ENV 101 EARTH SYSTEMS

Practical Exercise 8 – Atmosphere and Weather

1. OVERVIEW

The practical continues to increase your awareness of using ArcMap for analysing spatial patterns in data, this time using weather and climate data. In addition to using GIS, online data sources are explored, and students should become more confident in using Excel for creating basic graphs of numerical data.

1.1. Learning Outcomes

After completing this practical, students will be able to:

1. Use data provided by the Bureau of Meteorology to observe and understand site specific weather variations;
2. Construct climographs using data provided for three different locations;
3. Describe the differences observed in a climograph between marine and continental climates; and
4. Describe the spatial differences in rainfall and temperature across Australia between July and February.

1.2. Preparation

External students:

- Ensure that you have installed and licensed the ArcGIS 10 software from the CD that you received in the mail.
- Create a folder (e.g. Prac8) on your C drive on your home computer where you can store all the files and folders for this class. Regardless of the location, note that it is not good practice to use spaces in file or folder names. Instead, use an underscore to give the effect of a space between words.
- Copy all the data required for this tutorial from the CD you received in the mail, or download from week 8 of the ENV101 companion site http://learnline.cdu.edu.au/units/ses101/materials.htm, into the folder that you have just created. Hereafter this folder will be referred to as your *working directory*.

Internal students:

- Create a folder (e.g. Prac8) for today's practical on the desktop, your personal student folder (G:\ENV101\sXXXXXX), or a personal memory stick/hard drive. Hereafter this folder will be referred to as your *working directory*.
- Copy all the data required for this into the folder you created above (e.g. Prac8).
- If you are working in the GIS/RS lab, you can either work from the student server (slow, but will be backed up), your personal hard drive or your desktop (faster, but will NOT be backed up and all data will be removed on logout). If you are working from the desktop, you should copy your work onto a memory stick or the student server at the end of the session BEFORE logging out.

1.3. Required data

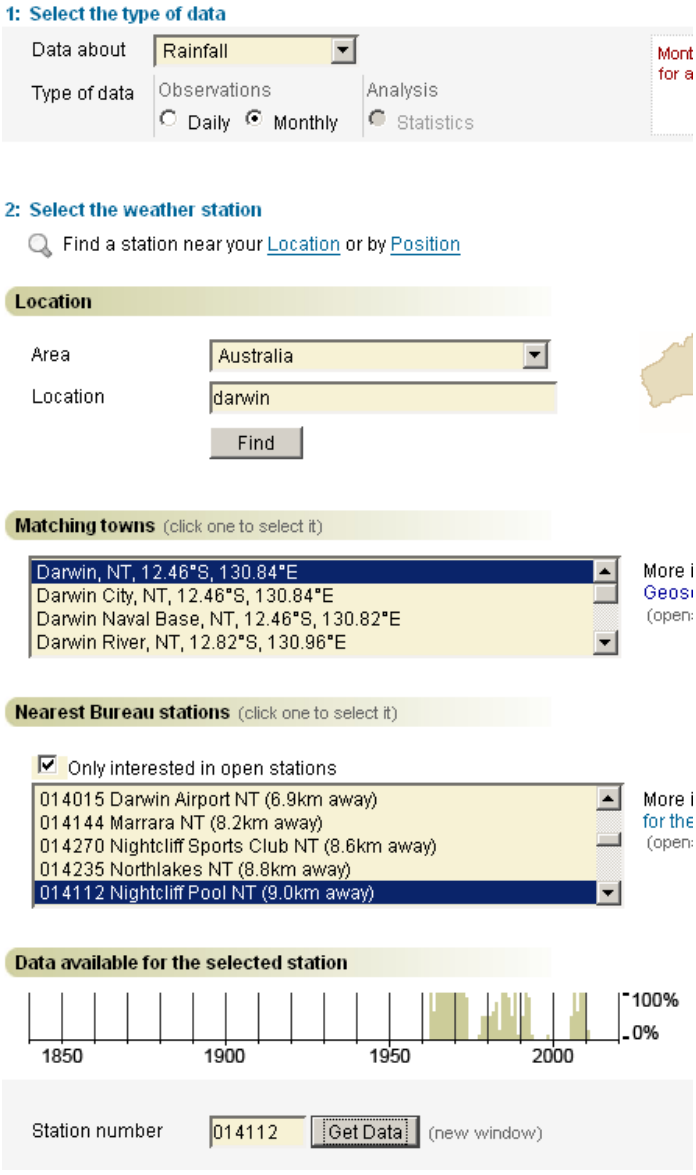
Climograph statistics.xls
Mean climate data extracted from BOM for Alice Springs and Gladstone, plus climate data of an unknown city extracted from a foreign metrological service.

