Hydrol. Earth Syst. Sci. Discuss., 8, C711–C713, 2011
www.hydrol-earth-syst-sci-discuss.net/8/C711/2011/
© Author(s) 2011. This work is distributed under
the Creative Commons Attribute 3.0 License.

Hydrology and Earth System Sciences Discussions

Interactive comment on "Comparison of predictions of rainfall-runoff models for changes in rainfall in the Murray-Darling Basin" *by* J. M. Whyte et al.

J. M. Whyte et al.

jason.whyte@adelaide.edu.au

Received and published: 2 April 2011

Our paper considers the case of a Threshold AutoRegressive model with eXogenous input (TARX) that has one threshold and hence an upper and a lower model. Both of these models are linear in the parameters (see Page 925 of our paper for details). The current day's rainfall is the exogenous variable and it is also used as the threshold variable. In this setting, the unknowns requiring estimation are the collection of parameters appearing in the upper and lower models, termed here β and the value of the current day's rain that defines the threshold, θ. For details on how the TVAR model is fitted to data we refer to "Threshold cointegration: overview and implemen-

tation in R" by Matthieu Stigler, downloadable from the link ThCointOverview.pdf: at http://127.0.0.1:19306/library/tsDyn/doc/index.html

Given a bivariate series and a TARX model, the objective of the model fitting process (model calibration) is to minimize a residual sum of squares (RSS) where each residual is the difference between a daily runoff datum and the runoff value predicted by the TARX for that day. The combination of the rainfall threshold value and the parameter values that minimize the RSS are used in the model when predictions are made subsequently under scaled input rainfall.

The nature of the TARX model means that unlike a model that is linear in the parameters, there is not an analytical form for the parameter values that minimize the RSS. The reference given above also notes that "...nor can usual optimization algorithms be used, [in minimizing the RSS] as the objective function is highly erratic." However, given a model and a particular θ, estimation of parameters in the upper and lower model proceeds by minimizing one RSS for each model as these terms are independent. The parameter estimates for each model are obtained by ordinary least squares (OLS). (We have commented on the OLS parameter estimate for models linear in parameters in our first response to reviewer $\#1$.) The TVAR function uses this feature to consider β as a function of the θ. If the objective function is called $SSR(\theta)$, then the estimate of the threshold is defined by

$$\hat{\theta} = \arg\min_{\theta} SSR(\theta). \tag{1}$$

Minimization of (1) is by a grid search, which in our application with a single threshold is along a line, which we will briefly describe. Values of the threshold variable occurring in the data are sorted from smallest to largest and repeated values are removed such that each value is only represented once. The TVAR routine has an input "trim" that can be set by the user to specify the minimum proportion of values of the threshold variable which must belong to each of the two regimes (1. less than or equal to the threshold and 2. greater than the threshold). Our studies used a trim value of 0.1.

Smallest and greatest values that cannot satisfy this condition are discarded from the set of possible θ values. For each of the remaining θ values, *SSR*(θ) is evaluated, requiring determination of $\beta(\theta)$ from OLS. The θ which minimizes (1) is taken as $\hat{\theta}$ and the accompanying $\hat{\beta}$ is taken as the estimate of β.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 917, 2011.