

# What's New in Eventus<sup>®</sup> 9.0

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## 1 Event study features

### 1.1 Output files

#### 1.1.1 New output file options and formats

The EvtStudy statement has several new options for creating output files. All options in the table on the following page are new in Eventus 9 except OutWin and FileWin, which first appeared in Eventus 8. Multiple options can be specified on the same statement. The OutSAS option of the EvtStudy statement re-

mains available but is not recommended for new users or new application development because other options provide the same data in easier to use file formats.

SAS data set names specified by the user may consist only of a member name (equivalent to a file name), or may be in libref.membername format. If you give only a member name, the data set will be created in the SAS Work library unless you have already used the SAS system option User= to specify a default permanent SAS library. The Work library is temporary by definition, so to preserve a Work data set after your WRDS SAS/Eventus run ends or after you close PC SAS, you must copy or move the data set to a permanent library. A permanent SAS library name (libref) is a shortcut to a folder or directory on the system. Please see SAS documentation for further information on SAS data sets and libraries.

Type of results	Type of file	EvtStudy statement option
<i>For two-step event studies</i>		
Time series (e.g. daily or monthly) of abnormal returns, one row per security-event	SAS data set	OutAR=SAS_data_set_name
	Excel 2007+	ExcelAR=file_name
	CSV	CSVAR=file_name
	Stata	DTAAR=file_name
Time series (e.g. daily or monthly) of abnormal returns, one column per security-event	SAS data set	Vertical OutAR=SAS_data_set_name
	Excel 2007+	Vertical ExcelAR=file_name
	CSV	Vertical CSVAR=file_name
	Stata	Vertical DTAAR=file_name
Cumulative or buy-and-hold abnormal returns for the windows, one row per security-event	SAS data set	OutWin=SAS_data_set_name
	Text	FileWin=file_name
	Excel 2002+	ExcelWin=file_name
	CSV	CSVWin=file_name
	Stata	DTAWin=file_name
Estimation period statistics and estimated linear model parameters (if applicable)	SAS data set	OutParam=SAS_data_set_name
	Excel 2002+	ExcelParam=file_name
	CSV	CSVParam=file_name
	Stata	DTAParam=file_name
<i>For calendar-time portfolio regression event studies</i>		
Calendar-time portfolio returns and corresponding market and factor returns	SAS data set	OutPortfolio=SAS_data_set_name
	Excel 2002+	ExcelPortfolio=file_name
	CSV	CSVPortfolio=file_name
	Stata	DTAPortfolio=file_name
Individual firm returns and corresponding market and factor returns used to create the above portfolio data set, one row per trading date per security-event	SAS data set	OutAR=SAS_data_set_name
	Excel 2002+	ExcelAR=file_name
	CSV	CSVAR=file_name
	Stata	DTAAR=file_name

For the options that create a non-SAS file type, you can specify the file name as nothing more than a name, or you can specify a fully qualified name that includes the directory or folder (start with the drive letter and : if you provide a fully qualified name in Windows). If you omit the directory or folder, the file is created in the current directory or folder. In Windows, the current folder is identified along the bot-

tom edge of the SAS application. Also, you can omit *.extension* from the end; if you omit it, Eventus creates the file with the appropriate extension. In Windows, the extension created by Eventus allows the system to identify the file type. If any part of the file name (including the folder if you are providing it) contains at least one blank or special character, enclose the entire name in single quotes.

The Excel workbook format created by Eventus is an XML format and is created with an extension of *.xml*. The XML format, although different from the *xls* and *xlsx* formats usually created when one saves a workbook from Excel, is recognized by Excel 2002 and later. The output of the ExcelAR option often will have too many columns to be opened in Excel versions earlier than 2007. If the one row per security-event format is used with monthly data, or the Vertical ExcelAR option combination is used with a sample size of fewer than 250 security-events, there is a good chance the resulting workbook can be opened in Excel 2002 and 2003 even though the table indicates Excel 2007 and later.

When you run a two-step event study with more than one benchmark type in the same run (e.g. market adjusted returns and market-model abnormal returns) or with both equal and value weighted indexes in the same run, most of the options produce and output data set or file with the different set of results stacked. That is, a full set of results for one combination of benchmark and index appears at the beginning of the file, followed by the next combination on subsequent rows using the same columns, and so on. The Excel options, instead of stacking the results in this manner, create separate worksheets within the workbook file for the different combinations of benchmark and index.

### 1.1.2 Issuer names in output data sets

The CAR or BHAR data set created by the EvtStudy statement OutWin= or the Extract statement option OutSAS= now includes the issuer name by default if the run uses a CRSP database or if it is a SAS-NONCRSP run where the mini-database includes a names data set. If you prefer to leave the issuer name out of the output data set, for example if you expect the data set to be very large and do not need the name, you can suppress it by specifying the EvtStudy statement NoNameOut.

### 1.1.3 Default variable names

The default variable-name stems for CARs, etc. in the created by the EvtStudy statement OutWin= or the Extract statement option OutSAS= now vary depending on whether the data set contains cumulative abnormal returns, buy-and-hold abnormal returns or cumulative abnormal relative volumes. As in previous versions, you can always specify your own stem using the VPrefix= option of the EvtStudy statement.

## 1.2 Enhancements to non-CRSP data handling

### 1.2.1 Increased error checking

Eventus 9 greatly increases the automatic checking performed on input data sets for non-CRSP event studies using SASNONCRSP mode. This should greatly increase the percentage of mini-database problems that result in clear, specific error messages in the SAS log. Also, there is a new option of the Eventus statement, AnalyzeMini, that performs even more detailed checks and lists every non-conforming data set row.

