



SAMPLE ASSESSMENT TASKS

MATHEMATICS APPLICATIONS
ATAR YEAR 11

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Sample assessment task

Mathematics Applications – ATAR Year 11

Task 5 (Test 2) – Unit 1

Assessment type: Response

Conditions:

Time for the task: Up to 50 minutes, in-class, under test conditions

Materials required:

| | |
|---------------------------------|--------------------------------------------|
| Section One: Calculator-free | Standard writing equipment |
| Section Two: Calculator-assumed | Calculator (to be provided by the student) |

Other materials allowed: Drawing templates, one page of notes in Section Two

| | |
|---------------------------------|-----------------|
| Marks available: | 55 marks |
| Section One: Calculator-free | (22 marks) |
| Section Two: Calculator-assumed | (33 marks) |

Task weighting: 5%

Section One: Calculator-free

(22 marks)

Suggested time: 20 minutes

Question 1**(7 marks)**

$$A = \begin{bmatrix} 2 & 3 \\ 5 & 7 \\ -1 & 8 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 2 & 8 \\ 7 & 0 & 11 \end{bmatrix} \quad C = \begin{bmatrix} -4 \\ -1 \\ 3 \end{bmatrix} \quad D = [2 \ 5 \ 10] \quad E = \begin{bmatrix} 7 & 9 \\ 11 & 3 \\ 10 & 5 \end{bmatrix} \quad F = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Using the matrices given above, calculate the following.

Where the operation is not possible, provide an explanation.

| | |
|------------------------|----------------------|
| a) $E + A$) (1 | b) DC) (2 |
| c) A^2) (1 | d) $3B$ (1) |
| e) FB) (1 | f) F^3) (1 |

Question 2**(5 marks)**

A section of a spreadsheet, provided below, shows the number of hours worked by three students during the course of a week. The students are paid time and a half on Saturdays and double time on Sundays.

| | A | B | C | D | E | F |
|---|-------------|-----------------------|----------------------|-----------------------|---------------------|------------------|
| 1 | Name | Rate (\$/hour) | Weekday hours | Saturday hours | Sunday hours | Total pay |
| 2 | Gen | 20 | 5 | 6 | 3.5 | |
| 3 | Bri | 22.5 | 10 | 3 | 3 | |
| 4 | Ala | 23.68 | 8 | 4 | 6 | |

a) How much will Gen earn in a week? (3 marks)

b) Using cell references (e.g. A1 for row 1 column A), state the formula to calculate Ala's total pay for one week. (2 marks)

Question 3**(6 marks)**

Give matrices to fit the following descriptions.

a) A row matrix with 3 columns (1 mark)

b) A square matrix A in which there are 2 rows and $a_{ij} = i + j$ (2 marks)

- c) Tickets to an exhibition are cheaper on weekdays than weekends. Adult tickets are \$15 on weekdays and \$20 on weekends. Student tickets are \$10 on weekdays and \$12 on weekends.
(3 marks)

Question 4**(4 marks)**

Members of one family, Gino, Cara, Nick and Tina, live in four different places and they communicate regularly. They all use the same internet texting app as well as email to send messages to each other. Skype is used by Cara, Nick and Tina but only to talk with Gino who is overseas. Both landline and mobile text are used by Cara, Tina and Nick to communicate locally. Facebook is used by Gino, Cara and Nick to communicate internationally.

With each row representing a different person, create a labelled matrix to represent the **number of ways** each person communicates with each of the others.

Assume no-one communicates with themselves.

Section Two: Calculator-assumed

(33 marks)

Suggested time: 30 minutes

Question 5**(3 marks)**

One formula for calculating the surface area (SA) of a person's skin is given below.

$$SA = 0.007184 \times W^{0.425} \times H^{0.725} \quad W = \text{weight (kg)}, H = \text{height (cm)}, SA = \text{surface area (m}^2\text{)}$$

Sol is 80 kg in weight and 159 cm tall.

a) Write an expression for calculating the SA of Sol's skin. (1 mark)

b) Calculate the SA of Sol's skin. (1 mark)

c) Express the SA of Sol's skin in cm^2 , given that there are 10 000 cm^2 in 1 m^2 . (1 mark)

Question 6**(8 marks)**

John wants to see which of the two banks in his portfolio of shares is the better performer, and he decides to use the P/E ratio to compare the two banks.

$$P/E \text{ ratio} = \frac{\text{Market price per share}}{\text{Annual earnings per share}}$$

AAA Bank's shares are currently \$33.65 while ZZZ Bank's shares are currently \$32.055.

AAA Bank has annual earnings of 207.5 cents per share.

ZZZ Bank has annual earnings of 223.1 cents per share.

- a) Calculate the *P/E* ratio for each bank and make a recommendation as to which bank John should buy more of, if the *P/E* ratio was the only indicator to be used. Justify your recommendation. (4 marks)

Dividends from both banks are paid twice a year and in the last year AAA Bank gave dividends at 82c and 84c per share.

- b) What percentage of its annual earnings does AAA Bank distribute to shareholders? (2 marks)

- c) ZZZ Bank paid an interim dividend of 66c per share. It has a policy of paying 65% of its annual earnings as dividends. What would you expect its final dividend payout to be? (2 marks)

Question 7

(6 marks)

Mary keeps records of her blood tests and some of the data are reproduced in the table below.

| | Blood test type | | | | Risk |
|--------------------|-------------------|----------------|----------------|----------------|----------------|
| | HDL | Chol. | LDL | PTRI | |
| Ideal range | 1.1 to 3.5 | <5.5 | <3.5 | <1.5 | <3.5 |
| Year | | | | | |
| 2009 | 1.4 | 5.7 | 3.8 | 1.1 | 4.1 |
| 2011 | 1.6 | 7.2 | 5 | 1.3 | |
| 2012 | 1.3 | 5.2 | 3.4 | 1.1 | |
| 2013 | 1.5 | 5.4 | 3.4 | 1 | |
| 2014 | 1.7 | 4.9 | 2.8 | 0.8 | |

- a) Circle all the entries for which Mary's test results are outside the ideal range of values. (2 marks)

- b) Mary knows that the 'Risk' value is found by dividing one variable by another but cannot remember the rule and she used a 'guess-and-check' method to work it out.

State a general expression to calculate the 'Risk' value. (2 marks)

- c) Calculate the 'Risk' value for 2014. (2 marks)

Question 8**(3 marks)**

Chocolate Easter eggs are on special at a local supermarket.

The larger eggs (110g each) are advertised at 'Two for \$4' and the smaller ones (39g) cost \$1 each. By calculating the cost per gram of chocolate, determine which size represents better value for money.

Question 9**(7 marks)**

Lucy has invented a new method for scoring points in the game of Tins. Each participant can score in any of four ways (M, S, T & G) and their scores are added to form a grand total.

There are as follows:

- 10 points for a match (M)
- 7 points for a set (S)
- 3 points for a touch (T)
- 1 point for each game (G).

