SCIE1000 Tutorial sheet 1

The following questions are intended to help you to get to know your classmates and tutors; these people will play important roles helping you settle into your Uni studies, particularly in SCIE1000. The questions focus on practising some modelling skills, and also cover a brief introduction to using Python.

As you go through your studies and your career, you will need to become good at solving problems. As you practise and develop your thinking and problem-solving skills, you will become more proficient. One of the most important skills in solving problems is knowing where to start. Rather than "jumping straight in" and doing some calculations, you will often need to think about what is being asked, how the situation can be modelled, and what you can do to find an answer.

The best study you can do for the final SCIE1000 exam is to **think** about what is being asked, and have the confidence to find an approach that works for you. Do not sit passively, waiting for someone to give you the answer. The final exam is "semi open book" (see the course profile (https://www.uq.edu.au/study/course.html?course_code=SCIE1000)), and examines your ability to think, and solve unfamiliar problems. If you practise doing this from the start of semester, you will find the final exam much more manageable.

There may be more questions on the tutorial sheet than you can finish in class; if so, do some of the remaining ones outside class, as they provide excellent exam preparation.

To be completed before class

Because this is the first week, there are no questions to do before class; in most weeks there will be.

To be completed in class

Complete the following questions in class. They involve a mix of individual work, and discussions with others. Make sure that you read the questions before class and think about how you might approach answering them. Don't rely on someone else doing all of the work. You need to work by yourself on the final exam, so it is important that you work hard now.

Feedback: Be proactive!

Australian government research shows that students often feel they don't receive adequate feedback on their work. In a class of 800 students, it is not possible for the course coordinator to give direct feedback to each student. Instead, tutorial classes are designed to be the place in which you can get feedback on your work from classmates and the tutors. You can ask for help, show them your answers, and discuss your understanding of any of the course material. As an adult learner, the onus is on **you** to seek feedback; tutors and classmates are happy to give it, if you want it.

Question (1)

Everyone (including tutors), in about 30 seconds each, tell the group of people around you:

- your preferred name;
- where you are from;
- in what degree program are you enrolled;
- what is your intended major (if appropriate);
- what sort of job you want, and why; and
- something which interests you, or is a hobby, or at which you are good.

Question (2)

Tutors will briefly explain the goals, rationale and organisation of tutorials throughout semester. Students are encouraged to ask questions.

Question (3)

Answer each of the following questions:

1. Working with a partner, estimate each of the following; make sure you can justify your answers: the approaches you take are much more important than your numerical answers.

   A. the number of babies born in the world during the two hour SCIE1000 tutorial class; and

   B. the total amount of pure alcohol consumed by people in Australia in a year (note that a standard drink contains 10 g of alcohol).

   Write your answers on a whiteboard, along with the values from other pairs of classmates.

2. (You may need to delay answering this question until most of your classmates have written their answers on the whiteboard. While you wait, keep on answering subsequent questions.) As a group, discuss the range of answers on the whiteboard, then come up with consensus estimates of the answers.

Question (4)

With your partner, then as a group, briefly discuss each of the following.

1. What is science, and what is it not?

2. Is mathematics a science? Justify your answer.

3. In your Uni science studies, what do you think should be the balance between learning *facts* and learning *how* to do things? Is either more important?

4. What do you think should be the role(s) of a University science education?

Question (5)

Consider the following quote from the American Physical Society (http://www.aps.org/policy/statements/99_6.cfm):

> Science extends and enriches our lives, expands our imagination and liberates us from the bonds of ignorance and superstition. The American Physical Society affirms the precepts of modern science that are responsible for its success.
>
> Science is the systematic enterprise of gathering knowledge about the universe and organizing and condensing that knowledge into testable laws and theories.
>
> The success and credibility of science are anchored in the willingness of scientists to:
>
> 1. Expose their ideas and results to independent testing and replication by others. This requires the open exchange of data, procedures and materials.
> 2. Abandon or modify previously accepted conclusions when confronted with more complete or reliable experimental or observational evidence.
>
>   Adherence to these principles provides a mechanism for self-correction that is the foundation of the credibility of science.

