Synchrony between time series.

The synchrony between two univariate time series of equal length is calculated as following:

Consider two time series X and Y of length N.

The vectors of changes, Cx and Cy, are created for each of the time series. The vector element Cx[i], where i = 1, 2, ..., N-1, is set to -1, 0 or 1, depending on the sign of the first derivative of X at the time point i:

```
Cx[i] =  1, if (X[i+1] - X[i]) > 0,
Cx[i] =  0, if (X[i+1] - X[i]) = 0,
Cx[i] = -1, if (X[i+1] - X[i]) < 0.
```

The Cy vector is calculated in similar way.

The Cx and Cy vectors are compared and the result is stored in the vector of synchronies, Sxy. The vector element Sxy[i], where i = 1, 2, ..., N-1, is set to -1, 0 or 1, depending on the values in Cx[i] and Cy[i]:

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Sxy[i] =  1, if Cx[i] =   Cy[i], positive synchrony case,
Sxy[i] = -1, if Cx[i] = - Cy[i], negative synchrony case,
Sxy[i] =  0, if abs(Cx[i]+Cy[i]) = 1, no synchrony case.
```

Since the Cx[i] and Cy[i] have 3 possible values each, the variants for the Sxy[i] value can be placed in a 3x3 matrix:

Cx[i] \ Cy[i]	-1	0	1
-1	1	0	-1
0	0	1	0
1	-1	0	1

The Sxy[i] value depends on the Cx[i] and Cy[i] values. It is 1, if the X and Y time series changes are synchronous at the time point i.

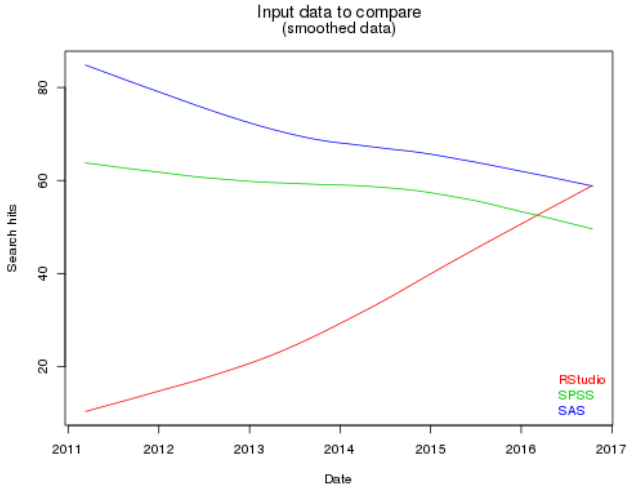
The synchrony between the X and Y time series, S, is equal to:

$$S = \frac{1}{N-1} \sum_{i=1}^{N-1} S_{xy}[i]$$

where N is the time series length, Sxy is the vector of synchronies between X and Y time series.

The synchrony value is varied from -1 to 1, where -1 is a perfect negative synchrony, 0 no synchrony and 1 a perfect positive synchrony.

Example for a positive and negative synchrony.



Synchrony

	RStud.	SPSS.	SAS.
RStud.		-1	-1
SPSS.			1
SAS.			