The number of matches, sets, touches and games for 5 different players (P1, P2, P3, P4, P5) are provided in the matrix below.

| | M | S | T | G |
|----|---|----|---|----|
| P1 | 2 | 10 | 5 | 20 |
| P2 | 1 | 6 | 3 | 10 |
| P3 | 2 | 10 | 4 | 20 |
| P4 | 3 | 15 | 2 | 30 |
| P5 | 0 | 3 | 1 | 15 |

- a) Write the column matrix, with rows representing in order M, S, T and G, that represents the points for each way of scoring. (1 mark)
- b) Show the matrix calculation needed to multiply the column matrix (from part a) by the matrix provided for Question 9. Calculate this product. (2 marks)
- c) What is the total score for P1? Where in the matrix from part b) is this score located? (2 marks)
- d) Describe the data stored in the matrix generated in part b). (2 marks)

Question 10**(6 marks)**

Three friends went on a trip overseas and brought back some unspent foreign currency which they need to exchange back to Australian dollars (AUD).

They have made a table showing the amounts of each currency they each have.

| | Bali (Indonesia) | Singapore | Hong Kong |
|------|------------------|-----------|-----------|
| Kate | 190 000 IDR | 200 SGD | 500 HKD |
| Guy | 175 000 IDR | 350 SGD | 250 HKD |
| Alex | 85 000 IDR | 75 SGD | 100 HKD |

The exchange rates when they convert their money are as follows:

10 000 IDR (Indonesian rupiah) = 0.9700 AUD

1 SGD (Singapore dollars) = 0.8666 AUD

1 HKD (Hong Kong dollars) = 0.1410 AUD

- a) How much in Australian dollars (to the nearest ten cents) will Kate get for her Indonesian rupiah (assuming she pays no commission fees)?
(1 mark)
- b) How much in Australian dollars (to the nearest ten cents) will Guy get for his Singapore dollars (assuming he pays no commission fees)?
(1 mark)
- c) Using the same exchange rates as given in the table for Question 10, what is one Australian dollar worth (to the nearest cent) in Singapore dollars?
(1 mark)
- d) Write a matrix operation to calculate the amount of Australian currency that each person will receive when their foreign currencies (as shown in the table for Question 10) are converted.
(3 marks)

Summary table of syllabus content assessed by Task 5 (Test 2)

| Question | Syllabus reference |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | 1.2.6 perform matrix addition, subtraction, multiplication by a scalar, and matrix multiplication, including determining the power of a matrix using technology with matrix arithmetic capabilities when appropriate |
| 2 | 1.1.8 use a spreadsheet to display examples ... consumer arithmetic 1.2.3 use a spreadsheet or an equivalent technology to construct a table of values from a formula, including tables for formulas with two variable quantities ... |
| 3 | 1.2.5 recognise different types of matrices (row, column, square, zero, identity) and determine their size |
| 4 | 1.2.4 use matrices for storing and displaying information that can be presented in rows and columns; for example, databases, links in social or road networks |
| 5 | 1.2.2 determine the value of the subject of a formula, given the values of the other pronumerals in the formula (transposition not required) |
| 6 | 1.1.7 ... compare share values by calculating a price-to-earnings ratio |
| 7 | 1.2.1 substitute numerical values into algebraic expressions, and evaluate ... 1.2.3 use a spreadsheet or an equivalent technology to construct ... |
| 8 | 1.1.4 compare prices and values using the unit cost method |
| 9 | 1.2.7 use matrices, including matrix products ... to model and solve problems |
| 10 | 1.1.6 use currency exchange rates to determine ... the value of a given amount of foreign currency when converted to Australian dollars 1.2.7 use matrices, including matrix products... to model and solve problems |

Solutions and marking key for sample assessment task 5 (Test 2)

***Note:** Each item has been classified as Simple(S) or Complex(C) to provide teachers with some indication of the anticipated difficulty, which may be helpful with grading. However, it must be recognised that the classifications have been provided **a priori** and will need refining once the tasks have been administered (that is, after evidence as to the effect has been gathered).

Section One: Calculator-free

(22 marks)

Question 1

(7 marks)

| | Solution | Behaviours | Marks | Item* (S/C) |
|----|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------|-------------|
| a) | $\begin{bmatrix} 9 & 12 \\ 16 & 10 \\ 9 & 13 \end{bmatrix}$ | Adds two matrices correctly | 1 | S |
| b) | $[17]$ | Correct multiplication of two matrices (1) Uses brackets to denote matrix type (1) | 2 | C |
| c) | Not possible because the number of columns in A does not equal the number of rows in A | Applies conditions for matrix multiplication to a 3x2 matrix | 1 | C |
| d) | $\begin{bmatrix} 3 & 6 & 24 \\ 21 & 0 & 33 \end{bmatrix}$ | Multiplies matrix by scalar | 1 | S |
| e) | $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ | Multiplies two matrices, one being the zero matrix | 1 | S |
| f) | $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ | Recognises unique property of zero matrix | 1 | S |

Question 2

(5 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|----|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------|------------|
| a) | Gen: $= 20 \times 5 + 6 \times 20 \times 1.5 + 3.5 \times 2 \times 20 = 100 + 180 + 140 = 420$ | Selects correct and all data to be included | 1 | S |
| | | Multiplies by 1.5 and 2 appropriately | 1 | C |
| | | Adds all three correctly | 1 | S |
| b) | $B4(C4 + D4 \times 1.5 + E4 \times 2)$ | Uses correct cell references throughout Correctly orders operations | 1 1 | C C |

Question 3

(6 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|----|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------|------------|
| a) | $[2 \ 5 \ 10]$ | Writes a matrix with 1 row and 3 columns | 1 | S |
| b) | $\begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$ | Creates a square matrix with 2 rows and 2 columns Calculates each element correctly | 1 1 | S C |
| c) | $\begin{bmatrix} 10 & 15 \\ 12 & 20 \end{bmatrix}$ or $\begin{bmatrix} 10 & 12 \\ 15 & 20 \end{bmatrix}$ | Writes a matrix with 2 rows and 2 columns Correctly applies values to rows and columns | 1 2 | S C |

Question 4

(4 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|---|-----------------------------------------------|--------------------------------|-------|------------|
| | G C N T | Labels rows and columns | 1 | S |
| G | $\begin{bmatrix} 0 & 4 & 4 & 3 \end{bmatrix}$ | Has 0s on the leading diagonal | 1 | S |
| C | $\begin{bmatrix} 4 & 0 & 5 & 4 \end{bmatrix}$ | Creates a symmetrical matrix | 1 | C |
| N | $\begin{bmatrix} 4 & 5 & 0 & 4 \end{bmatrix}$ | Enters correct data | 1 | C |
| T | $\begin{bmatrix} 3 & 4 & 4 & 0 \end{bmatrix}$ | | | |

Section Two: Calculator assumed section

(33 marks)

