension';**]
[**filename userdata 'G:\Some Folder\Filename.extension';**]

EVENTUS [**TWIN**] [**MONTHLY**];

DATECONV [**CUSIPERM**] [**ID=***variable* **IDFMT=***format*]
[**INSAS=***libname.membername*]
[**INSAS2=***libname.membername*]
[**DATEFMT=MMDDYY**|**YYMMDD**|**DDMMYY**|**DATE**|**CRSP**]
[**AUTODATE**[**=BACK**]] [**NDAYS=***n*]
[**SHIFT1=***n*$_1$] [**SHIFT2=***n*$_2$]
[**OUTDTFMT=MMDDYY**|**YYMMDD**|**DDMMYY**|**DATE**]
[**OUTSAS=***libname.membername*|**EXTFILE=***fileref*];

and sometimes other information. The request file also can be a SAS data set. If the request file is a text file, the SAS file shortcut `request` must point to it. If the request file is a SAS data set, specify its two-part name using the `INSAS=`*libname.membername* option. (See page 99 for further explanation.)

Each row of the request file for a `DATECONV` program should contain the following items: PERMNO or CUSIP, first date, second date if one of the options `TWIN` or `GETDATA` appears on the `EVENTUS` statement, and the identification variable value if any. Omit the second date if you specify `NDAYS=`, explained below, on the `DATECONV` statement. When converting calendar dates to CRSP month numbers, the calendar dates can be any day of the month in a text request file and should be the first of the month in a SAS data set request file.

Converting CUSIPs to PERMNOs

If you have CUSIPs in the request file, you can specify the `CUSIPERM` option to convert them to CRSP PERMNOs. Eventus uses the PERMNOs to search the CRSP database and label the results, but does not change the request file. Only the PERMNOs, not the CUSIPs, appear in the output file.

The CUSIPERM option is fully effective only if the program Update PERMNO-CUSIP Conversion Database.sas is run once after each annual or quarterly update of the CRSP stock database.

Including an identification variable

Each line of the input request file can include an optional identification variable (following the date(s) in a text request file). Eventus will include in the output request file an identification variable specified by the ID= option. Use IDFMT to specify the SAS format to use for reading (if the request file is a text file) and displaying the identification variable. IDFMT=4.0 means a 1–4 digit integer; IDFMT=$4.0 refers to a character string of length four. Other lengths and other SAS formats also are valid.

Using grouping variables, group weights and short-long indicators

If the input request file contains a grouping variable (see page 99), specify the GROUP option on DATECONV to have Eventus include the grouping variable in the updated file. Add the GRWEIGHT option if the request file also contains a within-group weight for each observation. If the input request file contains an S or an L to indicate short or long (see page 17), specify SHORT on the DATECONV statement. In a text request file, the S or L must follow the PERMNO, date(s), and any identification variable, grouping variable, and group weight. These options have no effect on the operation of DATECONV except to copy the grouping variable, weights or short-long indicator to the output file. DATECONV statement processing makes no use of the grouping variable, group weight, or short-long indicator except to copy them from the input request file to the same variable name or appropriate position in the updated request file.

Options for processing dates

The DATECONV statement allows you to specify how Eventus should handle the dates in the request file.

DATEFMT=

Calendar dates If the request file is a SAS data set, use SAS date variables. If the request file is a text file, you can list calendar dates in any conventional format. If you use either six- or eight-digit YYMMDD, the default, you don't need to specify DATEFMT. Besides MMDDYY and DDMMYY, you can use the SAS date format DATE.[1]

CRSP dates To convert CRSP day numbers back to calendar dates, specify DATEFMT=CRSP on the DATECONV statement.

AUTODATE

If some of the calendar dates in the request file may be days when the market is closed, specify AUTODATE on the DATECONV statement. AUTODATE selects conversion of non-trading dates to trading dates. Non-trading days are converted to the following trading day. For example, a Saturday would be changed to the following Monday, or Tuesday if Monday were a holiday. To convert non-trading dates to the previous trading date instead of the next, specify AUTODATE=BACK. The AUTODATE option has no effect when converting between calendar dates and CRSP month numbers, because all months within the range of the CRSP calendar are trading months.

NDAYS=

This option is primarily applicable to the conversion of request files for use in twin event studies and data retrieval runs. Specify NDAYS=*n* to create an ending request date, calculated by adding *n* trading days or months to the first date for each row in the request file. When using NDAYS, specify TWIN on the EVENTUS statement, but omit the ending request date from the input request file.

SHIFT1= **and** SHIFT2=

SHIFT1= and SHIFT2= shift the dates from the request file by a specified number of days. When the request file contains calendar dates, the options determine the number of calendar days by which to shift. When the request

[1] An example of a date in DATE format is 19OCT2003.

file contains CRSP trading day numbers, these options determine the number of trading days by which to shift. A positive shift adds days; a negative shift subtracts days.

`OUTDTFMT=`

This option if for converting from CRSP or similar day, week or month numbers back to calendar dates. (In this case, `DATEFMT=CRSP` also should appear on the `DATECONV` statement.) The option specifies the calendar date format into which to convert CRSP trading day numbers. You do not need this option when the request file contains calendar dates, because in that case Eventus always converts to CRSP day numbers. You can specify any SAS date format. The default is YYMMDD.

Sorting the output request file

The observations in the output request file will appear in PERMNO order by default. To have the observations sorted by the identification variable, include the `SORTBYID` option on the `DATECONV` statement. For this to work, the input request file must contain an identification variable value on each line and you also must specify the `ID=` option. Sorting is not necessary or relevant for using the output request file in subsequent Eventus runs.

Selecting an output file location

The converted request file is directed by default to the file to which the SAS file shortcut `userdata` points. If the shortcut is undefined, a file, `userdata.dat`, is usually created in the current SAS working directory. In Eventus for Windows, the current working directory is listed at the bottom of the SAS screen. When running SAS and Eventus from a Unix or Linux command line, the current working directory for SAS usually is the same as the current working directory for the operating system shell. To override the destination for the converted request file, use a `filename userdata` statement, before the `EVENTUS` statement, to give the path and name of the file to be created. To use a SAS file shortcut other than `userdata,` specify the shortcut with the `EXTFILE` option.

You can also store the converted dates in a SAS data set. Specify the two-part SAS data set name *libname.membername*, using the `OUTSAS` option.

Chapter 7

Converting CUSIP Identifiers Using CUSIPERM

CUSIPERM converts 8-character common stock CUSIP values to the corresponding CRSP permanent number, PERMNO. To maximize the effectiveness of CUSIPERM, run the program Update PERMNO-CUSIP Conversion Database.sas, available from the Eventus sample programs folder, after each installation of an updated CRSP U.S. stock database.

This chapter describes the stand-alone version of CUSIPERM, which requires its own Eventus run. Use this version to create a copy of your request file that contains PERMNOs. There also is a CUSIPERM option of the REQUEST statement; it converts CUSIPs "on the fly" during an event study or data retrieval run. Unlike the standalone CUSIPERM statement, the REQUEST statement option does not produce a converted version of the request file.

Figure 7.1 lists the Eventus statements required to convert CUSIP identifiers.

Figure 7.1
Eventus Statements to Convert CUSIP Identifiers to CRSP Permanent Numbers.

EVENTUS ;

CUSIPERM [**COLUMN**=*n*] [**EXTFILE**=*fileref*]**;**

7.1 The EVENTUS Statement

The EVENTUS statement is mandatory. The statement takes no option in a CUSIPERM run.

7.2 The CUSIPERM Statement

The CUSIPERM statement instructs Eventus to read your request file, which contains CUSIP identifiers. The SAS file shortcut request must point to the request file, which must be a text file. Unlike other Eventus features, the stand-alone version of CUSIPERM does not accept a SAS data set as a request file. On the other hand, the request file need not conform to the request file format described elsewhere in this *Guide*. An eight character CUSIP identifier must appear within the first 80 characters of each line. The CUSIP may be anywhere within the 80 character positions. Other desired information can appear on the same line. CUSIPERM exactly duplicates the input request file, with the exception that it replaces any CUSIP with the corresponding five-digit PERMNO followed by three blanks and sorts the lines in PERMNO order. However, any information beyond column 80 will not be copied.

Make sure that no leading zeros are omitted from the CUSIPs. CUSIPs can contain letters as well as digits; CUSIPERM internally handles the CUSIP as an eight-character string, not a numeric variable.

The following two options may be specified on the CUSIPERM statement.

In which column does the CUSIP identifier begin? The COLUMN option

The COLUMN option is needed only when non-blank characters precede the CUSIP identifier in the request file. Specify the column number of the first character of the CUSIP.

Selecting an output file location

The original request file remains unchanged. The converted request file containing PERMNOs is directed by default to the file to which the SAS file shortcut userdata points. If the shortcut is undefined, a file, userdata.dat, is created in the current working folder or directory. To specify where to store

the converted request file, use a `filename userdata` statement, before the `EVENTUS` statement, to give the path and name of the file to be created. To use a SAS file shortcut other than `userdata,` specify the shortcut with the `EXTFILE` option.

Appendix A

Technical Reference

A.1 Event Study Benchmarks

Benchmarks using a separate estimation period

Event study benchmark models using a separate estimation period include the market model, the market-adjusted return model, the comparison period mean-adjusted return model, the raw return model, and, when the `EVTSTUDY` statement option `TWOSTEP` is in effect, the Fama-French three- and four-factor models and custom factor models. The application of each benchmark model requires two time series of return data for each security-event: an *estimation period* for estimating the benchmark parameters (including standard deviation), and an *event period* for computing and testing the abnormal returns. Typically the estimation period and event period do not overlap, in order to avoid potentially biasing the parameter estimates.

Market model

Assume that security returns follow a single factor market model,

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \epsilon_{jt},$$

where R_{jt} is the rate of return of the common stock of the j^{th} firm on day t; R_{mt} is the rate of return of a market index on day t; ϵ_{jt} is a random variable that, by construction, must have an expected value of zero, and is assumed to be uncorrelated with R_{mt}, uncorrelated with R_{kt} for $k \neq j$, not autocorrelated, and homoskedastic. β_j is a parameter that measures

the sensitivity of R_{jt} to the market index. Define the *abnormal return* (or *prediction error*) for the common stock of the j^{th} firm on day t as:

$$A_{jt} = R_{jt} - (\hat{\alpha}_j + \hat{\beta}_j R_{mt}), \tag{A.1}$$

where the coefficients $\hat{\alpha}_j$ and $\hat{\beta}_j$ are ordinary least squares estimates of α_j and β_j.

The *average abnormal return* (or *average prediction error*) AAR_t is the sample mean:

$$AAR_t = \frac{\sum_{j=1}^{N} A_{jt}}{N}, \tag{A.2}$$

where t is defined in trading days relative to the event date (e.g. $t = -60$ means 60 trading days before the event).

Over an interval of two or more trading days beginning with day T_1, and ending with T_2, the *cumulative average abnormal return* is

$$CAAR_{T_1,T_2} = \frac{1}{N} \sum_{j=1}^{N} \sum_{t=T_1}^{T_2} A_{jt}. \tag{A.3}$$

Over an interval of two or more trading days beginning with day T_1, and ending with T_2, the *buy-and-hold abnormal return* is

$$\begin{aligned} BHAR_{j,T_1,T_2} = & \\ & \left[\prod_{t=T_1}^{T_2} (1 + R_{jt}) - 1 \right] - \left[(1 + \hat{\alpha}_j)^{(T_2 - T_1 + 1)} - 1 \right] \\ & - \hat{\beta}_j \left[\prod_{t=T_1}^{T_2} (1 + R_{mt}) - 1 \right]. \end{aligned} \tag{A.4}$$

The *average compounded abnormal return* is is

$$ACAR_{T_1,T_2} = \frac{1}{N} \sum_{j=1}^{N} BHAR_{j,T_1,T_2}. \tag{A.5}$$

When the `REQUEST` statement option `SHORT` is in effect, Eventus computes the buy-and-hold raw return using the daily (or monthly, etc.) returns as reported by the database — that is, the long position returns — then uses the negative of the buy-and-hold raw return in any buy-and-hold abnormal return calculations.

Market model with Scholes-Williams beta estimation

When the `SW` option appears on the `EVTSTUDY` statement, Eventus reports market model results using betas estimated by both ordinary least squares and the method of Scholes and Williams (1977). The Scholes-Williams beta estimator is

$$\hat{\beta}_j^{\star} = \frac{\hat{\beta}_j^{-} + \hat{\beta}_j + \hat{\beta}_j^{+}}{1 + 2\hat{\rho}_m},$$

where $\hat{\beta}_j^{-}$ is the OLS slope estimate from the simple linear regression of R_{jt} on R_{mt-1}, $\hat{\beta}_j^{+}$ is the OLS estimate from the regression of R_{jt} on R_{mt+1}, and $\hat{\rho}_m$ is the estimated first-order autocorrelation of R_m. As in OLS, the intercept estimator forces the estimated regression line through the sample mean:

$$\hat{\alpha}_j^{\star} = \overline{R_{jEst}} - \hat{\beta}_j^{\star}\overline{R_{mEst}}. \tag{A.6}$$

$\overline{R_j}$ is the mean return of stock j over the estimation period and $\overline{R_{mEst}}$ is the mean market return over the estimation period.[1]

Market model with GARCH or EGARCH estimation

The `EVTSTUDY` statement option `GARCH` invokes a single factor market model with GARCH(1,1) errors; the `EGARCH` option invokes exponential GARCH or EGARCH(1,1) (Nelson, 1990) errors:

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \epsilon_{jt}, \tag{A.7}$$

where $\epsilon_{jt}|\Psi_{t-1} \sim (0, h_{jt})$ and Ψ_{t-1} denotes all information available at time $t-1$. The conditional variance in the GARCH case is

$$h_{jt} = \omega_j + \delta_j h_{jt-1} + \gamma_j \epsilon_{jt-1}^2, \tag{A.8}$$

with $\omega_j > 0, \gamma_j > 0, \delta_j \geq 0$, and $\gamma_j + \delta_j < 1$. In the EGARCH case,

$$\log h_{jt} = \omega_j + \delta_j \log h_{jt-1} + \gamma_j \left|z_{jt-1}\right| + \phi_j z_{jt-1} \tag{A.9}$$

where $z_{jt} = \epsilon_{jt}/\sqrt{h_{jt}}$. The parameters are estimated by maximum likelihood.

[1] Eventus applies the simplifying assumption that the use of Scholes-Williams estimates does not affect the formula for $s^2_{A_{jt}}$ below. Analytically this assumption is not strictly correct, but simulation results obtained by the author show that tests using the assumption are well specified.

Fama-French three-factor model

The option combination `FAMAFRENCH TWOSTEP` selects the Fama-French (1993) three-factor model as the return-generating process using a separate estimation period. The model is:

$$R_{jt} = \alpha + \beta_j R_{mt} + s_j SMB_t + h_j HML_t + \epsilon_{jt}. \tag{A.10}$$

where R_{jt} is the rate of return of the common stock of the j^{th} firm on day t; R_{mt} is the rate of return of a market index on day t; SMB_t is the average return on small market-capitalization portfolios minus the average return on three large market-capitalization portfolios; HML_t is the average return on two high book-to-market equity portfolios minus the average return on two low book-to-market equity portfolios; ϵ_{jt} is a random variable that, by construction, must have an expected value of zero, and is assumed to be uncorrelated with R_{mt}, uncorrelated with R_{kt} for $k \neq j$, not autocorrelated, and homoskedastic. See Fama and French (1993) for a detailed description of SMB_t and HML_t. β_j is a parameter that measures the sensitivity of R_{jt} to the excess return on the market index; s_j measures the sensitivity of R_{jt} to the difference between small and large capitalization stock returns; and h_j measures the sensitivity of R_{jt} to the difference between value and growth stock returns.

Define the *abnormal return* (or *prediction error*) for the common stock of the j^{th} firm on day t as:

$$A_{jt} = R_{jt} - (\hat{\alpha}_j + \hat{\beta}_j R_{mt} + \hat{s}_j SMB_t + \hat{h}_j HML_t), \tag{A.11}$$

where the coefficients $\hat{\alpha}_j$, $\hat{\beta}_j$, $\hat{s}_j$ and $\hat{h}_j$ are ordinary least squares estimates of α_j, β_j, s_j and h_j.

The average abnormal return, cumulative abnormal return, buy-and-hold abnormal return and related concepts are analogous to those defined in the market model section above.

