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A NOTE ON SINGLE AND MULTI-SITE OPERATIONAL HYDROLOGY

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Matalas' Residual Method as given in our paper, McMahon, Codner & Philips (1972), contains an inconsistency. Initially we compute the non-seasonal spatial correlations; this implicitly standardizes the data *on a non-seasonal* basis. However, in the inverse standardization process, seasonal parameters are used to replace the non-seasonal cyclic component. Notwithstanding this inconsistency, the results as tabulated are satisfactory. The correct procedure produces results very similar to those given in the paper.

To clarify the correct method, the steps are listed below.

1. Assume a lag one Markov effect and no trend component.

2. Assume a probability distribution, for example the three parameter log normal distribution, as follows:

$$y_i^p = \log_e(x_i^p - A^p)$$

3. Calculate the historical parameters: seasonal and non-seasonal means and standard deviations. Other historical parameters are required for evaluation of the generated sequences but are not used in the actual generation process and are therefore not listed here.

4. Obtain weakly stationary data by standardizing the historical monthly flows on a seasonal basis. Then scale the standardized data to a non-seasonal distribution (u,σ) by means of the non-seasonal parameters as follows:

$$\left(\frac{x_i^p - u_j^p}{\sigma_j^p}\right)\sigma^p + u^p$$

where u^p, σ^p are non-seasonal mean and standard deviation and u_j^p, σ_j^p are mean and standard deviation for j^{th} season, p^{th} site. x_i^p is historical streamflow.

5. Using the non-seasonal standardized data (residuals), calculate non-seasonal skews and cross correlations.

6. Calculate non-seasonal log transformed parameters by using the non-seasonal means, standard deviations, skews and cross correlations of the non-seasonal standardized data in Eqs. (7), (8), (9) and (24) in Matalas (1967).

7. Compute generating matrices A and B.

8. Generate multi-site non-seasonal log residuals using the weakly stationary generating equation

$$[y_{i+1}] = [A][y_i] + [B][\varepsilon_{i+1}]$$

Apply inverse transforms as follows:

9. Transform generated log residuals to absolute values by applying $(y_{i+i}{}^P : S^P + Q^P)$ where S^P, Q^P are log normal moment estimates of the non-seasonal mean and standard deviation of the standardized historical data.

10. Apply the inverse normality transform on the non-seasonal log sequences from step 9 as follows:

$$x_{i+1}{}^P = \exp(y_{i+1}{}^P) + A^P$$

11. Replace the cyclic seasonal component, removed in the initial standardization process, to produce multivariate synthetic streamflow sequences. The required transform equation is as follows:

$$\left(\frac{x_{i+1}{}^P - u^P}{\sigma^P}\right)(\sigma_j{}^P) + u_j{}^P$$

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