Question 5

(3 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|----|-------------------------------------------------|----------------------------------------------------|-------|------------|
| a) | $0.007184 \times 80^{0.425} \times 159^{0.725}$ | Correctly substitutes given values for pronumerals | 1 | S |
| b) | 1.8247 m^2 | Uses calculator correctly | 1 | S |
| c) | 18247 cm^2 | Multiplies accurately by 10 000 | 1 | S |

Question 6

(8 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------|------------|
| a) | For AAA Bank, P/E ratio = $\frac{3365}{207.5} \approx 16.1$ | Calculates P/E ratios correctly for each bank (1 mark each) | 2 | S |
| | For ZZZ Bank, P/E ratio $\frac{32055}{223.1} \approx 14.4$ | Selects bank with the lowest ratio | 1 | S |
| | ZZZ Bank has a lower P/E ratio and so John would be paying less for every dollar of current earnings in ZZZ Bank than AAA Bank John should buy more of ZZZ Bank (other things being equal) | Gives qualified reason/explanation as to why the bank with the lowest P/E ratio should be selected | 1 | C |
| b) | Dividends paid $= 82+84 = 166c$ per share Annual earnings per share = $207.5c$ | Calculates the total dividend and divides by the annual earnings | 1 | S |
| | percentage of annual earnings distributed $= \frac{166}{207.5} \times 100 = 80\%$ | Expresses this as a percentage | 1 | S |
| c) | 65% of $223.1c = 145.015c$ $145.015 - 66 = 79.015$ i.e. expected final dividend will be approximately 79.1 or $79.2 c$ | Determines 65% of the annual earnings | 1 | S |
| | | Subtracts the interim dividend to determine the final dividend | 1 | S |

Question 7

(6 marks)

| | Solution | | | | | | Behaviours | Marks | Item (S/C) |
|----|--------------------|-------------------|----------------|----------------|----------------|----------------|------------------------------------------------------------------------------|-------|------------|
| a) | | HDL | Chol. | LDL | PTRI | Risk | Identifies all values outside the ranges given as ideal (1 if at least 3) | 2 | S |
| | Ideal range | 1.1 to 3.5 | <5.5 | <3.5 | <1.5 | <3.5 | | | |
| | Year | | | | | | | | |
| | 2009 | 1.4 | 5.7 | 3.8 | 1.1 | 4.1 | | | |
| | 2011 | 1.6 | 7.2 | 5 | 1.3 | | | | |
| | 2012 | 1.3 | 5.2 | 3.4 | 1.1 | | | | |
| | 2013 | 1.5 | 5.4 | 3.4 | 1 | | | | |
| | 2014 | 1.7 | 4.9 | 2.8 | 0.8 | | | | |
| b) | Chol. ÷ HDL | | | | | | Selects both variables correctly | 2 | C |
| c) | 2.9 | | | | | | Selects correct year | 1 | S |
| | | | | | | | Uses formula created to determine Risk | 1 | S |

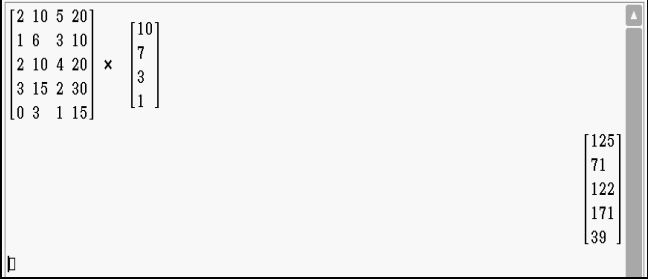
Question 8

(3 marks)

| Solution | Behaviours | Marks | Item (S/C) |
|-----------------------------------------------------------------------|--------------------------------------------------------|-------|------------|
| Large eggs cost $400 \div 220 = 1.81$ c/g | Accurately (1) divides number of cents | 1 | S |
| Small eggs cost $100 \div 39 = 2.56$ c/g | by number of grams (1) for both sizes | 1 | S |
| The larger eggs are the better value because they cost less per gram. | Correctly concludes on the basis of less cost per gram | 1 | S |

Question 9

(7 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|----|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------|------------|
| a) | $\begin{bmatrix} 10 \\ 7 \\ 3 \\ 1 \end{bmatrix}$ | Determines correct column matrix | 1 | S |
| b) |  | Writes down the correct matrix product Performs multiplication of matrices using technology | 1 1 | S C |
| c) | 125 Row 1 column 1 | Has the correct total for P1 Locates position of data in the matrix | 1 1 | S S |
| d) | Each row represents the total score for the players who are in row order of P1 to P5. | Identifies each row as belonging to a different player Nominates data as being the total number of points | 1 1 | S C |

Question 10

(6 marks)

| | Solution | Behaviours | Marks | Item (S/C) |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------|-------------|
| a) | $19 \times 0.97 = \$18.43$ | Divides by 10 000 and multiplies by 0.97 | 1 | S |
| b) | $350 \times 0.8666 = \$30.31$ | Multiplies by 0.8666 | 1 | S |
| c) | $1 \div 0.8666 = \$1.15$ | Chooses division of correct numbers | 1 | C |
| d) | $\begin{bmatrix} 190\,000 & 200 & 140 \\ 175\,000 & 350 & 250 \\ 85\,000 & 75 & 100 \end{bmatrix} \times \begin{bmatrix} 0.000097 \\ 0.8666 \\ 0.1410 \end{bmatrix}$ Each row of the first matrix represents one person's money for each currency. Each column of the first matrix represents the money for each country. In the second matrix the rows represent the exchange rate. | Establishes correct matrices Matrices are written in correct order Uses matrix multiplication | 1 1 1 | S S S |

Sample assessment task

Mathematics Applications – ATAR Year 11

Task 9 (Investigation 4) – Unit 2

Assessment type: Investigation

This investigation provides opportunity for students to develop the skills and understandings related to the statistical investigative process and univariate data analysis.

Notes for teachers

- The preparation activity could be completed during class time or at home.
- The preparation activity provides a valuable opportunity for students to develop familiarity with the statistical functionality of graphing calculators.
- Students should have had opportunity to receive feedback on Part A before attempting Part B (in-class validation).

Part A: Preparation activity

Materials required: Standard writing equipment
Calculator with graphing facilities (to be provided by the student)

Other materials allowed: In-class technology and/or calculator with graphic/statistical capabilities, drawing templates

Task weighting: 4.5% (1.5% from Part A: preparation activity and 3% from Part B: in-class validation)

Maximum number of marks for Part A: 24 marks

Task weighting for Part A: 1.5% of the school mark for this pair of units

Are males better drivers?

A student in class has suggested that males are better drivers than females. He went on to say that to be a good driver you need fast reflexes. This promoted some discussion with other students in the class saying the ability to concentrate was also very important.

Investigate the statements made above and produce a report that justifies your answer to the question 'Are males better drivers?'

A completed statistical investigation should include:

- an introduction that outlines the question to be answered and any further questions that could be explored
- selection and application of suitable mathematical and graphical techniques you have studied to analyse the provided data
- interpretation of your results relating your answer to the original problem
- communication of your results and conclusions in a concise systematic manner.

