Project 1: Weather and Life Quality

OVERVIEW

The growing effects of climate change in the recent decade has brought about two extremes: on one hand zones are more prone to flooding, and on the other hand severe droughts are prolonged. It is the latter case that has raised the need for sustainability and renewables. One form of sustainability is rainwater harvesting from household rooftops. But this is only worthwhile if enough rainfall can be collected to meet demand, which will in turn reduce utility bills and decrease the use of freshwater from reservoirs and catchments.

The question is raised; how do we check the feasibility of rooftop rainwater harvesting systems when we are faced with a certain degree of unpredictability in weather and seasonal climates? Short answer: data collection. In engineering, data collection plays an important role in daily practices. Regardless of the purpose, data sets allow engineers to investigate, forecast, and make final decisions.

The Bureau of Meteorology (BOM) collects large data sets on daily weather observations. These observations can range from temperature, rainfall, windspeed, etc. As an engineer working for the local government, you are tasked with working alongside the BOM to prepare a feasibility analysis into the expansion of sustainable community practices and green star households and buildings. This will primarily involve investigating the likely potential of rainwater harvesting systems, as well as the potential of renewable energy generation.

LENGTH

300-500 words per student, 1000-1500 words per team

DETAILS

Introduction to the project and requirements	Session 7/9 (depending on the group), 1-hr workshop
Data collection from BOM website Commence Matlab analysis	Session 7/9 (depending on the group), 4-hr PBL workshop
Write a Matlab program to complete Tasks 1-3	Session 8/10 (depending on the group), 3-hr PBL workshop
Project test	Session 8/10 (depending on the group), 1-hr PBL workshop
Report submission	After Session 8/10

