2022
VCE
Further Mathematics
Trial Examination 2

Suggested Solutions

Kilbaha Education

Quality educational content

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Data analysis

Question 1

a.
Name is the nominal variable.

It is a categorical variable that does not have a natural order.

(1 mark)

b.
Entering the height data into a calculator will give:

Mean = 160.7
Standard deviation = 10.1

(1 mark)

C
.
$Q_3 = 165$

(1 mark)

d.

$$\frac{9}{15} \times 100 \approx 60\ \%$$

(1 mark)

e.

$IQR = 165 - 152 = 13$

Upper fence $= Q_3 + 1.5 \times IQR$

$$= 165 + 1.5 \times 13$$
$$= 184.5$$

(1 mark)

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Question 2

a.

30

Shortest man is 169 cm, and 75% of women are shorter than this.
(1 mark)

b.

13

Median for men is 178 and median for women is 165.
(1 mark)

c.

25%

152 to 154 cm is the range for the lowest quarter or 25% of the women's heights.
(1 mark)

d.

10

IQR for the women = 169-154 = 15
IQR for the men = 180-175 = 5
(1 mark)

Data analysis

Question 3

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a.

$$z = \frac{x - \bar{x}}{s}$$
$$s = \frac{x - \bar{x}}{z}$$
$$= \frac{178 - 167}{2.9} = 3.793 \sim 3.8$$

(1 mark)

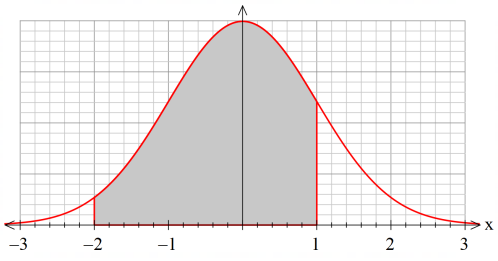
B.

1630

The mean = 167
Standard deviation = 3.8

159.4 and 170.8 are 2 standard deviations below the mean and 1 standard deviation above the mean respectively.

According to the 68-95-99.7 rule
81.5% of the sample is expected to lie within these limits.
81.5% of 2000 = 1630.



(1 mark)

c.

16%

King Willem-Alexander's height is 1 standard deviation above the mean.

In a normal distribution, it is expected that 16% will be more than 1 standard deviation above the mean.

(1 mark)

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Data analysis

Question 4

a. (i)

$height\ at\ age\ 25 = 110 + 0.495 \times height\ at\ age\ 10$ (1 mark)

a. (ii)

height at age 25 is the response variable
(1 mark)

a. (iii)

For every extra 1 cm in height at age 10, the height at age 25 is predicted to increase by 0.495 cm.
(1 mark)

b.

$r^2 = 0.8624^2 = 0.7437$

0.86242=0.7437…

0.7437… × 100 ~ 74%

(1 mark)

c.

$$110 + 0.495 \times 139 = 178.8\ cm$$

(1 mark)

D.

139 cm is within the range of the measured data, so this prediction is **interpolation**.
(1 mark)

e.

2

Actual = 182
Predicted $= 110 + 0.495 \times 141 = 179.795$

Residual = Actual – predicted
=182 – 179.795 = 2.205 ~ 2

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f.

The residual values from left to right follow a curved pattern of negative-positive-negative

(1 mark)

g.

$$height\ at\ age\ 25$$
$$= -165.6 + 160.7 \times \log_{10}(height\ at\ age\ 10)$$

(2 marks)

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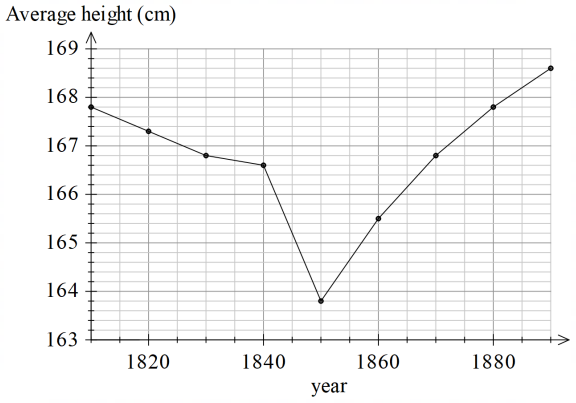
Data analysis

Question 5

a.



(1 mark)

b.

