

M140

TMA 01

2022B

Covers Units 1 and 2

Cut-off date 16 March 2022

You will find information about submitting TMAs in the ‘Assessment’ area of the M140 website. Please read that information before beginning work on this TMA.

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 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.

Note that the Minitab files that you require for this assignment should be downloaded from the ‘Assessment’ area on the module website.

Please note that you should round your answers to an appropriate level of accuracy.

If you have a disability that makes it difficult for you to attempt any of these questions, then please contact your Student Support Team or your tutor for advice.

PLAGIARISM WARNING – the use of assessment help services and websites

The **work that you submit for any assessment on any module should be your own**. Submitting work produced by or with another person, or a web service or an automated system, **as if it is your own** is cheating. It is **strictly forbidden** by the University.

You should not:

- provide any assessment question to a website, online service, social media platform or any individual or organisation, as this is an infringement of copyright.
- request answers or solutions to an assessment question on any website, via an online service or social media platform, or from any individual or organisation.
- use an automated system (other than one prescribed by the module) to obtain answers or solutions to an assessment question and submit the output as your own work.

The University actively monitors websites, online services and social media platforms for answers and solutions to assessment questions, and for assessment questions posted by students. Work submitted by students for assessment is also monitored for plagiarism.

A student who is found to have posted a question or answer to a website, online service or social media platform and/or to have used any resulting, or otherwise obtained, output as if it is their own work has committed a disciplinary offence under **Section SD 1.2** of our [Code of Practice for Student Discipline](#). **This means the academic reputation and integrity of the University has been undermined.**

The Open University's [Plagiarism policy](#) defines plagiarism in part as:

- using text obtained from assignment writing sites, organisations or private individuals.
- obtaining work from other sources and submitting it as your own.

If it is found that you have used the services of a website, online service or social media platform, or that you have otherwise obtained the work you submit from another person, this is considered serious academic misconduct and you will be referred to the Central Disciplinary Committee for investigation.

*You should be able to answer Questions 1 to 3 after you have studied Unit 1.
You will need Minitab to answer Questions 1, 2 and 3.*

You should be able to answer Questions 4 to 7 after you have studied Unit 2.

Question 1 (Unit 1) – 6 marks

You will need to use Minitab to answer this question.

The Minitab file that you require for this question should be downloaded from the ‘Assessment’ area on the module website.

A supermarket has ten different packs of oranges for sale. The Minitab worksheet **oranges.mwx** contains three columns. The first column **label** contains a label A to J that identifies each pack of oranges. The column **number** gives the number of oranges in each pack. The column **£ per pack** shows the price of each pack in pounds.

The price per orange, in pounds (£), for each pack can be calculated as:

$$\text{price} = (\text{£ per pack} / \text{number})$$

- (a) Use Minitab to produce a column of values headed **price**, containing the price per orange, in pounds (£), for each of the pack of oranges. The prices should be rounded to two decimal places. Include the column of prices in your answer. [2]
- (b) Using the **price** column that you created in part (a), calculate by hand (i.e. not using Minitab) the median price of an orange at this supermarket. Show your working. [2]
- (c) Using the **price** column, calculate by hand (i.e. not using Minitab) the range of prices for an orange at this supermarket. Show your working. [2]

Question 2 (Unit 1) – 10 marks

You will need to use Minitab to answer this question.

The Minitab file that you require for this question should be downloaded from the ‘Assessment’ area on the module website.

The Minitab worksheet **oventemp.mwx** contains the values of the temperature in degrees Celsius ($^{\circ}\text{C}$) in a commercial oven as recorded over a period of time by the oven’s sensors. Run Minitab and open this worksheet.

