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Further Mathematics

2013

Trial Examination 1

Core – Data analysis
Module 1 – Number patterns
Module 5 – Networks and decision mathematics
Module 6 – Matrices

SECTION A Instructions

Answer **all** questions

A correct answer scores 1, an incorrect answer scores 0.

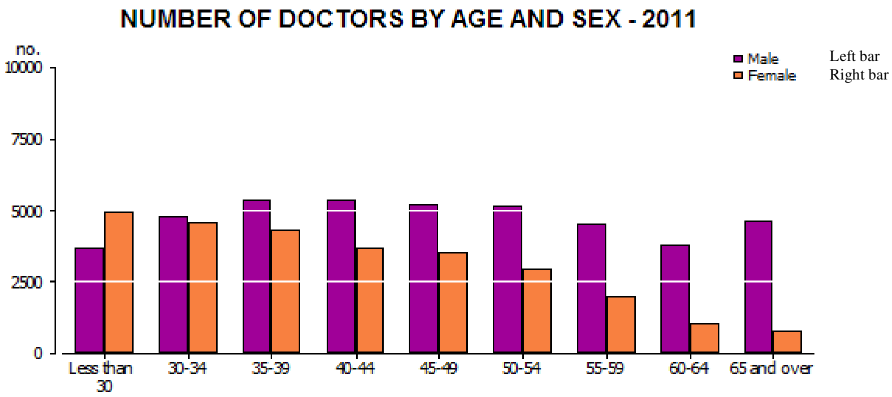
Marks will **not** be deducted for incorrect answers.

No marks will be given if **more than one** answer is completed for any question.

Core – Data analysis

The following information relates to Questions 1, 2 and 3

The distribution of doctors in Australia by age and sex in 2011 is shown in the graph below.



Source: ABS 2011 Census of Population and Housing

Question 1

The number of male and female doctors in Australia aged between 35 and 49 in 2011 was closest to

A. 15000

B. 20000

C. 25000

D. 35000

E. 40000

Question 2

In 2011

A. the number of female doctors was greater than the number of male doctors

B. the number of female doctors was less than the number of male doctors

C. the number of female doctors was about the same as the number of male doctors

D. the number of young female doctors was greater than the number of older female doctors

E. the number of young male doctors was greater than the number of older male doctors

Question 3

A doctor attending you in a clinic/hospital is most likely to be in the

A. 30-34 age group

B. 35-39 age group

C. 40-44 age group

D. 45-49 age group

E. 50-54 age group

The following information relates to Questions 4 and 5

The test results for a class of 26 students are displayed in the following back-to-back stem-and-leaf plot.

Boys		Girls
5 3	3	6
5	5	6 6 7 8
8 7 5	6	6 6 9 9 9
7 4 2 2	7	4 5
3 0	8	2 9

Question 4

The interquartile range of the test results is

A. between 57 and 75

B. 19

C. 18

D. the same for boys and girls

E. greater for girls than for boys

Question 5

The distribution of the test results is best described as

A. symmetric

B. normal

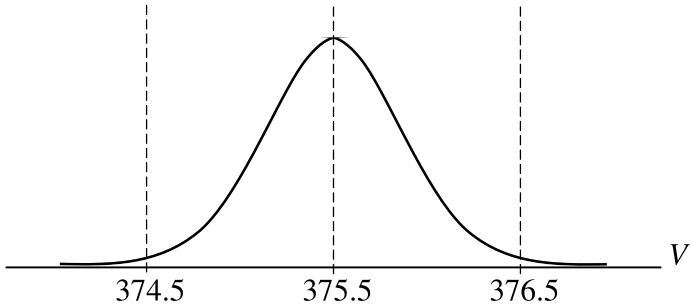
C. positively skewed

D. negatively skewed

E. bimodal

The following information relates to Questions 6 and 7

The volume V (ml) of soft drink in a can was found to have a normal distribution as shown below. 5% of the cans measured had a volume ***outside*** the 374.5 – 376.5 ml interval.