Briefly discuss the quote. Do you agree? Are any key points missing?

Question (6)

In December 2004, there was a very strong earthquake with epicentre offshore from Indonesia, which caused a series of very large tsunamis; if you are interested in more information see the Wikipedia page (https://en.wikipedia.org/wiki/2004_Indian_Ocean_earthquake_and_tsunami). A total of around 250000 people died in 14 countries, mostly as the tsunamis hit shore.

There are many examples of video footage of the tsunami online; spend a few minutes in class watching part of [this video](https://www.youtube.com/watch?v=fTn0UWMXpgo). (The selected footage is not gory and is not intended to be voyeuristic, but may be disturbing; it includes images of death. There is also some minor usage of coarse language in the audio and text captions. If you have very strong views, don't watch the video.)

In order to prepare for catastrophic events such as this, the United Nations, governments and emergency service bodies commission expert research groups to develop comprehensive models of earthquakes and their impacts, including risks, likely frequency, potential locations, rate and severity of casualties, and potential responses and mitigating factors. These expert groups can include human biologists, geologists, mathematicians, computer scientists, psychologists, medical researchers, medical practitioners, environmental scientists and physicists.

1. How would you go about modelling the possible occurrence and impact of an earthquake in a large city? What factors are important, what data would you need, and how effective would your model be? To answer these questions:

    A. First think about the answers by yourself, writing down some key points.
    B. Next, discuss your answers with other people sitting near you. What factors did you have in common, and what variations were there? Was there evidence of different approaches from people with different areas of scientific interest?
    C. Finally, discuss the answers as a whole class. Also discuss variations in approaches suggested by people with different interests.

2. What roles could scientists in each of the above discipline areas play in developing comprehensive models? Be specific.

Question (7)

In lectures, we say that science aims to *understand*, *explain*, *predict* and *influence* phenomena. This poses several questions, such as:

- *Why* do we want to understand, explain, predict and influence phenomena?
- Are there approaches other than science that attempt to achieve these outcomes?
- Are these other approaches valid or useful?
- Are there aspects of human existence that science cannot adequately address?

1. To what extent do you agree or disagree with the following statement? Justify your answer.

   > Humans seek to explain things, because at a fundamental level uncertainty is frightening. Scientists aim to understand, explain, predict and influence phenomena because doing so reduces uncertainty, and hence increases our physical, cognitive and/or emotional comfort and well-being. Thus, science aims to reduce our fear by understanding and describing aspects of the universe.

2. To what extent do you agree or disagree with the following statement? Justify your answer.

   > Humans seek to explain things, because at a fundamental level uncertainty is frightening. Religious leaders, artists, poets, authors and singers aim to understand, explain, predict and influence phenomena, because doing so reduces uncertainty, and hence increases our physical, cognitive and/or emotional comfort and well-being. Thus, fields of arts and humanities aim to reduce our fear by understanding and describing aspects of the universe.

3. Compare and contrast the roles, ways of thinking, and importance of scientific disciplines versus humanities disciplines. In terms of reducing uncertainty and fear, which area is more valuable? Why?

4. In Question (6) you watched this video (https://www.youtube.com/watch?v=fTn0UWMXpgo). Watch the section of the video from about 6:19 minutes until 6:36 minutes. A group of scientists could have explained to the distraught man all of the scientific factors that had caused the tsunami and why so many people died, with reference to geological science, physics, mathematics and biomedical science, without making any reference to God. How useful do you think he would have found those explanations to be?

5. Can you think of any beliefs, views, faiths, hopes or superstitions that you personally hold, which might be rejected by science? Should you change those beliefs given that they are rejected by science? Why, or why not?

6. When you answer a number of questions from later tutorial sheets, you will be asked to comment on how you *feel* about certain issues. Is that a valid question to ask in a science course? Justify your answer.

7. In Question (5), the quote from the American Physical Society included the statement that science "*liberates us from the bonds of ignorance and superstition*". Comment on this, with respect to your

answers to Parts 3, 4, 5 and 6 of this question.

