



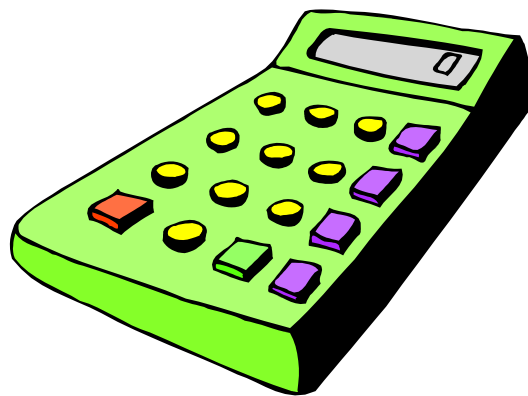
Test your mathematical ability

You will need to be confident about basic mathematical calculations before you start the Research Methods in Epidemiology and Basic Statistics Module (which begins at the start of the first semester).

The following advice is from the 'Research Methods in Epidemiology and Basic Statistics Module' tutors:

"We will have a brief maths tutorial in the first couple of weeks, but we strongly recommend that you brush up on your basic maths skills prior to the course, using this booklet. If you find it difficult, work on improving your ability so that you can cope with the statistics we will be teaching."

MATHS REFRESHER BOOKLET



INTRODUCTION

In your course, you will be learning about statistics, and this requires a certain degree of mathematical knowledge. It will be assumed that you know some basic 'school-level' maths, such as percentages, fractions, using a calculator, formulae and other things covered in this booklet. If you are not competent in these, you may struggle with the statistics element of this course.

This booklet is designed to help you

1. assess whether your maths skills are up to the required level
2. bring you up to that level, if necessary

Have a go at the exercises. If you want to check whether you have got the right answer, or are struggling with any of the questions, you will find solutions at the back.

You will need a calculator, preferably with scientific functions (a scientific calculator is needed for some of the later exercises only).

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SECTION 1: USING YOUR CALCULATOR

The basics

First of all, make sure you know where the plus, minus, multiply and divide buttons are on your calculator. Also you will need the decimal point button (.) and the = button.

Note: different symbols can be used to represent division:

$5 \div 17$ and $5 / 17$ and $\frac{5}{17}$ all mean 5 divided by 17.

1. Try the following using your calculator:

- a) $225 + 126$
- b) $609 - 152$
- c) 117×3.5
- d) $2068 \div 22$
- e) $67.2 / 8.7$ (give the answer to 2 decimal places)

Square and square root

Now find the 'squared' and 'square root' functions. They will probably look like x^2 and $\sqrt{\quad}$. You may need to use the 'inverse' or 'shift' button on your calculator to use one or both of these functions – all calculators are different!

2. Use these functions to calculate:

- a) 42×42
- b) 42^2
- c) $\sqrt{3136}$
- d) Square your answer to c) to get back to 3136
- e) $\sqrt{894}$ (give the answer to 2 decimal places)

More complicated calculations

Sometimes you need to work out something like the following:

$$23 \times (5^2 + 3)$$

The basic rule is:

1. Work out any functions first, eg 5^2
2. Then work out the bit inside the brackets.
3. Then do the rest

So in the example:

$$\begin{aligned} &23 \times (5^2 + 3) \\ &= 23 \times (25 + 3) \\ &= 23 \times (28) \\ &= 644 \end{aligned}$$

If there is a set of brackets within another set of brackets, do the innermost one first.

If at any step there are numbers after the decimal point, write down the answer to plenty of decimal places (at least 3), otherwise the final answer may not be accurate.

3. Try the following:

a) $14 + (3 \times 5)$

b) $83 - \frac{(9^2 + 21)}{3}$

c) $9 / \sqrt{45}$

d) $10 + (4 / \sqrt{5})$

e) $(2 \times 5^2) \times (1.61 + 1.28)$

f) $10 \div (5.5 \times (12 / 5))$

SECTION 2: FRACTIONS, PROPORTIONS AND PERCENTAGES

If 5 out of 50 people in a pub smoke, we can express this as a *fraction*: $\frac{5}{50}$

To express this as a *proportion* (or decimal), we simply use our calculator to divide 5 by 50 which gives 0.1. So the proportion who smoke is 0.1.