### 1.2.2 IndexDS data set not always required

In SASNONCRSP runs where custom factor, Fama-French factor, custom index or companion index returns are used instead of a market-wide index, so that the market index return columns in a IndexDS= data set are not needed, the IndexDS= specification may be omitted. In Eventus 8 and earlier, the IndexDS= data set was required because it was used as the master calendar for the mini-database. If provided, it is still used as the master calendar. If it is omitted (and the market index returns it would have provided are not needed), Eventus automatically selects the custom factor, Fama-French factor, custom index or companion index data set to use as the master calendar. As in Eventus 8 and earlier, Eventus requires the data set used as the master calendar to contain at least all calendar dates of individual security returns in the mini-database, with each calendar date appearing only once in the master calendar.

### 1.2.3 Automatic index-option selection

In SASNONCRSP runs where the IndexDS= data set is needed and contains only one of the allowed market index return column names in the format wWRETy, where w is replaced by E or V and y is replaced by D or X, Eventus now uses the market index return even if the column name indicates that the index is value weighted but the user omits the Value option or the column name indicates that the index is without dividends but the omits the NoDivIdx option. If applicable, Eventus automatically activates the needed option(s) and provides a message to that effect in the SAS log.

### 1.2.4 Ability to use data with values <-1.0

As in previous versions, the default behavior of Eventus 9 is to flag values less than -1.0 in a return column as an error, preventing the completion of a run until the values are corrected. In previous versions, there was no way to override this default.

A new option in Eventus 9 makes it possible to conduct event studies using non-return data that legitimately may include values less than -1.0. To do so, set up the mini-database following the instructions in the User's Guide, as if the data were returns, and add the option AllowAllRet to the EvtStudy statement to prevent rejection of values less than -1.0.

## 1.3 Companion portfolio enhancements

The optional MyCompanionIndex data set now may have up to 10,000 companion portfolio series, increased from 400 in Eventus 8.

The MyCompanionFreq option now accepts a new argument Constant (case doesn't matter) to indicate that the portfolio assignments data set lists each security identifier only once, instead of once per year or quarter.

The Companion option (Request statement) and Factors= option (EvtStudy statement) can now be used in the same event study. The matched companion portfolio return replaces an overall market index in the custom factor model. Except for the addition of being able to be used together and the other enhancements in this document, both options work as in Eventus 8.

The companion portfolio feature now can be used with the EstInter option, i.e., where different return frequencies are used for the estimation and event periods. Ask us for details if you are interested in using this.

## 1.4 Automatic value-weighting of grouped security-events

The existing Request statement option GrWeight has new specifications, GrWeight=Value and GrWeight=ValueUpdate. The GrWeight option is used in combination with the Group= option. The Group= option specifies the name of a grouping variable; security-events with a common value of the grouping variable are formed into a portfolio that is treated as a single security in the event study. In Eventus 8 and earlier, the GrWeight option required a group weight variable to be included in the request file. This still is true when GrWeight is specified without an = and argument. When you use GrWeight=Value, instead of a user-supplied weight, Eventus calculates the weight of each group member based on its market capitalization immediately before the event period and applies this constant weight for every day, month or window in the event period. When GrWeight=ValueUpdate is specified, the weight for the first day or month of the event period is the same as with GrWeight=Value, but the weight is updated each day or month. The market capitalization used in these specifications is calculated from prices and shares outstanding. Therefore, if these specifications are used with non-CRSP data, the mini-database must include prices and shares data sets.

The Request statement option SizeIndex=CRSPAccess can now be abbreviated to SizeIndex=CRSP. This specification selects the size decile index series embedded in the main CRSP U.S. stock database, which is available to you only if you subscribe to the separate CRSP Indices product.

## 1.5 Calendar-time tests

### 1.5.1 General

The options for calendar-time tests have been revamped in Eventus 9. The CalendarTime option of the EvtStudy statement has the same meaning as in Eventus 8, so users who are familiar with this option can continue to use it the same way in Eventus 9. However, this option had different meanings in different contexts and therefore could be confusing. The CalendarTime option is no longer suggested for new users or new Eventus applications because Eventus 9 offers clearer, more specific options to perform the same tasks and more.

Eventus offers two types of calendar-time event study methods, calendar-time portfolio regression and Jaffe-Mandelker-style tests. Both involve, as a step preliminary to calculating test statistics, find the mean calendar-time abnormal returns of portfolios. The portfolios are not merely imaginary portfolios of securities that a real investor could not hold because the securities are aligned in event time but experience the event on different calendar dates. Instead, a security is assigned to a calendar-date portfolio if the calendar date falls in a desired window relative to the security's literal event date.

The calendar-time portfolio regression method uses a time-series regression to estimate the relation between the portfolio return and a set of one or more factors that have been shown to be correlated with returns. The estimated regression intercept shows the average effect of the event per calendar pe-

riod. The Jaffe-Mandelker-style methods use a separate estimation period to derive the parameters of a linear benchmark model, if one is used, at the security level, and also, in most of the methods of this type, to obtain the variances of portfolio mean abnormal returns. The mean abnormal return across calendar-time portfolios is tested directly.

The new `CTMin=n` option of the `EvtStudy` statement allows you to specify the minimum number of members a calendar-time portfolio must have to be used in the analysis. If fewer than *n* firms with non-missing data are included in the portfolio for a given calendar date, the date is omitted from the calendar-time portfolio regression or from the Jaffe-Mandelker-style test statistic calculation. If the option is not specified, the default is to use every calendar date for which at least one security has non-missing data.

In Eventus 8, calendar time tests were not eligible for bootstrapping. In Eventus 9, all calendar-time tests of both types are eligible for the new wild bootstrap (see the `Bootstrap=Wild` option specification). The older nonparametric bootstrap is not available for calendar-time tests.