ENV101_Prac5_Atmosphere_and_Weather.mxd (linked to shapefile data)
ArcView project file containing data extracted from BOM – Australian Water Availability Project http://www.bom.gov.au/jsp/awap/

2. ONLINE DATA

Go to the Bureau of Meteorology (BOM) online climate data portal
http://www.bom.gov.au/climate/data/index.shtml

Select 'rainfall' as the type of data that you would like to retrieve (**monthly observations**), then work your way through the form to find the nearest open rain station near where you live (see below as an example). Once you've found the station, click on **Get Data.**



When the data has been retrieved, it will open in a new tab in your browser. Click on the two information links at the top left of the page in turn to find out more about the data that you are viewing.

Click on the small graph icon underneath the name of each month in the table. Scroll through the months and take note of the patterns in rainfall that you see for your chosen location.

Q3. What is the highest value of monthly rainfall recorded at your site? When did this occur?

Q4. Which were the wettest three years? Which were the driest?

Repeat the same procedure to **extract Monthly Mean Maximum and Monthly Mean Minimum Temperature data** for a location close to where you live (note that you may not be able to find the same location as you used for the rain station). View the figures and associated graphs and answer the following questions.

Q5. Describe the pattern of annual mean minimum temperature and annual mean maximum. Do they follow a similar trend?

Q6. Which month/s displays the most variation in minimum and maximum temperatures over the years of data collection?

3. RAINFALL AND TEMPERATURE VARIATIONS

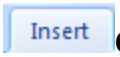
3.1. Constructing Climographs

Alice Springs, NT and Gladstone, Qld are nearly the same latitude but are far different in longitude and in environmental settings. You have been provided with some data to explore the climate differences in these two towns.

Open the Excel spreadsheet Climograph Statistics.xls containing the summary climate data included in the practical materials.

Create a graph for each location, showing the min temp, max temp, and rainfall.

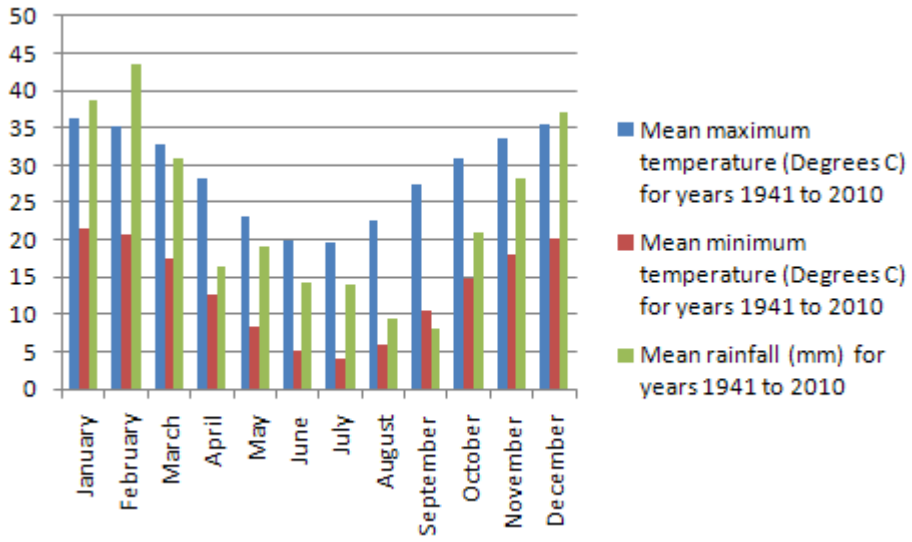
To do this (for Alice Springs for example), **highlight cells A2 – M5**.



Click on the 'Insert' tab

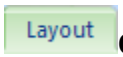
Click column and choose the **first option under 2-d column**

You will see that at graph automatically appears in your spreadsheet

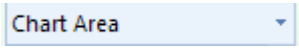


The problem with this automatic graph is that there is only one y-axis, yet there are two different units of measurement – one of temperature, and one for rainfall. As such, we need to split these on separate y-axes.