Fama-French-momentum four-factor model

The option combination `FAMAFRENCH MOMENTUM TWOSTEP` selects the Fama-French (1993) three-factor model, augmented by the momentum factor as suggested by Carhart (1997), as the return-generating process using a separate estimation period. The model is:

$$R_{jt} = \alpha + \beta_j R_{mt} + s_j SMB_t + h_j HML_t + u_j UMD_t + \epsilon_{jt}. \tag{A.12}$$

where R_{jt} is the rate of return of the common stock of the j^{th} firm on day t; R_{mt} is the rate of return of a market index on day t; SMB_t is the average return on small market-capitalization portfolios minus the average return on three large market-capitalization portfolios; HML_t is the average return on two high book-to-market equity portfolios minus the average return on two low book-to-market equity portfolios; UMD_t is the average return on two high prior return portfolios minus the average return on two low prior return portfolios. ϵ_{jt} is a random variable that, by construction, must have an expected value of zero, and is assumed to be uncorrelated with R_{mt}, uncorrelated with R_{kt} for $k \neq j$, not autocorrelated, and homoskedastic. β_j is a parameter that measures the sensitivity of R_{jt} to the excess return on the market index; s_j measures the sensitivity of R_{jt} to the difference between small and large capitalization stock returns; h_j measures the sensitivity of R_{jt} to the difference between value and growth stock returns; and u_j measures the sensitivity of R_{jt} to the difference between high prior return stock returns and low prior return stock returns.

Define the *abnormal return* (or *prediction error*) for the common stock of the j^{th} firm on day t as:

$$A_{jt} = R_{jt} - (\hat{\alpha}_j + \hat{\beta}_j R_{mt} + \hat{s}_j SMB_t + \hat{h}_j HML_t + \hat{u}_j UMD_t) \qquad \text{(A.13)}$$

where the coefficients $\hat{\alpha}_j$, $\hat{\beta}_j$, $\hat{s}_j$, $\hat{h}_j$ and $\hat{u}_j$ are ordinary least squares estimates of α_j, β_j, s_j h_j and u_j.

The average abnormal return, cumulative abnormal return, buy-and-hold abnormal return and related concepts are analogous to those defined in the market model section above.

Market adjusted returns model

Market adjusted returns are computed by subtracting the observed return on the market index for day t, R_{mt}, from the rate of return of the common stock of the j^{th} firm on day t:

$$A_{jt} = R_{jt} - R_{mt}. \qquad \text{(A.14)}$$

The definitions of the average abnormal return, cumulative average abnormal return and average compounded abnormal return are analogous to those for market model abnormal returns above.

Comparison period mean adjusted returns

Comparison period mean adjusted returns are computed by subtracting the arithmetic mean return of the common stock of the j^{th} firm computed over the estimation period, $\overline{R_j}$, from its return on day t:

$$A_{jt} = R_{jt} - \overline{R_j}. \tag{A.15}$$

The definitions of the average abnormal return, cumulative average abnormal return and average compounded abnormal return are analogous to those for market model abnormal returns above.

A benchmark model using combined estimation and event periods

In contrast to the two-step approach, the benchmark method in this section combines the estimation and event periods into a single time series for parameter estimation and testing.

Event parameter approach

Assume that security returns follow a conditional single factor market model,

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \sum_{t=T_pre}^{T_post} \gamma_{jkt} d_{jkt} + \epsilon_{jt}, \tag{A.16}$$

where d_{jkt} is a dummy variable equal to one on the k^{th} day or month in the event period; γ_{jk} is the estimated abnormal return of security j on day or month k. As in the conventional market model approach, ϵ_{jt} is a mean zero error term that is assumed uncorrelated with R_m and d_{jkt}. However, it is allowed to be potentially cross-correlated; it is not necessarily true that $E[\epsilon_{jt}, \epsilon_{it}] = 0$. In the case of cross-correlation, joint generalized least squares, also known as seemingly unrelated regressions (SUR) estimation, potentially can provide potentially more efficient estimation of the system of equations for a given sample. See Ingram and Ingram (1993) and Thompson (1985).

Benchmarks with no separate estimation period

Fama-French calendar time portfolio regressions

The `EVTSTUDY` statement option `FAMAFRENCH`, when neither the `TWOSTEP` option nor the `IRATS` option is used, invokes a calendar-time model using Fama-French (1993) factors:

$$R_{pt} - R_{ft} = \alpha + \beta\left(R_{mt} - R_{ft}\right) + sSMB_t + hHML_t + \epsilon_{pt},$$

where R_{ft} is the one-month Treasury bill rate and other symbols are as defined above. A portfolio is formed for each date that includes each sample firm having the date in its event period. In an event study using monthly data, portfolios are formed monthly in calendar time. Portfolios are equally weighted unless the `VALUEWEIGHTSAMPLE` option appears on the `EVTSTUDY` statement. The regression is estimated on portfolio returns. The estimate of the average abnormal return is α. If neither the `GMM` or `WLS` option is specified, Eventus uses ordinary least squares to estimate the model and test the null hypothesis $\alpha = 0$.

If the `MOMENTUM` option is specified, the model includes a fourth factor as described in the section "Fama-French-momentum four-factor model" on 76.

Ibbotson's "Returns Across Time and Securities"

The `EVTSTUDY` statement option `IRATS` invokes a simplified version of the Returns across Time and Securities, or RATS, model (Ibbotson, 1975):

$$R_{jt} = \alpha_t + \beta_t R_{mt} + \epsilon_{jt}, \tag{A.17}$$

Unlike the conventional market model, the RATS regression is estimated for each period in event time (day, month, etc.) The estimate of the mean abnormal return is α_t. Eventus uses ordinary least squares to estimate the model and test the null hypothesis $\alpha_t = 0$. For a window, Eventus reports the sum of the mean abnormal returns as the mean cumulative abnormal return and tests its significance assuming time-series independence. Therefore, the denominator of the test statistic for a window is the square root of the sum of the squares of the test-statistic denominators for the individual days or months that make up the window.

Fama-French factors with Ibbotson's "Returns Across Time and Securities"

The `EVTSTUDY` statement option combination `FAMAFRENCH IRATS` invokes a modified version of the Returns across Time and Securities, or RATS, model (Ibbotson, 1975) using Fama-French (1993) factors:

$$R_{jt} - R_{ft} = \alpha_t + \beta_t \left(R_{mt} - R_{ft}\right) + s_t SMB_t + h_t HML_t + \epsilon_{jt}.$$

The regression is estimated for each period in event time (day, month, etc.) The estimate of the abnormal return is α_t. Eventus uses ordinary least squares to estimate the model and test the null hypothesis $\alpha_t = 0$.

A.2 Event Study Test Statistics

Patell test

The `PATELL` option on the `EVTSTUDY` statement invokes the Patell (1976) test. It is also the default when the user does not select another parametric test and the event study does not use a multi-factor model or buy-and-hold returns. The literature also refers to the Patell test as a standardized abnormal return test or a test assuming cross-sectional independence. Many published studies use the Patell test (see, for example, Linn and McConnell, 1983; Schipper and Smith, 1986; and Haw, Pastena and Lilien, 1990).

Event studies centered on a single date

Under the null hypothesis, each A_{jt} has mean zero and variance $\sigma^2_{A_{jt}}$. The maximum likelihood estimate of the variance is,

$$s^2_{A_{jt}} = s^2_{A_j}\left[1 + \frac{1}{M_j} + \frac{(R_{mt} - \overline{R_{mEst}})^2}{\sum_{k=E_1}^{E_2}(R_{mk} - \overline{R_{mEst}})^2}\right]$$

where

$$s^2_{A_j} = \frac{\sum_{k=E_1}^{E_2} A^2_{jk}}{M_j - 2}, \tag{A.18}$$

R_{mt} is the observed return on the market index on day t, $\overline{R_{mEst}}$ is the mean market return over the estimation period and M_j is the number of non-missing trading day returns in the interval E_1 through E_2 used to estimate the parameters for firm j.

Define the *standardized abnormal return* (or *standardized prediction error*) as

$$SAR_{jt} = \frac{A_{jt}}{s_{A_{jt}}}. \tag{A.19}$$

Under the null hypothesis, each SAR_{jt} follows a Student's t distribution with $M_j - 2$ degrees of freedom. Summing the SAR_{jt} across the sample, we obtain

$$TSAR_t = \sum_{j=1}^{N} SAR_{jt}. \tag{A.20}$$

The expected value of $TSAR_t$ is zero. The variance of $TSAR_t$ is

$$Q_t = \sum_{j=1}^{N} \frac{M_j - 2}{M_j - 4}. \tag{A.21}$$

The test statistic for the null hypothesis that $CAAR_{T_1,T_2} = 0$ is

$$Z_{T_1,T_2} = \frac{1}{\sqrt{N}} \sum_{j=1}^{N} Z^j_{T_1,T_2}, \tag{A.22}$$

where

$$Z^j_{T_1,T_2} = \frac{1}{\sqrt{Q^j_{T_1,T_2}}} \sum_{t=T_1}^{T_2} SAR_{jt}, \tag{A.23}$$

and

$$Q^j_{T_1,T_2} = (T_2 - T_1 + 1)\frac{M_j - 2}{M_j - 4}. \tag{A.24}$$

Under cross-sectional independence of the $Z^j_{T_1,T_2}$ and other conditions (see Patell, 1976), Z_{T_1,T_2} follows the standard normal distribution under the null hypothesis.

The Patell test without the `SERIAL` option assumes that abnormal returns are serially uncorrelated. If abnormal returns are serially uncorrelated, the

variance of CAR_j is the sum of the variances of the daily abnormal returns:

$$s^2_{CAR_{T_{1j},T_{2j}}} = s^2_{A_j}\left[L_j + \frac{L_j}{M_j} + \frac{\sum_{t=T_{1j}}^{T_{2j}}\left(R_{mt} - \overline{R_{mEst}}\right)^2}{\sum_{k=1}^{M_j}\left(R_{mk} - \overline{R_{mEst}}\right)^2}\right]. \quad \text{(A.25)}$$

Eventus reports a precision-weighted cumulative average abnormal return when the Patell or other standardized abnormal return test is selected. The precision-weighted average is constructed using the relative weights implied by the definition of Z_{T_1,T_2}. Thus, the precision-weighted average will always have the same sign as the corresponding Z_{T_1,T_2}. The formula for the precision-weighted average is

$$PWCAAR_{T_1,T_2} = \sum_{j=1}^{N}\sum_{t=T_1}^{T_2} w_j A_{jt}, \quad \text{(A.26)}$$

where

$$w_j = \frac{\left(\sum_{t=T_1}^{T_2} s^2_{A_{jt}}\right)^{-\frac{1}{2}}}{\sum_{i=1}^{N}\left(\sum_{t=T_1}^{T_2} s^2_{A_{it}}\right)^{-\frac{1}{2}}}.$$

The precision-weighted CAAR fulfills the reporting needs for which researchers sometimes report an average standardized cumulative abnormal return (average *SCAR*). The precision-weighted *CAAR*, as a weighted average of the original *CAR*s, preserves the portfolio interpretation that *CAAR* offers but average *SCAR* does not.

`TWIN` event studies (two firm-specific event dates)

The major difference between `TWIN` and single date event studies is that `TWIN` cumulates returns over intervals of security-specific length. Instead of defining a window for return cumulation with reference to a single event date, the window is defined as the period between two event dates. The number of trading days between the two event dates varies from firm to firm.

Let the cumulative abnormal return for firm j be

$$CAR_{T_{1j},T_{2j}} = \sum_{t=T_{1j}}^{T_{2j}} A_{jt}, \quad \text{(A.27)}$$

where T_{1j}, T_{2j} are the two event dates specific to firm j. Let L_j be the length of the event period in trading days,

$$L_j = T_{2j} - T_{1j} + 1. \tag{A.28}$$

The z statistic for testing the significance of $CAR_{T_{1j},T_{2j}}$ is

$$z_j = \frac{\sum_{t=T_{1j}}^{T_{2j}} SAR_{jt}}{(L_j \frac{M_j-2}{M_j-4})^{\frac{1}{2}}}.$$

Assuming cross-sectional and time-series independence, the test statistic for

$$CAAR = \frac{1}{N} \sum_{j=1}^{N} CAR_{T_{1j},T_{2j}} \tag{A.29}$$

is

$$z_{CAAR} = N^{-\frac{1}{2}} \sum_{j=1}^{N} z_j. \tag{A.30}$$

Correction for correlation of abnormal returns

When the `SERIAL` option appears on the `EVTSTUDY` statement, Eventus uses a corrected version of the Patell test. The correction affects only windows, not single-period test statistics. Following Mikkelson and Partch (1988), the corrected test statistic for the null hypothesis that $CAAR = 0$ is

$$z_{CAAR} = N^{-\frac{1}{2}} \sum_{j=1}^{N} \frac{CAR_{T_{1j},T_{2j}}}{s_{CAR_{T_{1j},T_{2j}}}},$$

where

$$s^2_{CAR_{T_{1j},T_{2j}}} = s^2_{A_j} \left\{ L_j \left[1 + \frac{L_j}{M_j} + \frac{\left(\sum_{t=T_{1j}}^{T_{2j}} R_{mt} - L_j \overline{R_{mEst}} \right)^2}{\sum_{k=1}^{M_j} \left(R_{mk} - \overline{R_{mEst}} \right)^2} \right] \right\}. \tag{A.31}$$

For an event study centered on a single event date, T_{1j}, T_{2j} (and L_j if there is no missing return) are equal across firms and the subscript j can be dropped from them.

The corrected test accounts for the fact that within the window, the abnormal returns for each stock are serially correlated. The serial correlation occurs because all the abnormal returns are functions of the same market model intercept and slope estimators. Applications of the corrected test in addition to Mikkelson and Partch (1988) include Mais, Moore and Rogers (1989), Cowan, Nayar and Singh (1990), Mann and Sicherman (1991) and Lee (1992). Simulation evidence of the properties of the corrected and uncorrected Patell tests appears in Karafiath and Spencer (1991, using Monte Carlo experiments) and Cowan (1993, using sampling experiments with CRSP data). Both papers report that the bias in the uncorrected test is small in event windows shorter than 60 days but serious in event windows longer than 100 days. Mikkelson and Partch (1988) acknowledge Craig Ansley for the original derivation of the corrected test statistic in an event study context. For other derivations and discussion, see Cantrell, Maloney and Mitchell (1989) and Sweeney (1991).

When the `SERIAL` and `STDALL` options both appear on the `EVTSTUDY` statement, Eventus uses the following definitions for the standardized abnormal return tests with non-market model abnormal returns. For comparison period mean adjusted returns,

$$s^2_{CAR_{T_{1j},T_{2j}}} = s^2_{A_j}\left(L_j + \frac{L_j^2}{M_j}\right). \tag{A.32}$$

For raw returns and market-adjusted returns, there is no estimation of the mean. Instead, the mean is assumed to be equal to a known constant with probability one. The constant is zero for raw returns and is the realized market index return for market-adjusted returns. Thus,

$$s^2_{CAR_{T_{1j},T_{2j}}} = s^2_{A_j}\left(L_j\right). \tag{A.33}$$

Standardized cross-sectional test

Eventus uses the standardized cross-sectional test for market model abnormal returns when you specify `STDCSECT` on the `EVTSTUDY` statement. Boehmer, Musumeci and Poulsen (1991) introduce the test and report its empirical properties. The test is the same as the Patell test described above except

that there is a final empirical cross-sectional variance adjustment in place of the analytical variance of the total standardized prediction error. For additional discussion of event-date variance increases and related tests, see Sanders and Robins (1991).

For day t in the event period, the test statistic is

$$z_t = \frac{TSAR_t}{N^{\frac{1}{2}}\left(s_{SAR_{\bullet t}}\right)}, \tag{A.34}$$

where

$$s^2_{SAR_{\bullet t}} = \frac{1}{N-1}\sum_{i=1}^{N}\left(SAR_{it} - \frac{1}{N}\sum_{j=1}^{N} SAR_{jt}\right)^2.$$

Eventus extends the cross-sectional standardized test to multiperiod windows using the correction for serial correlation described above. Thus, the `STDCSECT` option implies the `SERIAL` option. Define the standardized cumulative abnormal return for stock j as

$$SCAR_{T_{1j},T_{2j}} = \left(CAR_{T_{1j},T_{2j}} / s_{CAR_{T_{1j},T_{2j}}}\right),$$

where $s_{CAR_{T_{1j},T_{2j}}}$ is as defined in equation A.31. Then the standardized cross-sectional test statistic for the null hypothesis that $CAAR = 0$ is

$$z_t = \frac{\sum_{i=1}^{N} SCAR_{T_{1j},T_{2j}}}{N^{\frac{1}{2}} s_{SCAR_{\bullet t}}},$$

where

$$s^2_{SCAR_{\bullet t}} = \frac{1}{N-1}\sum_{i=1}^{N}\left(SCAR_{T_{1i},T_{2i}} - \frac{1}{N}\sum_{j=1}^{N} SCAR_{T_{1j},T_{2j}}\right)^2.$$

Time-series standard deviation test

The `EVTSTUDY` statement option `CDA` invokes the time-series standard deviation test. The test is also called the "crude dependence adjustment" test (Brown and Warner, 1980). Unlike the standardized abnormal return test, the time series standard deviation test uses a single variance estimate for the entire portfolio. Therefore, the time series standard deviation test does

not take account of unequal return variances across securities. On the other hand, it avoids the potential problem of cross-sectional correlation of security returns. The estimated variance of AAR_t is

$$\hat{\sigma}^2_{AAR} = \frac{\sum_{t=E_1}^{E_2} (AAR_t - \overline{AAR})^2}{M-2},$$

where the market model parameters are estimated over the estimation period of $M = E_2 - E_1 + 1$ days and

$$\overline{AAR} = \frac{\sum_{t=E_1}^{E_2} AAR_t}{M}. \tag{A.35}$$

The portfolio test statistic for day t in event time is

$$\mathrm{t} = \frac{AAR_t}{\hat{\sigma}_{AAR}}. \tag{A.36}$$

Assuming time-series independence, the test statistic for $CAAR_{T_1,T_2}$ is

$$\mathrm{t} = \frac{CAAR_t}{(T_2 - T_1 + 1)^{\frac{1}{2}}\, \hat{\sigma}_{AAR}}. \tag{A.37}$$

Many studies use the time series standard deviation test (for example, see Dopuch, Holthausen and Leftwich, 1986 and Brickley, Dark and Weisbach, 1991).

