Package “rstars”

Title R package for the Sequential T-test Analysis of Regime Shifts (STARS)

Version 1.0 (STARS ver3.2)

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Depends R (>= 2.15.0)

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Description

Returns the position of shifts in the mean within time series, the RSI values of the shifts detected and the weighted average of the regimes. Time series with results can be automatically plotted and results can be saved in file.txt.

Details

Given a sequence X1, …, Xn of variables, observation by observation, from the beginning towards the end of a time series, STARS checks if a single observation is statistically different from the mean of the current regime average. The length of the regime is initially defined by the cut-off, a window environment that the user must choose. Then STARS automatically adjusts its window including new observations while the analysis is performing. Once a possible shift point is found, the algorithm calculates a cumulative sum of normalized deviations, called Regime shift Index (1) using the occurring observation

$$(1)\ \mathrm{RSI} = \sum_{i=c}^{c+m} \frac{x_i}{l\,\sigma_l}$$

where m = 0, …, l - 1 (i.e. number of years since the start of a new regime), l being the cut-off length of the regimes to be tested, and sl is the average standard deviation for all one-year intervals in the time-series. RSI represents a cumulative sum of normalized deviations xi) from the hypothetical mean

level for the new regime (x_{new}), for which the difference, diff (2), from the mean level for the current regime (x_{cur}) is statistically significant according to a Student's t-test:

$$diff = x_{new} - x_{cur} = t\sqrt{\frac{2\sigma_l}{l}}$$

where t is the value of the t-distribution with 2l - 2 degrees of freedom at the given probability level p. If, at any time from the start of the new regime, RSI becomes negative, the test fails and a zero value is assigned. If RSI remains positive throughout l - 1, then c is declared to be the time of a regime shift at the level ≤p. The search for the next regime shift starts with c + 1 to ensure that its timing is detected correctly even if the actual duration of the new regime is < l year (Rodionov and Overland 2005).

Note:"rstars" package is based on the STARS v3.2 algorithm developed by Rodionov (2004) and Rodionov and Overland (2005). A Visual-Basic version is available to download at http://www.beringclimate.noaa.gov/

When `rstars` is used for publication, please cite references listed in "References".

References

Rodionov, S., and Overland, J. E. 2005. Application of a sequential regime shift detection method to the Bering Sea ecosystem. ICES Journal of Marine Science, 62: 328–332. Oxford University Press.

Rodionov, S. N. 2004. A sequential algorithm for testing climate regime shifts. Geophysical Research Letters, 31: 2–5. Wiley Online Library.

Stirnimann, L., Conversi, A., and Marini, S. 2019. Detection of regime shifts in the environment: testing "STARS" using synthetic and observed time series. ICES Journal of Marine Science.