The median of 166.6, 163.8, 165.5, 166.8, 167.8 is **166.6** cm

(1 mark)

Recursion and financial modelling

Question 6

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a.

$45000

(1 mark)

b.

5.4%

$$\frac{r}{100} = 0.0045$$
$$r = 0.45$$

Compounding interest rate is 0.45% per month

$$= 0.45 \times 12 = 5.4\% \; per \; annum$$

c.

$A_n = 1.0045^n \times 45000$

(1 mark)

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Recursion and financial modelling

Question 7

a.

95000 -125 = $94875

(1 mark)

b.

Unit cost depreciation

$= \frac{depreciation\ amount}{number\ of\ copies} = \frac{125}{2500} = 0.05$

(1 mark)

c.

1600 ÷ 0.05 = **32000**

(1 mark)

D.

$$V_1 = 95000 - 1600 = 93400$$
$$V_2 = 93400 - 1600 = 91800$$
$$V_3 = 91800 - 1600 = 90200$$

(1 mark)

e.

c = 95000
d = -1600

(1 mark)

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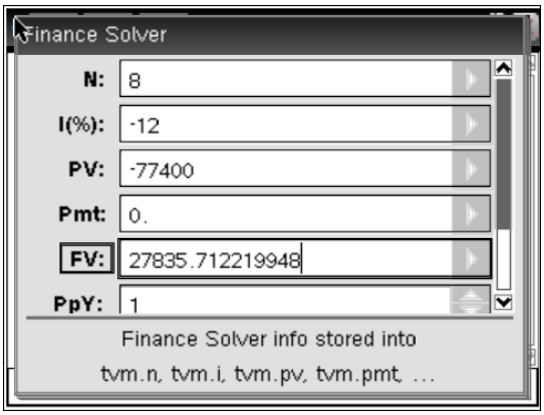
f.

$$V_{11} = 95000 - 11 \times 1600 = 77400$$

Now use finance solver to cover the next 8 years.



After 19 years, value is **$27836**

(1 mark)

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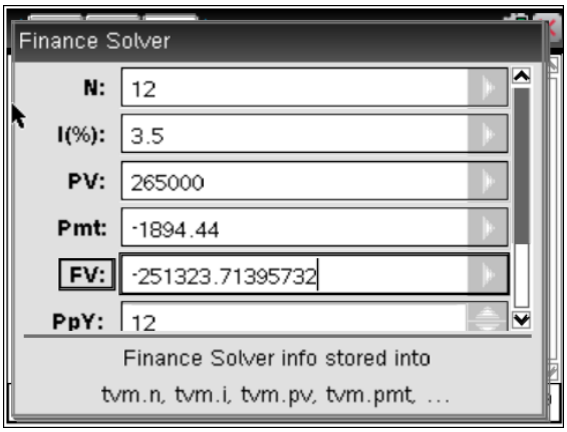
Recursion and financial modelling

Question 8

a.

$ 13676

Use finance solver:

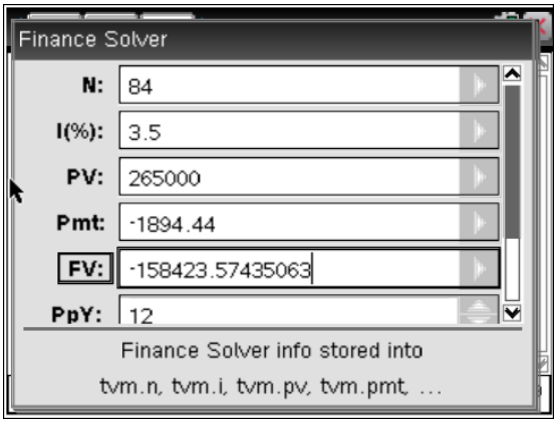


265000 – 251324 = 13676

(1 mark)

b.

Use finance solver to find that 158423.57435… is the balance after 7 years.



