**R course presented by Dr S van der Merwe**

**Dates: Session 1: 03/11/2020; Session 2: 17/11/2020 and Session 3: 01/12/2020**

**CASE STUDY: Rainfall trends for Bloemfontein 1974 – 2017 using Mann-Kendall tests in R (L. De Wet)**

**Objective**

Comparison of rainfall trends using Mann-Kendall tests in R to manually done Mann-Kendall tests.

**Materials and Methods**

Daily rainfall data was obtained from SAWS (2019) for Bloemfontein (1974 – 2017) and monthly totals for each month and each year were calculated in Excel. There were some months with missing data, i.e. March to June 1992. Unreliable data was (also) highlighted in the Excel sheet attached and was not included in the analysis using manual Mann-Kendall. Years with more than one month of missing data were excluded from this analysis.

Firstly, a regression analysis was performed using *Excel*. Secondly, as the data did not represent a normal distribution, trends were calculated using the Mann-Kendall and Sen’s slope tests. The advantage of these monotonic tests are that they are non-parametric (and therefore distribution-free), insensitive to outliers and skewed distributions and auto-correlation is non-significant.

**Results**

Results for a) linear regression revealed a slope of -2.54 with coefficients of determination R2 of 0.03 for total annual rainfall, while a b) polynomial 2nd order fit had a slope of -0.16 with an R2 equal to 0.04. In terms of monthly rainfall totals, slope values were -0.76 and -0.02 for linear and polynomial September values, respectively, with R2 = 0.08 for both linear and polynomial plots.

Preliminary results indicate that there was no significant trends for annual total, annual average or monthly averages over all the months, except in September. Results for total September rainfall over the 43 years produced an MK S-statistic of -201 indicating a downward trend; a Variance(S) of 8984.67; a Std error (s.e.) of 94.79; a Z-statistic of -2.12; a p-value of 0.03 (significant at α= 0.05). The null hypothesis (H0 = no change) can be rejected, indicating a long term downward trend for rainfall in Bloemfontein in September. In addition the Sen’s slope estimator calculated the absolute magnitude of the trend as (-)0.4. Sen’s slope is a robust test using the median of all the slope values in the dataset, with confidence levels between -0.89 and -0.03. The results in this case are similar to the results from the regression analysis in that both show downward trends, but the values differ. The Mann-Kendall and Sen’s slope tests are more reliable as agreed by most researchers in the literature.