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Free Exam
for 2006-15 VCE study design

Engage Education Foundation

Units 3 and 4 Further Maths: Exam 2

Practice Exam Solutions

Stop!

Don't look at these solutions until you have attempted the exam.

Any questions?

Check the Engage website for updated solutions, then email practiceexams@ee.org.au.

Core: Data analysis

Question 1a

Q3 = 47

Q1 = 26

IQR = Q3 – Q1 = 47 – 26 = 21 [1]

Question 1b

Upper fence = Q_3 + 1.5*IQR = 47 + 1.5*(21) = 78.5 [1]

Lower fence = Q_1 – 1.5*IQR = 26 – 1.5*(21) = -5.5 [1]

Question 2a

% of people earning more than $30/hr = 8.5 + 4.2 + 0.9 = 13.6%

Therefore, number of people earning more than $30/hr = 13.6% * 3000000 = 408000 people [1]

Question 2b

Yes, the data does support the opinion that people's wages are associated with the year in which they are employed. [1]

More people in 2000 are earning a wage which is towards the higher wage brackets, compared to people in 1960. For example, 53.6% of people in 1960 were earning a wage between $10-20/hr, while in 2000, only 28.7% of people were in that same wage bracket. [1]

Question 3a

There is a non-linear relationship between a person's age and the wage they are earning. [1]

There is a positive relationship between the two variables (b = 0.91) – as a person's age increases, so does their age. [1]

There is a strong relationship (or connection) between the two variables (r = 0.94). [1]

There are generally no people who stand out as possible outliers [1] OR There are generally no people who stand out as outliers however the 32 year old earning $20/hr may be considered a potential outlier. [1]

Question 3b

From the residual plot, a pattern exists which indicates the data has not been fitted appropriately by the linear regression line and a transformation is required. [1] OR From the residual plot, a pattern exists which indicates the linear regression line has not captured the essential features of the data and a transformation is required. [1]

Question 3c

Log(wage) = 1.11 + 0.01**(age)*

[1] for correct values and [1] for correct variables

Question 3d

Before transformation: $r = 0.94$, $r^2 = 0.87$

After transformation: $r = 0.84$, $r^2 = 0.71$ [1] (1 if both correct, 0 if at least one incorrect)

Both r and r^2 have worsened following the log(wage) transformation. There is a weaker correlation coefficient, meaning a weaker linear relationship between wage and age [1/2], and an even lower proportion of explained variation [1/2]. The scatterplot looks less linear.

Section B

Module 1 – Number Patterns and Applications

Question 1a
34 [1]

Question 1b
$S_n = 50 – 4 (n – 1)$ or $S_n = 54 – 4n$ [1]

Question 1c
13^{th} year [1]

Question 1d
288 [1]

Question 1e
Geometric [1]

Question 1f
117.18kg [1]

Question 1g
The average weight of sheep increases to infinite after a long time [1]

Question 2a
b = 6 [1]

Question 2b
q = 6 [1]

p = 2 [1]

Question 2c
c = 24 [1]

Question 3a
a = 2 [1]

b = 7 [1]

Question 3b
$t_{n+2} = t_n + t_{n+1}, where\ t_1 = 2\ t_2 = 5$ [1]

Question 3c
100 [1]

Module 2: Geometry and trigonometry

Question 1a

50° [1]

Question 1b

Heron's formula: A = √

1.97 m^2 [2]

Question 2a

44 cm^2 [2]

Question 2b

140 cm^3 [2]

Question 3a

V_{cone}= 1/3 $\pi r^2 h$ [1]

5.17 cm [2]

Question 3b

21 cm [2]

Question 3c

3 [2]

Module 3: Graphs and relations

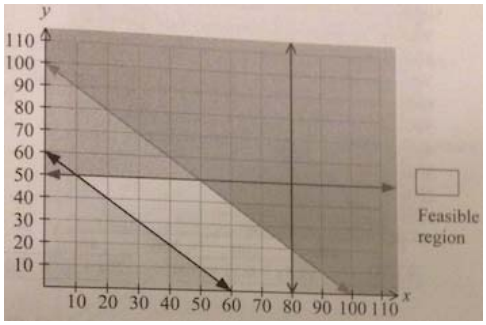
Question 1a

B $x + y \geq 60$ [1]

C $0 \leq x \leq 80$ [1]

D $0 \leq y \leq 50$ [1]

Question 1b



[3]

Question 1c

Question 1d

$P = 30x + 20y$ [1]

Question 1e

The extreme points are (60,0), (10,50), (50,50), (80,20) and (80,0). Calculating profit for each of these points gives, respectively \$1800, \$1300, \$2500, \$2800 and \$2400. Hence, Shadow Hero needs to manufacture 80 footballs and 20 volleyballs to make maximum profit. [2]

Question 1f

Maximum profit is \$2800. [1]

Question 2a

$P = 15x + 15y$ [1]

Question 2b

Calculating the new profit for each of the extreme points: \$900, \$900, \$1500, \$1500 and \$1200. The maximum profit occurs at two of the extreme points, (50,50) and (80,20), which means that any of the points along the line segment joining these two points will also produce maximum profit. [1]

Question 2c

(50,50), (80,20) and (60,40). Many other points are possible; they must satisfy the equation $x + y = 100$ and be whole numbers with $50 \leq x \leq 80$. [2]