Question 6

The percentage of cans measured to have a volume between 375.2 and 375.8 ml is closest to

A. 60

B. 70

C. 75

D. 80

E. 85

Question 7

The z-score of $V = 375.2$ is closest to

A. 1

B. 0.6

C. 0.3

D. -0.6

E. -1

Question 8

Given the bivariate statistics $s_x = 1.58$, $\bar{x} = 3$, $s_y = 2$, $\bar{y} = 1$ and $r = -0.395$, the equation of the least squares regression line is

A. $y = 0.5 + 2.5x$

B. $y = 2.5 - 0.5x$

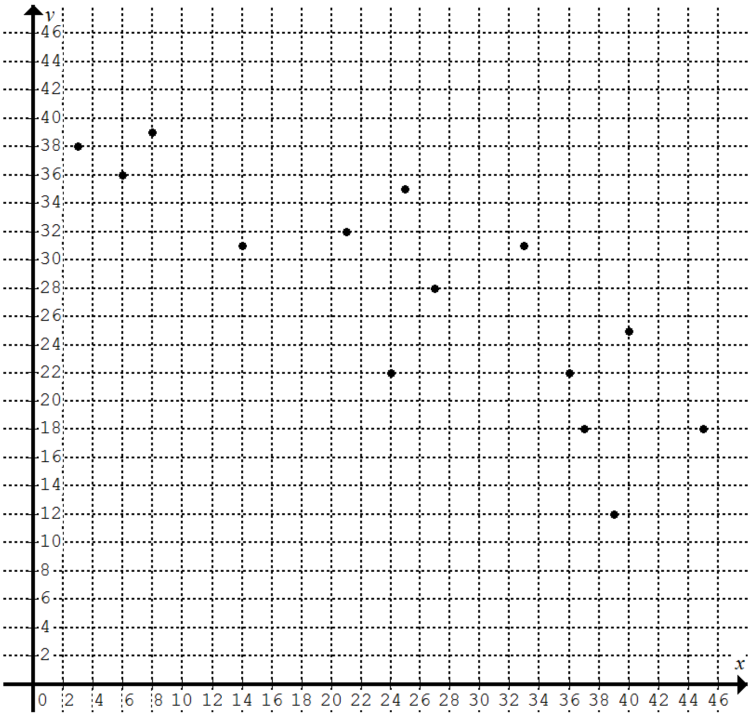
C. $y = 0.5 - 2.5x$

D. $y = 2.5 + 0.5x$

E. $y = 2.5x - 0.5$

The following information relates to Questions 9 and 10

The scatterplot displays a set of bivariate data. A ***three median line*** is to be fitted to the set of data.



Question 9

The three median points are

A. $(39,22)$, $(26,30)$ and $(8,36)$

B. $(39.5,18)$, $(26,30)$ and $(7,37)$

C. $(39,18)$, $(26,29.5)$ and $(8,36)$

D. $(40,18)$, $(26,30)$ and $(7,37)$

E. $(39,18)$, $(26,30)$ and $(8,36)$

Question 10

The equation of the three median line is closest to

A. $y = 44 - 0.6x$

B. $y = 41 - 0.58x$

C. $y = 40 - 0.58x$

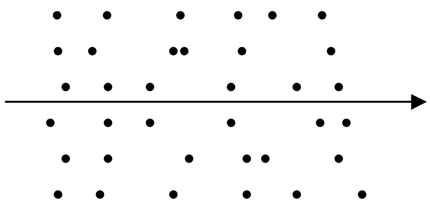
D. $y = 43 - 0.6x$

E. $y = 42 - 0.58x$

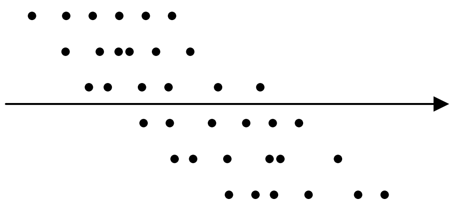
Question 11

The equation of the least squares regression line for a set of data is ***incorrect*** due to an arithmetic error. Which one of the following residual plots is ***most likely*** to be the result of using this incorrect equation to calculate the residuals?

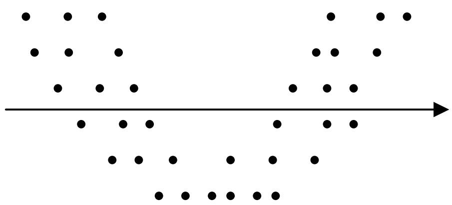
A.



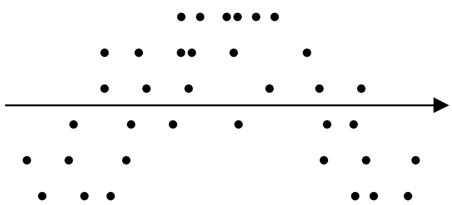
B.



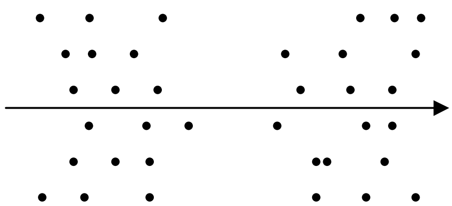
C.