### 1.5.2 Calendar-time portfolio regression method

To run the calendar-time portfolio regression method, specify the `CTPR` option of the `EvtStudy` statement. As in Eventus 8, this method is implied when the `FamaFrench` option is specified without adding the `TwoStep` option; the `CTPR` option may be included or omitted in this context with the same result. The `CTPR` option now may be used with the default single factor market model. Only one calendar-time portfolio regression is allowed in a single run. So, for example, you can specify `CTPR MM` or `CTPR FamaFrench` but not `CTPR` with both the above benchmark options at the same time. `CTPR` also works with custom factor models.

If Eventus is running under SAS 9.2, you can control the type of heteroskedasticity-consistent standard error used in the calendar-time portfolio regression. In SAS 9.1.3, and by default when using daily data in SAS 9.2, Eventus 9 reports `CTPR` significance tests based on the White (1980) heteroskedasticity-consistent covariance matrix estimator. This can also be selected explicitly by specifying the `EvtStudy` statement option `HCCMethod=0`. By default when using monthly data in SAS 9.2, Eventus 9 reports `CTPR` significance tests based on the MacKinnon and White (1985)  $H_3$  estimator. This estimator can be selected explicitly by specifying the `EvtStudy` statement option `HCCMethod=3`.

The displayed output from a calendar-time portfolio regression now includes the adjusted  $R^2$  and the regression F statistic. Also, the `PValue` option of the `EvtStudy` statement now works for calendar-time portfolio regressions.

Eventus 8 and earlier used the `MktRf` column in the data set pointed to by the `FFF=` option as the source of the excess return of the market index (market return minus risk-free return). Starting with version 9, Eventus calculates the excess market return using the market return from the main database (CRSP or user-built mini-database) and the risk-free return from the `FFF=` data set. The market index used to build the Fama-French factor data set available on Professor Kenneth French's web site is the CRSP value-weighted market index. Therefore, starting in version 9, the `EvtStudy` statement option `Value` is the default setting for Fama-French calendar-time portfolio regressions. (The former default of using the

equally weighted index is still in effect for all other situations.) The purpose of this change is to maintain consistency with Eventus 8 and earlier. However, when using CRSP data, there may be a very small change in results, because the Fama-French file's MktRf column used by Eventus 8 is more rounded than the index return data that Eventus 9 reads from the CRSP database. The results also can be affected by a 2009 CRSP database change for a subset of subscribers, explained in section 5.8.

### 1.5.3 Jaffe-Mandelker method

For Jaffe-Mandelker-style calendar-time tests in event studies, there are four new options, CTJM, CTMod, CTLBT and CTHCS. At most one of the CTJM, CTLBT or CTHCS options may be used in the same Eventus run. CTMod and CTJM can be used together or separately. Only one calendar-time test may be bootstrapped in one Eventus run. These tests may be run at the same time as non-calendar time two-step event study tests. However, a calendar-time test and a non-calendar-time test cannot be bootstrapped in the same run.

The CTJM option produces the test developed by Jaffe (1974) and Mandelker (1974) with the following differences. Jaffe (unnumbered equation between equations 3 and 4) and Mandelker (equation 9) estimate the variance of each monthly portfolio return over the immediately preceding 50 calendar months. The Eventus version of this test, however, uses the estimation period for a given security-event that Eventus would use with any other two-step event-study test (essentially anything other than calendar-time portfolio regression, Ibbotson RATS or the event-parameter approach.) As in earlier versions of Eventus, you can control the estimation period with the Est= and EstEnd= options. With the CTJM option, Eventus lines up the estimation-period returns, of the members of a calendar-time portfolio, in calendar time and takes the mean return of each calendar month or day. The resulting time series of calendar-time mean estimation-period returns is used to calculate the variance of abnormal returns for the calendar-time portfolio. When testing a window of two or more months or days, the number of distinct calendar trading days in the time series used for variance estimation can exceed the length of the estimation period for any one security-event. This is because the estimation period is defined relative to each security-event's month 0 or day 0, but two security-events with different event dates can be in the same calendar-time portfolio if their event dates overlap.

For example, suppose in a monthly event study we use Request statement options Est=-13 Estlen=36, and firms A and B have event dates in January 2007 and April 2007, respectively. Based on the options and event dates, firm A's estimation period is January 2003 through December 2005 and B's is April 2003 through March 2006. If we test window (-2,+2), a security belongs to a given calendar month portfolio if the month falls within two months before to two months after the security's month 0. Thus, both A and B belong to the February 2007 and March 2007 calendar time portfolios. Assuming A and B are the only members of the two portfolios, the variance of each portfolio is calculated from the 39-month January 2003-March 2006 time series of mean returns. In the first three months of the 39, the mean is only A's return and in the last three months the mean is only B's return.

Besides the period used to calculate the variance of a calendar-time portfolio return, another difference from Jaffe and Mandelker has to do with the test of the null hypothesis that the mean calendar-time portfolio abnormal return across all calendar months or days, applicable to a given window in event



time, is equal to zero. Jaffe (1974) and Mandelker (1974) assume that the time-series variance of this calendar time series is equal to one. (See Jaffe, equation 7 and Mandelker, equation 12.) Eventus 9 estimates the variance across the time series.

Eventus 9 also provides an additional test statistic corrected for first-order serial correlation of the calendar-time portfolio returns. This statistic does not take into account the fact that two consecutive returns in the calendar time series may not be adjacent in real time. For example, for a given window in event time, there may be firms that have calendar months May, June and August 2009 in the window, but none that has July 2009. In this case, June and August 2009 would be treated as consecutive months in estimating the first-order serial correlation. Therefore, the statistic corrected for serial correlation should not automatically be considered more accurate for every sample.

Jaffe and Mandelker use only the single-factor market model as the benchmark for abnormal returns, but their testing method is not specific to this benchmark. Eventus 9 can perform the test in conjunction with any benchmark method available for two-step event studies.