Your investigation report should include the following:

1. Introduction – two or three sentences providing an overview of your investigation. (3 marks)
2. Numerical and graphical analysis
 - choose various statistical measures you have studied to analyse the data (5 marks)
 - consider the most appropriate graphs which represent the data provided. (5 marks)
3. Interpretation of the results of this analysis in relation to the original question (7 marks)
 - describe any trend and pattern in your data (two to three sentences)
 - state how your data relates to the original problem (two to three sentences)
 - use your knowledge and understanding gained in this unit to explain your results in one paragraph.
4. Conclusion (4 marks)
 - summarise your findings and conclusions in one paragraph.

DATA

A sample of data from the 2013 *Census At School* survey is provided below. The data were generated from a random sample of 30 female and 30 male Year 11 and 12 students who provided information on their reaction time using their dominant hand, and their concentration activity.

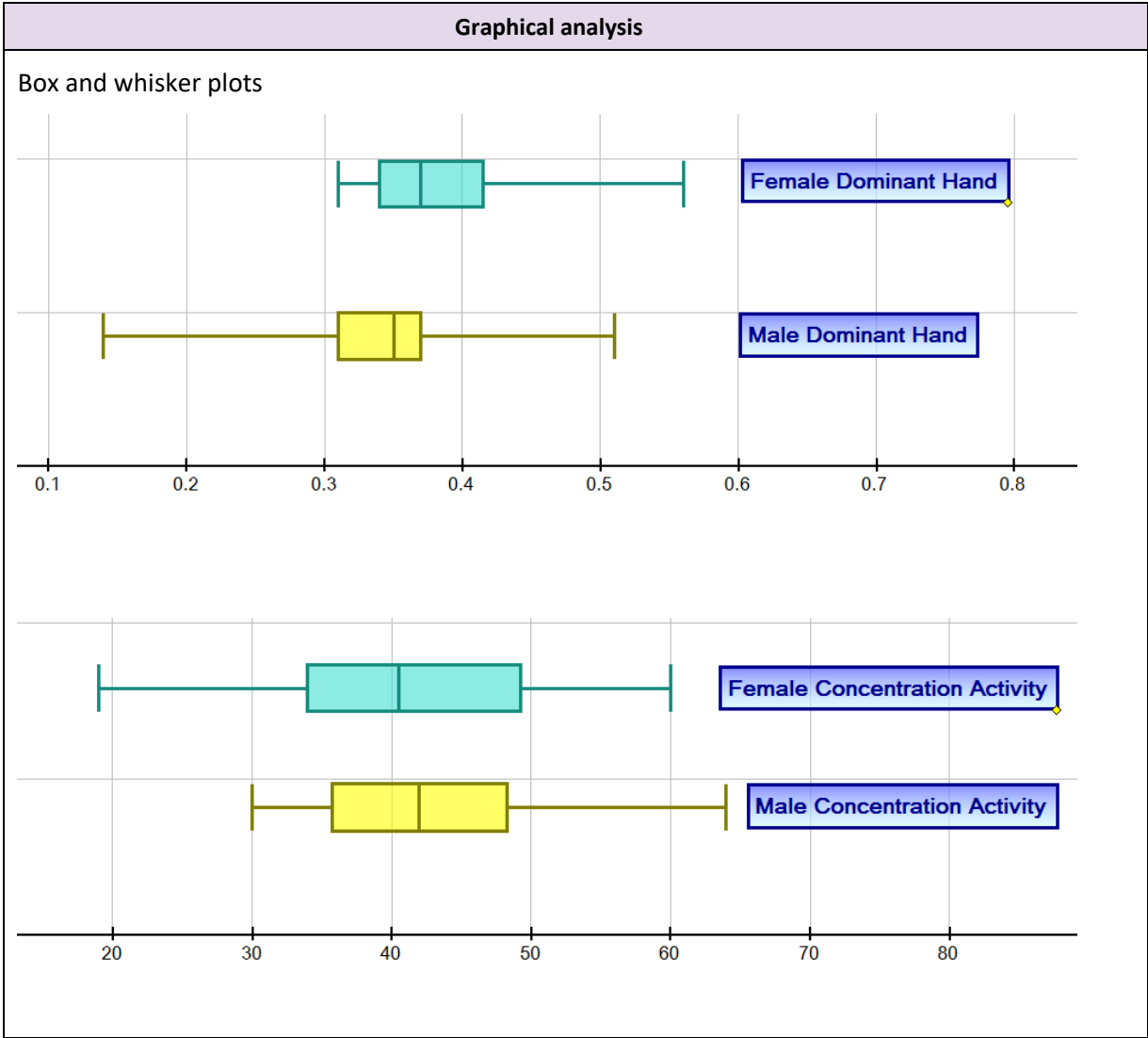
| Female | | |
|--------|----------------------------------------|----------------------------------|
| | Reaction time (sec) (dominant hand) | Concentration activity (secs) |
| 1 | 0.03 | 52 |
| 2 | 0.38 | 61 |
| 3 | 0.39 | 34 |
| 4 | 0.39 | 22 |
| 5 | 0.44 | 38 |
| 6 | 0.31 | 24 |
| 7 | 0.43 | 41 |
| 8 | 0.34 | 19 |
| 9 | 0.56 | 59 |
| 10 | 0.34 | 44 |
| 11 | 0.38 | 40 |
| 12 | 0.56 | 41 |
| 13 | 0.37 | 56 |
| 14 | 0.44 | 33 |
| 15 | 0.32 | 50 |
| 16 | 0.31 | 41 |
| 17 | 0.35 | 40 |
| 18 | 18.62 | 60 |
| 19 | 0.35 | 47 |
| 20 | 0.34 | 47 |
| 21 | 0.94 | 50 |
| 22 | 0.32 | 28 |
| 23 | 0.35 | 38 |
| 24 | 0.37 | 40 |
| 25 | 0.4 | 58 |
| 26 | 0.45 | 43 |
| 27 | 0.34 | 34 |
| 28 | 0.32 | 27 |
| 29 | 0.3 | 39 |
| 30 | 0.67 | 77 |

| Male | | |
|------|----------------------------------------|----------------------------------|
| | Reaction time (sec) (dominant hand) | Concentration activity (secs) |
| 1 | 0.35 | 35 |
| 2 | 0.51 | 61 |
| 3 | 0.35 | 38 |
| 4 | 0.32 | 43 |
| 5 | 0.37 | 43 |
| 6 | 0.38 | 47 |
| 7 | 0.37 | 48 |
| 8 | 0.31 | 64 |
| 9 | 0.37 | 38 |
| 10 | 0.31 | 43 |
| 11 | 0.45 | 33 |
| 12 | 0.37 | 38 |
| 13 | 0.31 | 31 |
| 14 | 0.34 | 52 |
| 15 | 2.61 | 58 |
| 16 | 0.35 | 34 |
| 17 | 0.4 | 49 |
| 18 | 0.31 | 35 |
| 19 | 0.32 | 47 |
| 20 | 0.42 | 37 |
| 21 | 0.35 | 36 |
| 22 | 0.32 | 38 |
| 23 | 0.41 | 43 |
| 24 | 0.31 | 60 |
| 25 | 0.32 | 36 |
| 26 | 0.35 | 47 |
| 27 | 0.3 | 30 |
| 28 | 0.14 | 35 |
| 29 | 0.36 | 41 |
| 30 | 0.27 | No data |