Cross-sectional standard deviation test

When the `CSECTERR` option appears on the `EVTSTUDY` statement, Eventus substitutes a daily cross-sectional standard deviation for the portfolio time-series standard deviation in the non-standardized tests. The portfolio test statistic for day t in event time is

$$\mathrm{t} = \frac{AAR_t}{\hat{\sigma}_{AAR_t}/\sqrt{N}}, \tag{A.38}$$

where

$$\hat{\sigma}^2_{AAR_t} = \frac{1}{N-1} \sum_{i=1}^{N} \left(A_{it} - \frac{1}{N} \sum_{j=1}^{N} A_{jt} \right)^2.$$

The estimated variance of $CAAR_{T_1,T_2}$ is

$$\hat{\sigma}^2_{CAAR_{T_1,T_2}} = \frac{1}{N-1}\sum_{i=1}^{N}\left(CAR_{i,T_1,T_2} - \frac{1}{N}\sum_{j=1}^{N} CAR_{j,T_1,T_2}\right)^2.$$

The test statistic for $CAAR_{T_1,T_2}$ is

$$\mathrm{t}_{CAAR} = \frac{CAAR_{T_1,T_2}}{\hat{\sigma}_{CAAR_{T_1,T_2}}/\sqrt{N}}. \tag{A.39}$$

Brown and Warner (1985) report that the cross-sectional test is well-specified for event date variance increases but not very powerful. Boehmer, Musumeci and Poulsen (1991) report that the standardized cross-sectional test (see above) is more powerful and equally well specified. Cowan (1992) reports that the generalized sign test (see below) also is well specified for event date variance increases and more powerful than the cross-sectional test.

Skewness-adjusted transformed normal test

The transformed normal test (Hall, 1992) can be applied to mean abnormal return and to window mean cumulative or compounded abnormal return. Assume that it is applied to average compounded abnormal return. Estimate the cross-sectional standard deviation by

$$\hat{\sigma}_{BHAR} = \left[\frac{1}{N-1}\sum_{i=1}^{N}\left(BHAR_{i,T_1,T_2} - ACAR_{T_1,T_2}\right)^2\right]^{\frac{1}{2}}$$

and the skewness by

$$\hat{\gamma} = \frac{N}{(N-1)(N-2)}\sum_{i=1}^{N}\left(BHAR_{i,T_1,T_2} - ACAR_{T_1,T_2}\right)^3 \hat{\sigma}^{-3}_{BHAR}.$$

Define

$$S = \frac{ACAR_{T_1,T_2}}{\hat{\sigma}_{BHAR}/\sqrt{N}}. \tag{A.40}$$

The skewness-adjusted transformed normal test statistic is

$$t_1 = S + \frac{1}{3}\hat{\gamma}S^2 + \frac{1}{27}\hat{\gamma}^2S^3 + \frac{1}{6N}\hat{\gamma}.$$

See Hall (1992) for derivation, simulation evidence and discussion.

Generalized sign test

For each trading day or month in the event period, and for each window, Eventus reports the number of securities with positive and negative average abnormal returns (cumulative or compounded abnormal returns for windows). Also reported is a test statistic (in the default output format) and significance level symbols for the generalized sign test. The null hypothesis for the generalized sign test is that the fraction of positive returns is the same as in the estimation period. For example, if 46% of market adjusted returns are positive in the estimation period, while 60% of firms have positive market adjusted returns on event day -1, Eventus reports whether the difference between 60% and 46% is significant at the five percent, one percent, or one-tenth of one percent level. The actual test uses the normal approximation to the binomial distribution. For examples of the generalized sign test in the literature, see Sanger and Peterson (1990), Singh, Cowan and Nayar (1991), and Chen, Hu and Shieh (1991). (Chen, Hu and Shieh refer to the test as a binomial sign test.) For a more detailed explanation of the generalized sign test, see Sprent (1989) and Cowan (1992).

Rank test

Corrado (1989) describes the rank test for a one-day event window. The ranks of the abnormal returns of different days are dependent by construction. However, the effect of ignoring the dependence should be negligible for short event windows. Eventus extends the rank test to multiple day windows by assuming that the daily return ranks within the window are independent.

The rank test procedure treats the combined estimation period and event period as a single set of returns, and assigns a rank to each daily (or monthly, etc.) return for each firm.[2] Let K_{jt} represent the rank of abnormal return A_{jt} in the sample of $M_j + L_j$ abnormal returns of stock j. L_j is the number of non-missing returns of stock j in the event period; if there are no missing returns, $L_j = L =$ `POST` $-$ `PRE` $+ 1$ and $M_j = M =$ `ESTLEN`. Rank one signifies the smallest abnormal return. The mean (and median) rank across

[2]Eventus does not require that the estimation and event periods be contiguous. The estimation and event period returns used for the other computations in the current event study are used for the rank test also.

the combined estimation and event period is

$$\widetilde{K} = \frac{M + L + 1}{2}. \tag{A.41}$$

The rank test statistic for the event window composed of days T_1 through T_2 is

$$z_r = (L)^{\frac{1}{2}} \left\{ \frac{\overline{K_{T_1,T_2}} - \widetilde{K}}{\left[\sum_{t=1}^{M+L} \left(\overline{K_t} - \widetilde{K} \right)^2 / (M + L) \right]^{\frac{1}{2}}} \right\},$$

where

$$\overline{K_{T_1,T_2}} = \frac{1}{L} \sum_{t=T_1}^{T_2} \frac{1}{N} \sum_{j=1}^{N} K_{jt}$$

is the average rank across the N stocks and $L = T_2 - T_1 + 1$ days of the event window and $\overline{K_t} = (1/N) \sum_{j=1}^{N} K_{jt}$ is the average rank across N stocks on day t of the $M + L$ day combined estimation and event period. The expected rank still is $\widetilde{K}$ for event windows shorter than L days, because the full $M + L$ day set of returns is used for the assignment of ranks.

Jackknife test

The discussion in this subsection is adapted from Giaccotto and Sfiridis (1996). The jackknife test incorporates the standardized abnormal return for each stock j, computed using the event period sample standard deviation. The standardized abnormal return for day t is

$$\hat{\theta} = \frac{A_{jt}}{\tilde{\sigma}_{A_{jt}}} \tag{A.42}$$

where

$$\tilde{\sigma}_{A_{jt}} = \left\{ \sum_{t=T_1}^{T_2} \frac{\left(A_{jt} - \overline{A_j} \right)^2}{L_j} \right\}^{\frac{1}{2}} \tag{A.43}$$

and $\overline{A_j}$ is the mean abnormal return of stock j during the event period of L days. If there is an event-induced, transient variance change on day t, then $\tilde{\sigma}_{A_{jt}}$ is a biased estimator of $\sigma_{A_{jt}}$ and $\hat{\theta}$ is a biased statistic. Giaccotto

and Sfiridis propose reducing the bias by jackknifing the $\hat{\theta}$ values. The first step of the jackknife is to sequentially delete one abnormal return A_{jT_s} from equation A.43 and re-compute $\tilde{\sigma}_{A_{jt}}$, using the new value in turn to re-compute $\hat{\theta}$ using equation A.42. Call the latter value $\hat{\theta}_{(-s)}$. The next step is to form pseudo-values

$$\theta_{(-s)} = (L_j)\,\hat{\theta} - (L_j - 1)\,\hat{\theta}_{(-s)}$$

The jackknife estimator for stock j on day t is the mean of the pseudo-values,

$$\theta_{jt} = \frac{1}{L_j} \sum_{t=T_1}^{T_2} \theta_{(-s)} \tag{A.44}$$

To gain efficiency, the estimates are averaged across the sample of stocks:

$$\overline{\Theta}_t = \frac{1}{N} \sum_{j=1}^{N} \theta_{jt} \tag{A.45}$$

Finally, the jackknife test statistic for the sample of stocks on day t is

$$t_{Jackknife} = \frac{\overline{\Theta}_t}{S_{Jackknife,t}/\sqrt{N}} \tag{A.46}$$

where

$$S_{Jackknife,t} = \left[\frac{1}{N-1} \sum_{i=1}^{N} \left(\theta_{jt} - \overline{\Theta}_t\right)^2 \right]^{\frac{1}{2}}. \tag{A.47}$$

The distribution of $t_{Jackknife}$ under the null hypothesis is approximately normal with mean zero and unit variance.

To test the significance of the cumulative average abnormal return over the window from date T_1 through date T_2, define

$$\hat{\theta}_{T_1,T_2} = \frac{\sum_{t=T_1}^{T_2} A_{jt}}{(T_2 - T_1 + 1)^{\frac{1}{2}}\,\tilde{\sigma}_{A_{jt}}} \tag{A.48}$$

Sequentially delete one abnormal return A_{jT_s} from equation A.43 and re-compute $\tilde{\sigma}_{A_{jt}}$, using the new value in turn to re-compute $\hat{\theta}$ using equation A.48. Call the latter value $\hat{\theta}_{(-s),T_1,T_2}$. Form pseudo-values

$$\theta_{(-s),T_1,T_2} = (L_j)\,\hat{\theta}_{T_1,T_2} - (L_j - 1)\,\hat{\theta}_{(-s),T_1,T_2}$$

The jackknife estimator for stock j in window (T_1, T_2) is the mean of the pseudo-values,

$$\theta_{j,T_1,T_2} = \frac{1}{L_j} \sum_{t=T_1}^{T_2} \theta_{(-s)} \tag{A.49}$$

The estimates are averaged across the sample of stocks:

$$\overline{\Theta}_{T_1,T_2} = \frac{1}{N} \sum_{j=1}^{N} \theta_{j,T_1,T_2} \tag{A.50}$$

The jackknife test statistic for the sample of stocks in window (T_1, T_2) is

$$t_{Jackknife} = \frac{\overline{\Theta}_{T_1,T_2}}{S_{Jackknife,T_1,T_2}/\sqrt{N}} \tag{A.51}$$

where

$$S_{Jackknife,T_1,T_2} = \left[\frac{1}{N-1} \sum_{i=1}^{N} \left(\theta_{j,T_1,T_2} - \overline{\Theta}_{T_1,T_2} \right)^2 \right]^{\frac{1}{2}}. \tag{A.52}$$

A.3 Different Estimation and Event Return Frequencies

The `ESTINTER` option of the `EVENTUS` statement allows the use of different return frequencies for parameter estimation and event testing. For example, it is possible to conduct a daily-return event study with estimates of market model or factor model parameters from monthly returns. When this option is in effect, Eventus adjusts any estimated linear model intercept or comparison period mean return, and standard errors, for the difference in the return frequency. The market or factor model intercept, mean estimation-period market index and factor returns, and comparison period mean stock return are divided by the adjustment factor shown in Table A.1; the standard error is divided by the square root of the adjustment factor. The number of returns in the estimation period, M_j, is multiplied by the adjustment factor. Other reported statistics, such as the estimation-period standard deviation of raw returns, reflect appropriate adjustments using the same factor.

A.4 Variable Names in Eventus Output SAS Data Sets

Data sets created by the `OUTSAS` option on the `EVTSTUDY` statement represent each day by one or more variables. Any variable ending in 255 represents the last day of the estimation period. The first estimation-period variable in a series depends on the length of the estimation period. If the estimation period is 100 trading days long, for example, the first day is represented by a variable ending in the number 156. The sequence of variable numbers is ascending in time. Thus, variable number 255 contains a data item for day −46 if `EST=-46` is specified on the `REQUEST` statement. If `EST=+91 ESTLEN=100` were specified, variable number 255 would represent day +190.

Variable names ending in 256 represent the first day of the event period, regardless of estimation-period length. For example, if `PRE=20` is specified, then variable number 256 corresponds to day −20.

Table A.2 presents most potential variable names in an output event study data set (`OUTSAS` data set). Only variables needed to represent days as described above are included in the data set.

`_Weight_` is a character variable of length 14 that describes the market index or companion portfolio. When the `BOTH` option is used to run separate event studies with the equally weighted index an alternative index, there are two stored observations per stock-event date combination per abnormal return method: one for each value of `_Weight_`.

The `ResType` variable takes a two- or three-character value of `raw` for un-

Table A.1
Adjustment Factors for Estimation and Event Return Frequency Pairs.

Event Period	Estimation Period Frequency				
	Day	Week	Month	Quarter	Year
Day	1.00	4.88	21.08	63.25	253.00
Week	0.21	1.00	4.32	12.96	51.84
Month	0.05	0.23	1.00	3.00	12.00
Quarter	0.02	0.08	0.33	1.00	4.00
Year	0.01	0.02	0.08	0.25	1.00

Note: Values are rounded to two decimal places for display. Internally, values for event period frequencies longer than a day are calculated from the values for daily event periods and are not rounded.

Table A.2
Variable Names in a Saved Event Study Data Set.

Data	Variable Name	
	Estimation Period	Event Period
Daily abnormal return	AR1-AR255	AR256-AR9999
Daily abnormal return[a]	ARX1-AR744	
Daily raw return	RETN1-RETN255	RETN256-RETN9999
Daily raw return[a]	RETNX1-RETNX744	
Daily market index return		
Equally weighted	MKT1-MKT255	MKT256-MKT9999
Equally weighted[a]	MKTX1-MKTX744	
Value-weighted	VWMK1-VWMK255	VWMK256-VWMK9999
Value-weighted[a]	VWMKX1-VWMKX744	
$s_{A_{jt}}^{-1}$	—	WDEN256-WDEN9999
Dummy variable =1 if abnormal return> 0	—	NPOS256-NPOS9999
Parameters		
$\hat{\alpha}_j$	ALPHA	
$\hat{\beta}_j$	BETA	
s_j	SFactor	
h_j	HFactor	
u_j	UFactor	
mean return	CPR	
$\overline{R_{mEst}}$	RMBAR	
$\sum_{k=E_1}^{E_2}(R_{mk} - \overline{R_{mEst}})^2$	SSRM	
return variance	OWNVAR	
s_{A_j} for market model	_RMSE_	
$s_{A_j}\sqrt{1+\frac{1}{M_j}}$ for raw or MAR	STDENOM	
Fraction of returns > 0	NPOS_EST	
M_j	Ti	
CUSIP as specified by user	Request_File_CUSIP	
Most recent CUSIP	CUSIP	
Market index or companion portfolio description	_Weight_	
Type of abnormal return	ResType	

[a] Additional variable names, used only when the estimation period exceeds 255 trading days. "X" variable subscripts start with 1 and go up to $M - 255$ where M is the length of the estimation period. The "X" variables contain the first M days of the estimation period, then subscript 1 of the regular variables continues with the $M + 1$st day. For example, if ESTLEN=300, the first 55 days of event period abnormal stock returns are in ARX1 through ARX45 and the 56th through 300th days are in AR1 through AR255.

adjusted raw returns, `CMF` for custom factor-model adjusted, `CP` for comparison period mean-adjusted, `FF` for Fama-French three-factor model adjusted, `FFM` for Fama-French-Momentum four-factor model adjusted, `MAR` for market adjusted, `MM` for OLS, GARCH or EGARCH market model adjusted or `SW` for Scholes-Williams market model adjusted returns.

A.5 Missing Returns

CRSP codes any missing return on its files as an integer strictly less than -1.0. Eventus internally converts each of these CRSP missing return codes to the SAS special missing value. Special missing values work the same way as the regular SAS missing value, `.`, in all arithmetic operations.

When an estimation period contains a sequence of one or more missing values, Eventus does not use the first succeeding non-missing return. The reason is that the first non-missing return is a multi-period return. Permitting multi-period returns could have unexpected consequences for parameter estimates. The first non-missing return following a sequence of missing estimation-period returns is replaced by the special missing value `.N`.