Click on the graph so that it is highlighted



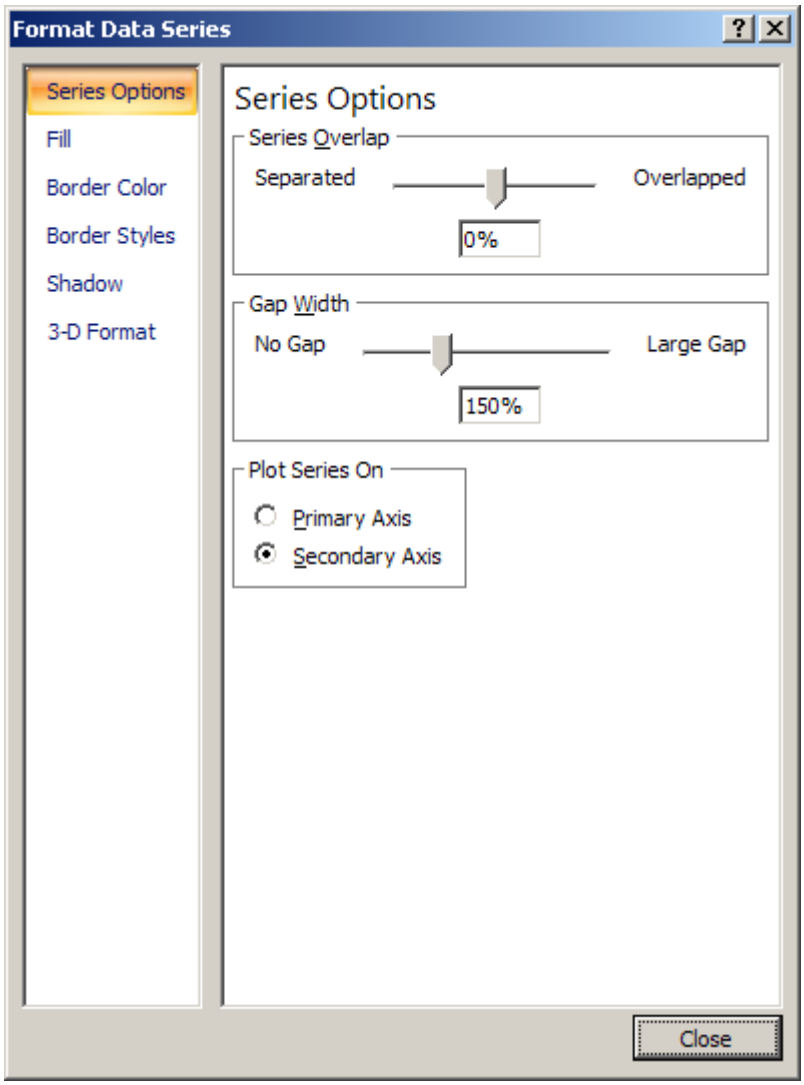
Click on the Layout tab



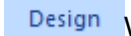
Click on the pull down box next to where it says 'Chart Area', and **select Series "mean rainfall…"**

Click Format Selection

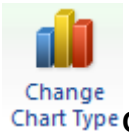
Select to plot the series on the Secondary Axis