- (a) Use Minitab to produce the default stemplot of the oven temperatures (i.e. the stemplot produced when the **Increment** field is left blank and the Trim outliers option is not selected). Include a copy of your plot in your answer. [1]
- (b) Use the stemplot you obtained in part (a) to find the median temperature of the oven. Show your working. [1]
- (c) Produce a new stemplot of the data using Minitab, this time with the seven levels 22, 23, 24, 25, 26, 27 and 28. Include a copy of your plot in your answer. Explain how you calculated an appropriate value to put in the **Increment** field. [2]
- (d) Briefly describe the shape of the stemplot of oven temperatures that you produced in part (c). Your answer should include whether the distribution is unimodal, bimodal or multimodal, whether it is left-skew, right-skew or symmetric and whether or not there are outliers. In each case, justify your answer. [6]

Question 3 (Unit 1) – 9 marks

You will need to use Minitab to answer this question.

The Minitab file that you require for this question should be downloaded from the ‘Assessment’ area on the module website.

The National Travel Survey (NTS) is a survey of English households. It is used to monitor long-term trends in personal travel and to inform the development of Government policy. It is an official source of data on personal travel patterns by residents in England. The survey collects information on how, why, when and where people travel as well as factors affecting travel (e.g. car availability and driving licence holding). The Minitab worksheet **travel.mwx** contains four columns. The column **year** gives the survey year. The column **trips** gives the total number of trips made per person per year. The column **distance** gives the total distance (in miles) travelled per person per year. The column **time** gives the total time taken for those trips (in hours).

- (a) Examine the data in the **travel.mwx** Minitab worksheet. In which year(s) was the total distance travelled per person highest? How many trips were there per person in that year, and how long did those trips take? [2]
- (b) Produce a scatterplot of year (the **X variable**) against time (the **Y variable**). Include the plot in your answer. [1]
- (c) Using the scatterplot from part (b), describe how the total length of time spent travelling changed between 2002 and 2012. [1]
- (d) Using the scatterplot from part (b), describe how the length of time spent travelling has changed since 2012. [1]
- (e) Discuss whether or not it would be appropriate to use a straight-line graph to represent the data points for the entire period of 2002-2019 as depicted on your scatterplot from part (b). [2]
- (f) The average trip distance per person (in miles), can be calculated from the total number of trips and the total distance travelled in miles. In 2007, the average trip distance per person was calculated as 7.147295 miles. Report this figure to
 - (i) two decimal places [1]
 - (ii) two significant figures. [1]

Question 4 (Unit 2) – 8 marks

Do not use Minitab to answer this question.

In an experiment to measure the ability to estimate the speed of a van, members of a group of 20 people were asked to estimate how fast a van was moving in miles per hour as it passed them. Their estimates were recorded, and the results are represented in the following stemplot.

Stem-and-leaf of Speed (mph) N=20

Leaf Unit = 1

2	3	01
5	3	223
6	3	4
7	3	6
10	3	889
10	4	000011
4	4	23
2	4	44

3|0 represents 30 miles per hour

Figure 1

- (a) Use the stemplot to find the median and the range of this batch of data. Show all your working. [2]
- (b) Calculate the (arithmetic) mean of the data. Show all your working. [1]
- (c) Calculate the lower and upper quartiles for this batch of data. Again, show all your working. [2]
- (d) Suppose that there was a data entry error such that a person who estimated the speed as 37 miles per hour accidentally recorded it as 31 miles per hour. Which of the statistics that you have obtained – median, range, mean, lower quartile and upper quartile – would have to be revised? For any statistic that would need to be revised, would you expect the value to go up or down? You do not need to calculate the new values. Explain your answer. [3]

Question 5 (Unit 2) – 5 marks

The Open University has developed some statistical models that can generate information on how likely registered students are to complete all the assignments for a given module. This information is usually summarised as a number somewhere on a scale from 0 to 1 – which in this question will be called the ‘likelihood’ – with 0 meaning very unlikely to complete, and 1 meaning very likely to complete. Figure 2 is a boxplot showing this information for all the students registered in a geographical area for M140 in a previous year.