To express this as a *percentage*, we simply multiply the proportion by 100. 0.1×100 gives 10, so we say 10% of people smoke.

1. In a survey of 450 people, we find 67 have asthma.
 - a) what fraction have asthma?
 - b) what proportion have asthma?
 - c) what percentage have asthma?
2. There are 40 students on your MSc course in 2004 and 38 pass at the end of the year.
 - a) what fraction pass?
 - b) what proportion pass?
 - c) what percentage pass?

We can also work the other way, and say if we have 50 people in a pub and 10% of them smoke, how many smoke? In other words, what is 10% of 50?

To do this we express 10% as a decimal (ie 0.1) and multiply it by 50.

$$0.1 \times 50 = 5$$

So 5 people in the pub smoke.

3. You know the population of the Nottingham is 300,000 and 8% of this population have hayfever. How many people in Nottingham have hayfever?
4. There were 60 marks available in an exam, and the pass mark was 40%. How many marks are needed to pass?

We can also apply proportions or percentages to a different group of people or situation. For example, we know 5 out of 50, or 10%, of people in a particular pub smoke. Suppose there are 90 people in another similar pub. We would expect 10% of them to smoke also, but how many people is this?

Express 10%, or $5/50$ as a decimal, and multiply by the new population:

$$0.1 \times 90 = 9$$

So we expect to find 9 smokers in this pub.

5. 30 in a 1000 people are left handed:

- a) If you examined 10,000 people, how many would you expect to be left handed?

- b) If you examined 13,500 people, how many would you expect to be left handed?

6. Derby has a population of 225,000. How many people in Derby would you expect to have hayfever, if Derby is similar to Nottingham (use info in question 3)?

SECTION 3: FORMULAE

Think about what you would say to someone who wants to know how old they will be in 20 years time. You might say you will be your current age + 20. We could write it down using a *formula* as follows:

$$\text{New age} = \text{current age} + 20$$

Formulae allow us to leave an unknown 'current age' which can be filled in later. For example if someone tells you their current age is 35, you can use the formula to calculate new age. Simply substitute 35 in place of current age in the formula:

$$\begin{aligned}\text{New age} &= 35 + 20 \\ &= 55\end{aligned}$$

Try the following examples:

1. The formulae is a / \sqrt{b} . Work this out when:

$$a = 10 \text{ and } b = 25.$$

$$a = 12 \text{ and } b = 36.$$

$$a = 35 \text{ and } b = 40.$$

2. The formulae is $a + [1.96 \times (b / \sqrt{c})]$. Work this out when:

$$a = 23.5, b = 10 \text{ and } c = 25.$$

$$a = 43.5, b = 12 \text{ and } c = 36.$$

$$a = 10.2, b = 35 \text{ and } c = 40.$$

SECTION 4: POWER AND LOGS

Powers

Sometimes we have to deal with very large numbers & sometimes very small ones! To deal with big and small numbers we can use powers of 10.

10 to the power of 2 is 10 squared, or 10×10 .
10 to the power of 3 is 10 cubed, or $10 \times 10 \times 10$

1. Fill in the gaps in the following:

$$\begin{aligned} 1,000,000 &= 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^6 \\ 100,000 &= 10 \times 10 \times 10 \times 10 \times 10 = ? \\ 10,000 &= 10 \times 10 \times 10 \times 10 = ? \\ 1,000 &= 10 \times 10 \times 10 = 10^3 \\ 100 &= 10 \times 10 = 10^2 \\ 10 &= 10 = ? \end{aligned}$$

2. Now try the following (a bit harder):

$$\begin{aligned} 1 &= 1 = 10^0 \\ 0.1 &= 1 / 10 = 10^{-1} \\ 0.01 &= 1 / 10 \times 10 = ? \\ 0.001 &= 1 / 10 \times 10 \times 10 = 10^{-3} \\ 0.0001 &= ? = ? \end{aligned}$$

Large numbers on your calculator

Calculators use this method to express big and small numbers. Try calculating 1 divided by 1000 using your calculator. We know the answer to this by looking at the table above. It should be 0.001 or 10^{-3} . However, the calculator probably gives this as 1^{-03} (although some calculators may display 0.001). 1^{-03} on your calculator means 1×10^{-3} .