D.



E.



The following information relates to Questions 12 and 13

The following table shows the daily turnovers of a restaurant in the first two weeks of its operation. Two entries in the cells are labeled as *X* and *Y*. Four 7-point moving averages are shown.

Day	Daily turnover (nearest $)	7-point moving average (nearest $)
1	12532	
2	11895	
3	8957	
4	7761	10676
5	13031	*X*
6	14422	
7	6137	
8	5226	9408
9	*Y*	
10	10134	
11	8927	9718
12	15008	
13	13678	
14	7074	10205

Question 12

The values of *X* and *Y*, correct to the nearest $, are respectively

A. 8821 and 8014

B. 8821 and 9187

C. 7690 and 8014

D. 9633 and 7979

E. 7749 and 9327

Question 13

The ***total*** turnover, correct to the nearest $, of days 15, 16 and 17 was

A. 19859

B. 24783

C. 27011

D. 25337

E. 26748

SECTION B Instructions

Answer **all** questions

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if **more than one** answer is completed for any question.

Module 1: Number patterns

Question 1

The 15th term of the sequence -1, 2, 7, 14, 23, 34, …… is

A. 122

B. 133

C. 203

D. 223

E. 332

Question 2

A fruiterer stacks oranges in the shape of a tetrahedron. There are 8 layers of oranges in the stack. The total number of oranges in the stack is

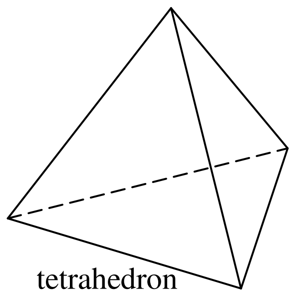
A. 90

B. 100

C. 105

D. 110

E. 120



Question 3

The sum of the ***last*** 10 terms of the sequence -7.3, -6.5, -5.7, ……, 7.9 is

A. 42.2

B. 43

C. 43.8

D. 44

E. 44.6

Question 4

$S_\infty = a + ...$ is an infinite geometric series where $a = 12$ and $S_\infty = 18$. An extra term, *b*, is added to form a second infinite geometric series, $b + a + ...$

The value of the ***second*** infinite geometric series is

A. 30

B. 42

C. 54

D. 62

E. 70

Question 5

Given the ***arithmetic*** sequence: t_1, t_2, t_3, t_4, t_5, ……, t_{12}, t_{13}, t_{14}, t_{15} where $t_3 + t_{13} = 16$, the value of S_{15} is

A. 100

B. 106

C. 110

D. 116

E. 120

Question 6

If the cost of living increases by 5.5% every year, the % increase at the end of three consecutive years is closest to

A. 16.5

B. 17.0

C. 17.5

D. 18.0

E. 18.5

Question 7

Given $t_{n+1} + t_n = 2t_n - 1$ and $t_2 = -1$, the value of t_{21} is

A. -20

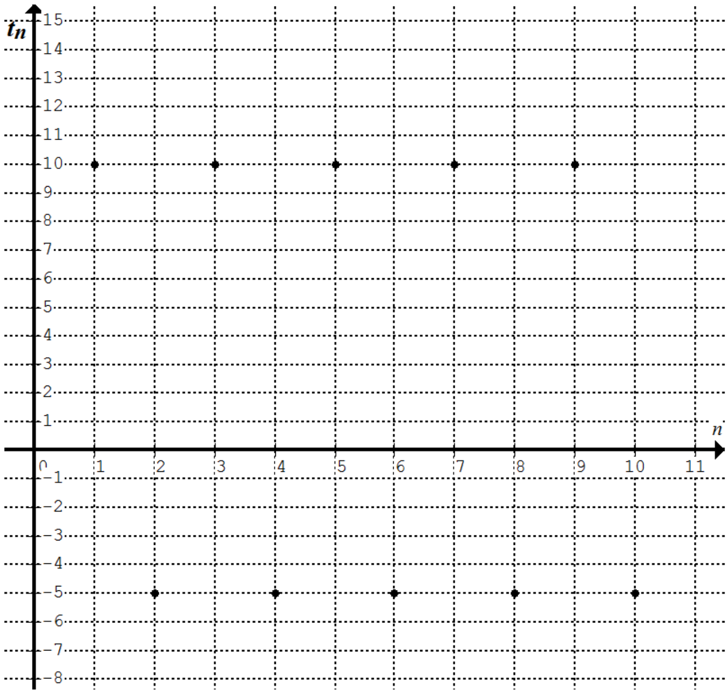
B. -21

C. -22

D. 21

E. 20

Question 8



The first order difference equation of the sequence shown in the above graph is

A. $t_n + 2t_{n+1} = 0$

B. $t_n - t_{n+1} = 5$

C. $t_n - t_{n+1} = 15$

D. $t_n - t_{n+1} = -15$

E. $t_n + t_{n+1} = 5$

Question 9

A sequence has the following property:
The sum of any three consecutive terms of the sequence $= 2\times$ the last one of the three consecutive terms