Module 4 – Business-related Mathematics

Question 1a
$1300 [1]

Question 1b
19.5% [1]

Question 1c
The simple interest loan will be a cheaper option over a 5-year period since with the compound interest rate of 6% the student will have to pay back $1352 in interest[1]

Question 2a
$3405 [1]

Question 2b
$2963.5 [1]

Question 2c
Consider the original bike, after 4 years the bike will be valued at $120 [1] whereas the second hand bike will be valued at $2489 [1]. Although the second-hand bike was more expensive when the student bought it, it will be more valuable in 4 years. So the student should purchase the second-hand bike now. [1]

Question 3a
$\frac{12000 \times 0.04 \times 3 + 12000}{36} =$ [1]

$373.33 per month [1]

Question 3b
6% [1]

Question 3c
Simple flat interest does not take into account reductions in the outstanding balance as repayments are made [1]

Question 4a
$600 x 0.8 x 1.35 = $648 [1]

Increased [1]

Question 4b
$629.87 [1]

Module 5 – Networks and Decision Mathematics

Question 1a

$$\begin{array}{c} \\ A \\ B \\ C \\ D \end{array} \begin{array}{c} \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{bmatrix} 0 & 2 & 1 & 1 \\ 2 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

[2, -0.5 for every incorrect element]

Question 1b

6 [1]

Question 2a

4 [1]

Question 2b

16 minutes [1]

DBAC [1]

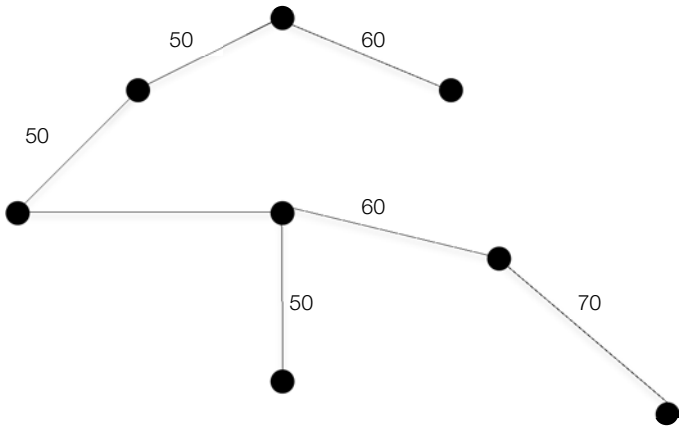
Question 2c

The number of edges in a network must be even for an Euler path to exist [1]

Question 2d

No [1]

Question 3a



[1]

Question 3b

400 metres [1]

Question 3c

$9680[1]

Question 4

Start with Bipartite graph and make into a matrix:

$$\begin{bmatrix} 10 & 12 & 14 & 8 \\ 12 & 14 & 12 & 8 \\ 8 & 10 & 15 & 10 \\ 11 & 8 & 8 & 14 \end{bmatrix}$$ [1]

Take away smallest element from each row from that row (row reduce):

$$\begin{bmatrix} 2 & 4 & 6 & 0 \\ 4 & 6 & 4 & 0 \\ 0 & 2 & 7 & 2 \\ 3 & 0 & 0 & 6 \end{bmatrix}$$ [1]

Since allocation does not work here continue with column reduction, subtract smallest element in column from that column:

$$\begin{bmatrix} 0 & 2 & 2 & 0 \\ 2 & 4 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 1 & 0 & 0 & 4 \end{bmatrix}$$ [1]

Allocation can now be made A does Q, B does P, C does R and D does S. Therefore, maximum time is 12+12+15+14 = 53 minutes [1]

Module 6: Matrices

Question 1a

$\begin{bmatrix} 10 & 13 & 6 \end{bmatrix}$ [1]

Question 1b

Question 2a

$$\begin{bmatrix} 50 & 75 & 30 & 25 \\ 81 & 63 & 134 & 42 \\ 83 & 143 & 64 & 32 \\ 87 & 104 & 119 & 59 \\ 45 & 32 & 90 & 86 \end{bmatrix}$$

[1]

Question 2b

$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 \end{bmatrix}$ [1]

Question 2c

$\begin{bmatrix} 346 & 417 & 437 & 244 \end{bmatrix}$ [1]

Question 3a

0.9	0.4
0.1	0.6

[2]

Question 3b

$$T = \begin{bmatrix} 0.9 & 0.4 \\ 0.1 & 0.6 \end{bmatrix}$$ [1]

Question 3c

$$S_0 = \begin{bmatrix} 0.55 \\ 0.45 \end{bmatrix}$$ [1]

Question 3di

$$T \times S_0 = \begin{bmatrix} 0.675 \\ 0.375 \end{bmatrix}$$ [1]

Giggity Grocers has 67.5% of the market after one transition period. [1]

Question 3dii

$T^5 \times S_0 = \begin{vmatrix} 0.792 \\ 0.208 \end{vmatrix}$ [1]

Giggity Grocers has 79.2% of the market after 5 transition periods. [1]

Question 3e

$T^9 \times S_0 \approx T^{10} \times S_0 \approx \begin{vmatrix} 0.800 \\ 0.200 \end{vmatrix}$

After 10 transition periods. [1]

Question 3f

The steady state percentage for Giggity Grocers is 80%. [1]