

Notes on Statistical Analyses for Data Trends, and Related Notes

Data shows no serial correlation – note that serial correlation may over-predict cases where trends occur, but not otherwise, so not correcting for serial correlation is conservative

Graphical – Box Plots – require replicate samples each round

Papastergiou and Papadopoulou-Mourkidou (2001)

Parametric – Sequential T-Test (see Appendix F of EPA, 1992)

Hess et al (2001):

Parametric – Regression Analysis

Gibbs et al (2002)

Pelayo and Evangelista (2003): Linear regression analysis in time – w **groundwater**

Non-Parametric – Mann-Kendall Test

High power, robust test (Manly and MacKenzie, 2000; Hess et al, 2001)

“With the rule of six consecutive data points described above, the chance of erroneously concluding that a trend exists is only 1 in 360, or about 0.3 percent.” (EPA, 1992) “In contrast, a rule based on five consecutive points has a 1 in 60 chance (1.6 percent) of erroneously concluding that there is a trend.” (EPA, 1992).

“The [Mann-Kendall] trend analysis requires at least four independent sampling events (Wiedemeier et al., 1999).” (from Lee and Lee, 2003).

Yue and Wang:

Yue et al (2002):

Burn and Hag Elnur:

Zetterqvist (1991):

van Belle & Hughes and χ^2

Dixon and Chiswell (1996):

van Belle and Hughes (1984) took the work of Hirsch et al. (1982) a step further, and presented a method for testing the homogeneity assumptions implicit in the use of intrablock methods (which include the seasonal Kendal tests) and aligned rank methods (Farrell, 1980) for trend testing. They showed how χ^2 statistics could be derived to test for overall trend and for site and seasonal heterogeneity and interaction. They also gave advice on the analysis of nonuniformly-sampled data sets.

Berryman *et al.* (1988) reviewed nonparametric tests for trend, and gave a useful flowchart for the selection of a statistical test for a monotonic trend. Their best choices for use with water quality time series were the Mann-Whitney, Spearman and Kendall tests. Yu et al. (1993) gave a case study of the performance of four, established, nonparametric methods in detecting trends in water quality data of rivers in Kansas. These were the Mann-Kendall, seasonal Kendall and Sen’s t-tests, and Sen’s estimator of slope. They found that the tests had similar powers at a 0.05 significance

level for data records of over nine years. They also discussed the use of the van Belle and Hughes' χ^2 test for homogeneity of trends with the above tests, and found heterogeneity in station-wide or basin-wide trends.

Gan(1998)

Mass Flux

e.g., Suarez and Rifai (2002)

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MTBE in Groundwater example