Try 1.5 divided by 1000. You should get 1.5^{-03} which means 1.5×10^{-3} , or in other words 0.0015. Move the decimal point the same number of places to the left as the superscript number (ie 3 places if $^{-03}$) to give the answer in decimal format.

3. a) What does 3.65^{-02} displayed on your calculator mean?

b) What does 7.98^{-05} displayed on your calculator mean?

Logarithms

Powers of 10 are also used in logs!

If you calculate log of 100 on your calculator, the answer should be 2. The log button tells us to what power of 10 the number is.

We call the log of 100 simply 'log 100' or we say we have 'log transformed 100'.

Depending on the calculator, you will either need to
- press the 'log' button, then type 100 and then =, or
- type 100 and then press the log button.

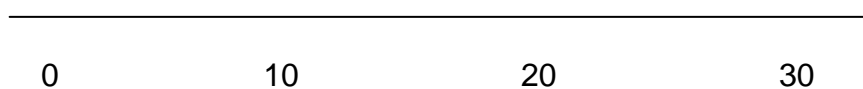
4. a) What is the log of 1000?

b) Calculate log 10,000.

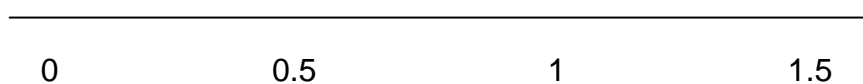
c) Look at your answer to a) and b) and think what you might estimate log 5000 to be. Now calculate log 5000 on your calculator.

5. Look at the following numbers and plot them on the scale below.

1, 2, 3, 5, 10, 18, 30



Now try taking the log of each number above and mark the new 'log transformed' number on the scale below. What effect does log transforming have on the small numbers, and what effect does it have on the big numbers?



If you have logged a number, you can always revert back to the original number. This is called the anti-log.

How you do this will depend on your calculator. Either

- press 'shift' 10^x , and then type in your answer, or
- start by typing in the answer to log 2000 and then press the inverse function and then the 10^x button.

6. a) Calculate log 2000. Write down the answer

b) Now calculate 10 to the power of this answer.

7. What is the anti-log (ie 10^x) of 1.47

SOLUTIONS

Section 1

1
a) **351** b) **457** c) **409.5** d) **94** e) **7.72**

2.
a) **1764** b) **1764** c) **56** d) **3136** e) **29.90**

3.
a) $14 + (3 \times 5) = 14 + 15 = \mathbf{29}$

b) $83 - \frac{(9^2 + 21)}{3} = 83 - \frac{(81 + 21)}{3} = 83 - \frac{102}{3} = 83 - 34 = \mathbf{49}$

c) $9 / \sqrt{45} = 9 / 6.708 = \mathbf{1.34}$

d) $10 + (4 / \sqrt{5}) = 10 + (4 / 2.236) = 10 + 1.789 = \mathbf{11.79}$

e) $(2 \times 5^2) \times (1.61 + 1.28) = (2 \times 25) \times (1.61 + 1.28) = 50 \times 2.89 = \mathbf{144.5}$

f) $10 \div (5.5 \times (12 / 5)) = 10 \div (5.5 \times 2.4) = 10 \div 13.2 = \mathbf{0.76}$