The CTMod option performs the same test of monthly or daily abnormal returns as the CTJM option. For windows of two or more months or days, the CTMod option performs a modified calendar-time test. Assume that monthly returns are being used. We form a subportfolio of all firms having the same calendar month 0 and therefore the same estimation period in calendar time. We calculate the time-series variance of the subportfolio mean abnormal return across the estimation-period months. This variance is used to standardize the subportfolio mean cumulative abnormal return (CAR) in the event window. For example, to get the standardized CAR for window  $(-2,+2)$ , multiply the variance by 5, take the square root, and divide into the subportfolio mean CAR for the window. Once we have the standardized CARs for all subportfolios, we calculate the test statistic for the window as a simple t-test using the standardized CARs. This modified test is computationally faster than the original Jaffe-Mandelker test, especially with daily data and multiple window definitions, but as of this writing no simulation evidence of its power and specification is known to exist.

The CTLBT option performs a version of the Jafee-Mandelker test proposed by Lyon, Barber and Tsai (1999). This test differs from the test performed by the CTJM option only in that the calendar-time portfolio returns are not standardized.

The CTHSC option performs the HSC\_t test, an extension of the Lyon, Barber and Tsai (1999) version of the Jafee-Mandelker test developed by Jegadeesh and Karceski (2009) to correct for heteroskedasticity and autocorrelation. Jegadeesh and Karceski demonstrate the test using control portfolios or control firms as benchmarks for calculating abnormal returns, but their testing method is not specific to this type of benchmark. Eventus 9 can perform the test in conjunction with any of the benchmark methods available for two-step event studies. The HSC\_t test is performed only for event windows. The calendar-time test produced by the CTHSC option for the monthly or daily abnormal return section of the output is the same as the CTLBT option.

## 1.6 Bootstrap event-study tests

### 1.6.1 Wild bootstrap option

In addition to the nonparametric bootstrap (sometimes called a percentile-t bootstrap or case bootstrap) of Eventus 8 and earlier, Eventus 9 offers the wild bootstrap, a relatively new and potentially more robust method in the statistics literature. To obtain the wild bootstrap, specify `Bootstrap=Wild` on the `EvtStudy` statement. Specifying the option `Bootstrap` (or just `Boot`) without `=Wild` continues to invoke the nonparametric bootstrap.

Wild bootstrapping requires an auxiliary distribution, from which pseudo-random drawings independent of the original data are generated and used to modify the residuals to create a resample. By default, Eventus uses the Rademacher distribution to generate an auxiliary random variable. An alternative is to use a product of normal random variables proposed by Liu (1988); to use this in the wild bootstrap instead of the Rademacher distribution, specify the additional `EvtStudy` statement option `Regina`.

When bootstrapping event-study tests, Eventus computes the eligible test statistics selected by the user for each resample. In a wild bootstrap, each resample contains the same observations as the original sample, but with the residuals modified by the auxiliary random variable. For event-study tests other than calendar-time portfolio regression, Eventus 9 treats the abnormal return as the residual. The nonparametric bootstrap as implemented in Eventus 9 and earlier does not impose the null hypothesis. The wild bootstrap as implemented in Eventus 9 imposes the null hypothesis.

### 1.6.2 Additional bootstrap issues

#### 1.6.2.1 One- and two-tail tests

The former `BTail=` option of Eventus 8 and earlier is no longer available in Eventus 9. Bootstrap significance levels or p-values now follow the `Tail=` option. When `Tail=1`, the bootstrap significance level or p-value is determined for a lower- (upper-) tailed alternative hypothesis if the parametric test statistic is negative (positive).

#### 1.6.2.2 Number of bootstrap iterations

The default number of iterations (also called resamples, replications or bootstraps) has been reduced from 1000 to 999. Davidson and MacKinnon (2000) recommend that the number of iterations  $B$  be such that  $(B+1)\alpha$  is an integer, where  $\alpha$  is the nominal significance level of the test. A new option of the `EvtStudy` statement, `Iterations=n`, now allows the user to select the number of iterations.

#### 1.6.2.3 Resampling ratio

The default resampling ratio (the size of each resample as a fraction of the original sample size) is now 1.0 instead of 0.25 in previous versions. To reduce the resampling ratio of a nonparametric bootstrap, use the `Resample=` option of the `EvtStudy` statement, e.g., `Resample=0.25`. In the nonparametric bootstrap procedure, resamples are selected with replacement from the original sample. For example, with an original sample size of 100 security-events and the default settings of Eventus 9, the nonparametric bootstrap is based on 999 resamples of size 100, each of which is drawn with replacement from the orig-

inal sample using a discrete uniform random number generator. The Resample option has no effect on a wild bootstrap, in which each resample is based on all original observations.

#### 1.6.2.4 *Random-number generator seed value*

The new EvtStudy statement option Seed= $n$  allows you to specify the random-number generator seed for bootstrapping. Please see the SAS documentation of random number routines for an explanation of seeds. By default, Eventus creates a seed for each run based on the time of day and the number of seconds past the minute. The seed is shown in the SAS log. Specifying the same seed in another run with the identical request file and options will produce the same bootstrap results.

#### 1.6.2.5 *Miscellaneous*

The EvtStudy statement has a new option BootAtOnce= $n$ , where  $n$  is an integer from 1 to the number of bootstrap iterations. This determines how many iterations (resamples) Eventus internally runs at once. The total number of iterations used to derive the bootstrap results is not affected. In most cases this option should not be needed, because Eventus automatically selects an appropriate number. However, if you are trying to run a bootstrap on a large sample and are running out of disk space or memory, you can try specifying the option with  $n$  equal to the number of iterations divided by an integer such that the dividend also is an integer.

As in Eventus 8 and earlier, only event window tests are bootstrapped. To bootstrap a test of a single day or month, specify a window with the same beginning and ending relative date on the Windows statement. The calendar-time portfolio regression test of alpha, where the entire event period is the only window, also is eligible for wild bootstrapping.