Marking key for sample assessment task 9 – Part A

| Introduction | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| After being posed the question are male drivers better than female drivers, I have been asked to investigate this statement. Whilst other factors may affect someone's ability to drive I will use the data provided of reflex and concentration times to try to explore this statement. | |
| Specific behaviours | Marks |
| Provides a simple introduction of the question | 1 |
| Restates question in own words | 1 |
| Mentions reflexes and concentration as two measures of driving ability | 1 |
| Total | /3 |

| Numerical analysis | | | | |
|--------------------------------------------------------------------|-----------------------------|---------------------------|--------------------------------------|------------------------------------|
| | | Dominant hand | Concentration activity | |
| Females | | | | |
| (f) | Mean | 0.38 | 42.77 | |
| | Median | 0.36 | 41.00 | |
| | Standard Deviation | 0.07 | 12.94 | |
| Males | Mean | 0.35 | 43.33 | |
| (m) | Median | 0.35 | 42.00 | |
| | Standard Deviation | 0.06 | 9.61 | |
| | Female dominant hand | Male dominant hand | Female concentration activity | Male concentration activity |
| Minimum | 0.3 | 0.14 | 19 | 30 |
| Q1 | 0.34 | 0.31 | 34 | 36 |
| Median | 0.37 | 0.35 | 40.5 | 42 |
| Q3 | 0.43 | 0.37 | 47.75 | 47.75 |
| Maximum | 0.56 | 0.51 | 61 | 64 |
| Specific behaviours | | | | Marks |
| Calculates measures of central tendency, including mean and median | | | | 1 |
| Calculates mean, median with outliers removed | | | | 1 |
| Calculates range | | | | 1 |
| Calculates standard deviation or inter-quartile range | | | | 1 |
| Calculates standard deviation and IQR | | | | 1 |
| Total | | | | /5 |



Graphical analysis

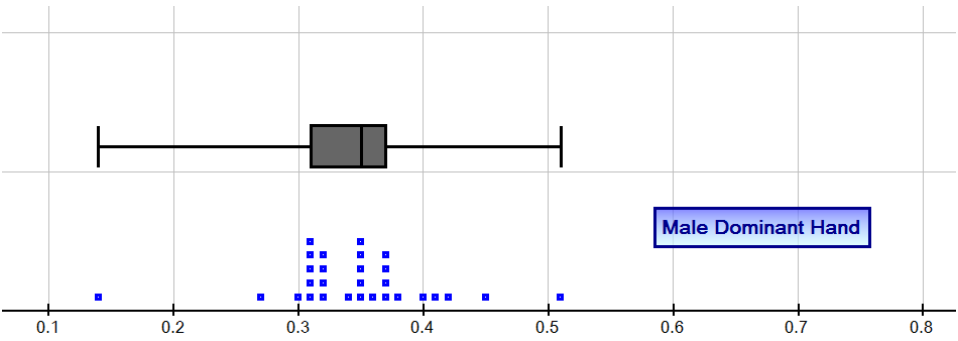
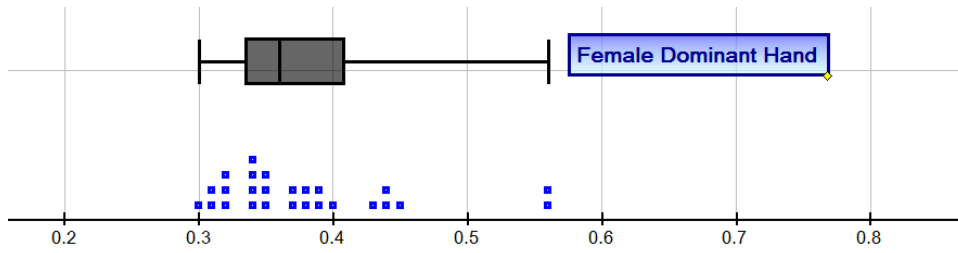
Back-to-back stem and leaf plots

| | Stem and leaf | |
|---------------------------------------|---------------|-----------------------------------------|
| Female dominant hand | Seconds | Male dominant hand |
| | 0.0 | |
| | 0.1 | 4 |
| | 0.2 | 7 |
| 9 9 8 8 7 7 5 5 5 4 4 4 4 2 2 2 1 1 0 | 0.3 | 0 1 1 1 1 1 2 2 2 2 4 5 5 5 5 6 7 7 7 8 |
| 5 4 4 3 0 | 0.4 | 0 1 2 5 |
| 6 6 | 0.5 | 1 |
| 7 | 0.6 | |
| | 0.8 | |

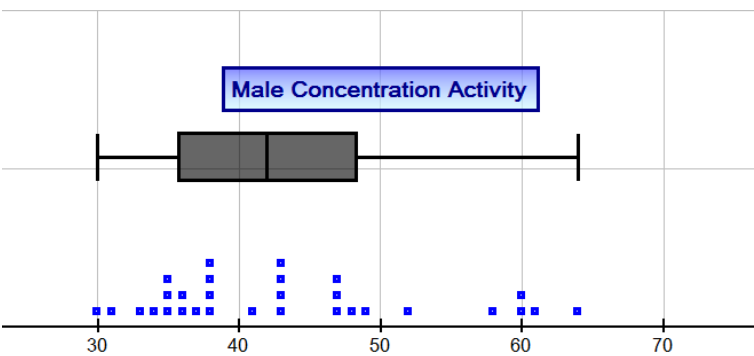
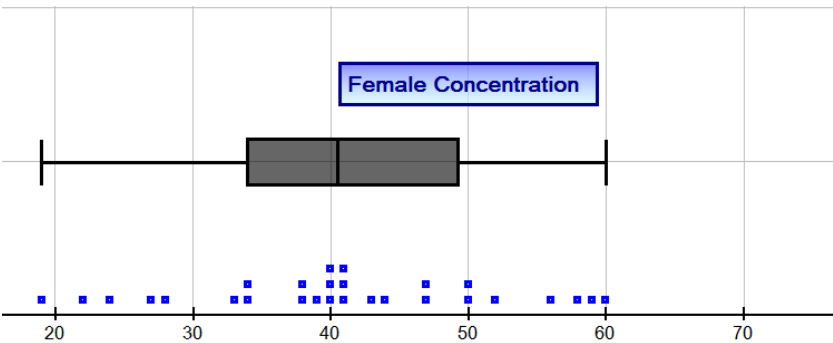
| | Stem and leaf | |
|-------------------------------|---------------|-----------------------------|
| Female concentration activity | Seconds | Male concentration activity |
| | 0 | |
| 9 | 10 | |
| 8 7 4 2 | 20 | |
| 9 8 8 4 4 3 | 30 | 0 1 3 4 5 5 5 6 6 7 8 8 8 8 |
| 7 7 4 3 1 1 1 0 0 0 | 40 | 1 3 3 3 3 7 7 7 8 9 |
| 9 8 6 2 0 0 | 50 | 2 8 |
| 1 0 | 60 | 4 |
| 7 | 70 | |
| | 80 | |