One off payment of $25000 brings this to
$133423.57435…

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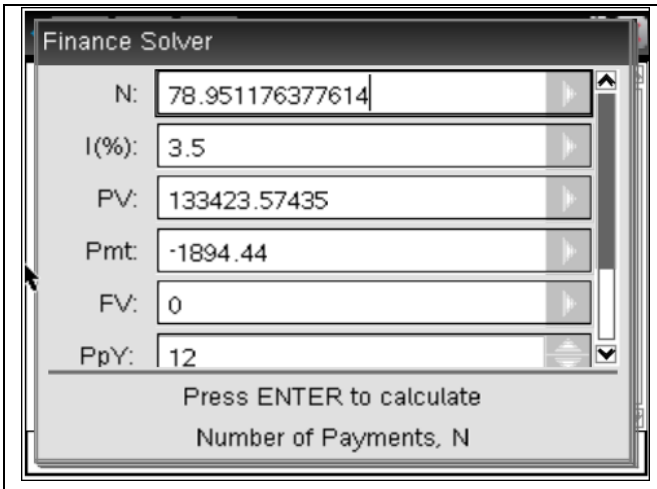

It will take another 79 months to pay off the loan, making a total of 84 + 79 = 163 months.
Comparing this with 180 months (15 years) makes a saving of **17 months**.

(2 marks)

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Module 1 – Matrices

Question 1

a.

4×1

(1 mark)

b.

[3 0 2 0] (1 mark)

c.

A = [18]

(1 mark)

d.

Matrix A gives the total number of points gained by Mahila.

(1 mark)

Question 2

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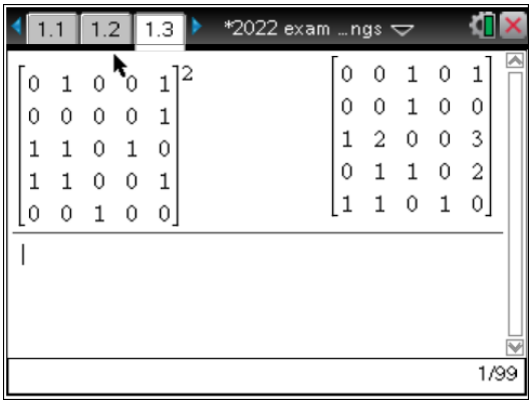
a.

4

Squaring the dominance matrix gives 2- step dominances.
The row for Paula adds to 4.

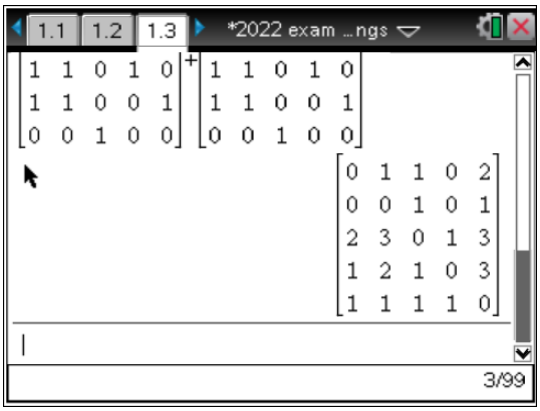


(1 mark)

b.

Mahila and Questo. (1mark)

Adding the dominance matrix to the two-step dominance matrix gives the ranking of the players.



Mahila and Questo both have rows adding to 4.

(1 mark)

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Module 1 – Matrices

Question 3

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a.

From B to B is 0.2, so that box is **20%**
From C to V is 0.3, so that box is **30%**

(1 mark)

b.

$$T \times \begin{bmatrix} 300 \\ 200 \\ 400 \\ 100 \end{bmatrix} = \begin{bmatrix} 320 \\ 180 \\ 310 \\ 190 \end{bmatrix}$$

(1 mark)

c.
The number who do **not** change their choice is

$$0.2 \times 300 + 0.2 \times 200 + 0.4 \times 400 + 0.1 \times 100 = 270$$

So, 1000 – 270 = **730** change their choice.

(1 mark)

d.

There were 180 card game players on day 2.
Of these, 0.3×180 = 54 switch to video games on day 3.

$$\frac{54}{299} \times 100 \sim 18\%$$

(1 mark)

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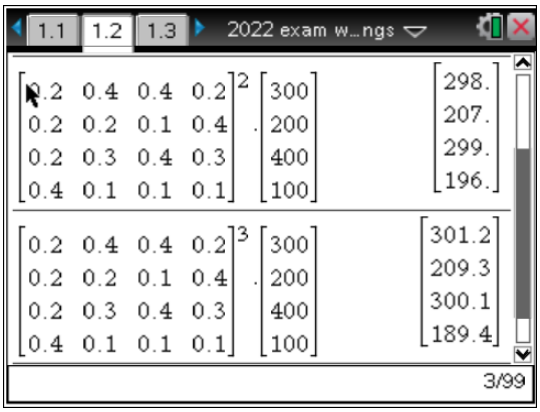
e.