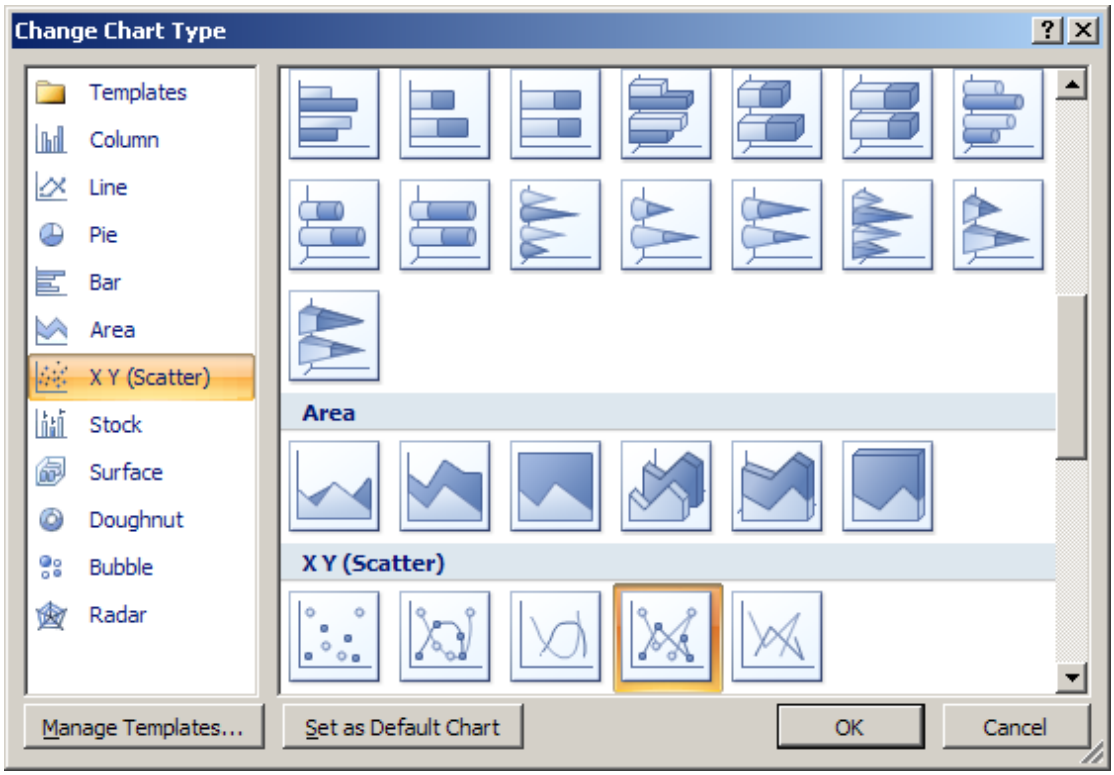
Click Close



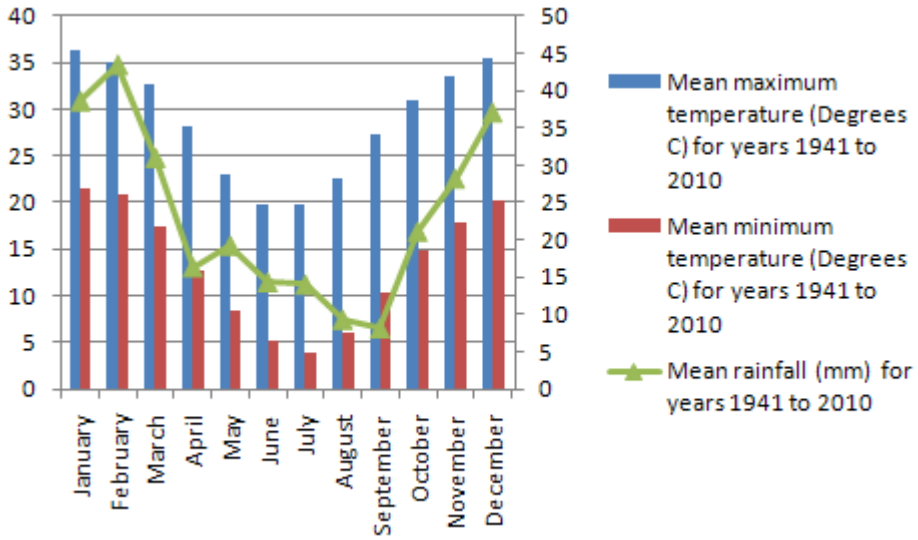
While that series is still selected, **click on the design tab**

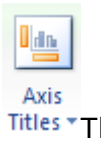


Click Change Chart Type → X Y (Scatter) and **choose the 4th option presented → OK**



Your graph should now show the mean temperatures as columns plotted on the left hand y axis, and the rainfall a joined dots plotted on the right hand axis





The final step is to make sure that you correctly label the axis so that your graph makes sense to a viewer. You can do this under the Layout tab by selecting Axis Titles.