Graphical analysis

Distributions: Dominant hand



Distribution: Concentration activities



| Specific behaviours | Marks |
|----------------------------------------------------------------------|-----------|
| Constructs simple single graphs | 1 |
| Shows comparative graphs: stem and leaf, histograms or dot frequency | 1 |
| Uses box and whisker plots to compare male and female attributes | 1 |
| Presents correct graphs, including labelling | 2 |
| Total | /5 |

| Interpretation | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <p>Discussion of frequency/proportion, measures of central tendency, removal of outliers and measures of spread</p> <p>Sample interpretation:</p> <p>It is clear from looking at measures of central tendency, such as mean and median, that males performed faster on the reflex activity.</p> <p>Outliers have been removed from six data points, as these would have increased the mean and median for female reflexes.</p> <p>Females produced better results on the concentration activity, with the mean and median indicating females were faster.</p> <p>The range of scores for males was higher for the reflex activity, and higher for females on the concentration activity.</p> <p>The inter-quartile ranges are higher for females in both reaction times and also the concentration activity.</p> <p>On the concentration task there was a greater range for the female results, which is confirmed by the larger standard deviation compared with the males. The distribution for females is symmetrical, but the male distribution indicates a tail of students with larger times, indicating a positive skew in the results.</p> | |
| Specific behaviours | Marks |
| Discusses frequency | 1 |
| Discusses proportion e.g. median | 1 |
| Discusses removal of outliers and effects on mean, median | 1 |
| Makes comparisons using measures of spread e.g. range, IQR | 1 |
| Makes comparisons using central tendency measures: mean and median | 1 |
| Discusses clusters of results in the data | 1 |
| Interpretation linked to numerical and graphical data | 1 |
| Total | /7 |

| Conclusion | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <p>Short statement outlining summary of findings</p> <p>Sample conclusion:</p> <p>To summarise, while the mean and median scores were better for males than those for females for the reflex activity, female concentration times were better than males, with a cluster of males with slower concentration results and a significant number of females with very good concentration results (with the median being lower than the mean).</p> <p>Reaction times and concentration are important skills for driving, but we would need to make a study of other skills or data to answer the question posed. Other skills are important, such as general knowledge and adherence to road rules, risk taking behaviour etc. Road accident statistics could also help to answer the question 'Are males better drivers?'</p> | |
| Specific behaviours | Marks |
| Makes a valid statement about the results | 1 |
| Relates conclusion back to the original question | 1 |
| Proposes that other data should be collected to help answer question | 1 |
| Provides a concise and coherent summary of the analysis | 1 |
| Total | /4 |

Part B: In-class validation

Time allowed for this task: Up to 50 minutes, in-class, under test conditions

Materials required: Standard writing equipment, calculator with graphic/statistical capabilities, drawing templates

Marks available: 31 marks

Task weighting for Part B: 3%

Some of the students who completed the preparation activity in Part A thought that the non-dominant hand reaction time could also provide significant evidence in answering the question, 'Are males better drivers?'

Another sample of data, this time from the 2014 *Census At School* survey, was extracted and is provided below. The data were generated from a random sample of 25 female and 25 male Year 11 and 12 students who provided the information. The tables below display the students' reaction times using their non-dominant hand, and the results for the concentration activity.

| Female | | |
|--------|--------------------------------------------|------------------------------|
| | Reaction time (sec) (non-dominant hand) | Concentration activity (sec) |
| 1 | 0.42 | 69 |
| 2 | 0.35 | 36 |
| 3 | 0.97 | 66 |
| 4 | 0.33 | 49 |
| 5 | 0.37 | 54 |
| 6 | 0.38 | 31 |
| 7 | 0.37 | 36 |
| 8 | 0.44 | 31 |
| 9 | 0.47 | 51 |
| 10 | 2 | 50 |
| 11 | 1.6 | 35 |
| 12 | 0.36 | 50 |
| 13 | 0.45 | 30 |
| 14 | 0.29 | 41 |
| 15 | 0.4 | 33 |
| 16 | 0.4 | 28 |
| 17 | 0.18 | 46 |
| 18 | 0.32 | 32 |
| 19 | 0.4 | 28 |
| 20 | 0.35 | 56 |
| 21 | 0.42 | 33 |
| 22 | 0.39 | 24 |
| 23 | 0.42 | 34 |
| 24 | 0.4 | 36 |
| 25 | 0.32 | 33 |

| Male | | |
|------|--------------------------------------------|------------------------------|
| | Reaction time (sec) (non-dominant hand) | Concentration activity (sec) |
| 1 | 0.33 | 5 |
| 2 | 0.38 | 5 |
| 3 | 0.37 | 60 |
| 4 | 3.3 | 15 |
| 5 | 0.35 | 5 |
| 6 | 0.29 | 3 |
| 7 | 0.32 | 2 |
| 8 | 0.32 | 10 |
| 9 | 0.28 | 2 |
| 10 | 0.45 | 25 |
| 11 | 0.39 | 30 |
| 12 | 0.36 | 6 |
| 13 | 0.4 | 30 |
| 14 | 0.47 | 5 |
| 15 | 0.38 | 17 |
| 16 | 0.34 | 20 |
| 17 | 0.37 | 8 |
| 18 | 0.33 | 10 |
| 19 | 0.42 | 20 |
| 20 | 2.4 | 10 |
| 21 | 0.3 | 10 |
| 22 | 0.29 | 10 |
| 23 | 0.37 | 25 |
| 24 | 0.38 | 45 |
| 25 | 0.31 | 11 |