The bootstrapping algorithm in Eventus 9 is somewhat less disk-space intensive than in previous versions and tends to run slightly faster, all else being equal.

## 1.7 **Post-delisting returns**

Eventus 9 adds the ability to "fill in" a security-return time series that ends before the security's event period ends. In Eventus 8, and by default in Eventus 9, there is no explicit compensation for a security that has only a partial event-period time series. For example, suppose that in an event study on daily data where the user specifies windows including the 61-day window  $(-30,+30)$ . Assume that security A is delisted from CRSP after trading day +15, so that day +15 is the last return observation available. Also assume that the user does not specify the MaxMiss option (which can be used in Eventus 8 and 9 to exclude security-events with more than a specified number of missing values in the event period from all analysis in the current run). The CAR or BHAR for security A, by default, is calculated from the available 46 trading days  $-30$  through +15 only.

In Eventus 9, the post-delisting trading days can be replaced by various values using the new Fill= option of the EvtStudy statement as shown in the table below.

To fill post-delisting date return cells with	Use EvtStudy option
Zero	Fill=Z
The market index return being used in the event study.	Fill=M
Companion index returns (requires MyCompanionIdx and Port1DS specifications on the Eventus statement)	Fill=C
Custom fill returns (requires MyFillReturns and Port1FillDS specifications on the Eventus statement)	Fill=F
CRSP delisting return, when available, in addition to the above	Fill=Dx where x is one of the above fill codes
Missing value codes (equivalent to omitting the Fill= option)	Fill=N

If you specify Fill=Dx and a CRSP delisting return is found, the delisting return is compounded with the other fill return. For example, if you specify Fill=DM and a CRSP delisting return  $r_{dt}$  is found for day t (a day after the final regular CRSP return), the filled return for day t is equal to  $(1+r_{dt})(1+r_{mt})-1$  where  $r_{mt}$  is the market index return. The CRSP delisting return is a special field of the CRSP database that is separate from the time series of trading date returns. As of this writing, delisted stocks have a CRSP delisting return for at most one day or month. Please see CRSP documentation for further information on this type of data.

The new MyFillReturns and Port1FillDS options of the Eventus statement point to user-provided SAS data sets that contain various series of fill returns and map security codes to fill series. The structure of these data sets is the same as the MyCompanionIdx and Port1DS options respectively, except that the return columns in MyFillReturns must have sequential names starting with FillIdxR instead of CmpIdxR. There is a new MyFillFreq= option of the Eventus statement that is similar to the existing MyCompanionFreq option. The default is MyFillFreq=constant, meaning that each security is mapped to the same fill return time series (i.e. the same column of MyFillReturns) regardless of date.

In a companion portfolio event study (where the Companion option appears on the Request statement), the companion return takes the place of the market index return (as in Eventus 8). Therefore, Fill=C and Fill=M are equivalent in this context.

## 1.8 New option to reverse short and long positions

This description of the new feature assumes a little familiarity with the existing Short option, which is described in the Eventus User's Guide.

The Request statement has a new option, ShortReverse= $n$ , used in conjunction with the existing Short option to specify that long and short positions are to be interchanged on the specified relative date in the event period. For example, in an event study centered on a single date, ShortReverse=+1 indicates that long and short positions are interchanged starting on trading day or month +1 relative to the event date.

As with all Eventus syntax allowing the user to specify a relative date in event time, the date specified by the ShortReverse option refers to the date of a return. Therefore, in effect, securities designated L in the request file are purchased at the last closing price before the event period; then, at the closing price on day  $n-1$  or the last trading day of month  $n-1$ , the long position is liquidated and a new short position simultaneously established and held until the end of the event period, i.e., it is covered at the last closing price of the event period. Securities designated S are sold short at the last closing price before the event period, then the short position is covered and a new long position established at the close of  $n-1$ , to be liquidated at the last closing price of the event period. In addition to the existing L and S indications of long or short status, Eventus 9 allows A for always short and N for never short. If the Short and ShortReverse options are used, A and N securities are initially sold short or purchased in the same manner as S and L securities respectively, but A and N securities are not reversed, i.e., they hold their short or long status for the entire event period. If Short is specified but ShortReverse is not, the Short option works as in Eventus 8 and earlier, with A and N acting as synonyms for S and L respectively.

The existing TradingCost option of the EvtStudy statement interacts with the new ShortReverse option as follows. When ShortReverse is in effect, the TradingCost option may be omitted or TradingCost=LongShort specified. In the latter case, short positions are established at the bid or low price and covered at the ask or high price; long positions are established at the ask or high price and covered at the bid or low price. For example, an S stock is sold short at the closing bid or low just before the event period, bought back (covered) at the closing ask or high of day or month  $n-1$  and immediately bought long at the closing ask or high of day or month  $n-1$ , then sold at the last closing bid or low of the event period.

## 1.9 Absolute return and volume event studies

Bailey, Karolyi and Salva (2006), Fernandes and Ferreira (2008), Gomes, Gorton and Madureira (2006) and Rogers and Van Buskirk (2008), among others, use the absolute of abnormal return, cumulative abnormal return or (cumulative) abnormal volume as a volatility-based measure of the information content of an announcement.

To run an absolute return or absolute relative volume event study, add the option Absolute to the EvtStudy statement. For multi-day or multi-month windows, the signed abnormal return or abnormal relative volume is cumulated, then the absolute value taken.

## 1.10 Additional event-study options

### 1.10.1 Linear model intercepts

Two new EvtStudy statement options affect the use of a constant term in the market model or other linear factor model. The NoIntercept option omits the constant term from the model, so no intercept is estimated; the intercept is constrained to be zero. The DiscardIntercept option, which is applicable only to two-step methods, allows the intercept to be estimated normally in the estimation step, while in the event period abnormal return calculations, the intercept is assumed to be zero.