When a sequence of one or more returns is missing in the event period, Eventus adjusts the abnormal return computation procedure to account for the multi-day character of the first post-missing return. For example, if the number of missing days is q, the market model abnormal return for the first post-missing day, t, is

$$A_{jt} = R_{jt} - \left[(q+1)\hat{\alpha}_j + \hat{\beta}_j \sum_{h=0}^{q} R_{m(t-h)} \right],$$

while the maximum likelihood estimate of the variance of A_{jt} is,

$$s^2_{A_{jt}} = s^2_{A_j} \left\{ (q+1)(1 + \frac{1}{M_j}) + \frac{\sum_{h=0}^{q} \left(R_{m(t-h)} - \overline{R_{mEst}} \right)^2}{\sum_{k=E_2}^{E_1} (R_{mk} - \overline{R_{mEst}})^2} \right\}.$$

Table A.3
Eventus Special SAS Missing Values for Missing Returns from the CRSP Database.

Reason	CRSP missing return code	Special SAS missing value
No portfolio assignment for excess-return file	−44	`.X`
Missing delisting price	−55	`.D`
>10 trading days between non-missing prices	−66	`.G`
No trading on Nasdaq	−77	`.T`
Date outside return date range	−88	`.R`
No price available	−99	`.B`
Event dropped	NA	`.M`
Date outside Eventus search range	NA	`.A`
Day in estimation period after a missing-return day	NA	`.N`

Appendix B

Eventus Statements and Options in Alphabetical Order

B.1 `CUSIPERM` Statement

This statement is used after the `EVENTUS` statement to convert CUSIP identifiers to PERMNOs. The statement reads the user request file and performs the conversion. The statement accepts the following options.

COLUMN=*n* Use when the CUSIP is not the first item on each line of the request file. Substitute the starting column for the CUSIP for *n*. This option is not needed if only blanks precede the CUSIP on each line.

EXTFILE= Selects the SAS file shortcut or name of a text file in which Eventus is to store the updated copy of the request file. The default is `request`. If the specification is not a SAS file shortcut, it is interpreted to be file in the current working folder or directory defined by SAS.

REQFILE=*fileref* The request file for `CUSIPERM` must be a text file. Replace *fileref* with the SAS file shortcut associated with the file. The `REQFILE` specification may be omitted if the shortcut is `REQUEST`. The file need not be sorted.

B.2 DATECONV Statement

The DATECONV statement is used after the EVENTUS statement to convert dates between calendar and CRSP formats. It reads the user request file and performs the date conversion operation. The statement accepts the following options.

AUTODATE Specifies that any calendar date in the request file that is not a trading day should be converted to the following trading day.

CUSIP This DATECONV statement option is obsolete since Eventus 7.

CUSIPERM Specifies that the request file contains CUSIPs that Eventus should attempt to match to CRSP PERMNOs. The option requires a PERMNO-CUSIP database, a component of Eventus created by the program `Update PERMNO-CUSIP Conversion Database.sas` at Eventus installation and preferably refreshed after each update of the CRSP database.

DATEFMT=*format* Specifies the input format of the dates being read from the request file, when the request file is not a SAS data set. The specification must be either a valid SAS date informat or the word CRSP. CRSP specifies a 1–to–5 digit integer representing a CRSP date. CRSP dates are sequence numbers starting with 1 on a fixed base date and incremented by 1 each trading day or month. Leading zeroes need not (but may) be included in the CRSP date. Any format other than CRSP must be a valid SAS date format (the period at the end is usually optional). The default, DATEFMT=YYMMDD, accommodates both two digit and four digit years automatically.

EST=*periods* **and POOL** These options are provided for compatibility with the REQUEST statement; they have no effect when specified on the DATECONV statement.

ESTLEN=*n* This option is provided for compatibility with the REQUEST statement.

EXTFILE=*fileref*|*file name* Specifies the SAS file shortcut or file name of a text file in which Eventus is to store the converted request file lines. If the argument is a file name, it may include the path but must not

include any blank or period. A `.dat` extension will be added to the file name automatically. The default is `userdata`. Eventus creates the file if it does not exist or overwrites it if it already exists.

GROUP=*variable* Selects and specifies the name of an optional grouping variable. The variable has no function in `DATECONV` except to be copied to the output request file for potential use in a subsequent event study. The grouping variable must be numeric. In an input text request file, the grouping variable must appear after the dates and any `ID` variable.

GRWEIGHT Valid only if the `GROUP` option is specified. Denotes that the request file contains a group weight variable. This variable, expressed as a decimal, specifies the weight to be given the individual stock within its group portfolio. All the weights for a single group should sum to 1. This option is included on the `DATECONV` statement for compatibility with the `REQUEST` statement; weights are copied to the output file.

ID=*variable* Optionally names a variable to be used as a security-event identifier. The identification variable may be of any data type, character, numeric or date. If `INSAS` is specified, the identification variable name must exist on the SAS data set specified.

IDFMT=*format* Gives the SAS format of the identification variable in the text request file. For example, if the identification variable is an integer that varies from one to four digits, specify `IDFMT=4.0`.

INSAS=*libname.membername* Points to the request file when the request file is a SAS data set. The SAS data set request file can contain the variables described in the reference documentation of the `REQUEST` statement (page 130), the most common of which are:

- `CUSIP` (8-character string). Required if and only if `CUSIP` or `CUSIPERM` appears on the `DATECONV` statement.
- `PERMNO` (5-digit integer). Required unless `CUSIP` or `CUSIPERM` appears on the `DATECONV` statement.
- The dates to be converted. For a single date per PERMNO, either `eventdat` (SAS date variable) or `crspday` (integer CRSP date). For programs that convert two dates per PERMNO (specify `TWIN` on the `EVENTUS` statement), two names must appear: `eventda1`

and `eventda2`, or `crspday1` and `crspday2`. If you want Eventus to look for `crspday` (and `crspest`), specify `DATEFMT=CRSP` (see below).

- If you specify `ID=`*variable* (see above), the *variable* named there.

IX2Y Obsolete since Eventus 7.

NAME Indicates that the input request file includes a firm name. Rarely used.

MONTHS=*n* Selects creation of a second date by adding *n* trading days or months to the first date for each PERMNO on each line of the request file. If you specify `MONTHS`, omit the second date from the request file.

NDAYS=*n* Selects creation of a second date by adding *n* trading days or months to the first date for each PERMNO on each line of the request file. If you specify `NDAYS`, omit the second date from the request file.

OUTDTFMT=*format* When `OUTSAS=` is not used, gives the date format for Eventus to use in creating the output text request file. Valid formats are all SAS date formats and `CRSP`. The default is `YYMMDDN8`.

OUTSAS=*libname.membername* Selects for the output request file to be a SAS data set, and specifies its two-part name. The data set is created if it does not exist or overwritten if it already exists.

REQFILE=*fileref* Optionally specifies the SAS file shortcut pointing to the text request file. Omit if the shortcut is the default (`request`) or if the request file is a SAS data set. Each line of a text request file for `DATECONV` should contain the following variables in order (brackets denote variables that are not always applicable):

```
PERMNO event [event    [specific     [ID number  [grouping  [group  [S or
       date   2]  estimation date]  or string]  variable]  weight]   L]
```

Each value must be separated by at least one blank, but the exact position of the values is unimportant as long as they appear in the order shown. Whether a bracketed item should appear is determined by the options on the `EVENTUS` and `DATECONV` statements. Omit the brackets themselves. The file need not be sorted. If the `CUSIPERM` option or the `CUSIP` option is specified, the first variable on the line should be `CUSIP` instead of `PERMNO`.

REQFILE2=*fileref* Specifies a second request file to be used in the same job. The format required for the second request file is the same as for the first.

SHIFT1=n_1,SHIFT2=n_2 The first date in the request file is shifted by n_1 periods and the second date is shifted by n_2 periods. For the monthly file, the periods are months. For the default daily return frequency, the periods are trading days if `DATEFMT=CRSP` and calendar days otherwise. Both n_1 and n_2 may be specified as any integer value. For example, when using CRSP U.S. stock data, `SHIFT1=-1` shifts December 1, 2006 back to November 30, 2006. The December 1 date was a Friday and the market was open both days, so in this example the effect would be the same whether the request file contained calendar dates or CRSP dates.

`SHIFT1` and `SHIFT2` can be used singly or together. Applying them to calendar dates can produce shifted dates on which the market is not necessarily open unless `AUTODATE` is also specified.

SHORT Available for compatibility with the `REQUEST` statement. If used, the request file must contain an `S` or `L` code (at the end of each line of a text request file), which is copied to the converted request file.

SORTBYID Selects sorting of the converted request file by the variable listed in the `ID` option. The default is to sort by PERMNO or CUSIP as applicable. Sorting is for user convenience and is irrelevant for re-input into Eventus.

B.3 `EVENTUS` Statement: General

The `EVENTUS` statement is required at the beginning of each Eventus run. Options to specify input data set names are listed in section B.4.

ANNUAL Applicable only when the `SASNONCRSP` option is in effect; indicates that user-extracted input data are annual.

BIGSAMPLE This option makes adjustments to reduce the chance of exceeding available disk and memory when a very large sample is run. It reduces the default internal length of numeric variables from 8 bytes

to 4 bytes and prevents Eventus from trying to keep copies of certain data sets in RAM. It also widens certain fields in Eventus listing output to accommodate larger values.

DBFNSTMT[=0] Indicates that input CRSP stock database is identified by the SAS file shortcut `crspdb` instead of by environment variables. Specifying `=0` turns the option off.

ESTINTER=*interval* The holding interval of the estimation-period returns, if different from the holding interval of event period returns. Valid values of *interval* are `YEAR`, `QUARTER`, `MONTH`, `WEEK`, and `DAY`.

EXCESS This option is obsolete since Eventus 7. It has been replaced by the `REQUEST` statement options `BETAINDEX` and `STDINDEX`.

GETDATA Specify this option only in a program that uses the `RETURNS`, `PRICES` or `VOLUME` statement to assemble data.

MONTHLY Indicates that Eventus is to read from the monthly CRSP stock database, or when the `SASNONCRSP` option is in effect, indicates that the user-supplied mini-database is monthly.

NONCRSP No longer recommended. Selects the old method of reading user-extracted data, which requires a Userstok file. Please use the `SASNONCRSP` method instead.

PAGE=TALL|WIDE Selects suggested combinations of SAS `pagesize` and `linesize` settings for portrait and landscape formats, respectively, of listing output.

QUARTER Applicable only when the `SASNONCRSP` option is in effect; indicates that the user-supplied mini-database is quarterly.

SASNONCRSP Denotes that stock and index data from a user-constructed mini-database pointed to by the options in section B.4 are to be used.

TWIN Specify `TWIN` in event study runs to estimate variable-length (security-event-specific) event windows, instead of the conventional abnormal returns and windows around a single firm-specific event date. When `TWIN` is in effect, the request file must contain two event dates for each

observation unless the NDAYS option is in effect. See the REQUEST statement description below for details of the required request file format. TWIN is also used this way in DATECONV runs to convert a pair of dates.

WEEKLY Valid only when the SASNONCRSP option is in effect; indicates that the user-supplied mini-database is weekly.

B.4 EVENTUS Statement: Specifying Input Data Sets

Several options in this section call for a two-part SAS data set name in the form libname.membername. The first part of the two-part name can be work to refer to a temporary data set created in the current SAS session, or can be a previously defined SAS library name (also called a libref) that points to a folder or directory in which the data set exists. The member name is the name of the SAS data set within the folder or directory. (The full Windows, Unix or Linux file name consists of the member name and a file extension that is recognized internally by SAS but omitted in programs, logs, and other user interactions.) A SAS data set can contain more variables (columns) than required by the current Eventus run; the additional variables are ignored. Variable names are not case sensitive.

In a few instances it is necessary or can be desirable to *index* a data set in preparation for use with Eventus. Data set indexing allows SAS and Eventus to use a data set as if it were sorted by the indexing variables. To index a SAS data set, use the index= data set option when the data set is created, or use proc datasets or proc sql to add an index to an existing data set. Please see SAS documentation for details.

ASKDS=*libname.membername* This option is for use when the SASNONCRSP option is active. It points to the SAS data set containing trading dates (SAS date variable CalDt), security issue identifiers, and ask (offer) price quotations (column name Ask). Ask prices are observed daily, weekly, monthly, quarterly or annually according to the frequency of the database. The data set must be indexed by date, by issue identifier, and by a compound index on date and identifier jointly. The structure of the data set is similar to the RETURNDS data set below.

ASKHIDS=*libname.membername* This option is for use when the `SASNONCRSP` option is active. It points to the SAS data set containing trading dates (SAS date variable `CalDt`), security issue identifiers, and a column of mixed intraperiod high transaction prices, when available, and ask (offer) price quotations otherwise (column name `AskHi`). Prices are observed daily, weekly, monthly, quarterly or annually according to the frequency of the database. The data set must be indexed by date, by issue identifier, and by a compound index on identifier and date jointly, in that order. The structure of the data set is similar to the `RETURNDS` data set below.

BIDDS=*libname.membername* This option is for use when the `SASNONCRSP` option is active. It points to the SAS data set containing trading dates (SAS date variable `CalDt`), security issue identifiers, and bid price quotations (column name `Bid`). Bid prices are observed daily, weekly, monthly, quarterly or annually according to the frequency of the database. The data set must be indexed by date, by issue identifier, and by a compound index on date and identifier jointly. The structure of the data set is similar to the `RETURNDS` data set below.

BIDLODS=*libname.membername* This option is for use when the `SASNONCRSP` option is active. It points to the SAS data set containing trading dates (SAS date variable `CalDt`), security issue identifiers, and a column of mixed intraperiod low transaction prices, when available, and bid price quotations otherwise (column name `BidLo`). Prices are observed daily, weekly, monthly, quarterly or annually according to the frequency of the database. The data set must be indexed by date, by issue identifier, and by a compound index on date and identifier jointly. The structure of the data set is similar to the `RETURNDS` data set below.

DELISTDS=*libname.membername* Reserved for future use.

DISTDS=*libname.membername* Reserved for future use.

FFF=*libname.membername* This option is required to use the `EVTSTUDY` statement option `FAMAFRENCH`. Points to the data set containing Fama-French factors. The variables listed in Table B.1 must be present in the data set the `FAMAFRENCH` and `MOMENTUM` options. If the momentum factor is absent, the three-factor model still may be used. `Date` must

Table B.1
Columns Required in the Fama-French Factor SAS Data Set.

Variable Name	Type	Definition
Date	SAS date variable	Date of observation
Smb	Numeric	Small minus big factor
Hml	Numeric	High minus low factor
Umd	Numeric	Up minus down (momentum) factor
Rf	Numeric	Risk-free interest rate
Mktrf	Numeric	Market factor minus risk-free rate

be a SAS date variable, not an integer date nor a trading-day sequence number such as a CRSP date. Eventus for Windows includes a program, found in the Start menu folder for Eventus, to construct a monthly or daily Fama-French factor data set, in the required format, using data from Professor Ken French's web site.

FFF_EST=*libname.membername* Required when the `ESTINTER` option is used with the `EVTSTUDY` statement option `FAMAFRENCH`. Points to the data set containing Fama-French factors for the estimation-period data frequency. See the `FFF` option above for a detailed description of the data set.

HEADDS=*libname.membername* Ignored unless `NOMINICHECK` also is specified. When the `SASNONCRSP` option is active, optionally points to a header data set containing the security identifier, and SAS date variables named `BegDt` and `EndDt` that identify the beginning and ending dates of stock data in time-series input data sets. See the documentation of the `RETURNDS` option for an explanation of the security identifier.

INDEXDS=*libname.membername* This specification is required for an event study when the `SASNONCRSP` option is active. It points to the data set containing a column of trading dates (SAS date variable `CalDt`) and one to four market index variables (*?*`wret`*?*, where the prefix is `e` or `w` for equal or value weight and the suffix is `d` or `x` for with or without dividends, respectively).

MYCOMPANIONIDX=*libname.membername* Points to the optional companion portfolio returnsSAS data set in the directory or folder pointed to

by the SAS library name *libname*. The data set must contain the following columns: `CalDt`, a SAS date variable corresponding to the calendar date of the data; `CmpIdxR1` through `CmpIdxR`*n*, numeric variables containing the returns of companion portfolios 1 through *n* in decimal (not multiplied by 100) format. The `EVENTUS` statement option `PORT1DS` is required if you specify `MYCOMPANIONIDX`. The companion portfolio returns are used in the event study only if the `REQUEST` statement option `COMPANION` is present.

MYCOMPANIONFREQ=MONTH|QUARTER For the companion portfolio method, specifies the frequency of the portfolio-assignments data set that the `PORT1DS=` option points to when the frequency is not annual. Omit when the frequency is annual.

MYCOMPANIONLABEL=*label* For the companion portfolio method, optionally specifies a custom label for the class of companion portfolios. The label cannot include blanks. The default is `My_Companion_Index`. Eventus uses the label in listing and data set output.

