

CHAPTER 5: CRSP CALCULATIONS

This section contains formulas and methodologies used to derive CRSP variables in the stock and index files and generated by the CRSP data utilities. These are organized alphabetically by name.

Adjusted Data

Price, dividend, shares, and volume data are historically adjusted for split events to make data directly comparable at different times during the history of a security. CRSP provides raw, *Unadjusted Data*, but data utilities *stk_print* and *ts_print* can be used to generate *Adjusted Data*.

An adjustment base date is chosen as the anchor date. All data on this date are unadjusted, and other data are converted based on the split events between the base date and the time of that data. The adjustment base date is usually chosen to be the last available day of trading.

Split events always include stock splits, stock dividends, and other distributions with price factors such as spin-offs, stock distributions, and rights. Shares and volumes are only adjusted using stock splits and stock dividends. Split events are applied on the Ex-Distribution Date.

Price and dividend data are adjusted with the calculation:

$$A(t) = P(t) / C(t),$$

where $A(t)$ is the adjusted value at time t , $P(t)$ is the raw value at time t , and $C(t)$ is the cumulative adjustment factor at time t .

Share and volume data are adjusted with the calculation:

$$A(t) = P(t) * C(t),$$

where $A(t)$ is the adjusted value at time t , $P(t)$ is the raw value at time t , and $C(t)$ is the cumulative adjustment factor at time t .

In both cases, where C_0 is the adjustment base date, the cumulative adjustment factor is:

$$\text{if } t = C_0, C(t) = 1.0$$

$$\text{if } t > C_0 \text{ and no split events since } t-1, C(t) = C(t-1)$$

$$\text{if } t > C_0 \text{ and a split event with factor } f \text{ since } t-1, C(t) = C(t-1) * f$$

$$\text{if } t > C_0 \text{ and split event change } C(t-1)/f$$

$$\text{if } t < C_0 \text{ and a split event change } C(t+1)*f$$

Where factor is typically the *Factor to Adjust Prices* variable + 1.

If there is a gap in trading where possible split events are not known, all adjusted values are set to missing when the gap is between the observation and the adjustment base date.

Monthly: If monthly summary data (*Bid or Low Price* (Page 45), *Ask or High Price* (Page 43), and *Volume Traded* (Page 114)) are adjusted, the adjustment factor cannot take into account adjustments that take place in the middle of the month. Therefore, the result assumes all adjustment events occur on the last trading day of the month. A more accurate monthly adjusted value can be derived by adjusting and resummarizing the underlying daily data.

Annualized Return

Annualized Return is the constant annual return applied to each period in arrays that would result in the actual compounded return over that range. An *Annualized Return* is a special case of a *Geometric Average Return* (Page 120) where the time periods are expressed in terms of years.

Associated Portfolio Returns

Associated Portfolio Returns are a composite of a group of portfolio index series based on a time-dependent portfolio assignment for a security. They are built for each security based on assignments within the specified portfolio type. The associated portfolio return at any time is the return of the portfolio to which the security belongs at that time. If the security is not assigned to a portfolio of that type at the time, the associated portfolio return is set to a missing value.

Capital Appreciation

Capital Appreciation is the change in value of a security over a holding period. It is similar to *Holding Period Total Returns* (Page 63), except that ordinary dividends and certain other regularly taxable dividends are excluded from the returns calculation. The formula is the same as for security *Holding Period Total Returns* except that $d(t)$ is usually 0. See *Returns* (Page 122) for missing values. *Capital Appreciation* is also known as *Return without Dividends*.

Compounded Returns

A *Compounded Return* is a measurement of the change of an investment over a time range when individual returns over all subsets of the time range are known. This is equivalent to reinvestment in the investment each time period.

Compounded Returns are calculated using the formula below:

$$r_c = \prod_{i=1}^n (1 + r_i) - 1$$

Where

r_c = *Compounded Return*

r_i = return over period i . If r_i is missing, that return is ignored and thus in effect treated as a return of 0. If all returns are missing, the result is also missing.

Cumulative Return

A *Cumulative Return* is a compounded return from a fixed starting point. Each period in a time series of *Cumulative Returns* contains the compounded return from the first period in the time series to the end of that period.

