**Exercise 1A. Catchment Rainfall and Runoff**

Part 2 Rainfall and Runoff Data Analysis

Student ID:

**Statistical Properties of Rainfall Data:**

1. **Plot the time series of DAILY rainfall (1 mark). Describe the main features of this data set. What is the most appropriate type of graph for rainfall data? (3 marks)**
2. **Calculate the annual SUM of rainfall (1 mark). What are the main features of this annual data set? What variability can you see? (2 marks)**
3. **Complete Table 4 for your site (and others when they are done). Describe the values you got and what they mean. How “useful” are these statistics for your understanding of the system? What if any assumptions are there about these statistics? (4 marks)**
4. **Plot a histogram of the rainfall data (you will need to decide on a reasonable bin size) and plot the cumulative probability distribution. What do these plots tell you about the rainfall data? Are the data normally distributed? (2 marks)**
5. **Plot the seasonal (monthly average) rainfall. Plot the annual sums as a timeseries (2 marks). How would you describe the seasonal pattern of rainfall (hint look at the climate type)? What factors may influence it (hint, think about earth orbit)? (2 marks)**

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| *Table 4: Bureau of Meteorology Automatic Weather Station data and station ID across WA and SWWA. Complete the table for each site.* | | | | | |
| Station | Station ID | Years | Mean | SD | Min / Max |
| Swanbourne | 009215 |  |  |  |  |
| Perth | 009225 |  |  |  |  |
| Perth Airport | 009021 |  |  |  |  |
| Bickley | 009240 |  |  |  |  |
| Mundaring | 009030 |  |  |  |  |
| Chidlow | 009007 |  |  |  |  |
| Northam | 010111 |  |  |  |  |
| Kellerberrin | 010073 |  |  |  |  |
| Merredin | 010092 |  |  |  |  |
| Kalgoorlie-Boulder | 012038 |  |  |  |  |
| Leonora | 012241 |  |  |  |  |
| Cape Leeuwin | 009518 |  |  |  |  |
| Busselton | 009515 |  |  |  |  |
| Geraldton Town | 008050 |  |  |  |  |
| Carnarvon | 006011 |  |  |  |  |
| Exmouth Gulf | 005004 |  |  |  |  |
| Broome | 003003 |  |  |  |  |
| Wyndham | 001006 |  |  |  |  |
| Bridgetown Comparison | 009510 |  |  |  |  |
| Wagin | 10647 |  |  |  |  |
| Hyden | 010568 |  |  |  |  |
| Albany | 009500 |  |  |  |  |
| Esperance Downs | 009631 |  |  |  |  |
| Manjimup | 009573 |  |  |  |  |
| Narrogin | 010614 |  |  |  |  |

**Temporal Trends in Rainfall:**

1. **Calculate the trend in rainfall for the last 5 years.  What did you find and what were you expecting? Is this long enough for a reliable trend? Is the relationship really linear – discuss? (3 marks)**
2. **Calculate the trend in rainfall for all years available at the site. Select the all years of data and INSERT a SCATTER plot. Add a trend line and “display the equation” on the chart. Add the Pearson correlation coefficient (r2) value as well. Add the information for your site into Table 5 (and insert the other class data when you can). (2 marks)**

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| *Table 5: Bureau of Meteorology Automatic Weather station data and station ID across WA and SWWA. Complete the table adding any trend information for rainfall for each site.* | | | | | | |
| Station | Station ID | Years of data | Sign of trend | Trend rate (mm/decade) | T-value | Significance (p value) |
| Swanbourne | 009215 |  |  |  |  |  |
| Perth | 009225 |  |  |  |  |  |
| Perth Airport | 009021 |  |  |  |  |  |
| Bickley | 009240 |  |  |  |  |  |
| Mundaring | 009030 |  |  |  |  |  |
| Chidlow | 009007 |  |  |  |  |  |
| Northam | 010111 |  |  |  |  |  |
| Kellerberrin | 010073 |  |  |  |  |  |
| Merredin | 010092 |  |  |  |  |  |
| Kalgoorlie-Boulder | 012038 |  |  |  |  |  |
| Leonora | 012241 |  |  |  |  |  |
| Cape Leeuwin | 009518 |  |  |  |  |  |
| Busselton | 009515 |  |  |  |  |  |
| Geraldton Town | 008050 |  |  |  |  |  |
| Carnarvon | 006011 |  |  |  |  |  |
| Exmouth Gulf | 005004 |  |  |  |  |  |
| Broome | 003003 |  |  |  |  |  |
| Wyndham | 001006 |  |  |  |  |  |
| Bridgetown Comparison | 009510 |  |  |  |  |  |
| Wagin | 10647 |  |  |  |  |  |
| Hyden | 010568 |  |  |  |  |  |
| Albany | 009500 |  |  |  |  |  |
| Esperance Downs | 009631 |  |  |  |  |  |
| Manjimup | 009573 |  |  |  |  |  |
| Narrogin | 010614 |  |  |  |  |  |

1. **What hypothesis can we make about changes in rainfall amount over time? How do we frame the hypothesis? What statistical test can we use to test the significance of the hypothesis? Describe the results and conclusions of this analysis. Calculate the appropriate t-value and p-value and enter them also into Table 5. (5 marks)**
2. **Highlight the station where there is a statistically significant slope. Are there statistically significant changes in rainfall? Are they consistent across WA? What may be causing the changes? (5 marks)**

**Spatial Patterns in Rainfall:**

1. **Think about the spatial patterns not the temporal ones (i.e climate modes). What spatial patterns might you expect and what do you notice? What may be causing these spatial patterns? (6 marks)**

**Interannual Variability in Rainfall:**

1. **What relationships do you see between rainfall and climate mode and why? Do they correlate in specific seasons? How strong are these correlations really? How are they consistent or different across WA? (6 marks)**

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| *Table 6: Complete rainfall and climate indices (DMI for IOD and SOI for ENSO) correlations (****1 mark****).* | | | | |
| Month | DMI  Corr | DMI  p-value | SOI  Corr | SOI  p-value |
| Jan |  |  |  |  |
| Feb |  |  |  |  |
| March |  |  |  |  |
| April |  |  |  |  |
| May |  |  |  |  |
| June |  |  |  |  |
| July |  |  |  |  |
| Aug |  |  |  |  |
| Sept |  |  |  |  |
| Oct |  |  |  |  |
| Nov |  |  |  |  |
| Dec |  |  |  |  |

1. **What areas of Australia have significant correlations and what time of year? For SOI which month had the highest (positive) correlation (add that plot here). What areas of Australia have significant correlations and what time of year? Does this match with your own rainfall station correlations (6 marks)?**

**Relationship Between Rainfall and Runoff:**

1. **Plot a scatter plot of discharge and annual rainfall, add a line to the chart. What are the relationships between rainfall and discharge? Are they linear or non- linear and why? Are they consistent across WA? (4 marks)**