INSTRUCTIONS

1. Download observation data from BOM website (one city per team).

   Team1: Canberra

   Team2: Sydney

   Team3: Melbourne

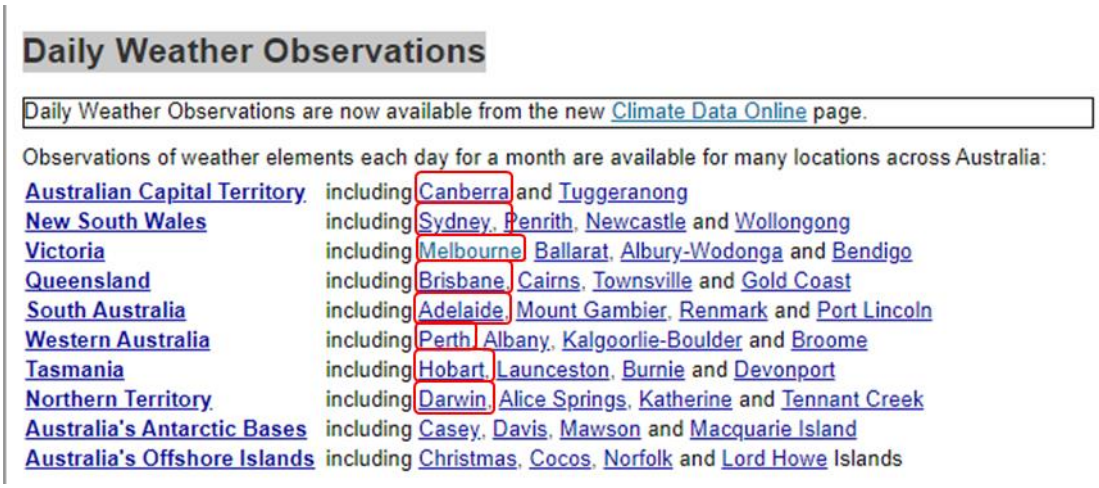
   Team4: Brisbane

   Team5: Adelaide

   Team6: Perth

   Team7: Hobart

   Team8: Darwin



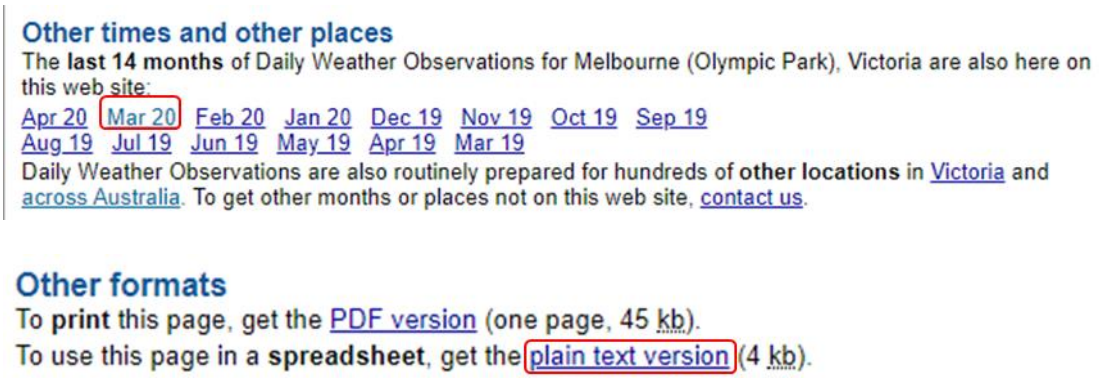
Daily Weather Observations

Daily Weather Observations are now available from the new Climate Data Online page.

Observations of weather elements each day for a month are available for many locations across Australia:

Australian Capital Territory	including Canberra and Tuggeranong
New South Wales	including Sydney, Penrith, Newcastle and Wollongong
Victoria	including Melbourne, Ballarat, Albury-Wodonga and Bendigo
Queensland	including Brisbane, Cairns, Townsville and Gold Coast
South Australia	including Adelaide, Mount Gambier, Renmark and Port Lincoln
Western Australia	including Perth, Albany, Kalgoorlie-Boulder and Broome
Tasmania	including Hobart, Launceston, Burnie and Devonport
Northern Territory	including Darwin, Alice Springs, Katherine and Tennant Creek
Australia's Antarctic Bases	including Casey, Davis, Mawson and Macquarie Island
Australia's Offshore Islands	including Christmas, Cocos, Norfolk and Lord Howe Islands

2. Choose a month then click “plain text version” (it will return a .csv file).



Other times and other places

The **last 14 months** of Daily Weather Observations for Melbourne (Olympic Park), Victoria are also here on this web site:

Apr 20 Mar 20 Feb 20 Jan 20 Dec 19 Nov 19 Oct 19 Sep 19
Aug 19 Jul 19 Jun 19 May 19 Apr 19 Mar 19

Daily Weather Observations are also routinely prepared for hundreds of **other locations** in Victoria and across Australia. To get other months or places not on this web site, contact us.

Other formats

To **print** this page, get the PDF version (one page, 45 kb).

To use this page in a **spreadsheet**, get the plain text version (4 kb).

3. Download all the weather data of the past 12 months for your chosen city.

   Note:

   - Exclude the current month, i.e. if it’s May, download data from May 19 to April 20.
   - Rename each .csv file using “year-month”, i.e. “19-04.csv”.
   - Include all the .csv files in the same folder.

TASKS

After downloading all the 12-month weather data, write a MATLAB program to:

1. **Present temperature information**
   1) Line plot daily maximum and minimum temperature on the same graph.
   Note: use 3x4 subplot to include monthly graphs on the same figure.
   2) Calculate the total number of days with comfortable temperature (10-30 degrees Celsius) and show the result on the Command Window.
2. **Present daily rainfall information**
   1) Bar plot daily rainfall data of a year (x-axis: 365 days, y-axis: daily rainfall (mm)).
   2) Calculate the number of days with
      a) no rain;
      b) normal rain (0-10mm);
      c) heavy rain (>10mm).
      Plot the three categories on a pie chart.
   3) Calculate
      a) The volume of annual rainwater collected from a rooftop based on the following floorplan (see Fig 1);
      b) Total cost saving if using the rainwater collected from the above rooftop. (Hint: check your household water bills for water cost $/L or $/KL.)
      Present the results at the title of the bar chart.