### 1.10.2 Risk-free return

Two new EvtStudy statement options affect the subtraction of a risk-free return from the security and market index returns. Where a risk-free return is not used by default, for example in two-step methods, you can specify RfAdjust to perform the subtraction. Where a risk-free return is used by default, for example Fama-French calendar-time portfolio regressions and the IRATS method, you can specify NoRfAdjust to omit the subtraction.

If you specify the RfAdjust option, you have to make sure that the risk-free is available to Eventus. The CRSP U.S. Stock Database does not include a risk-free return, nor does the Eventus SASNONCRSP mini-database standard provide for a mandatory risk-free rate column. When using CRSP, a simple way to provide a risk-free return is to use the FFF= option of the Eventus statement to point to a Fama-French factor data set. This can also be done in a non-CRSP run if you have a factor data set built to cover the same trading dates as the mini-database. Alternatively, include the risk-free return in a custom index or custom factor data set or in the IndexDS= component of the mini-database. The risk-free return variable must have the name RF.

### 1.10.3 One-tail and two-tail tests

The Tail= option of the EvtStudy statement has two new specifications in addition to the existing Tail=1 and Tail=2. The new specifications are Tail=L and Tail=U for one-tailed tests. The new specifications select the alternative hypotheses to be lower and upper tailed respectively, in contrast to Tail=1, which provides "generic" one-tailed tests where each alternative hypothesis is assumed to point in the same direction as the calculated test statistic. One Tail= specification applies to every test in a given run; it isn't possible to select the tail specification on a test-by-test basis. This affects only the significance levels and p-values in the displayed output. The default continues to be Tail=1.

### 1.10.4 Broadened meaning of the MinEstN option

The MinEstN= option of the Request statement now causes benchmark returns such as market index returns, companion portfolio returns or factor returns, in addition to individual security returns, to be screened for the specified number of non-missing returns. In Eventus 8 and earlier, only security returns were screened by MinEstN. This change has no practical effect when using a CRSP database unless a user-provided benchmark return data set is being used at the same time, e.g., the MyCompanionIndex= and Companion options are used, where the times series in the data set may be shorter than the time series of security returns or the user-provided benchmark returns may contain missing values. Similarly, the new screening can affect SASNONCRSP runs.

## 2 Data retrieval (other than event studies) features

### 2.1 IndexData statement to obtain market index data from CRSP

This new statement in Eventus 9 allows index data to be extracted when no individual stocks are involved or over a period when the individual stocks are not listed. (Eventus 8 and earlier could extract market index data in the context of an event study or with the Returns statement, but only in connection with individual stocks and only during the stocks' period of listing.) The request file format is the

same as for other Eventus functions, except that you have the option to make the request file a single row with no security identifier.

Options specific to the IndexData statement:

Compound	adds a column of compounded index returns to the output file (default is cumulative)
CUSIP	specifies that there are security CUSIPs in the request file
PERMNO	specifies that there are security PERMNOs in the request file

Other options that can be used on the IndexData statement:

The following options are used in the same way as the Request statement options of the same names: InSAS, ID, IDFmt, SizeIndex, BetaIndex, StdIndex, SP500, Composit, NoDivIdx, Companion, DateFmt, AutoDate, NDays, NMonths, Shift1, Shift2, AllowMissingDate.

The following options are used in the same way as the Returns statement options of the same names: NoPrint, NoNames, VSAS, HSAS, Text, HText, Value, Equal, Both, ExtFile=, OutSAS=

Example of IndexData statement usage (partial screen shot of output SAS data set on next page):

```
data request;
  input permno:5.0 eventda1:yymmdd8. eventda2:yymmdd8.;
datalines;
76104 19891212 19900111
76110 19900108 19900207
80204 19931107 19931207
86332 19980505 19980604
86322 19980512 19980611
89048 20010601 20010701
89172 20000711 20000810
89213 20010709 20010808
90366 20040309 20040408
90980 20050715 20050814
90962 20050923 20051023
run;
```

```
Eventus GetData;
  IndexData permno insas=request autodate value compound out-
sas=market_pre_offer;
```

Example of IndexData statement without security identifiers (sample output not shown):

```
data request;
  input eventda1:yymmdd8. eventda2:yymmdd8.;
datalines;
19891212 19900111
run;
```

```
Eventus GetData;
  IndexData insas=request autodate outsas=some_ew_mkt_returns;
```

	PERMNO	Date of Data	Market index distinction	CRSPDay1	Running Compound Index Return	crspday	Market
1	76104	19891212	Value	17222	0.0064290664	17222	0.0064290664
2	76104	19891213	Value	17222	0.0093640393	17223	0.0029162243
3	76104	19891214	Value	17222	0.0041830736	17224	-0.005132901
4	76104	19891215	Value	17222	0.0007162266	17225	-0.003452405
5	76104	19891218	Value	17222	-0.01592497	17226	-0.016629286
6	76104	19891219	Value	17222	-0.019968293	17227	-0.004108755
7	76104	19891220	Value	17222	-0.018608632	17228	0.0013873639
8	76104	19891221	Value	17222	-0.013239553	17229	0.0054708854
9	76104	19891222	Value	17222	-0.005294445	17230	0.0080517083
10	76104	19891226	Value	17222	-0.005802216	17231	-0.000510473
11	76104	19891227	Value	17222	-0.000716967	17232	0.005114927
12	76104	19891228	Value	17222	0.003911891	17233	0.0046321787
13	76104	19891229	Value	17222	0.0118450553	17234	0.0079022516
14	76104	19900102	Value	17222	0.0264493337	17235	0.014433315
15	76104	19900103	Value	17222	0.0264716426	17236	0.000021734
16	76104	19900104	Value	17222	0.0198133787	17237	-0.006486554
17	76104	19900105	Value	17222	0.0120309153	17238	-0.007631262
18	76104	19900108	Value	17222	0.0151430566	17239	0.0030751445
19	76104	19900109	Value	17222	0.0057336142	17240	-0.00926908
20	76104	19900110	Value	17222	-0.00114964	17241	-0.006844013
21	76104	19900111	Value	17222	0.0014667693	17242	0.0026194209
22	76110	19900108	Value	17239	0.0030751445	17239	0.0030751445
23	76110	19900109	Value	17239	-0.006222439	17240	-0.00926908
24	76110	19900110	Value	17239	-0.013023866	17241	-0.006844013
25	76110	19900111	Value	17239	-0.010438561	17242	0.0026194209
26	76110	19900112	Value	17239	-0.032753731	17243	-0.022550566
27	76110	19900115	Value	17239	-0.041364951	17244	-0.008902821
28	76110	19900116	Value	17239	-0.033002945	17245	0.0087228259
29	76110	19900117	Value	17239	-0.039720934	17246	-0.006947269
30	76110	19900118	Value	17239	-0.039401416	17247	0.0003327339
31	76110	19900119	Value	17239	-0.036375459	17248	0.0031500747
32	76110	19900122	Value	17239	-0.057782316	17249	-0.022214936
33	76110	19900123	Value	17239	-0.05785905	17250	-0.00008144
34	76110	19900124	Value	17239	-0.062357315	17251	-0.004774513
35	76110	19900125	Value	17239	-0.071596625	17252	-0.009853764