Question 1

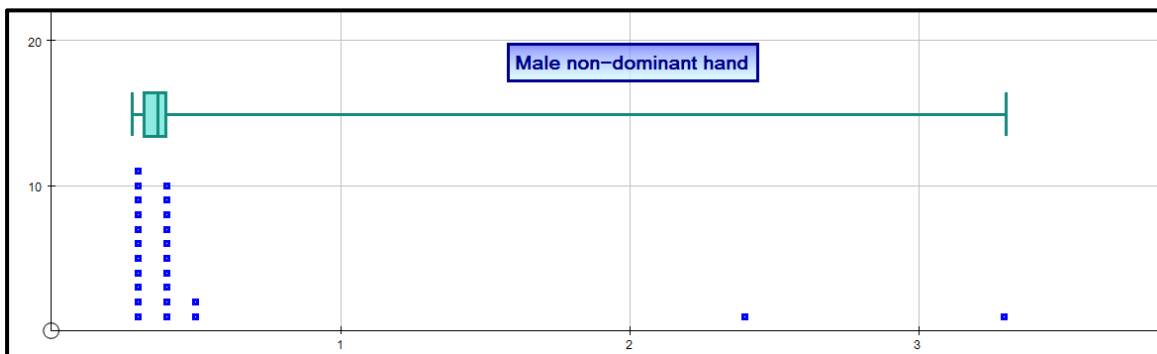
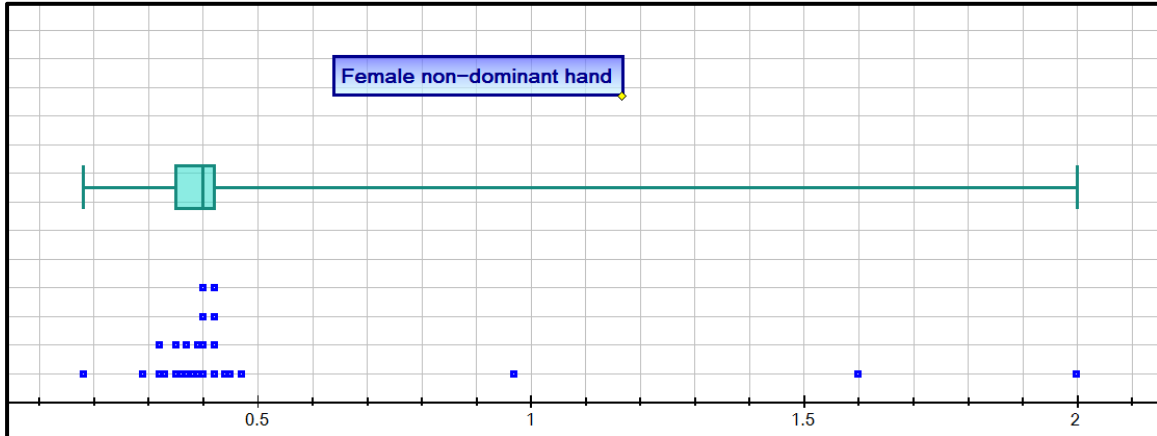
(12 marks)

One of the class members conducted a numerical analysis of the data, producing the following results.

| | | Non-dominant hand | Concentration activity |
|---------|--------------------|--------------------------|-------------------------------|
| Females | Mean | 0.512 | 40.48 |
| (f) | Median | 0.4 | 36 |
| | Standard Deviation | 0.405 | 11.88 |
| Males | Mean | 0.556 | 15.56 |
| (m) | Median | 0.37 | 10 |
| | Standard Deviation | 0.69 | 13.82 |

| | Female non-dominant | Male non-dominant | Female concentration | Male concentration |
|---------|----------------------------|--------------------------|-----------------------------|---------------------------|
| Minimum | 0.18 | 0.28 | 28 | 2 |
| Q1 | 0.35 | 0.32 | 31.5 | 5 |
| Median | 0.4 | 0.37 | 36 | 10 |
| Q3 | 0.43 | 0.395 | 50 | 22.5 |
| Maximum | 2 | 3.3 | 69 | 60 |

She also provided the following graphical display of the data on reaction time.



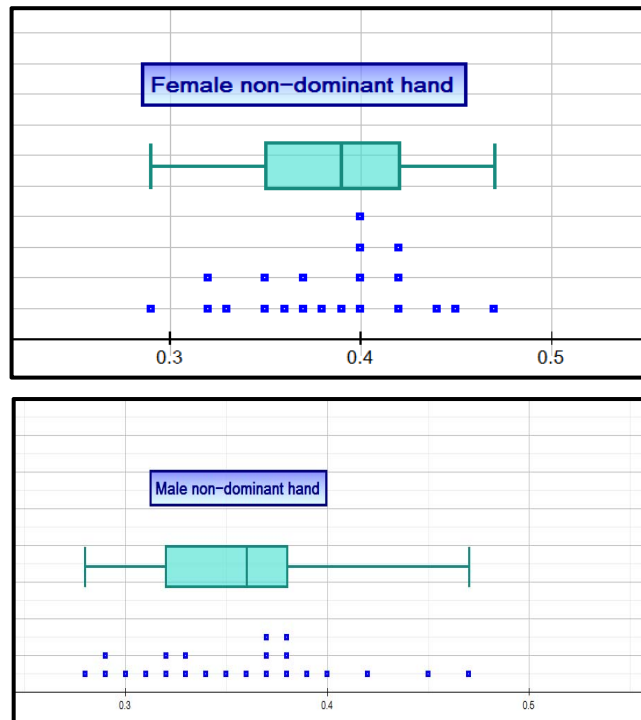
Another class member argued that this was misleading as the data obviously included outliers and these should be removed before drawing conclusions. She provided the following alternative, but incomplete analysis, after removal of outliers.

| | | Non-dominant hand | Concentration activity |
|---------|--------------------|--------------------------|-------------------------------|
| Females | Mean | 0.38 | |
| (f) | Median | 0.38 | |
| | Standard Deviation | 0.045 | |
| Males | Mean | 0.36 | |
| (m) | Median | 0.36 | |
| | Standard Deviation | 0.049 | |

| | Female non-dominant | Male non-dominant | Female concentration | Male concentration |
|---------|----------------------------|--------------------------|-----------------------------|---------------------------|
| Minimum | 0.29 | 0.28 | | |
| Q1 | 0.35 | 0.32 | | |
| Median | 0.39 | 0.36 | | |
| Q3 | 0.42 | 0.38 | | |
| Maximum | 0.47 | 0.47 | | |

- a) Remove any outliers from the data, providing evidence of how you decided, and complete the tables above. (6 marks)

The distributions of the reaction times for males and females, with outliers removed, are displayed below.



- b) Interpret these displays and state any conclusions that you think can be drawn from the data relating to the non-dominant hand reaction times of males and females. (6 marks)

Question 2**(12 marks)**

- a) Provide a suitable graphical display for the comparison of the data relating to the concentration activity. (6 marks)

- b) Interpret your graphical displays and state any conclusions that you think can be drawn from the data relating to the concentration activity times of males and females. (6 marks)

Question 3**(7 marks)**

Summarise your overall findings and conclusions, based on analysis of the data provided, in relation to the question 'Are males better drivers?'

Marking key for sample assessment task 9 – Part B

Question 1

a) Using data from calculator for

Females: $Q_3 - Q_1 = 18.5$, so for outliers, the concentration time needs to be less than 3.75 ($= Q_1 - 1.5 \times 18.5$) or greater than 81.5 ($= Q_3 + 1.5 \times 18.5$). Hence no outliers in the data.