MYESTFACTORS=*libname.membername* Applies to the estimation period when `ESTINTER` is specified and a benchmark method that uses a separate estimation period is in effect. Similar to `MYFACTORS`, points to the custom factor SAS data set in the directory or folder pointed to by the SAS library name *libname*. The data set must contain the columns described under `MYFACTORS` below.

MYFACTORS=*libname.membername* Points to the optional custom factor SAS data set in the directory or folder pointed to by the SAS library name *libname*. The data set must contain the following columns: `CalDt`, a SAS date variable corresponding to the calendar date of the data; `Factor1` through `Factor`*n*, numeric variables containing the factor returns in decimal (not multiplied by 100) format. The `EVTSTUDY` statement option `FACTORS` determines how many of the factors, starting from `Factor1`, are used.

MYVWINDEX=*libname.membername* Points to the optional user-supplied market index portfolio return SAS data set in the directory or folder pointed to by the SAS library name *libname*. The data set must contain the following columns: `CalDt`, a SAS date variable corresponding to the

Table B.2
Variables Required in the Name History Data Set when NAMEDS is Specified.

Variable Name	Type	Length	Definition	Required
issue identifier			See RETURNDS	Yes
Namedt	SAS Date Variable	4–8	Date of observation	Yes
Comnam	Character	32	Issue(r) name	Yes
Shrcls	Character	1–8	Issue class	Yes
Exchcd	Numeric	3–8	Exchange code	For EXCHCODE
Shrcd	Numeric	3–8	Share type code	For SHRCODE
Siccd	Numeric	3–8	SIC code	For SIC

calendar date of the data; and DVWR, the user-supplied market index return in decimal (not multiplied by 100) format. The user-supplied market index return replaces the value-weighted index return from the main CRSP database or SASNONCRSP mini-database when the EVTSTUDY statement options VALUE are in effect.

MYVWLABEL=*label* Optionally specifies a label for the user-supplied market index pointed to by the MYVWINDEX option. The label may not contain blanks. The default is My_VW_Index. Eventus uses the label in listing and data set output.

NAMEDS=*libname.membername* Applicable when the SASNONCRSP option is active. It points to the optional name history data set. The data set, if used, must contain at least one observation (row) per security, and must be indexed by the issue identifier. The data in each row apply from the date in the row until the date in the next row for the same security, or until the end of time-series data if the row is the last one for the security. Eventus uses this data set only if the REQUEST statement option NAME is specified. Table B.2 lists additional format requirements.

NASDAQDS=*libname.membername* Reserved for use by a future Eventus version.

NOMINICHECK Turns off most automatic integrity checking of the SAS-NONCRSP mini-database, automatic construction of a header data set and automatic mini-database data set indexing. This option requires

that the user provide a header data set pointed to by the HEADDS= option.

PORT1DS=*libname.membername* Points to the portfolio assignment SAS data set in the directory or folder pointed to by the SAS library name *libname*. The data set provides securities' portfolio numbers to be used in conjunction with the MYCOMPANIONIDX option. It must contain the following columns: PERMNO if the companion portfolio returns are to be used with a CRSP database or the variable name of the user-determined security identifier in SASNONCRSP mode; Portfolio_Number, an integer variable containing the portfolio number; and YY, an integer variable containing the four-digit calendar year or coded month or quarter of the portfolio assignment, depending on whether each security's portfolio assignment can change annually, monthly or quarterly. If portfolio assignments are monthly or quarterly, specify the frequency using the EVENTUS statement option MYCOMPANIONFREQ. A coded month or quarter is $12Y-(12-M)$ or $4Y-(4-Q)$, where Y is the four-digit year, M is the month (1=January, 12=December) and Q is the quarter number. Portfolio numbers must be consecutive integers starting with 1 to a maximum of 400. The data set must contain as many observations for each security as there are years, quarters or months of data for the security in the main database (CRSP or mini-database). The data set must be indexed by a composite SAS data set index named IssuYrKey (not case-sensitive) that indexes by PERMNO (or other issue key in SASNONCRSP mode) and YY in that order.

PORT2DS=*libname.membername* Reserved for use by a future Eventus version.

PRICEDS=*libname.membername* This option is for use when the SASNONCRSP option is active. It points to the SAS data set containing trading dates (SAS date variable CalDt), security issue identifiers, and closing prices or quote midpoints (column name Prc). Prices are observed daily, weekly, monthly, quarterly or annually according to the frequency of the CRSP database or mini-database. If the NOMINICHECK option is present, the data set must be indexed by date, by issue identifier, and by a compound index named IssuDatKey on date and identifier jointly. The structure of the data set is similar to the RETURNDS data set below.

RETURNDS=*libname.membername* This option is for use when the `SASNONCRSP` option is active. It points to the SAS data set containing trading dates (SAS date variable `CalDt`), security issue identifiers, and returns (column name `Ret`). The return is daily, weekly, monthly, quarterly or annual, for the period ending on the trading date, according to the frequency of the database. In a daily database, dates on which the market was closed, such as weekends and holidays, should be omitted completely. The securities are stacked in the data set; that is, each row contains the trading date, security issue identifier and return for one security on one date. Thus, the same date may appear on many different rows and the same issue identifier may appear on many different rows. However, each security identifier-date pair should appear only once. The data set need not be sorted.

The security issue identifier can be any numeric or character variable that uniquely identifies a single security in the database. If the identifier is character valued, it may not start with a blank. Internal blanks are permitted but not recommended. The variable name of the identifier should not be something likely to conflict with another variable; for example `date` would not be a good choice. Otherwise, it can be any valid SAS variable name.

If the `NOMINICHECK` option is present, the data set must already be indexed by date, by issue identifier, and by a compound index on date and identifier jointly. The compound index must be named `IssuDatKey`.

RETXDS=*libname.membername* This option is reserved for future use.

SHAREDS=*libname.membername* This option is for use when the `SASNONCRSP` option is active. It points to a shares outstanding observation data set. The data set must contain three columns: the security issue identifier, the date of the shares outstanding observation (SAS date variable `ShrsDt`) and the shares outstanding (column name `ShrOut`). The data set, if used, must contain at least one observation (row) per security, and must be indexed by the issue identifier. The data in each row apply to the security from the date in the row until the date in the next row for the same security, or until the end of time-series data if the row is the last one for the security. This data set is required to perform a volume event study in `SASNONCRSP` mode.

TRADESDS=*libname.membername* This option is for use when the SASNONCRSP option is active. It points to the SAS data set containing trading dates (SAS date variable CalDt), security issue identifiers, and number of trades (column name NumTrd). The number of trades is a daily, weekly, monthly, quarterly or annual total according to the frequency of the database. The data set must be indexed by date, by issue identifier, and by a compound index on date and identifier jointly. The structure of the data set is similar to the RETURNDS data set above.

VOLUMEDS=*libname.membername* This option is for use when the SASNONCRSP option is active. It points to the SAS data set containing trading dates (SAS date variable CalDt), security issue identifiers, and share trading volume totals (column name Vol). The share volume totals are daily, weekly, monthly, quarterly or annual according to the frequency of the database. The data set must be indexed by date, by issue identifier, and by a compound index on date and identifier jointly. The structure of the data set is similar to the RETURNDS data set above.

VOLUMEINDEX=*libname.membername* This option specifies the location of a market volume index data set for volume event studies. The data set should contain the column crspday (CRSP day or month number, or trading period sequence number matching the input mini-database in SASNONCRSP mode), and at least one of the columns EW_relative_volume, EW_log_relative_volume, VW_relative_volume, and VW_relative_volume_log. A column name beginning EW (VW) designates an equally (value) weighted index. log_relative_volume indicates that individual security volumes have been log transformed as described by Campbell and Wasley (1996) before averaging. relative_volume_log indicates that the mean relative volume has been log transformed.

B.5 EVTSTUDY Statement

EVTSTUDY is required to run an event study.

ALLDAYS This option is obsolete in Eventus 7 and higher.

BOOT Specifies nonparametric bootstrap analogs of eligible parametric tests. The Patell, standardized cross-sectional, time-series standard devia-

tion, skewness-corrected transformed normal, and cross-sectional tests are eligible for the bootstrap. Bootstraps are performed only for tests of window abnormal returns. Bootstrap p-values are reported in addition to the parametric results for the selected tests. If the Patell test is selected, `BOOT` activates the `SERIAL` option.

BOTH Please see `VALUE`.

BTAIL=1|2 Selects one- or two-tailed bootstrap tests. The default is the number of tails used for other tests. This option is ignored unless `BOOT` also is specified.

BUYHOLD Selects buy-and-hold compounded return computation for windows instead of the default additive cumulation.

CALENDARTIME Selects the calendar-time test similar to that of Jaffe (1974) and Mandelker (1974) if none of the following options is also specified: `BUYHOLD`, `FAMAFRENCH` or `FACTORS`. If the `BUYHOLD` option is in effect, `CALENDARTIME` selects the simpler calendar-time test described by Lyon, Barber and Tsai (1999, section V.B.2) if the `BUYHOLD` option is specified. If the `FAMAFRENCH` option or the `FACTORS` option is in effect, `CALENDARTIME` is the default and refers to the calendar-time portfolio regression approach.

CDA Selects the time-series standard deviation-based test, sometimes called the Crude Dependence Adjustment (Brown and Warner, 1980). The default is not to compute this test.

CDCSI Selects the Collins and Dent (1984) test assuming cross-sectional independence (Sanders and Robins, 1991).

CP Selects comparison-period mean-adjusted returns as a benchmark.

CSECTERR Selects the parametric cross-sectional test.

DETAIL Selects reporting, in the listing output, of the window cumulative or compounded abnormal returns and standardized cumulative abnormal returns (SCAR) (if a standardized test is selected) for each security-event individually, in addition to the usual results for the overall sample. Also see the `OUTWIN` and `FILEWIN` options.

DETAIL=FULL Expands the `DETAIL` output to include the individual daily (monthly, etc.) abnormal returns and standardized abnormal returns (if a standardized test is selected) for each security-event. This option may produce a large amount of listing output, depending on the sample size and event-period length.

EGARCH Causes the market model to be estimated assuming an exponential GARCH(1,1) error process. The `EGARCH, GARCH` and `SW` options are mutually exclusive, and none is available when the `FAMAFRENCH` option is specified.

EGLS Selects the estimated generalized least squares test (Sanders and Robins, 1991).

EXCHCODE Adds the exchange listing code from the CRSP name history array, under variable name `exchange_code`, to the output data set specified by the option `OUTSAS=`. See CRSP stock database documentation for a listing of exchange codes.

FACTORS=*n* Specifies how many user-supplied factors to use in addition to the market factor. Requires the `MYFACTORS` option on the `EVENTUS` statement.

FILEWIN=*file shortcut or name* Writes window abnormal returns (CARs or BHARs) for each security-event to the text file pointed to by the argument, which must be a SAS file shortcut or a quoted file name. Eventus creates the file if it does not exist or overwrites if it already exists. The file also includes standardized abnormal returns and WLS regression weights when a standardized-type parametric test (Patell, standardized cross-sectional, Collins-Dent or EGLS) is included in the event study.

FAMAFRENCH Selects the Fama-French (1993) time-series model as the benchmark. This option implies the `CALENDARTIME` option unless either the `IRATS` option or the `TWOSTEP` option also is specified.

GARCH Causes the market model to be estimated assuming a GARCH(1,1) error process. The `EGARCH, GARCH` and `SW` options are mutually exclusive.

GENSIGN[=0] With no argument, selects the generalized sign test (Cowan, 1992). For applicable event studies, the generalized sign test is reported

by default if no other nonparametric test is selected. To suppress the generalized sign test, either select a different nonparametric test or specify `GENSIGN=0`.

GMM Selects a generalized method of moments test for the calendar-time portfolio regression method only.

INSAS=*libname.membername* This `EVTSTUDY` statement option has no effect except when the legacy `NONCRSP` option appears on the `EVENTUS` statement. Points to the SAS data set from from which to take the user-supplied return information The file must include the following variable names: `CUSIP, RETURN, MARKET` and the variable specified in the `ID` option, if any. The variable name `CUSIP` is required; the variable can contain any character string up to eight characters in length. For each observation in the request file, there must be `ESTLEN+PRE+POST+1` observations in the `INSAS` file. (If the `IRATS` option is specified, `ESTLEN` is zero.) The default if the `INSAS` option is not specified is to read the user-supplied data from a text file, to which the SAS file shortcut (fileref) `userstok` must point. When the `INSAS` option is in effect, it is not necessary to define the SAS file shortcut `userstok`. In this case, the input SAS data set still is called the "`USERSTOK` file" even though it is not a text file.

IRATS Selects the Returns Across Time and Securities method (Ibbotson, 1975).

ITSUR Selects the event parameter approach with iterated seemingly unrelated regressions (joint generalized least squares) estimation..

JACKKNIFE|JACKNIFE Selects the jackknife test.

MAR Selects the market-adjusted, or when the corresponding `REQUEST` statement options appear, the size or risk decile-adjusted returns or companion portfolio-adjusted returns benchmark method.

MAXMISS=*n* Removes from the sample any security-event with more than *n* days (or months, etc.) of missing returns in the event period.

MEDIAN Includes the median abnormal return and median cumulative or compounded abnormal return (or abnormal volume) in the listing output.

MM Selects the market-model benchmark. By default, the market model is used if no other benchmark is selected.

MOMENTUM Adds the momentum factor to the Fama-French model.

NOLOGTRANS Suppresses the default log transformation of volume in volume event studies. This option has no effect unless the `VOLUME` option is specified.

NOMARKET Suppresses use of the market index when the `FACTORS=` option is used. This option has no effect unless the `FACTORS=` option is present.

NONAMES Suppresses the data availability report, which lists PERMNOs or CUSIPs, issuer names, and number of estimation and event period returns available.

NOPLIST Suppresses the estimation period statistics that normally appear in the listing output between the input report and the event study results.

NOPRINT Equivalent to `NONAMES NOPLIST`.

NOSINGLEPERIOD Suppresses the display of day-by-day or month-by-month results. Has no effect on results for windows defined in a `WINDOWS` statement.

NUMFM=*SAS_numeric_informat* Specifies the numeric format of stock and market index returns in an input `USERSTOK` file (legacy `NONCRSP` option). Must be a valid SAS numeric informat. Defaults to 11.6 (11 character positions wide including sign, decimal point and 6 digits to the right of the decimal point).

OLSPARAM Selects the event parameter approach, with OLS estimation. In the event parameter approach, the market or factor model, augmented by a dummy variable for each window specified on the `WINDOWS` statement, is estimated on the combined estimation-period and event-period return series.

OUTSAS=*libname.membername* Optionally specifies a SAS data set in which to save abnormal returns and other data for each event. Eventus creates the SAS data set if it does not already exist, or replace it if it

does. See the PACKAGE= option below for a detailed description of the contents of the event study data set. Also see the OUTWIN option.

OUTWIN=*libname.membername* Writes window abnormal returns (CARs or BHARs) for each security-event to the named SAS data set, which Eventus creates if it does not exist or overwrites if it already exists. The data set also includes standardized abnormal returns and WLS regression weights when a standardized-type parametric test (Patell, standardized cross-sectional, Collins-Dent or EGLS) is included in the event study.

OVERLAP Suppresses checking for overlapping estimation period and event period.

PACKAGE=*specified*[*specified...*] Limits the contents of the SAS data set created by OUTSAS. Table B.3 lists the available specifiers. The default is PACKAGE=1. The OUTSAS file always contains at least the variables PERMNO, Name, identification variable if any, crspday and eventdat (or crspday1, crspday2, eventda1 and eventda2 for TWIN event studies), _Weight_ and ResType. When the CUSIPERM option appears on the REQUEST statement, the saved data set includes the cusip variable in addition to PERMNO. When the SIZEINDX option appears on the REQUEST statement, the saved data set includes the variable __Cap__, the size-based portfolio number as of the event date. In a TWIN event study, the portfolio number is as of the first event date. CRSP assigns the number 1 to the smallest market capitalization portfolio and 10 to the largest. A stock's size portfolio membership changes from year to year.

PATELL Specifies the Patell (1976) test. The default is not to compute the Patell test unless no other parametric test is selected. To suppress all parametric tests, specify PATELL=0 and omit options corresponding to other parametric tests.

PLOT Produces plots of the event-period average abnormal return and running average cumulative (compounded with the BUYHOLD option) abnormal return. Plots are not produced by default, are not available with TWIN event studies, and are not available with the event parameter approach or other methods that do not use traditional two-step estimation and testing.

Table B.3
PACKAGE Specifiers for the EVTSTUDY Statement.

Data[1]	Package Specifier		Remarks
	Estimation Period	Event Period	
Data required for OLDSTUDY	1		Same as OADGHP.
Daily abnormal returns	A	D	
Daily raw returns	B	E	Even if RAW not specified.[2]
Daily market index returns	C	F	
Daily standard deviation		G	Ignored if NOSTD specified.
Dummy variable =1 if abnormal return> 0		H	Mainly for OLDSTUDY use.
Parameters	P		Mean returns, α, β, etc.