## 2.2 Issuer names, original dates and CUSIP in output data set

The Returns, Prices, Volume and new IndexData statements include a new option IncludeName to include the issuer name in the output data set. This is available only for the default vertical format of the output data set, not the format specified by the HSAS option.

In GetData runs where request file dates or CUSIPs are affected by Shift1, Shift2, AutoDate or CusiPerm options or the standardization of dates in monthly event studies (Eventus uses the first of the month internally), the original dates and CUSIP are now added to the output SAS data set (but not a text output file).



## 2.3 SAS data set and text file output in same run

The Returns, Prices, Volume and new IndexData statements now allow the user to specify both an output SAS data set and a text output file in the same run.

# 3 General options for request files

## 3.1 Use six-character CUSIPs with CRSP data

When using Eventus with CRSP data and specifying the CusiPerm option of the Request statement, the request file may contain either six- or eight-character CUSIPs. Before Eventus 9, eight-character CUSIPs were required. The request file must contain all six-character or all eight-character CUSIPs, not a mixture. It is not necessary to specify an additional option to cause Eventus to accept six-character CUSIPs. As with all past versions of the CusiPerm option, Eventus matches current header and historical CUSIPs on the CRSP database. Please be aware that eight characters are required to uniquely identify a security; using six-character CUSIPs can produce unexpected matches. For example, if an issuer has two publicly traded classes of common stock outstanding on the request file date, the six-character CUSIP, which identifies only the issuer, is likely to match both classes, potentially increasing the sample size. You may want to check the report of security names that Eventus includes in the default listing output.

When the request file contains six-character CUSIPs, you can have Eventus select the stock from the CRSP database by only a five-character match when no six-character match is available by specifying CusiPerm=5 instead of CusiPerm. This option is available only if the request file contains five-character CUSIPs. When a five-character match is used, a warning appears in the SAS log. Five-character matches must be verified manually, because fewer than six characters cannot uniquely identify an issuer.

## 3.2 Missing dates in request files

Eventus 9, as a default setting, no longer allows a date variable, in a request file that is a SAS data set, to have a missing value. If you want to allow missing date values, add AllowMissingDate to the Request, DateConv or IndexData statement. Otherwise, a missing date value in a SAS data set request file will cause Eventus to stop and provide an error message in the SAS log.

## 3.3 Integer date format

When the request file is a SAS data set, the new Request statement option DateFmt=Integer allows the dates in the request file to be integer dates instead of SAS date values. A SAS date value is an integer equal to the number of days (potentially negative) since January 1, 1960. An integer date is a numeric value recognizable as a date in a YYYYMMDD pattern, e.g. 20090430. Data sets imported from Excel may contain integer dates, SAS date values or a mixture depending on column headings and the import method. To determine the type of values in a data set, run the following SAS code to display them:

```
proc print data=datasetname;  
  var names of date columns;  
  format names of date columns YYMMDDN8.;  
run;
```

Replace the italicized words with actual names before running. The results appear in the SAS Output window or \*.lst file. If the dates column values are recognizable as correct dates, they are SAS date values. If you re-run the above code with YMMDDN8. in the format statement changed to 8.0 and the dates look good, they are integer dates.

### 3.4 Automatic assignment of SAS format for ID= variable

When the request file is a SAS data set, if the ID= option is specified but not the IDFMT= option, Eventus tries to select a format for the ID variable automatically.

### 3.5 More flexible date variable naming rules

If the request file is a SAS data set, the variable names EventDat and EventDa1 are now interchangeable. If DateFmt=CRSP is specified, then CRSPDay and CRSPDay1 are interchangeable. This means that it is no longer necessary to change names or make duplicate variables when the same request file is used to run an event study centered on a single date and in a Twin event study or GetData run.

If the request file is a SAS data set, the event date column can have the variable name EventDate or EventDay instead of EventDat when running an event study centered on a single date only.

## 4 SuperReg: A new regression tool

Eventus 9 introduces SuperReg, a new tool that is not specifically related to Event studies but is designed to extend the regression capabilities of SAS. SuperReg provides a common interface for several tasks that are not easily accomplished with existing SAS features or require the use of multiple SAS procedures with different syntax rules. SuperReg makes it easy to:

- Automatically run t-tests using heteroskedasticity-consistent (HC, also known as White) standard errors and display OLS and HC t-statistics and p-values side-by-side.
- Automatically detect influential outliers.
- Re-run a regression with specific observations excluded.
- Run a regression with one-way or two-way cluster-robust standard errors (sometimes called Rogers standard errors), rapidly becoming standard for panel data analysis.
- Run wild bootstraps of OLS or HC t-tests for greater robustness.
- Run wild cluster bootstraps on panel data with one-way clustering for greater robustness.
- Automatically generate year dummy variables and include them as fixed effects.