Question (8)

Do each of the following activities:

1. Read and understand Section A.1 in the Python Appendix of the lecture notes, covering "Getting started".

2. Type each of these expressions into the following Python cell, and understand the output from each line. (See the hints below the list of expressions before typing any.)

```
2+3
2+3*4
(2+3)*4
10*4/5
2**8
49**0.5
6 > 3
```

Because this is the first time you have used Python, here are some useful hints. Start by typing only the first line into the following Python cell, without any indentation at the start of the line. To *run* or *execute* that line, you can either use the *Cell* menu, or press the *Shift* and *Enter* keys at the same time. The output will appear below your expression. When you are ready to try the second expression, simply type over the first one, and execute the new one.

```
In [ ]: # This line is a comment. Type each expression below here, one at a time.
```

Question (9)

By default, Python displays numbers in standard form, but switches to scientific notation when needed.

1. Type each of these numbers into the following Python cell (one at a time, and press *Shift* and *Enter* to evaluate each expression), and understand the output each time.

   - `1e3`
   - `0.0000000001`

2. Using the following Python cell, experiment to determine at what order of magnitude Python switches to scientific notation for large numbers and for small numbers.

3. Some numbers are too large for Python to understand (unless special commands are imported at the beginning of the program, which will not be covered in this course). If you ask Python to print a number which is too big, it rounds it up to infinity. Type `1e400` into the following Python cell and understand the output.

4. Similarly, some numbers are too small for Python to understand. If you ask Python to print a number which is too small, it rounds it down to zero. Type `1e-400` into the Python cell, and understand the output.

5. Type `1e100 * 1e-100` into the Python cell, and understand the output.

6. Type `1e400 * 1e-400` into the Python cell, and understand the output.
   Note that **`nan`** means "not a number". What does this mean?

7. Python tries to give useful error messages when appropriate. Type `1/0` into the Python cell, and understand the error message.

In [ ]:
```
# Type each number below here.
```

Question (10)

Read and understand Section A.2 in the Python Appendix of the lecture notes, covering "Basic use of Python". In Questions (8) and (9) you were able to evaluate single expressions, but had to type only one and then run it, before you could evaluate a second expression. However it is typically much more useful to write programs with multiple lines that can be saved and executed repeatedly.

1. Type the following line into the next Python cell: `print("Hello World!")`. Then run your program (using the *Shift* and *Enter* keys).

2. Modify your program so that it also:
   A. Has a brief comment as the new first line
   B. Imports the standard module `pylab` as the new second line
   C. Has a blank line after the `import` line
   D. Prints "Have a nice day!" after "Hello World!"

Check that your program works properly!

In [ ]:
```
# Write your program here.
```

Question (11)

In most weeks there will be questions on the tutorial sheet that contribute towards your final assessment for SCIE1000. **To receive these marks, you and your partner must demonstrate your program, its output and the answers to any questions to a tutor during your tutorial.**

Because this is the first tutorial of the semester, there are no marks associated with this tutorial sheet. However, this question has been included to familiarise you with what will be expected of you in future tutorials.

1. Write down **exactly** what you would expect the output to be from the following program. Work out your answers "by hand".

```
# Some printing examples
print("Peter is a cool dude!")
print("Viva", "Las", "Vegas!")
print(2*3, 2*4, 2*5)
print(0.00001, "0.00001", 2e0, '2e0')
print(6+4*5," is not ", (6+4)*5)
print("")
# print("Slartibartfast")
print("SCIE1000 is fun.")
print("I ate ",2**3," apples.")
print("-10 > -6")
print(-10 > -6)
```

2. Type or paste the program into the following Python cell and verify whether your answers were correct or not. If not, can you understand why? Ask a tutor if you need help. (Hint: if you paste the program, make sure there is no indentation at the start of any lines.)

3. Show your program and its output to your tutor.

In [ ]:
```
# Write or paste your program here
```

Final comments

Typically there will be additional questions that you can complete outside class, for extra exam preparation. There are none this week.

In most weeks, solutions to the tutorial sheets will be distributed in the week following the tutorial class. However, there are no solutions to this first sheet, because most questions do not have "right or wrong" answers. The aims of the questions and activities are to encourage you to start to think, to interact with your classmates, and to start using Python.