Calculating the state matrix for each of the four days shows that the maximum number of word game participants is **196**.

(1 mark)

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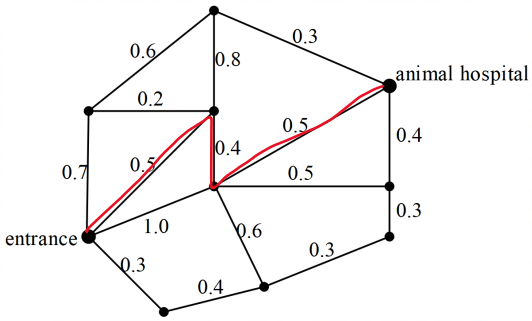
Module 2: Networks and decision mathematics

Question 1

a.

By inspection, the shortest distance is 1.4 km.

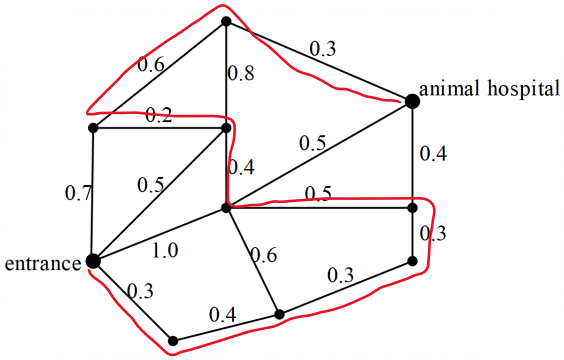


(1 mark)

b. (i)

Hamiltonian path (1 mark)

b. (ii)



(1 mark)

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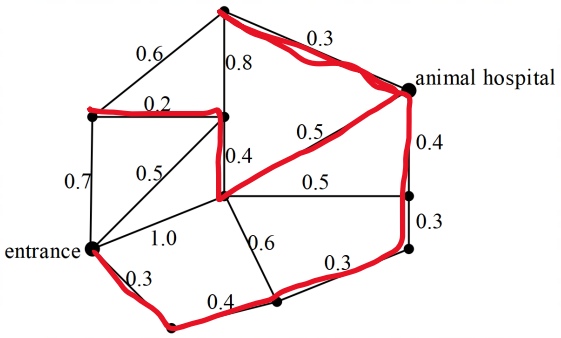
c.

3.1 km

We are looking for a minimal spanning tree. One such tree would be as shown.
The value of the tree is 3.1



(1 mark)

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Module 2: Networks and decision mathematics

Question 2

a.

Four (A, C, D, E)

(1 mark)

b. (i)

B (the only odd vertex apart from the gate.)

(1 mark)

b. (ii)

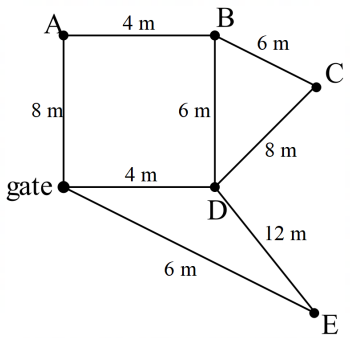
Eulerian trail

(1 mark)

c. (i)

The circuit EDBCDgateABDgateE

gives the least distance Laura will need to walk to satisfy the conditions.



The distance is **64 metres**

(1 mark)

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c. (ii)

Enclosures **B** and **D**

(1 mark)

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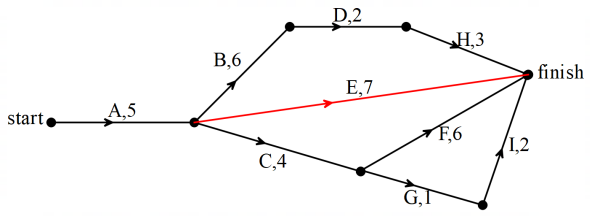
Module 2: Networks and decision mathematics

Question 3

a.



The only immediate predecessor of activity E is activity A.
Activity E is not an immediate predecessor to any other activity, so activity E can be shown as an edge going directly from the end of A to the finish.

(1 mark)

b.

The shortest completion time is the longest path.
This is ABDH, with a time of 5 + 6 + 2 + 3 = 16 weeks.

(1 mark)

c.

Activity G must finish before activity I can start.
The activity table gives the latest starting time of activity I as 14 weeks.
Activity G has a duration of 1 week, so it must start no later than 13 weeks.

(1 mark)

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