[1]Table A.2 on page 93 lists SAS variable names. You do not need to know variable names to use the EXTRACT or OLDSTUDY statements.
[2]The EXTRACT statement does not extract raw returns unless the EVTSTUDY statement that produced the SAS data set included RAW and PACKAGE=D....

POST=*periods* Specifies the number of trading days, months, etc. immediately following the event date for which to compute abnormal returns. The default is POST=30 for daily and weekly and POST=12 for monthly event studies.

PRE=*periods* Specifies the number of trading days, months, etc. immediately preceding the event date for which to compute abnormal returns. The default is PRE=30 for daily and weekly event studies and PRE=12 for monthly event studies.

PVALUE Selects numeric p-values for the listing output instead of significance symbols.

RANKTEST Selects the rank test (Corrado, 1989).

RAW Selects no adjustment of raw returns as a benchmark model.

RESAMPLE=*fraction* Specifies the resampling ratio for the bootstrap. The default is 0.25.

RUNNING Adds running abnormal returns, cumulated (or compounded with `BUYHOLD`) from the beginning to the end of the event period, to the event study report. Running cumulative or compounded abnormal returns are not reported by default, are not available with `TWIN` event studies, and are not available with the event parameter approach or other methods that do not use the traditional two-step estimation and testing.

SERIAL Corrects the window Patell z tests for the serial correlation of abnormal returns that is present by construction. This correction is not performed by default for the Patell test, but is always performed for the tests selected by the `STDCSECT`, `EGLS` and `CDCSI` options. The correction is also invoked by the joint specification of the `PATELL` and `BOOT` options.

SHRCODE Causes Eventus to store the two-digit share code from the CRSP name history array as the variable `ShrCode` in any `OUTSAS` data set.

SIC Adds the Standard Industrial Classification code from the CRSP name history array, under variable name `SICCode`, to the output data set specified by the option `OUTSAS=`.

SKIP=*n* Gives the number of header lines in the Userstok data file used in the legacy `NONCRSP` method. Eventus ignores the header lines. This option applies only to a text Userstok file and has no effect when the Userstok file is a SAS data set.

SPORT This option is obsolete in Eventus 7 and higher. Please see the `REQUEST` statement option `STDINDEX`.

STACK Selects an alternative event study report format in which medians are listed below means and numeric p-values are listed below test statistics.

STDCSECT Specifies the standardized cross-sectional test (Boehmer, Musumeci and Poulsen, 1991). The default is not to perform this test. This option implies `SERIAL` option.

STDONLY This option is obsolete in Eventus 7 and higher.

SUR Selects the event parameter approach with seemingly unrelated regressions (joint generalized least squared) estimation.

SW Selects Scholes-Williams (1977) market model results in addition to the default OLS results. The `EGARCH, GARCH` and `SW` options are mutually exclusive.

T_FORMAT=*SAS_numeric_format* Specifies the format for reporting test statistics in listing output. The default is 7.3.

TAIL=1|2 Specifies the significance levels of the reported test statistics are to be based on one or two tailed tests. The default is `TAIL=1`. The `TAIL` option does not set the tails for bootstrapped tests; please see the `BTAIL` option.

TIMEUNIT=*n* Selects aggregation of returns in the estimation and event periods into n-day or month (for example) returns before performing the analysis. For example, in an event study using the CRSP daily stock database, `TIMEUNIT=2` specifies that two-day returns are to be computed and used as if they were daily returns. (For an illustration of the technique, see the lower panel of Table VI in Bhagat, Marr and Thompson, 1985.) When n is even, period 0 in event time contains day 0 (the date in the request file), $\frac{n}{2} - 1$ days following day 0 and $\frac{n}{2}$ preceding day 0. Additional periods are formed on either side of period zero.For example, `TIMEUNIT=2` results in period zero containing days -1 and 0, period $+1$ contains days 1 and 2, and period -1 contains days -3 and -2. If n is odd, period 0 is centered on day zero. `TIMEUNIT=3` produces a period 0 containing days -1, 0 and $+1$; a period $+1$ containing days $+2$, $+3$ and $+4$, and so on.

`TIMEUNIT` combines daily, weekly, monthly or quarterly returns into period returns by addition. If the `LOG` option is specified on the `REQUEST` statement, individual daily or monthly returns are converted to continuously compounded (logarithmic) form before adding.

When `TIMEUNIT` is specified, Eventus interprets the `WINDOWS` statement arguments and the `PRE`, `POST` and `MAXMISS` options or their defaults in terms of multiday, multiweek or multimonth periods. All results are reported in terms of multiday periods as well. However, Eventus interprets the `EST`, `ESTLEN`, `MINESTN` and other `REQUEST` statement

options in terms of the original days, weeks, months, or quarters. For example, in a daily event study, suppose the user specifies `ESTLEN=100` and `TIMEUNIT=2`. The market model and other estimates are computed on 50 two day returns — a total of 100 single days in the estimation period.

The use of `TIMEUNIT` precludes the examination of the returns of single actual days, weeks or months in the same run. Eventus converts each sequence of n returns to a multiday, multiweek or multimonth return as soon as it is read from the CRSP database.

TRADINGCOST[=REVERSE|=LONGSHORT] Selects adjustment of the first and last returns of the event period for trading costs. The options should be used with the `BUYHOLD` option and only for the purpose of investigating a window compound abnormal return that spans the entire event period, (−`PRE`,+`POST`).

`TRADINGCOST` without an argument adjusts the first return in the event period by assuming that the security is purchased at the ask price; the final return is adjusted by assuming that the security is sold at the bid price. With `TRADINGCOST=REVERSE`, the adjustments are reversed: the first return is adjusted by assuming that the security is purchased at the bid price; the final return is adjusted by assuming that the security is sold at the ask price.

The `TRADINGCOST=LONGSHORT` specification applies when the `SHORT` option appears on the `REQUEST` statement and the sample contains a mixture of securities held long and short. It performs the buy at the ask, sell at the bid adjustment described above for securities held long, and the reverse adjustment described above for securities held short. In this context, the reverse adjustment can be interpreted as "sell short at the bid, buy back at the ask."

When the `SASNONCRSP` input mode is active, the bid, ask and price time-series data arrays must be present in the mini-database.

TRANSNORM Selects the skewness-corrected transformed normal test T1 (Hall, 1992).

VALUE|BOTH By default, Eventus uses only the CRSP equally weighted market index of all NYSE, AMEX and Nasdaq stocks with the mar-

ket model, market adjusted returns and Fama-French two-step benchmarks. Specify VALUE to change to the CRSP value-weighted index of all NYSE, AMEX and Nasdaq stocks or BOTH to produce separate event studies using both indexes. When the FAMAFRENCH TWOSTEP option combination is in effect, VALUE substitutes the CRSP value-weighted index for the equally weighted index but has no effect on other factors.

VALUEWEIGHTSAMPLE Selects market-capitalization weighting of the event-time portfolio. The market capitalization is computed on day or month $-$(PRE+1) and held constant. The default is to equally weight the event-time portfolio.

VOLUME Performs the event study on trading volume.

WLS Selects a weighted least squares test for the calendar-time portfolio regression method only. Each period is weighted by the number of securities in the calendar-time portfolio during the period. The default is unweighted least squares.

WSR Selects the Wilcoxon signed-rank cross-sectional test.

B.6 EXTRACT Statement

Extracts window cumulative or compounded abnormal returns and optional weighted least squares regression weights from a SAS data set previously saved by the Eventus EVTSTUDY statement with the OUTSAS option. The INSAS specification is required. Relatively few options are available, because EXTRACT uses the specifications from the original event study. The following options can be specified on the EXTRACT statement.

BOTH Selects both the equally weighted and value-weighted market indexes for inclusion in the output data set or file. The BOTH option must have been present (and applicable) on the EVTSTUDY statement that produced the input to EXTRACT.

CMF Includes the custom factor model benchmark method in the output data set or file. The FACTORS=*n* TWOSTEP option combination must have been present on the EVTSTUDY statement that produced the input to EXTRACT.

CP Includes the comparison period-adjusted return benchmark method in the output data set or file. The `CP` option must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

EXTEND=*n* If there are missing returns in a window for a security, attempts to fill out the window by searching *n* trading days (or weeks, months, quarters or years) following each window for nonmissing returns. The default is `EXTEND=0`, indicating no filling out.

EXTFILE=*fileref|file name* Gives the SAS file shortcut (fileref) or the file name of a text file in which Eventus is to store the converted request file. If the argument is a file name, it may include the path but must not include any blank or period. SAS may add a `.dat` extension to the file name. The default is `userdata`.

FF Includes the Fama-French three-factor model benchmark method in the output data set or file. The `FAMAFRENCH TWOSTEP` option combination must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

FFM Includes the Fama-French-momentum four-factor model benchmark method in the output data set or file. The `FAMAFRENCH MOMENTUM TWOSTEP` option combination must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

INSAS=*libname.membername* Points to a SAS data set created by the `EVTSTUDY` statement option `OUTSAS`.

INSAS*n***=***libname.membername* *N* is an integer from 2 through 10. These options point to additional SAS data sets, containing saved event study results, created by the `EVTSTUDY` statement option `OUTSAS`. If one or more of these options is specified, the `EXTRACT` statement reads the input data sets as if they were stacked to form a single data set. All `INSAS` and `INSAS`*n* specifications on the same `EXTRACT` statement must point to data sets that use the same security identifier name (`PERMNO`) and return frequency.

MAR Includes the market-adjusted return benchmark method in the output data set or file. The `MAR` option must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

MM Includes the market model benchmark method in the output data set or file. The `NOMM` option must not have been present or implied on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

OUTSAS=*libname.membername* Selects output to a SAS data set and names the data set to be created or overwritten in the directory or folder to which the SAS library name *libname* points. The default is to create a text file, not a SAS data set.

RAW Includes the raw return benchmark method in the output data set or file. The `RAW` option must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

SW Includes the market model with Scholes-Williams beta benchmark method in the output data set or file. The `SW` option must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

TYPE=CMF|CP|FF|FFM|MAR|MM|RAW|SW Selects custom factor model, comparison period mean adjusted, Fama-French three-factor model adjusted, Fama-French-momentum four-factor model adjusted, market adjusted, market model adjusted, raw, or Scholes-Williams market model adjusted returns for output. The selected type must exist in the input SAS data set. The default is `TYPE=MM` if no `TYPE`, `CMF`, `CP`, `FF`, `FFM`, `MAR`, `MM` or `RAW` option is present. The `TYPE` option is included for compatibility with older versions of Eventus and allows only one benchmark type per run. The `CP`, `MAR`, `MM` and `RAW` options can be specified in combination to include more than one benchmark type in the same run.

VALUE Selects results based on the value-weighted market index for inclusion in the output data set or file. The `VALUE` option or `BOTH` option must have been present on the `EVTSTUDY` statement that produced the input to `EXTRACT`.

VPREFIX=*prefix* Sets the variable name prefix to use for the window abnormal returns. Acceptable values of *prefix* are valid SAS names up to 29 characters long. Longer values are truncated to 29 characters. The default prefix is `WINAR`.

WPREFIX=*prefix* Causes Eventus to include WLS regression weights in the output and sets the variable name prefix to use for the weights. Acceptable values of *prefix* are valid SAS names up to 29 characters long. The default is not to output weights; there is no default prefix.

B.7 `OLDSTUDY` Statement

The `OLDSTUDY` statement redisplays the event study results from previous runs of the Eventus `EVTSTUDY` statement or creates new results by merging two or more `OUTSAS=` data sets from previous runs into a single sample. Few options are available, because `OLDSTUDY` uses the options from the original run.

INSAS=*libname.membername* Points to a SAS data set created by the `EVTSTUDY` statement option `OUTSAS`.

INSAS*n***=***libname.membername* *N* is an integer from 2 through 10. These options point to additional SAS data sets, containing saved event study results, created by the `EVTSTUDY` statement option `OUTSAS`. Each input data set must use the same security identifier name (PERMNO) and return frequency, and should have been created by event studies using the same test-statistic and other methodological selections.

B.8 `PRICES` Statement

Retrieves prices or closing bid and ask quotes from CRSP daily or monthly stock databases and saves them in a SAS data set or text file.

BIDASK Specifies that the secondary price variables are to be retrieved in the output. Secondary prices are either bid and ask quotes or intraday or intramonth high and low transaction prices; see the CRSP *Data Description Guide* for details.

BINARY Similar to the `TEXT` format below, except that the prices themselves are written in real binary format (SAS format `FLOAT4.`).

DISTRIB Retrieves dividends and other cash distributions (CRSP distribution code ≤ 4999) with prices. When the `DISTRIB` option is in effect,

the listing or SAS data set output includes one zero or nonzero value for each trading date, containing the total cash distribution per share for which the stock went ex on that date. Two or more cash distributions with the same date are added and the total reported with MULT in the distribution code field. If the SPLITADJ option also is specified, the reported distribution total reflects the same split adjustment as the price. The DISTRIB option is not available when the HSAS option is specified unless only one trading day (or month) per stock is being extracted. The variables DistCode, containing the four-digit CRSP distribution code, and DivAmt, containing the cash distribution per share, are added to any output data set.

EXCHCODE Adds the exchange listing code from the CRSP name history array, under variable name exchange_code, to the output data set specified by the option OUTSAS=. See CRSP stock database documentation for a listing of exchange codes.

EXTFILE= Gives the SAS file shortcut of a text file in which Eventus is to store the prices. This option is only valid with the default TEXT or optional BINARY file format options. If EXTFILE is not specified, the prices are written to the file associated with the shortcut userdata, or to the file userdata.dat in the SAS current working folder or directory if the shortcut is not defined.

HSAS Selects a horizontal format output SAS data set. Specify the SAS data set name using the OUTSAS= option. The data set contains as many of the following variables as applicable: pri1 through pri*nnnn*, bidl1 through bidl*nnnn*, askh1 through askh*nnnn*, trad1 through trad*nnnn*, PERMNO, eventda1, eventda2, Shares and any ID= variable specified on the REQUEST statement.

eventda1 and eventda2 are SAS date variables representing the beginning and ending trading days of the interval you request. The one to three digit number *nnnn* is the maximum number of trading days retrieved. For example, if the number of trading days requested ranges from two for some stocks to 90 for others, *nnnn* is 90. For a stock in this example with only two trading days, pri3 through pri90 contain missing values. Because the SAS system stores information on each variable for its own use, a horizontal format data set occupies more disk space than a vertical format data set (see the VSAS option).

NMS Instructs Eventus to obtain bid and ask quotes (if you also specify `BIDASK`) and the number of trades (if you also specify `TRADES`) from the Supplemental Nasdaq Data Arrays. When available, quotes from the Supplemental Nasdaq Data Arrays (CRSP names *Bid* and *Ask*) replace secondary prices (CRSP names *Bid or Low Price* and *Ask or High Price*).

To prevent the replacement of secondary prices, and instead have Eventus report both secondary prices and Supplemental Nasdaq quotes when the latter are available, specify `NMS NOCLOSE` on the `PRICES` statement. When both `NMS` and `NOCLOSE` appear on the `PRICES` statement, Eventus produces an output file or data set that contains both the secondary prices and the Supplemental Nasdaq quotes. The secondary prices are identified as `BID OR INTRADAY LOW` and `ASK OR INTRADAY HIGH` in a text file, or by the variable names `BidLo` and `AskHi` in a vertical SAS data set or `bidl1` through `bidl`*nnnn* and `askh1` through `askh`*nnnn* in a horizontal SAS data set. The Supplemental Nasdaq quotes are identified as `BID FROM NMS FILE` and `ASK FROM NMS FILE` in a text file or by variable names `BidNM` and `AskNM` or `bidn1` through `bidn`*nnnn* and `askn1` through `askn`*nnnn* in a vertical or horizontal SAS data set, respectively.

When the option combination `BIDASK NMS` is in effect without `NOCLOSE`, Eventus reports only one pair of merged secondary price variables, containing Supplemental Nasdaq bid and ask quotes for those stocks and date ranges for which the supplemental quotes are available, and the *Bid or Low Price* and *Ask or High Price* data items from the main CRSP secondary prices arrays in all other cases. The merged secondary price variables are identified as `BID OR INTRADAY LOW` and `ASK OR INTRADAY HIGH` or by variable names `BidLo` and `AskHi` or `bidl1` through `bidl`*nnnn* and `askh1` through `askh`*nnnn*. The CRSP *Data Description Guide* for the stock database provides a full explanation of the underlying stock data.

NOCLOSE Specifies that primary closing prices are to be omitted; used together with the `BIDASK` option when only secondary prices are desired. Note the special interaction of this option and the `NMS` option.

NOMINUS Strips the negative sign from negative prices. The default is to keep the sign as reported on the input database.

