

Aims

The aims of this computing tutorial are to:

- understand how to use arrays and the Python `plot` function to plot graphs;
- see how to control graph formatting, including different colours and line styles, titles and labels.

Note that this is the last substantial new material we will cover in Python programming in SCIE1000. However, for the rest of semester we will continue to practise using the concepts we have covered, and some programs will become more sophisticated. It is important that you remember what you have learned so far, as all of your programming skills can now come together to solve problems.

[Ref: *Python Notes Section A.7.1-A.7.4*] Read Section 7 of the Python Notes carefully. Ask your tutor if you are confused about anything in this section.

1. The World Factbook lists estimates of the populations of countries. An extract from that list is:

Rank	Country	Population
53	Romania	22,215,421
54	Mozambique	21,669,278
55	Sri Lanka	21,324,791
56	Australia	21,262,641
57	Madagascar	20,653,556
58	Cote d'Ivoire	20,617,068

- (a) Write a program to plot the above population data. Your plot should have population size on the y-axis and country number on the x-axis and (just for fun) mark data points with a magenta "+". (Hint: you will need to use two arrays in your program.)
 - (b) Modify your program from (a) to join the data points with a solid line, add a title to your plot and put appropriate labels on the x and y-axes.
2. In Question 6 of the Week 6 Computing Tutorial, you wrote a program to calculate the probability of thrush-positive cells in a habitat, according to the quadratic equation given in the Lecture Notes:

$$p(t) = -0.0747t^2 + 1.8693t - 10.918$$

- (a) Write a program to plot this function over the range $t = [8,18]$. Use points equally spaced by 0.1°C to produce a smooth curve. (Note: clearly it is meaningless to have a negative probability of thrush occurring at some values of t . While the value of the equation can be calculated for any value of t , as a model for thrush distribution it only makes sense for a certain range of temperature values.)
 - (b) It is important to remember that a plot of a mathematical function is just a visualization of function values evaluated at a set of points (possibly with lines drawn between the points). Modify your program from Part (a), gradually increasing the spacing between points (e.g. 0.2, 0.5, 1, 2, 3, 4, 5). Write down your observations and discuss with the person next to you.
3. Over the last four weeks we have developed a Python program that estimates the human body surface area (BSA) given the weight and height of a person, estimates the value of the Widmark factor r for males and females, estimates the time for BAC to return to 0 after consuming a range of quantities of alcohol, and models absorption of alcohol for an hour after drinking on an empty stomach and a full

stomach. This week we will extend what this program does. First, take a copy of your program from last week and give it a new name. We will work on this new copy of the program.

Before you start modifying your program, make sure you think about what you are doing. Apart from plotting the graphs, most of the code you need is already in your program, but you may need to combine several aspects of the existing program.

Modify your program so that (in addition to what it did before):

- The following, modified menu is printed at the start:

```
Please select from this list of options:
Enter 1 to calculate body surface area.
Enter 2 to estimate the time for BAC to return to 0.
Enter 3 to calculate BACs during the absorption phase.
Enter 4 to plot BAC until it reaches zero.
Your choice?
```

- If the user chooses Option 4, then:
 - the user is asked to enter the number of standard drinks consumed (we will assume that these drinks are consumed very rapidly)
 - the user is asked to enter the gender, weight and height of the drinker
 - the program calculates the time T_0 at which BAC will return to 0
 - the program uses the modified Widmark formula (with the exponential absorption term) to model BACs at 5 minute intervals from time 0 hours to time T_0 , for alcohol consumed on an empty stomach and on a full stomach (so two models are run).
 - the program plots both modelled BACs on the same set of axes, with a meaningful title and labels on the axes.

4. **Assessment Question (1.5%): BSA/BAC to 0/Absorption/BAC graph program.**

Make sure that your program from the previous question is commented, has sensible variable names, includes useful output messages, and has appropriate formatting of the graph. Test your program on the following cases, where appropriate comparing the output values with hand calculations you have done previously.

Case	Drinks	Weight (kg)	Height (cm)	gender
BSA	–	38.5	155	female
Time for BAC to 0	5	107	188	male
BAC during absorption	2	38.5	155	female
BAC graph	5	107	188	male

This program will contribute 1.5% towards your final assessment for SCIE1000. **To receive these marks, you must demonstrate your program and its output to a tutor during your tutorial.** Program output, including text messages and correct values, are together worth up to 1.0%. Appropriate comments and variable names are together worth 0.5%.

This is the last time that we will modify this program. Of course, the program is a genuine, reasonably accurate model of some aspects of your your body and its response to alcohol. You can use it in real life – enter data relating to you or your friends when you go drinking, and the program output will give a realistic model of what will happen to BACs over time.