The sequence ***must be***

A. a sequence of Lucas numbers

B. an arithmetic sequence

C. a Fibonacci sequence

D. a geometric sequence

E. a sequence consisting of odd and even numbers

Module 5: Networks and decision mathematics

Question 1

A complete graph has n vertices and 253 edges. The value of n is between

A. 11 and 20

B. 21 and 30

C. 31 and 40

D. 41 and 50

E. 51 and 60

Question 2

A graph has an odd number of vertices. The sum of the degrees of all the vertices of the graph

A. must be an odd number

B. must be an even number

C. can be odd or even

D. cannot exceed two times the number of vertices

E. cannot be zero

Question 3

A complete planar graph has n vertices. The maximum value of n is

A. 2

B. 3

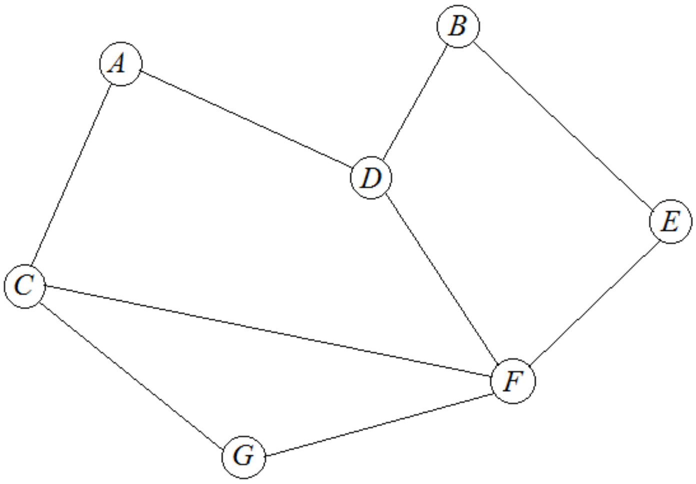
C. 4

D. 6

E. greater than 7

The following information relates to Questions 4 and 5

A connected graph of seven vertices A, B, C, D, E, F and G is shown below.



Question 4

The number of unique ***Euler circuits*** of the connected graph is

A. 0

B. 3

C. 4

D. 5

E. 7

Question 5

Starting from vertex G the number of unique ***Hamiltonian paths*** of the connected graph is

A. 0

B. 3

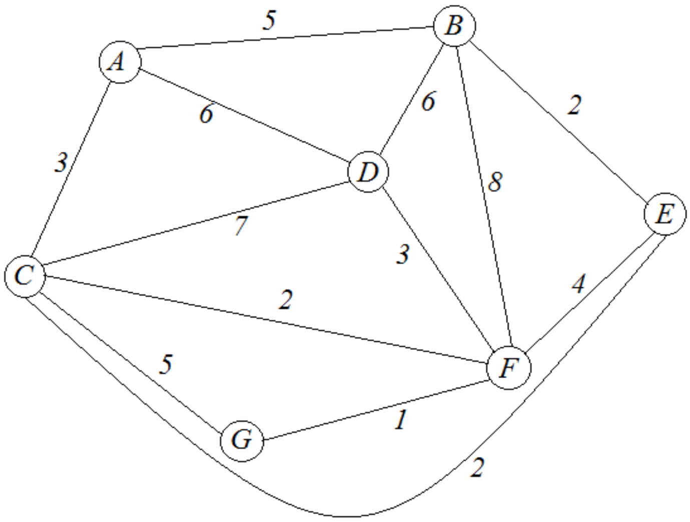
C. 4

D. 5

E. 7

The following information relates to Questions 6 and 7

Seven scenic spots A, B, C, D, E, F and G are connected by roads. The lengths in kilometres of the roads are shown in the following weighted graph.



