



M140

TMA 04

Covers Units 10 and 11.

Cut-off date: 30 April 2014

Please read the Assessment Guide on the module website before beginning work on this TMA. Note in particular that you should send your TMA answers to your tutor by post, together with a completed TMA form (PT3), to arrive by the cut-off date given above.

This TMA is marked out of 50. Your overall score for this TMA will be the sum of your marks for each question. Note, however, that because the University requires the TMAs to be marked out of 100, the mark returned to you by the University will actually be out of 100 (i.e. twice the total of marks on your TMA script).

The marks allocated to each part of each question are indicated in brackets in the margin.

Guidance about how to answer TMA questions is given in Subsection 7.2 of Unit 1.

This assignment covers *Units 10 and 11*. You should be able to answer Questions 1 to 3 after you have studied Unit 10. You will need to use Minitab to answer parts (b) and (e) of Question 1.

You should be able to answer Questions 4 to 6 after you have studied Unit 11. You will need to use Minitab to answer Question 6.

Question 1 (Unit 10) – 26 marks

This question concerns the analysis of the mustard seedlings experiment that you were asked to carry out in Unit 10. You will need to use Minitab to answer parts (b) and (e)

- (a) In one or two sentences, describe how your experiment went; for example, mention any difficulties you faced along the way. Then present a table of your results, similar in layout to Table 3 of Unit 10 (Subsection 3.4). Indicate clearly the units in which you made your measurements (for example, millimetres) and the measurements which correspond to seedlings whose stems were cut during their growth. Then proceed to part (b) of the question.

If, however, you were unable to collect data of your own, then state this and explain why. Instead of presenting results in a table, draw stemplots for each of the two samples of data given below in Table 1 – from seedlings whose stems were cut during growth. Also, give the main reason for producing such stemplots in the context of a t -test, and comment on the shape of the stemplots relative to this reason.

Table 1 Lengths of roots (in mm) obtained in a mustard seedlings experiment

| Seedlings grown in light | | | | | Seedlings grown in dark | | | | |
|--------------------------|-----------|----|-----------|-----------|-------------------------|-----------|-----------|-----------|-----------|
| 22 | × | 47 | 21 | × | 29 | × | × | 30 | 34 |
| × | 29 | × | 18 | 34 | 25 | 21 | 28 | × | 38 |
| 17 | 36 | 15 | × | 28 | 38 | 32 | 31 | 29 | × |
| 19 | 27 | × | 26 | 30 | 26 | 17 | 35 | 27 | 36 |

In Table 1, measurements which are bold were obtained from seedlings whose stems were cut during their growth. A cross indicates a seed which did not germinate.

[6]

To answer the remainder of this question, you should use your own data if you have it. Otherwise, use the data from Table 1.

- (b) Run Minitab and type your data into columns headed **Light**, for lengths of roots of seedlings grown in light, and **Dark**, for lengths of roots of seedlings grown in the dark, for all the seedlings whose stems you cut. Provide a printout of the data in your answer. (You should also save a copy of your worksheet in order to be able to work on it again at another time.)

Use Minitab to calculate the values of the sample *variances* of the two columns of data. Include a copy of the relevant Minitab output in your answer.

[3]

- (c) Using the information you obtained in part (b), check whether it is reasonable to assume that the two samples come from populations whose distributions have a common variance.

[3]

- (d) To investigate whether light affects root growth (when stems have been cut during growth), a t -test is to be performed on the measurements you made. State the null and alternative hypotheses of this test. [2]
- (e) Use Minitab to perform the appropriate t -test on your data. (You should assume that the assumption of a common population variance is reasonable, regardless of the outcome of your investigation in part (c).) Include a copy of the relevant Minitab output in your answer.
- What is the result of the t -test? Carefully report your conclusions concerning the question of whether light affects root growth of mustard seedlings. [6]
- (f) What reservations do you have about your conclusions in part (e), given the way the experiment was designed and carried out? Full marks for this part of the question can be obtained by providing three valid reservations. [6]

Question 2 (Unit 10) – 3 marks

A matched-pairs t -test is a one-sample t -test with a particular value specified by the null hypothesis. Explain how this statement comes about, and give, with a reason, the value specified by the null hypothesis. [3]

Question 3 (Unit 10) – 5 marks

You should not use Minitab to answer this question, but do the calculations ‘by hand’ (using a calculator), showing your working.

A research pharmacist wishes to determine the average amount of time (in seconds) that it takes a particular type of tablet to fully dissolve in water. She collected data from a sample of these tablets dissolved in water. The results are summarised as follows:

$n = 20$, sample mean $\bar{x} = 28.95$, sample standard deviation $s = 6.15$.

- (a) What is the number of degrees of freedom and the critical value for a t -test applied to these data? [2]
- (b) Hence calculate a 95% confidence interval for the population mean time taken for this type of tablet to fully dissolve in water. [3]

Question 4 (Unit 11) – 6 marks

In each part of this question a statement is made that is not correct. In part (a), state why the trial described is not a double-blind trial and give the correct name for the type of trial being described. In parts (b) and (c), identify what is wrong with each statement and describe how to modify the statement to make it correct.

- (a) ‘In a double-blind clinical trial comparing a new drug with a placebo, neither the patients receiving the placebo nor the patients receiving the drug being tested know whether they are receiving the drug or the placebo. The researchers who assess the outcomes of the treatments do know, for ethical reasons. However, there might also be an independent person (perhaps a pharmacist) who keeps records of which treatment each patient has received.’ [2]
- (b) ‘In a crossover trial comparing a new and an old drug, all the patients should be divided at random into two groups. Patients in one group take both drugs at once; patients in the other group take first the old drug and then the new drug.’ [2]
- (c) ‘In a placebo-controlled matched-pairs trial, pairs of patients are chosen completely at random in order to avoid biasing the experiment. Then one from each pair is chosen at random and given the treatment, while the other is given the placebo.’ [2]

Question 5 (Unit 11) – 4 marks

A drug company conducts a clinical trial to test a new drug intended to reduce the pulse rate of certain patients. A group-comparative design is used. One group comprises ten patients who are given the new drug for a week, and a second group comprises ten patients who are given a placebo for a week. At the end of the week, the reduction in pulse rate of each patient is recorded. The resulting data are to be analysed using a hypothesis test.

- (a) What *type* of data are produced in this trial? [1]
- (b) From the hypothesis tests listed at the start of Subsection 4.4 of Unit 11, give the most appropriate test for analysing these data, together with the reasons for your answer. [3]

Question 6 (Unit 11) – 6 marks

You will need to use Minitab to answer this question.

In this question, you are going to assign 30 patients at random to treatment 0 or treatment 1. Run Minitab.

- (a) Set the seed of Minitab’s random number generator to the value 2014. Why do you think you have been asked to do this? [1]
 - (b) Use the appropriate facilities of Minitab to assign the 30 patients to treatment groups 0 and 1 at random, with probability 0.5. How many patients are randomised to receive treatment 1? Using worksheet row numbers as patient ID numbers, list the IDs of the patients who will receive treatment 1. [3]
 - (c) Is the treatment allocation obtained in part (b) balanced? Comment on the outcome of the random allocation you obtained in part (b). [2]
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