NONAMES Suppresses the list of PERMNOs or CUSIPs, firm names, and number of estimation and event period returns available. The default is to produce the list.

OUTSAS= Specifies a two-level SAS name (*libname.membername*) under which to create the SAS data set containing the prices. This option is valid only with the `HSAS` or `VSAS` file format options.

SHARES Includes the number of shares outstanding on the event date, in thousands, in the output file. The option is ignored unless either `NDAYS=1` is specified on the `REQUEST` statement, or `VSAS` is specified on the `PRICES` statement. The shares outstanding data may not be as timely as the price data; refer to CRSP documentation for more information.

SHRCODE Causes Eventus to store the two-digit share code from the CRSP name history array as the variable `ShrCode` in any `OUTSAS` data set.

SIC Causes Eventus to read the SIC code from the CRSP database and to add the variable `SICCode` to any output SAS data set.

SPLITADJ Causes Eventus to adjust for stock splits, reverse splits, and stock dividends using distribution data from the CRSP database. The adjustment takes place only within the range of data being extracted for each stock. For splits and stock dividends occurring after the first date extracted, Eventus multiplies prices and cash distributions by a split factor, and divides shares outstanding by the same factor. The split factor is equal to 1.0 on the first date being extracted and is cumulative within the range of data being extracted. The split factor changes by a factor equal to one plus the CRSP "factor to adjust price" each time there is a split or stock dividend. The split factor (variable `SplFac`) is added to any output SAS data set. The `SPLITADJ` option is not supported with the `HSAS` output option.

TEXT This is the default. Eventus writes the prices to a text file. The data are arranged in columns, with each row reporting the PERMNO, identification variable if applicable, CRSP trading day or month number, and prices. All the data for the first stock are listed, with each trading day on its own row, followed by all the data for the second stock, and so on.

Use the EXTFILE= option on the PRICES statement to specify the SAS file shortcut (fileref) pointing to the file in which to write the prices.

TRADES This option is ignored unless NMS is specified on the PRICES statement. Retrieves the number of trades on each date from the Supplemental Nasdaq Data includes them in the output data set or file.

VSAS Selects a vertical format output SAS data set. Specify the SAS data set name using the OUTSAS= option. The following variables are included in the data set: PERMNO, CUSIP if the CUSIPERM option is in effect, crspday1, Date, BidLo and AskHi if applicable, Price, Shares when applicable, Trades when applicable, and any identification variable you list on the REQUEST statement. crspday1 is the CRSP-style day (or month, etc.) number for the beginning date you request; date is the actual date of each price, recorded as a SAS date variable. Price is the closing stock price, and Shares is the number of shares outstanding in thousands.

B.9 REQUEST Statement

Required after the EVENTUS statement and before the EVTSTUDY, RETURNS, PRICES or VOLUME statement.

AUTODATE Applicable only to daily or weekly event studies where the request file contains calendar dates. Converts any date in the request file on which the market is closed to the following trading day. Eventus converts a date in the request file that follows the last trading day in the database to a SAS missing value, which may cause unexpected error messages.

AUTODATE=BACK Specifies that a calendar date in the request file that is not a trading day is to be converted to the preceding trading day.

BETAINDEX Selects a NYSE-AMEX beta decile-portfolio return, corresponding to each stock's ranking, in place of the market index. See also BETAINDEX=NASDAQ and BETAINDEX=OWNSYSTEM below. This option is available only with daily returns and requires the *CRSP Indices Database and Security Portfolio Assignment Module*.

BETAINDEX=NASDAQ Selects a Nasdaq beta decile-portfolio return corresponding to each stock's ranking in place of the market index. This option is available only with daily returns and requires the *CRSP Indices Database and Security Portfolio Assignment Module*.

BETAINDEX=OWNSYSTEM Selects a beta decile-portfolio return corresponding to each stock's ranking in place of the market index. NYSE-AMEX decile portfolio returns are provided for NYSE-AMEX stocks and Nasdaq decile portfolio returns are provided for Nasdaq stocks. This option is available only with daily returns and requires the *CRSP Indices Database and Security Portfolio Assignment Module*.

COMPANION Selects the use of user-supplied companion portfolios, or characteristic-dependent indexes, in lieu of a market-wide index. See also the `EVENTUS` statement options `MYCOMPANIONIDX`, `MYCOMPANIONFREQ` and `PORT1DS`.

COMPOSIT See `SP500`.

CUSIPERM Specifies that the request file contains CUSIPs to be matched CUSIPs to CRSP PERMNOs during execution. This requires the program `Update PERMNO-CUSIP Conversion Database.sas`, included with Eventus, to have been run once since the most recent CRSP database update.

DATEFMT=*format* Specifies the format of the dates in the request file. The *format* specification must be either a valid SAS date informat or the word `CRSP`. `CRSP` specifies a 1–to–5 digit integer representing a CRSP date. CRSP dates are sequence numbers where 1=the first day or month of data; the CRSP date is incremented by one each trading day or month. Leading zeroes need not (but may) be included in the CRSP date. Any format specification other than `CRSP` must be a valid SAS date format (the period at the end is optional). The default is `DATEFMT=YYMMDD8`.

EST=*periods* **and POOL** Specifies the estimation period for benchmark return parameters, for example, standard deviation and market model slope and intercept. The absolute value of the argument of `EST` determines how many trading periods (days, months, etc.) the estimation

period is offset from the event date. The sign of the argument determines whether the estimation period is pre-event or post-event. For a `TWIN` event study, negative values are relative to the first event date, positive values relative to the second.

- The default is `EST=−46` for daily event studies, `EST=-10` for weekly event studies and `EST=−13` for monthly event studies.
- `EST=SPECIFIC` selects an estimation period ending on the calendar or CRSP date specified in the estimation date column of the request file. The estimation date column must appear immediately after the event date in a text request file, or be named `estend` (calendar date) or `crspest` (CRSP date) in a SAS data set request file. This option does not affect the estimation period length, which is determined by `ESTLEN`.
- `POOL` specifies to split the estimation period into equal pre-and post-event periods, each offset from the event date by `EST` trading periods and of length one-half `ESTLEN`. `POOL` and `EST=SPECIFIC` may not be used together. This option does not affect the total estimation period length except that an odd-valued length is reduced by one.

ESTLEN=*n* Specifies the length of the estimation period in trading days, weeks, months, quarters or years, depending on the return interval being used for estimation in the current run. The maximum permitted is 999. The default is 255 trading days for daily returns, 60 months for monthly returns, 52 weeks for weekly returns, 20 quarters for quarterly returns, or 10 years for annual returns. Odd values of `ESTLEN` are reduced by one when `POOL` is specified. The number of usable returns in the estimation period may be lower than `ESTLEN` in individual cases if there are missing returns on the CRSP database.

EVENTSTREAM Specifies that the mini-database was created by EventStream software. This option is for use in conjunction with the mini-database mode of EventStream version 2003.05 or higher.

GROUP=*group_variable* Names a grouping variable to be used in an event study to combine multiple observations into a single equally weighted portfolio. The value of the grouping variable for each observation is

listed on the appropriate line of the request file after the dates and `ID` variable if any. The grouping variable must be numeric; in output data sets, it is assigned a display format that assumes a one- to five-digit integer. Two or more observations with identical grouping variable values are combined into a portfolio treated as a single observation. The default is to use no grouping variable so that each observation is weighted equally.

GRWEIGHT Valid only if the `GROUP` option is specified. Denotes that the request file contains a group weight variable. The variable specifies the weight, between 0 and 1, to be given the individual security within the security's group portfolio. The weights for a single group must sum to 1. When the request file is a SAS data set, the column name of the group weight must be `grweight`.

ID=*variable* Names the variable to be used as an observation (event) identifier. The identification variable can be of any data type: numeric, character or date. If `INSAS` is also present, the identification variable must exist on the SAS data set request file. Specify `IDFMT` also. The identification variable should not be the active security identifier (e.g. PERMNO, CUSIP) or event date variables unless copied into a new variable with a different name.

IDFMT=*format* Specifies the SAS format of the optional `ID=` variable. If the request file is a text file, *format* must be any valid SAS informat that is also valid as a format (for output). If the request file is a SAS data set, *format* must be a valid SAS format but need not be valid as an informat.

INSAS=*libname.membername* Used when the request file is a SAS data set. The data set request file must contain these variables:

- `PERMNO` (numeric variable containing the five-digit CRSP permanent number), unless `CUSIPERM` or `SASNONCRSP` is in effect.
- `CUSIP` (character variable of length eight containing the CUSIP identifier for CRSP input). When the Eventus run uses a CRSP stock database, the `CUSIP` variable on the input data set is ignored unless the `CUSIPERM` option is specified. The `CUSIP` variable is mandatory only in the legacy `NONCRSP` input mode.

- *issue_key* When the SASNONCRSP input mode is active, the issue key specified by the user must be present in the request file.
- For single event date event studies only, either eventdat (SAS date variable containing day 0) or crspday (integer CRSP date).
- For TWIN event studies, and for data retrieval using RETURNS or PRICES, the two SAS date variables eventda1 and eventda2, must be present, or if DATEFMT=CRSP is in effect, then the variables crspday1 and crspday2 must be present. However, if the NDAYS= option is specified, omit eventda2 or crspday2.
- If EST=SPECIFIC (see below) is in effect, either estend (SAS date variable) or crspest (CRSP date, used when DATEFMT=CRSP is in effect) must also be present in the data set.
- If an ID=*variable* (see below) specification exists, the *variable* that it names must be present in the data set request file.
- If GROUP=*group_variable* is specified, *group_variable* must be present.
- If GRWEIGHT is specified, a numeric variable named GrWeight, containing the weight of the security-event within the group, must be present.
- In the legacy NONCRSP mode only, if the NAME option appears, a character variable of length 33, name, must be present. This does not apply to the recommended method of using non-CRSP data, SASNONCRSP.
- If the SHORT option is specified, a character variable of length one, named sl, must have a value of either 'S' or 'L'.
- If DATEFMT=CRSP (see above) is in effect, the event day or month number (crspday), or, for a TWIN event study, the beginning and ending day or month numbers (crspday1 and crspday2). If EST=SPECIFIC is also in effect, the ending day or month number of the estimation period must be included as variable crspest.

ISSUEFMT=SAS *format name* Required when SASNONCRSP input mode is active and ignored otherwise. Selects the SAS format to associate with the issue key variable.

ISSUEKEY=SAS *variable name* Required when SASNONCRSP input mode is active and ignored otherwise. Gives the column name in mini-database

data sets, such as the data set to which the EVENTUS statement option RETURNDS= points, that uniquely identifies each security.

IX2Y Obsolete.

LOG Causes returns to be transformed to continuously compounded returns by taking $\ln(R_{jt})$ for stock returns and $\ln(R_{mt})$ for market index returns.

MINESTN=*n* Optionally specifies the minimum number of usable trading days in the estimation period. The default is two if no linear benchmark model is in use or one plus the number of linear model coefficients if a market model or multi-factor model is in use. Eventus considers an estimation-period return usable if it is non-missing, except the first return following a sequence of one or more missing returns.

NAME This option is primarily for event studies using non-CRSP input data. When the SASNONCRSP option is in effect, the option indicates that a name history array data set is available. When the legacy NONCRSP option is in effect, the option indicates that a firm or issue name appears as the last item on each line of the request file. Also see the EVENTUS statement option NAMEDS.

NMONTHS=*n* An option on REQUEST statements in conjunction with the RETURNS, PRICES and VOLUME statements, and TWIN event studies. Selects retrieval of *n* consecutive trading months or days of data (including months or days with missing data values) for each observation. If you specify NMONTHS, the first month or day is the date in the request file; omit the ending date, which must be specified in the above situations when NMONTHS is not used, from the request file. The NMONTHS and NDAYS options are synonymous and are automatically applied to the monthly, daily or other data frequency of the main CRSP database or mini-database being used.

NDAYS=*n* An option on REQUEST statements in conjunction with RETURNS, PRICES and VOLUME statements, and TWIN event studies. Specifies that you want to retrieve *n* consecutive trading days or months of data (including days or months with missing data values) for each observation. If you specify NDAYS, the first day or month is the date in the request

file; omit the ending date, which must be specified in the above situations when NDAYS is not used, from the request file. The NDAYS and NMONTHS options are synonymous and are automatically applied to the daily, monthly or other data frequency of the main CRSP database or mini-database being used.

NODIVIDX Causes Eventus to use market indexes excluding dividends instead of the default indexes including dividends.

POOL See EST.

PORTYPE=1|2|... Specifies the portfolio-type position within a CRSP stock database portfolio assignment structure which Eventus reads when extracting decile ranks for the SIZEINDX option. This option is rarely if ever needed.

REQFILE=*fileref* Specifies the SAS file shortcut (fileref) that points to a text request file containing the security identifier such as PERMNO, event date or dates and other information depending on Eventus options in effect. The option defaults to request, and is ignored when the INSAS option appears on the REQUEST statement. Each line of the request file contains the following variables (in the order shown, in the case of a text request file).

```
PERMNO event  [event       [specific     [ID number  [grouping  [group  [S or
        date   date 2]  estimation date]  or string]  variable]  weight]  L]
```

Each value must be separated by at least one blank, but the precise column position of the values is unimportant as long as they appear in the order shown. The square brackets simply indicate items that need not always appear; do not include them in the file. Whether an optional item should appear is determined by the options specified on the EVENTUS and REQUEST statements. The file need not be sorted. If the CUSIPERM option or SASNONCRSP input is in effect, the first variable on the line should be the appropriate security identifier instead of PERMNO.

The combinations of security issue key (such as PERMNO), event date and identification variable specified by ID=, if any, should be unique. For example, if two rows of the request file have the same security issue key and same event date (or dates in the same month in a monthly event

study), the REQUEST statement should specify the ID= option and the two request file rows should have different values of the identification variable.

SHIFT1=n_1,SHIFT2=n_2 The SHIFTn options are intended primarily for the DATECONV statement, and for the REQUEST statement in a RETURNS or PRICES run, but may also be used on the REQUEST statement in a TWIN EVTSTUDY program. The first date in the request file is shifted by n_1 periods and the second date is shifted by n_2 periods. In the case of monthly event studies or monthly data retrieval, the periods are months. When working with daily data, the periods are trading days if DATEFMT=CRSP and calendar days otherwise. Both n_1 and n_2 may be specified as any integer value. For example, SHIFT1=-1 shifts June 1, 2003 back to May 31, 2003.

SHIFT1 and SHIFT2 can be specified singly or together. Using the options with calendar dates and daily data could cause shifted dates that are not trading days, leading to security-events being dropped unless AUTODATE is also specified. To shift by trading days instead of calendar days, first run DATECONV to convert to CRSP trading day numbers.

SHORT Specifies that an S (for short position) or L (for long position) code appears at the end of each line of the request file if it is a text file, or in a character variable of length one named sl if the request file is a SAS data set. When S appears, all non-missing stock returns for the event are multiplied by -1 before any analysis. Market index returns, factor returns, size or risk decile returns and companion portfolio returns are not sign-reversed. Exception: in an event study that uses buy-and-hold abnormal returns, the BHAR of an S security-event is first calculated from non-sign-reversed data, then multiplied by -1.

SIZEINDX Selects the use of size decile-portfolio returns in place of market index returns in event studies and return retrieval runs. The size decile is matched to the size portfolio number as of the event date in the annual data structure of the CRSP stock database. In a TWIN event study, the portfolio number is the one on the first event date; in a PRICES, RETURNS or VOLUME run, the number is on the starting request date. If SIZEINDX is specified without an argument, Eventus expects

the SAS file shortcut `sizeindx` to be associated with a binary file in the format that the `SizBuild` statement produces. In this format, each line is 44 bytes long and contains the date as an eight-digit integer (SAS format `IB4.` followed by the returns on size decile portfolios 1–10 (SAS format `FLOAT4.`).

SIZEINDX=CAPBASED Selects CRSP Cap-Based Portfolio returns, based upon portfolios containing stocks from the entire CRSP universe of NYSE, Nasdaq, and AMEX stocks with decile breakpoints based on NYSE stocks only (INDNOs 1000340–1000349), as replacement market indexes for NYSE, AMEX and Nasdaq stocks. Available in monthly data frequency only. Requires the *CRSP Indices Database and Security Portfolio Assignment Module* (or analogous user-supplied arrays in the `SASNONCRSP` method). The portfolio assignments come from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one for the first event month; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is for the starting request month.

SIZEINDX=CRSPACCESS Selects Stock File Capitalization Decile index returns, based upon rankings of the entire CRSP universe of NYSE, Nasdaq, and AMEX stocks (INDNOs 1000082–1000091), in place of market index returns. Requires the *CRSP Indices Database and Security Portfolio Assignment Module*. Eventus uses the portfolio assignments from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is on the starting request date.