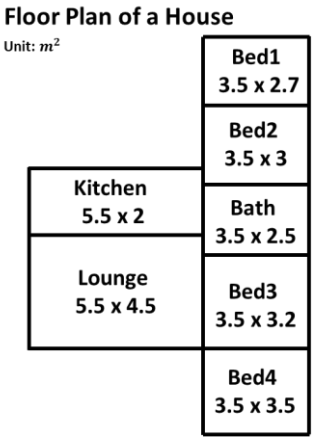


Figure 1 Floor Plan of a House

3. **Present Speed of Maximum Wind Gust and corresponding Power Generation Capability.**
   1) Line plot the annual "speed of maximum wind gust" on a daily basis.
   2) Based on the given "Wind Power Curve" (see Fig 2), calculate the instantaneous power generation capability of a wind turbine.
   Hint: Derive 2 linear equations for a) wind speed is between 13km/h – 50km/h; b) wind speed is between 50km/h – 100km/h. Use "if-else" condition to determine which equation to use.
   3) Bar plot the wind turbine's daily power generation capability.
   4) (optional/bonus): highlight the days with wind speed greater than 100km/h or less than 13km/h (zero power generation capability).

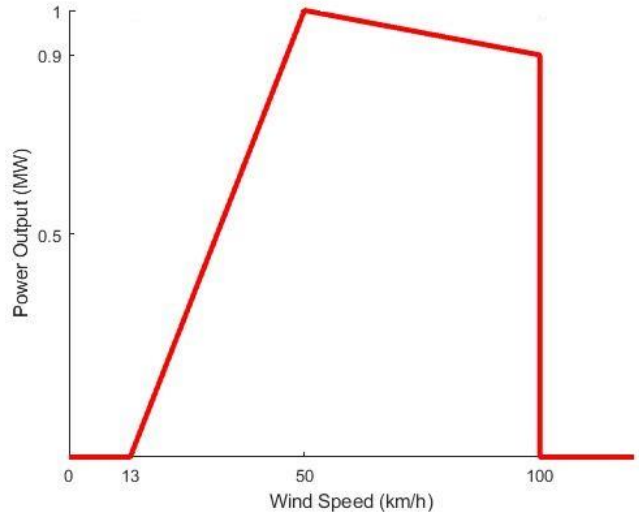


Figure 2 Wind Power Curve

TEAM-BASED PROJECT REPORT

Each team of 3-4 students is to conduct separate investigations and produce a technical report.

A possible PBL process can include:

- Aim or objective
- Initial investigations
- Equipment list
- Setup procedures and measurements
- Data analysis
- Results
- Discussion of results and observations
- Consider difficulties and sources of error
- A conclusion related to the aim and objective

Please note: Although the activity and associated equipment are inherently safe, due caution must be applied, especially if you are planning to use public spaces. Make sure that any space you use to generate vibration data is safe and appropriate for the purpose.

The technical report your group produces should include the following:

- An introduction to the problem
- The methodology of analysis (how/why the data is manipulated)
- A detailed description of your analysis software (computer code)
- Results and discussion of observations
- Conclusion including suggestions on how to improve the detection algorithm (if any)

ASSESSMENT CRITERIA AND SUBMISSION

The report should be up to 1500 words, word processed in standard report format with correct spelling, grammar, and referencing. Individual team members must indicate the sections they were responsible for in the team report by marking their initials in the Contents Page next to their section(s). You should also indicate the overall editor(s).

Note: Your report must be written in your own words. Please do not copy or cut and paste information from sources— this is plagiarism. You must provide in-text references for every source of information and include a Reference List at the end of your report.

Upload your report to the Assessment Dropbox by the due date. Refer to the rubric attached to the Assessment Dropbox for details of how your technical report will be assessed.