Section 2

1
a) $\frac{67}{450}$ b) **0.149** c) **14.9%**

2.
a) $\frac{38}{40}$ *or* $\frac{19}{20}$ b) **0.95** c) **95%**

3. $8/100 \times 300,000 = 0.08 \times 300,000 = \mathbf{24,000}$

4. $40/100 \times 60 = 0.4 \times 60 = \mathbf{24}$

5
a) $30/1000 \times 10,000 = 0.03 \times 10,000 = \mathbf{300}$

b) $0.03 \times 13,500 = \mathbf{405}$

6. 8% or 0.08 have hay fever, so $0.08 \times 225,000 = \mathbf{18,000}$

Section 3

1. a / \sqrt{b} , so substituting in the values of a and b gives:

$$10/\sqrt{25} = 10/5 = \mathbf{2}$$

$$12/\sqrt{36} = 12 / 6 = \mathbf{2}$$

$$35/ \sqrt{40} = 35/6.325 = \mathbf{5.53}$$

2. $a + [1.96 \times (b / \sqrt{c})]$, so substituting in the values of a, b and c gives

$$\begin{aligned} & 23.5 + [1.96 \times (10 / \sqrt{25})] \\ & = 23.5 + [1.96 \times (10/5)] \\ & = 23.5 + [1.96 \times 2] \\ & = 23.5 + 3.92 \\ & = \mathbf{27.42} \end{aligned}$$

$$\begin{aligned} & 43.5 + [1.96 \times (12 / \sqrt{36})] \\ & = 43.5 + [1.96 \times (12/6)] \\ & = 43.5 + [1.96 \times 2] \\ & = 43.5 + 3.92 \\ & = \mathbf{47.42} \end{aligned}$$

$$\begin{aligned} & 10.2 + [1.96 \times (35 / \sqrt{40})] \\ & = 10.2 + [1.96 \times (35 / 6.325)] \\ & = 10.2 + [1.96 \times 5.53] \\ & = 10.2 + 10.84 \\ & = \mathbf{21.04} \end{aligned}$$

Section 4

- 1.

$$1,000,000 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^6$$

$$100,000 = 10 \times 10 \times 10 \times 10 \times 10 = \mathbf{10^5}$$

$$10,000 = 10 \times 10 \times 10 \times 10 = \mathbf{10^4}$$

$$1,000 = 10 \times 10 \times 10 = 10^3$$

$$100 = 10 \times 10 = 10^2$$

$$10 = 10 = \mathbf{10^1}$$

2.

$$\begin{aligned} 1 &= 1 && = 10^0 \\ 0.1 &= 1 / 10 && = 10^{-1} \\ 0.01 &= 1 / 10 \times 10 && = 10^{-2} \\ 0.001 &= 1 / 10 \times 10 \times 10 && = 10^{-3} \\ 0.0001 &= 1 / 10 \times 10 \times 10 \times 10 && = 10^{-4} \end{aligned}$$

3

a) 3.65^{-02} mean **0.0365** (move the decimal point 2 places to left)

b) 7.98^{-05} means **0.0000798** (move the decimal point 5 places to left)

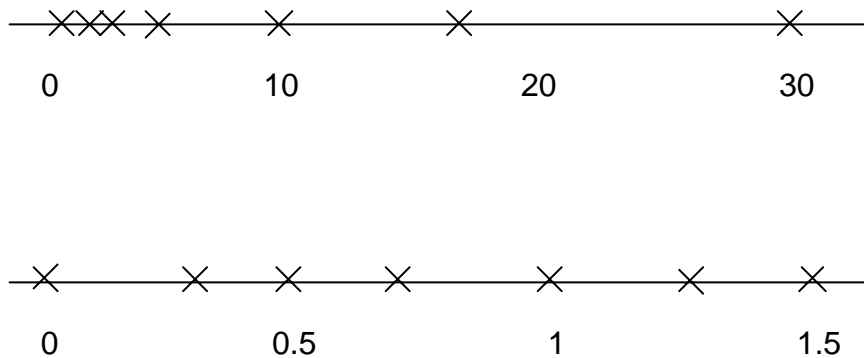
4.

a) **3**

b) **4**

c) We would expect $\log 5000$ to be somewhere between 3 and 4. The actual answer is **3.699**

5.



The small numbers were originally squashed up and are now more spread out and the large numbers have come slightly closer together. In other words the low end of the scale has been stretched and the high end compressed.

6.

a) **3.301**

b) $10^{3.301} = 1999.9$ or **2000** if rounded up

7. **29.51**