## 5 Miscellaneous improvements

### 5.1 Output file overwrite protection

When an output SAS data set name specified by the user already exists, the existing data set is not overwritten but instead is backed up, and the backup copy name is displayed in the SAS log.

When an output non-SAS file name already exists, the existing file is not overwritten. Instead, Eventus generates a new file name. The new file is created in the same folder as the file name specified by the user, and a message is written to the SAS log stating that the specified file already exists and will not be overwritten and giving the new file name.

## 5.2 CusiPerm option always up to date

In runs that use the CRSP database, the PERMNO-CUSIP table used by the CusiPerm option if missing or out of date, is created or update automatically. It is no longer necessary to run the PermnoUp statement manually, though this is still possible.

## 5.3 CusiPerm statement refurbished

The CusiPerm statement (distinct from the CusiPerm option of the Request and other statements), after years as an obsolescent holdover from earlier versions, now is potentially more useful for preparing request files for subsequent Eventus runs. CusiPerm now has two modes. The default is passthrough mode, in which the CusiPerm statement operates as in Eventus 8 and earlier. The new optional mode is rebuild mode, which is where the added usability is found. In rebuild mode, CusiPerm creates an output SAS data set, with six- or eight-character CUSIPs from the input file converted to PERMNOs, for use as a request file based on an input text file or SAS data set. The original CUSIPs and other data from the input request file are included in the output file. The following options apply only to rebuild mode: InSAS=, OutSAS=, DateFmt=, ID=, IDFmt=, Group=, GroupFmt=, GrWeight=, Est=, Short=, NDays=, NMonths=. These options work the same way as the corresponding Request statement and DateConv statement options.

To use the CusiPerm statement in the new rebuild mode, specify CusiPerm followed by any of the above options and ending with a semicolon (;). If the input request file is a text file and none of the above options is needed, add the word Rebuild after CusiPerm to cause the statement to operate in rebuild mode.

## 5.4 New specialty index builder for CRSP users

A new unified tool for building size-decile return indexes and market and decile volume indexes will be documented in the near future.

## 5.5 Direct your data sets to a folder by default

Earlier versions of Eventus internally created numerous temporary data sets in the SAS "default library". Unless the user specifies otherwise, SAS defines the default library as Work, a temporary location the contents of which are discarded when SAS terminates. SAS allows users to specify a different library — really a shortcut to a folder or directory on the computer or network — with the SAS system option User=. This has the potential advantage of automatically saving data sets when you close PC SAS or when your non-interactive SAS run finishes. Some users may have found the User= option impractical for Eventus runs because the data sets that Eventus created internally would be written to the specified library. Eventus 9 writes all its internal temporary SAS data sets to the Work library even if you set another library as the SAS default. To set a default location for the data sets you create deliberately, please see the SAS documentation of the User= system option.

## 5.6 Building size decile and volume indexes from CRSP data

The former SizBuild and Volume\_Index\_Build statements have been replaced by an integrated Specialty\_Index\_Build statement. The new builder provides both equally weighted and value-weighted size-decile index portfolio returns. The population used to build either size-decile or volume indexes can be limited in the same manner as in the former volume index builder, except that the argument of the XL= option now includes a fourth digit to indicate the inclusion or omission of Arca stocks.

## 5.7 Cleaner SAS log, clearer messages

Eventus 9 greatly reduces the number of lines created in the SAS log window or \*.log file relative to previous versions and produces more informative error and warning messages when necessary.

## 5.8 CRSP stock-only data 2009 compatibility

Some organizations subscribe to CRSP stock-and-indices and others subscribe to “stock only”. The stock-only database version isn’t completely without indices. It includes equal and value-weighted indices of a CRSP market universe. For many years, this universe consisted of stocks meeting certain criteria (for example, no ADRs, REITs, closed-end funds etc.) traded on the NYSE, NYSE Alternext (formerly known as AMEX) and Nasdaq. Starting with database editions that include two or more months of 2009 data, CRSP stock-only subscribers no longer receive the NYSE-Alternext-Nasdaq indices, but instead receive NYSE-Alternext-Nasdaq-Arca indices. As the index codes in the database differ between the two index series, this is a database format change that is incompatible with Eventus 8. This change does not affect CRSP stock-and-indices subscribers. Eventus 9 is compatible with the newest CRSP data as well as recent years’ editions, both stock-only and stock-and-indices versions.

With the stock-and-indices version of the CRSP database, Eventus 9 continues to use the NYSE-Alternext-Nasdaq index series by default. To use the NYSE-Alternext-Nasdaq-Arca indices, specify AllMktIdx on the Request statement. This new option has no effect if used with a CRSP stock-only database containing at least two months of 2009 data, where the four-market indices are already the default. Using the AllMktIdx option with a CRSP database that does not contain the new four-market indices will cause the Eventus run to fail with error messages.

The AllMktIdx option does not affect size- or risk-decile portfolios, i.e., it has no effect when the SizIdx, BetaIdx or StdIdx option is also used. The AllMktIdx option, when available, does affect the market index used with the Fama-French three- or four-factor model or a custom factor model that incorporates the CRSP market index, but does not affect the SMB, HML, UMD or custom factors themselves.

## 6 Usage tip for Eventus for Windows

After you install Eventus on your PC, the Start or main Windows menu includes a folder for Eventus. The folder includes an item “Check for Eventus 9 Update.” We recommend using this updater monthly and just before starting Eventus runs for a new research project. Doing so will ensure that you have the latest problem fixes and usage enhancements. The updater may also install new sample programs or documentation updates.

## 7 References

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