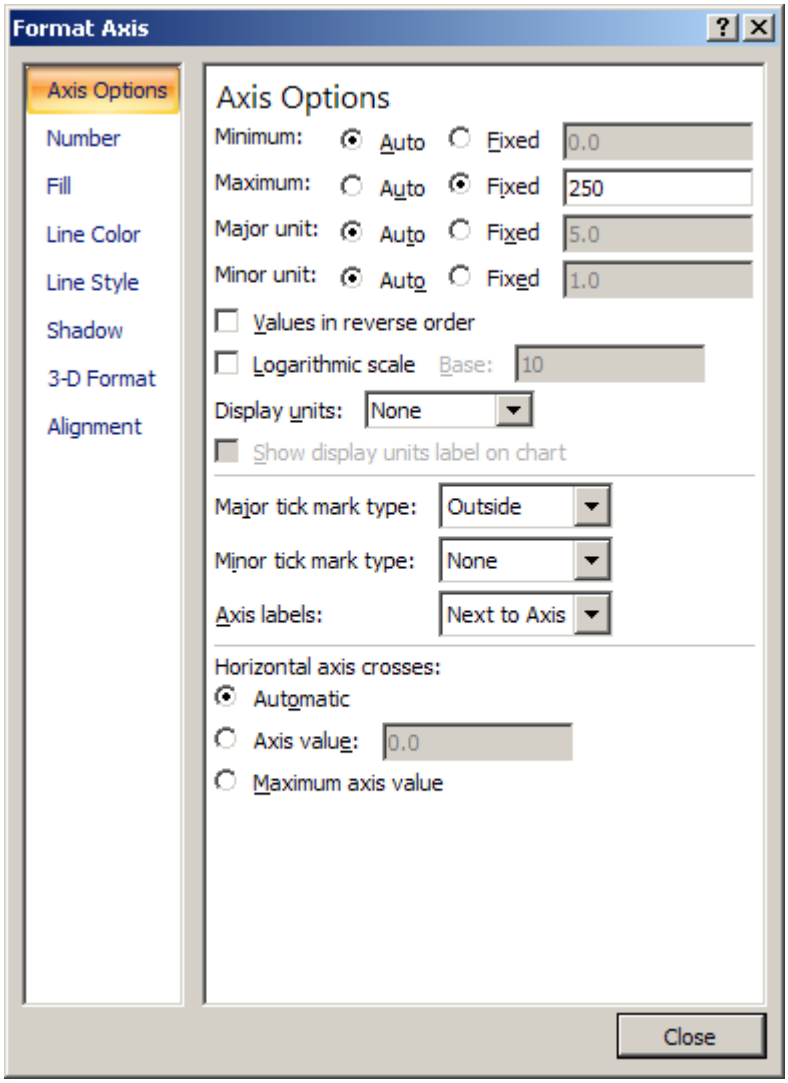
Repeat the above steps for Gladstone, and City 3.

Be aware that Excel will default to using a scale on the Y axis that is most appropriate for an individual graph – however this is not always useful when trying to compare graphs. For example, look at the values on the right hand Y axis for Rainfall. As Gladstone has considerably higher values in the dataset for this variable, the Y values will range from 0-250mm, to ensure that all data points can be displayed. However, Alice Springs does not receive such a high level of precipitation, so displaying up to 250mm is not necessary.

To make your graphs comparable, **right click on each hand axis** in turn, and select **Format Axis.** You will see that the minimum and maximum values are set at 'Auto'.

Click the radio button for maximum to 'fixed'

Change the value to 250 → close



Do the same to ensure that your left hand Y axes for temperature are also comparable (e.g., set a scale 0-40).

Q7. Describe the general patterns in rainfall and temperature at the three sites

Q8. The influence of a large body of water on adjacent land is to *decrease* the range of temperatures experienced compared to an area without the influence of the water. Areas near water are said to have a *marine* climate, and areas remote from large water bodies are said to have a *continental* climate. What type of climate pattern is exhibited at each of the three sites?

Q9. What other main conclusion can you draw about City 3 by observing these climate data?

3.2. Visualizing Spatial Patterns

Open the ArcView project file SES101_Prac8_Atmosphere_and_Weather.mxd

View each of the data layers in turn to understand the spatial variability in temperature, rainfall, and vapour pressure across Australia between summer and winter. Read the information provided on the Bureau of Meteorology website regarding each of these layers:
http://www.bom.gov.au/climate/austmaps/about-rain-maps.shtml
http://www.bom.gov.au/climate/austmaps/about-temp-maps.shtml
http://www.bom.gov.au/climate/austmaps/about-vprp-maps.shtml

Q10. Describe in your own words what each of these layers are depicting

Mean maximum temperature

Total Rainfall

Mean Vapour Pressure

Q11. Compare and contrast the spatial patterns between the seasons in the following datasets:

Mean maximum temperature – where can you see the effects of the main controls on earth's surface temperature?

Total Rainfall

Mean Vapour Pressure

Create a table in Excel and list each of the capital cities. If your home town is not a capital city, add it to the list.

In turn, **find each city in ArcView** and **record the values for temperature, rainfall, and vapour pressure**, entering them into Excel as you go (hint, use the 'find' and then 'identify' tools in ArcView).

Construct three individual column graphs to compare and contrast the statistics for each capital city.

Q12. Which city is showing the *largest* difference in average maximum temperature between the two months?

Q13. Which city is showing the *smallest* difference in average maximum temperature between the two months?

Q14. Which city/ies show a wetter winter than summer?

Q15. Which city is showing the *largest* difference in mean vapour pressure between the two months?

Q16. Which city is showing the *smallest* difference in mean vapour pressure between the two months?