SIZEINDX=NYSEAMEX Selects Stock File Capitalization Decile index returns, based upon rankings of the NYSE-AMEX-only stocks (INDNOs 1000042–1000051), in place of market index returns. Requires the *CRSP Indices Database and Security Portfolio Assignment Module* (or analogous user-supplied arrays in the `SASNONCRSP` method). Eventus uses the portfolio assignments from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is on the starting request date.

SIZEINDX=NASDAQ Selects Stock File Capitalization Decile index returns, based upon rankings of the Nasdaq-only stocks (INDNOs 1000062–

1000071), in place of market index returns. Requires the *CRSP Indices Database and Security Portfolio Assignment Module*.

SIZEINDX=OWNMARKET Selects Stock File Capitalization Decile index returns, based upon NYSE-only (INDNOs 1000002–1000011), AMEX-only (INDNOs 1000022–1000031) and Nasdaq-only (INDNOs 1000062–1000071) size-decile portfolios as replacement market indexes for NYSE, AMEX and Nasdaq stocks, respectively. When this option is active, Eventus matches each stock in the sample to a market and size decile using the CRSP-reported exchange and decile number as of the event date. Requires the *CRSP Indices Database and Security Portfolio Assignment Module*. Eventus uses the portfolio assignments from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is the one on the starting request date.

SIZEINDX=OWNSYSTEM Selects Stock File Capitalization Decile index returns, based upon NYSE-AMEX-only (INDNOs 1000042–1000051) and Nasdaq-only (INDNOs 1000062–1000071) size-decile portfolios as replacement market indexes for NYSE-AMEX and Nasdaq stocks, respectively. When this option is active, Eventus matches each stock in the sample to a market and size decile using the CRSP-reported exchange and decile number as of the event date. In a `TWIN` event study, the decile number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is on the starting request date. Requires the *CRSP Indices Database and Security Portfolio Assignment Module*.

SP500|COMPOSIT `SP500` selects the return on the Standard and Poor's 500 Composite Index. `COMPOSIT` selects the return on the Nasdaq Composite Index. These options select the CRSP stock database indexes, not indexes from the additional CRSP indexes subscription. Therefore, the returns may be without dividends, regardless of whether `NODIVIDX` is specified; see CRSP documentation for the definitions of the index returns. When the `BOTH` option appears, the index selected by one of these options replaces the value-weighted market index.

STDINDEX Selects a NYSE-AMEX standard deviation decile-portfolio return, corresponding to each stock's ranking, in place of the market index. See also `STDINDEX=NASDAQ` and `STDINDEX=OWNSYSTEM` below.

This option is available only with daily returns and requires the *CRSP Indices Database and Security Portfolio Assignment Module*. Eventus uses the portfolio assignments from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is on the starting request date.

STDINDEX=NASDAQ Selects a Nasdaq standard deviation decile-portfolio return corresponding to each stock's ranking in place of the market index. This option is available only with daily returns and requires the *CRSP Indices Database and Security Portfolio Assignment Module*. Eventus uses the portfolio assignments from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is on the starting request date.

STDINDEX=OWNSYSTEM Selects a standard deviation decile-portfolio return corresponding to each stock's ranking in place of the market index. NYSE-AMEX decile portfolio returns are provided for NYSE-AMEX stocks and Nasdaq decile portfolio returns are provided for Nasdaq stocks. This option is available only with daily returns and requires the *CRSP Indices Database and Security Portfolio Assignment Module*. Eventus uses the portfolio assignments from the CRSP database as of the event date. In a `TWIN` event study, the portfolio number is the one on the first event date; in a `PRICES`, `RETURNS` or `VOLUME` run, the number is on the starting request date.

B.10 `RETURNS` Statement

Retrieves returns from a CRSP stock database. No analysis occurs. Missing returns are converted from CRSP to SAS special missing value codes.

BINARY Selects an output format similar to the `TEXT` format, except that the returns themselves are written in real binary (SAS format `FLOAT4.`).

BOTH See `VALUE`.

EXCHCODE Adds the exchange listing code from the CRSP name history array, under variable name `exchange_code`, to the output data set spec-

ified by the option OUTSAS=. See CRSP stock database documentation for a list of exchange codes.

EXTFILE=*target* Gives the SAS file shortcut (fileref) of a text file in which Eventus is to store the returns, if applicable. The default is userdata. If *target* is not defined as a SAS file shortcut, a file with the name *target* plus the .dat extension is created in the current working folder or directory. This option is used only with the default TEXT or optional BINARY format; it is ignored when the OUTSAS option is present.

HSAS Selects a "horizontal format" output SAS data set. Specify the SAS data set name using the OUTSAS= option. Eventus creates the data set if it does not exist or overwrites it if it already exists. The data set contains as many of the following variables as applicable: retn1 through retn*nnnn*, mkt1 through mkt*nnnn* (only if the INDEX option appears), PERMNO, eventda1, eventda2, and the variable listed as the argument of the ID= option, if any, of the REQUEST statement. If the BOTH option appears, value-weighted index returns are stored as vwmk1 through vwmk*nnnn*.

eventda1 and eventda2 are SAS date variables representing the beginning and ending event dates requested, after applying the AUTODATE and SHIFT options if applicable. The one to four digit number *nnnn* is the maximum number of trading days. For example, if the number of trading days requested ranges from two for some stocks to 90 for others, *nnn* is 90. For a stock in this example with only two trading days, retn3 through retn90 contain missing values. Because the SAS system stores information about each variable for its own use, a horizontal format data set, having more variables, occupies more file space than a vertical format data set.

INDEX Includes market index returns in the output file. The default is not to include market index returns.

NONAMES Suppresses the list of PERMNOs or CUSIPs, firm names, and number of estimation and event period returns available. The default is to produce the list.

OUTSAS= Specifies a two-level SAS name (*libname.membername*) under which to create a SAS data set containing the returns. Also specify the

HSAS or VSAS option.

SHRCODE Retrieves the two-digit share code from the CRSP database's name history array (or user-supplied name history data set in the SAS-NONCRSP method) and saves it as the variable ShrCode in any OUTSAS data set. The share code does no appear in the listing output or text file.

SIC Retrieves the SIC code from the CRSP database and saves it as the variable SICCode in any output SAS data set. The SIC code does not appear in the listing output or text file.

TEXT This is the default. Eventus writes the prices to a text file. The data are arranged in columns, with each row reporting the PERMNO, identification variable if applicable, CRSP date, and return. All the data for the first stock are listed, with each trading day or month on its own row, followed by all the data for the second stock, and so on.

Specify the file name or SAS file shortcut (fileref) to which to write the returns with the EXTFILE= option on the RETURNS statement. If the argument of EXTFILE is a file name, it may include the path but must not include any blank or period. SAS may add a .dat extension to the file name.

VALUE|BOTH In the absence of one of these options, Eventus includes only equally weighted market index returns in the output when the INDEX option is specified. Specify VALUE to change to the value-weighted index (or the alternative index indicated by SP500 specified on the REQUEST statement) or BOTH to get both.

VSAS Selects a vertical format output SAS data set. Specify the SAS data set name using the OUTSAS= option. The following variables are included in the data set: PERMNO, CUSIP if the CUSIPERM option is in effect, crspday1, Date, Return, and any identification variable you list on the REQUEST statement. If you specify INDEX on the RETURNS statement, Market and _Weight_ are also included. crspday1 is the CRSP-style trading day number for the beginning date you requested; Date is the actual date of the return, recorded as a SAS date variable. Return is the security return, and Market is index return (including dividends). The variable _Weight_ is a character variable of length 14

that describes the type of market index return data. For example, the default equally weighted index of the CRSP universe of NYSE, Nasdaq, and AMEX stocks is identified by a _Weight_ value of 'Equal'; the corresponding value-weighted index is identified by 'Value'. Other indexes and index replacements such as size decile-portfolio returns are identified by distinctive values of _Weight_.

There is one row in the data set for each trading day or month in the request requested period. The VSAS format is versatile and particularly recommended if you plan to process the data with a SAS program that uses BY-variable techniques.

B.11 TITLE and TITLE2 Statements

TITLE statements are optional; they specify page headings, mainly for event study output. Enter title statements after the EVENTUS statement. TITLE and TITLE2 are regular SAS statements, not part of Eventus as such. Any additional title statements (TITLE3, etc.) in user input are overridden by Eventus-determined listing output.

B.12 VOLUME Statement

Retrieves trading volume from the CRSP stock database.

BINARY Selects an output file format identical to the TEXT format, except that the volume data are written in real binary (SAS format FLOAT4.).

EXCHCODE Adds the exchange listing code from the CRSP name history array, under variable name exchange_code, to the output data set specified by the option OUTSAS=. See CRSP stock database documentation for a listing of exchange codes.

EXTFILE= Gives the SAS file shortcut (fileref) to a text file in which Eventus is to store the volume data, if applicable. The argument of EXTFILE may be a file name instead of a fileref, in which case it may include the path but may not any blank or period. When a file name is specified, a .dat extension may be added to the file name by SAS. The EXTFILE option is not for use with the VSAS and HSAS options, which select SAS data set output.

HSAS Selects a "horizontal format" output SAS data set. Specify the SAS data set name using the `OUTSAS=` option. The data set will contain as many of the following variables as applicable: `vol1` through `vol`*nnn*, `PERMNO`, `eventda1`, `eventda2`, `shares` and any identification variable you list on the `REQUEST` statement.

`eventda1` and `eventda2` are SAS date variables representing the beginning and ending trading days of the interval you request. The one to three digit number *nnn* is the maximum number of trading days retrieved. For example, if the number of trading days requested ranges from two for some firms to 90 for others, *nnn* is 90. For a firm in this example with only two trading days, `vol3` through `vol90` contain missing values. Because the SAS system stores a large amount of information on each variable for its own use, a horizontal format data set occupies considerably more file space than a vertical format data set.

NASDINFO Retrieves trading status trait code, NMS indicator and market maker count from the Nasdaq information arrays of the CRSP database. Valid only when `SHARES` (see below) is a valid option.

NONAMES Suppresses the list of PERMNOs or CUSIPs, firm names, and number of estimation and event period returns available. The default is to produce the list.

OUTSAS= Gives the two-level SAS name (*libname.membername*) in which to store the volume data, if applicable. The first part of the two-level name can be `work` for a temporary data set that exists only until SAS is closed, or a user-defined SAS library name (libref) that points to a folder or directory in which to save the data set. In either case, the data set is created if it does not exist already, or replaced if it does exist.

SHARES Selects to include the number of shares outstanding on the event date, (in thousands if from the CRSP database), in the output file. This option is ignored unless either `NDAYS=1` is specified on the `REQUEST` statement or `VSAS` is specified on the `VOLUME` statement.

SHRCODE Causes Eventus to store the two-digit share type code from the CRSP name history array as the variable `ShrCode` in the `OUTSAS` data set, if one is created.

SIC Causes Eventus to read the SIC code from the CRSP database and to add the variable `SICCode` to any output SAS data set.

SPLITADJ Causes Eventus to adjust for stock splits, reverse splits, and stock dividends using distribution data from the CRSP database (or user-supplied distribution data set in the `SASNONCRSP` method). The adjustment takes place only within the dates from the current row of the request file. For splits and stock dividends occurring after the starting date of the current request file row, Eventus multiplies share volume by a split factor, and divides shares outstanding (if selected) by the same factor. The split factor is equal to 1.0 on the first requested date and is cumulative within the dates from the current request file row. The split factor changes by a factor of (one plus the CRSP "factor to adjust price") each time there is a split or stock dividend. The split factor (variable `SplFac`) is added to any output SAS data set. The `SPLITADJ` option is not supported with the `HSAS` output option.

TEXT This is the default. Eventus writes the prices to a text file. The data are arranged in columns, with each row reporting the PERMNO, identification variable if applicable, date, and volume. All the data for the first stock are listed, with each trading day on its own row, followed by all the data for the second stock, and so on.

Specify the SAS file shortcut (fileref) to which to write the prices with the `EXTFILE=` option on the `VOLUME` statement.

TRADES Specifies that the number of trades on each date should be read from the Supplemental Nasdaq Data Arrays and included in the output file.

VSAS Selects a "vertical format" for the output SAS data set. Specify the SAS data set name using the `OUTSAS=` option. The following variables are included in the data set: `PERMNO`, `CUSIP` if the `CUSIPERM` option is in effect, `crspday1`, `date`, `Volum`, `Shares` when applicable, and any identification variable you list on the `REQUEST` statement. `crspday1` is the CRSP-style day, month, etc. number for the beginning date you request; `Date` is the actual date of the volume figure, recorded as a SAS date variable. `Volum` is the trading volume in shares, and `Shares` is the number of shares outstanding in thousands.

There is one observation in the SAS data set for each trading day in the interval you request. The `VSAS` output is versatile and particularly recommended if you plan to process the data with a SAS program that uses BY variable techniques.

B.13 `WINDOWS` Statement

A single `WINDOWS` statement may precede the `EVTSTUDY` and `OLDSTUDY` statements, and must precede the `EXTRACT` statement.

For a single event date event study, use `WINDOWS` to list up to 200 event windows for which cumulative or compounded abnormal returns and test statistics are to be reported on the output. The earliest and latest possible dates are determined by the value of the `PRE` and `POST` options respectively. If the `WINDOWS` statement is not present, Eventus automatically supplies three windows, including (−1,0), the part of the event period preceding date −1, and the part following date 0. A `WINDOWS` statement with no windows listed suppresses the window output.

With a two-date event study (`TWIN` option on the `EVENTUS` statement), there is only one window, bounded by the two event dates. In a twin study, specify event date labels, up to 64 letters, numbers, underscores or blanks each, on the `WINDOWS` statement as shown above. Enclose a label containing one or more blanks in a SAS `%str` function.

When it appears immediately before an `EVTSTUDY` statement that contains an `OUTWIN` or `FILEWIN` options, or immediately before an `EXTRACT` statement, `WINDOWS` specifies the event windows that appear in the output data set or file. When used with the `EXTRACT` statement, there is no default window. The `WINDOWS` statement syntax in this usage is the same as for the type of event study (single date or `TWIN`).

Appendix C

How Eventus Finds CRSP Stock Data

C.1 CRSP Stock Databases

Eventus looks for a Windows, Unix or Linux environment variable variable named `CRSP_DSTK` to automatically identify the location of the daily CRSP stock database and the environment variable `CRSP_MSTK` to identify the monthly CRSP stock database. The document CRSP *Annual Stock and Indices Release Notes* describes how to set the environment variables on supported systems. However, if for some reason the appropriate environment variable is not set, it is possible to manually tell Eventus where the database is located. To do so, use a `filename crspdb` statement to point to the folder or directory containing the data, and also specify the option `DBFNSTMT` on the `EVENTUS` statement, for example:

```
filename crspdb 'c:\crspdata\dix200612';
eventus dbfnstmt;
etc.
```

To use a different data frequency in the estimation period of an event study from that used in the event period (in conjunction with the `EVENTUS` statement option `ESTINTER`) when the `DBFNSTMT` option is in effect, the SAS file shortcut `mcrspdb` must point to the folder or directory containing the CRSP stock database from which Eventus is to read the estimation-period returns.

In Eventus 6.3c and earlier, the `EVENTUS` statement option `EXCESS` was used to access risk decile-portfolio returns included in the *CRSP Indices Database and Security Portfolio Assignment Module*. This method is obsolete. Since version 7, Eventus reads the risk decile-portfolio returns from the data arrays that are integrated with the main CRSP stock database when the *CRSP Indices Database and Security Portfolio Assignment Module* is installed. The newer method is invoked by the `REQUEST` statement options `BETAINDEX` and `STDINDEX`.

C.2 Size Index Data

If the *CRSP Indices Database and Security Portfolio Assignment Module* (an add-on to the stock database) is installed, it is integrated with the stock database and therefore Eventus needs no additional information about its location.

The `REQUEST` statement option `SIZEINDX=CRSP` is obsolete. Instead, use `SIZEINDX=CRSPACCESS` and related options to read the integrated index arrays.

To use a size index file built by the `SizBuild` statement, the `REQUEST` statement option `SIZEINDX` with no argument must be used, and the SAS file shortcut `sizeindx` must point to the file.

To use size indexes with non-CRSP security data, we recommend the Eventus companion portfolio facility; please see page 105.

C.3 CRSP Data Stored in SAS Data Sets

We do not recommend trying to use Eventus with complete copies of the CRSP U.S. stock databases stored in SAS data sets. Even if you have other reasons to store the CRSP data this way, it is simpler and less time consuming to keep a full copy of the databases in the native format, installed from the CRSP discs, for use with Eventus. The data occupy little space relative to the size of modern hard drives.

Appendix D

How to Cite Eventus

If you would like to cite Eventus or this *Guide*, the following entries may be used.

Cowan, Arnold R. *Eventus* software, version 8.0.
(Cowan Research LC, Ames, Iowa, 2005.)

Cowan, Arnold R. *Eventus 8.0 User's Guide,* Standard Edition 2.1.
(Cowan Research LC, Ames, Iowa, 2007.)

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