Delisting Return

Delisting Return is the return of security after it is delisted. It is calculated by comparing a value after delisting against the price on the security's last trading date. The value after delisting can include a price on another exchange or the total value of distributions to shareholders. If there is no opportunity to trade a stock after delisting before it is declared worthless, the value after delisting is zero. *Delisting Returns* are calculated similarly to total returns except that the value after delisting is used as the current price.

Valid delisting payment information is either a valid price with at least a bid and ask quote within ten trading periods, or a complete set of payments received for the shares. If information after delisting is insufficient to generate a return a missing value is reported.

Monthly: The monthly *Delisting Return* is calculated from the last month ending price to the last daily trading price if no other delisting information is available. In this case the delisting payment date is the same as the delisting date. If the return is calculated from a daily price, it is a partial-month return. The partial-month returns are not truly *Delisting Returns* since they do not represent values after delisting, but allow the researcher to make a more accurate estimate of the *Delisting Returns*.

When valuing a portfolio, the *Delisting Return* or other representation can be used to assign a value to the delisted security. The researcher must decide whether to assign alternate estimated values based on the *Delisting Code* (Page 53) when delisting payment information is unavailable. If using monthly data and an alternate estimate for *Delisting Return* is used, partial month returns should also be adjusted by this factor.

Dividend Amount in Period (ts_print item)

Dividend Amount is the cash adjustment factor in a holding period return time period used to calculate returns. It is an adjusted summation of all distribution cash amounts available in the distribution history with Ex-distribution dates after the previous period and up to and including the current period, adjusted to the basis at the end of the previous period. *Dividend Amount* can be divided into nonordinary and ordinary types. Nonordinary dividends include return of capital distributions. Ordinary dividends are excluded from capital appreciation returns calculations.

To calculate an adjusted Dividend Amount in Period to its basis at the end of a date range, the following formula may be used with data items extracted through ts_print:

Divamt in period adjusted to end of range = divamt / cumfacpr / facpr

Where

divamt = Dividend Amount in Period
 cumfacpr = Cumulative Factor to Adjust Prices over a Date Range
 facpr = Factor to Adjust Price in Period

Thus, to calculate a total return using adjusted prices and dividends,

Total Return = (adjprc + (divamt / cumfacpr / facpr)) / prev_adjprc - 1

Where

adjprc = Price Adjusted, End of Period
 prev_adjprc = Price Adjusted, End of Previous Period

Factor to Adjust Prices in Period (ts_print item)

Factor to Adjust Prices in Period is the amount the current price is multiplied by in returns calculations so that current and previous prices are on the same split-adjusted basis. *Factor to Adjust Prices in Period* is derived from the *Factor to Adjust Price* (Page 61) field of distributions with Ex-Distribution Dates after the previous period and up to and including the current period. In simple stock splits, *Factor to Adjust Prices in Period* is distribution *Factor to Adjust Price* plus one.

Excess Returns

An *Excess Return* is defined as the return in excess of a comparable benchmark. The benchmark can be a single associated index series or a composite of a group of portfolio index series based on security and time-dependent portfolio assignments.

If an *Excess Return* is based on a single index series, the *Excess Return* for a period is

$$E(t) = R(t) - I(t),$$

where $E(t)$ is the *Excess Return* at time t , $R(t)$ is the security return at time t , and $I(t)$ is the index return at time t . If the security return $R(t)$ is based on a previous price t' that is not the previous time period, $I(t)$ is the compounded index return from $t' + 1$ to t .

If an *Excess Return* is based on associated portfolios, the *Excess Return* for a period is

$$E(t) = R(t) - I(p(t),t)$$

where $E(t)$ is the *Excess Return* at time t , $R(t)$ is the security return at time t , $p(t)$ is the portfolio assignment of the security at time t , and $I(p(t),t)$ is the return of that portfolio at time t . If the security return $R(t)$ is based on a previous price t' that is not the previous time period, $I(p(t),t)$ is the compounded return of the security's portfolio return from $t' + 1$ to t . If the security is not assigned a portfolio assignment of the given type at time t , $E(t)$ is set to a missing value.

When cumulating *Excess Return*, the security returns and the index returns are cumulated separately before subtracting the difference.