Males: $Q_3 - Q_1 = 17.5$, so for outliers, the concentration time needs to be less than 0 or greater than 48.75. Hence no outliers below Q_1 but the 60 needs to be removed as an outlier above Q_3 .

| | | Non-dominant hand | Concentration activity |
|---------|--------------------|-------------------|------------------------|
| Females | Mean | 0.38 | 40.48 |
| (f) | Median | 0.38 | 36 |
| | Standard Deviation | 0.045 | 11.88 |
| Males | Mean | 0.36 | 13.75 |
| (m) | Median | 0.36 | 10 |
| | Standard Deviation | 0.049 | 10.64 |

| | Female non-dominant | Male non-dominant | Female concentration | Male concentration |
|---------|---------------------|-------------------|----------------------|--------------------|
| Minimum | 0.29 | 0.28 | 28 | 2 |
| Q1 | 0.35 | 0.32 | 31.5 | 5 |
| Median | 0.39 | 0.36 | 36 | 10 |
| Q3 | 0.42 | 0.38 | 50 | 20 |
| Maximum | 0.47 | 0.47 | 69 | 45 |

| Specific behaviours | Marks |
|-------------------------------------------------------------------------------------|-----------|
| Calculates $Q_3 - Q_1$ | 1 |
| Calculates the correct 'boundaries' to identify outliers | 1 |
| Identifies no outliers for the females and enters the required statistics correctly | 1 |
| Identifies the need to remove the 60 from the male data | 1 |
| Calculates and enters the required new statistics for males correctly | 2 |
| Total | /6 |

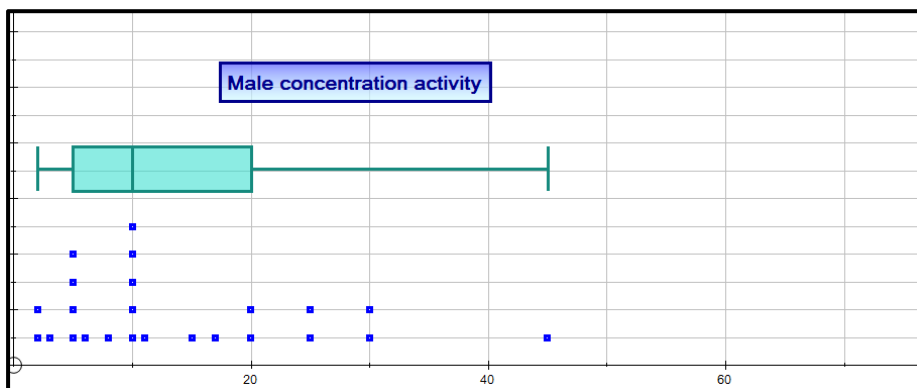
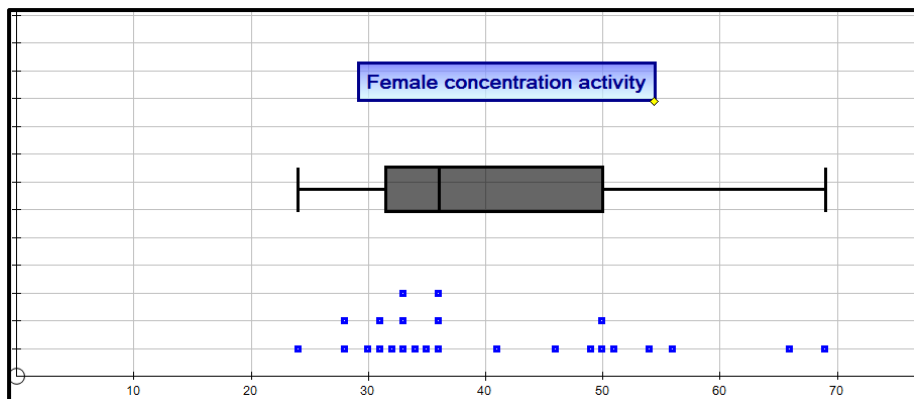
b) Reaction time comparisons

After the removal of outliers, the median reaction time for males is slightly less than for females (0.36 compared with 0.39 seconds) and while there is not much difference in the range between the two data sets (min: 0.28 (M) 0.29(F) and max: 0.47(M and F)), Q_3 is higher for females than males (0.42 compared with 0.38). The distribution for females is skewed towards higher reaction times compared with the distribution for males, which is skewed towards lower reaction times. Overall this tends to suggest that males have lower reaction times (although it is only a small sample).

| Specific behaviours | Marks |
|--------------------------------------------------------------------|-----------|
| Discusses proportion e.g. median | 1 |
| Makes comparisons using measures of spread e.g. range, IQR | 1 |
| Makes comparisons using central tendency measures: mean and median | 1 |
| Discusses clusters of results or 'skewness' in the data | 2 |
| Links results and draws inferences relating to original question | 1 |
| Total | /6 |

Question 2

a) Graphical displays



| Specific behaviours | Marks |
|------------------------------------------------------------------|-----------|
| Constructs simple single graphs | 1 |
| Shows comparative graphs: stem and leaf, dot frequency etc. | 1 |
| Uses box and whisker plots to compare male and female attributes | 1 |
| Presents correct graphs, including labelling | 2 |
| Graphs reflect use of data with outliers removed | 1 |
| Total | /6 |

b) Discussion of frequency/proportion, measures of central tendency and measures of spread.

Sample interpretation:

Females produced far better results on the concentration activity, with the mean and median indicating females concentrate for longer. The inter-quartile range for both males and females is roughly the same, but the standard deviation of the females was higher than for the males. 75% of the males surveyed had a lower concentration time than the female with the lowest time.

The distribution for females is more symmetrical, although both distributions indicate a close 'clumping' of students at the lower end of the data. However, there is more 'clumping' of males in the lower half.

| Specific behaviours | Marks |
|---------------------------------------------------------------------|-----------|
| Discusses frequency | 1 |
| Discusses proportion e.g. median | 1 |
| Makes comparisons using measures of spread e.g. range, IQR | 1 |
| Makes comparisons using central tendency measures: mean and median | 1 |
| Makes comment about the 'skewness' or symmetry of the distributions | 1 |
| Draws an appropriate conclusion(s) | 1 |
| Total | /6 |

Question 3

Statement outlining summary of findings and any conclusions drawn.

Sample:

To summarise, while the mean and median scores were slightly better for males than those for females for the non-dominant hand reaction time activity, female concentration times were far better than males, with all the females showing a better concentration time than 75% of the males.

Reaction times and concentration are important skills for driving and if they were the only factors, then it could be concluded that 'females are better drivers than males'. However, there is a need to make a study of other skills or data to answer the question posed. Other skills are important, such as general knowledge and adherence to road rules, risk taking behaviour etc. Road accident statistics could also help to answer the question.

| Specific behaviours | Marks |
|----------------------------------------------------------------------|-----------|
| Makes valid statement(s) about the results | 2 |
| Provides a concise and coherent summary of the analysis | 2 |
| Relates conclusion back to the original question | 1 |
| Proposes that other data should be collected to help answer question | 2 |
| Total | /7 |

ACKNOWLEDGEMENTS

Data from: Australian Bureau of Statistics. (2013). [Driver reaction time and concentration activity data]. Retrieved May, 2014, from www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSMa06+ARE+MALES+BETTER+DRIVERS#hello
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