

Utah State University
Department of Civil and Environmental Engineering
CEE7430 Physical Hydrology

Single site model SOLUTION

1. Given a 50 year record of monthly streamflow at a single site describe all the steps that you would use to apply stochastic methods to generate representative synthetic streamflow sequences for this river. In answering this draw upon your experience from what you have learned so far and be as complete as possible in giving the issues to address, characteristics to reproduce and tests to perform.

SOLUTION

1. Plot the data to examine trends patterns and seasonal cycles.
 - a. Plot the raw time series
 - b. Plot the ACF and PACF to examine linear dependence structure and seasonality.
 - c. Separate the flows into flows for each month and compute the monthly mean, standard deviation and skewness. Plot boxplots to examine the seasonal cycle in these.
 - d. Plot histograms or cumulative distribution functions to examine the marginal distributions of streamflow each month.
 - e. Compute seasonally dependent lag 1, 2 and 3 correlation and plot to examine seasonal cycle in dependence structure.
2. Based on plots in c and d decide upon normalizing transformation for each month, for example Log or Box Cox. Estimate normalizing transformation parameters for each month maximizing a goodness of fit measure. Once each monthly flow is normalized, deseasonalize it by subtracting the monthly mean and dividing by the monthly standard deviation.
3. Plot ACF and PACF of the standardized data. Compute seasonally dependent correlation. Decide whether you need a seasonal model (separate parameters for each month) or the same model for each month based.
4. Identify the model to use through examination of the ACF and PACF.
5. Estimate parameters either by fitting moments, or minimizing the sum of squares of residuals (maximum likelihood).
6. Verify the model by simulating from it and checking that it reproduces the properties and moments that are directly reproduced by the model.
7. Test whiteness and normality of residuals from the fitted model.
8. Validate the model by simulating from it and checking against a broader suite of statistics, including storage statistics, crossing statistics, higher moments etc. If a deficiency is identified try another model and repeat the steps.