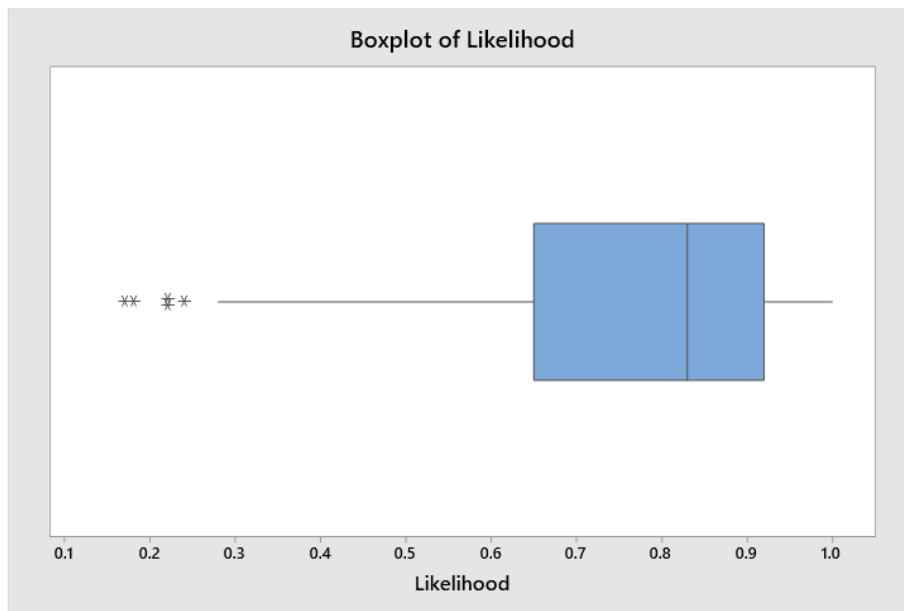


Figure 2

- (a) Is the distribution of this batch of data left skew, right skew or symmetric? Justify your answer. [2]
- (b) Explain what the asterisks (*) on the plot represent. [1]
- (c) The statistical model, which generates the likelihood of completing all assignments on M140 for each student, uses data available at the start of the module that reflect each student's motivation, opportunity, determination, resilience and interest in study. Where would you place yourself – in terms of the median, quartiles and whiskers – on the boxplot? Briefly justify your answer. [2]

Question 6 (Unit 2) – 6 marks

An office manager places a bulk order with its supplier of stationery each December for the following year's requirements. This includes supplies of small notepads and large notepads. The data for 2019 and 2020 are displayed in **Table 1**.

Table 1

	2019	2020
Small notepad price (£ per pad)	1.34	1.52
Small notepad expenditure (£)	268.0	304.0
Large notepad price (£ per pad)	2.12	2.35
Large notepad expenditure (£)	530.0	540.5

Calculate the (chained) price index for 2020, taking 2019 as the base year. [6]

Question 7 (Unit 2) – 6 marks

The Office for National Statistics publishes the Consumer Prices Index (CPI) (www.ons.gov.uk/economy/inflationandpriceindices). The monthly values of the CPI, for the last four months of 2018, 2019 and 2020, are listed in Table 2.

Table 2 CPI values

	CPI 2018	CPI 2019	CPI 2020
September	106.6	108.5	109.1
October	106.7	108.3	109.1
November	107.0	108.5	108.9
December	107.1	108.5	109.2

(a) Use the values of the CPI in Table 2 to calculate the annual inflation rates, based on the CPI, for each of the months September 2019, September 2020, December 2019 and December 2020, as a percentage rounded to two decimal places. (The base year is 2015.) [2]

(b) Comment briefly on

- The September 2020 inflation rate compared to the September 2019 rate.
- The December 2020 inflation rate compared to the December 2019 rate.
- How the inflation rate in September 2020 compared with that in December 2020, and comment on the same comparison for 2019.

(There is no need to try to justify any changes that you observe.) [3]

(c) A CPI index-linked pension was £695 per month in November 2019. How much should the pension be per month in November 2020? Please give your answer rounded to the nearest pound. [1]