Question 6

The shortest total length (km) of roads connecting the seven scenic spots is

A. 13

B. 14

C. 15

D. 16

E. 17

Question 7

To visit each of the seven scenic spots at least once the shortest distance (km) required to travel is

A. 15

B. 16

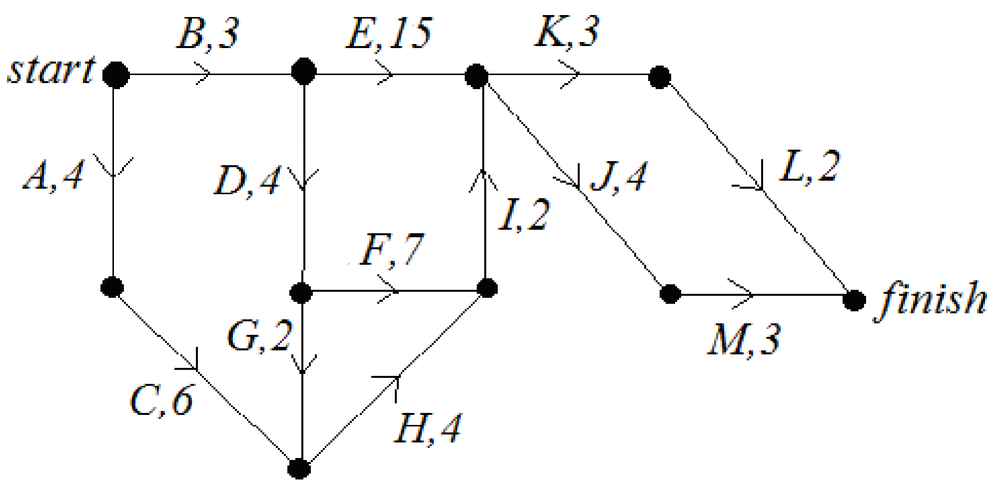
C. 17

D. 18

E. 19

The following information relates to Questions 8 and 9

The following directed graph shows the activities *A*, *B*, *C*, ……, *L and M* required to complete a project. Next to each activity is its completion time in hours.



Question 8

The minimum time (in hours) required to complete the project is

A. 25

B. 23

C. 22

D. 21

E. 19

Question 9

When the times required to complete activities *E* and *F* are reduced to 11 and 5 hours respectively, the critical path is

A. *B-E-J-M*

B. *B-E-K-L*

C. *A-C-H-I-J-M*

D. *A-C-H-I-K-L*

E. *B-D-G-H-I-J-M*

Module 6: Matrices

Question 1

$$\begin{bmatrix} a \\ b \\ c \\ 0 \end{bmatrix}\begin{bmatrix} 0 & a & b \end{bmatrix}$$

A. has order of 3×4

B. has order 2×3

C. has order 4×3

D. has order 3×2

E. is undefined

The following information relates to Questions 2 and 3

Let $A=\begin{bmatrix} -2.8 & -1.2 \\ -0.4 & 0.4 \end{bmatrix}$, $B=\begin{bmatrix} -3 & 1 \\ 1 & -2 \end{bmatrix}$, $C=\begin{bmatrix} 2 & -1 \\ 0 & 3 \end{bmatrix}$ and $X=\begin{bmatrix} 1 & x \\ 0 & -1 \end{bmatrix}$.

Question 2

The inverse of X is

A. $\begin{bmatrix} -1 & -x \\ 0 & 1 \end{bmatrix}$

B. $\begin{bmatrix} 1 & x \\ 0 & -1 \end{bmatrix}$

C. $\begin{bmatrix} -1 & 0 \\ x & 1 \end{bmatrix}$

D. $\begin{bmatrix} -1 & 0 \\ -x & 1 \end{bmatrix}$

E. $\begin{bmatrix} 1 & 0 \\ x & -1 \end{bmatrix}$

Question 3

If $C=B(A+2X)$, the value of x is

A. 2.5

B. 2.0

C. 1.5

D. 0.5

E. -1.0

The following information relates to Questions 4 and 5

Consider the simultaneous equations in x, y and z: $2x-3y=5$, $3x+2y=1$, $x-y=2$

Question 4

The matrix form of the simultaneous equations is

A. $\begin{bmatrix} 2 & -3 \\ 3 & 2 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 5 \\ 1 \\ 2 \end{bmatrix}$

B. $\begin{bmatrix} 2 & 3 & 1 \\ -3 & 2 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 5 \\ 1 \\ 2 \end{bmatrix}$

C. $\begin{bmatrix} 2 & -3 \\ 3 & 2 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} x & y & z \end{bmatrix}=\begin{bmatrix} 5 & 1 & 2 \end{bmatrix}$

D. $\begin{bmatrix} x & y & z \end{bmatrix}\begin{bmatrix} 2 & -3 \\ 3 & 2 \\ 1 & -1 \end{bmatrix}=\begin{bmatrix} 5 & 1 & 2 \end{bmatrix}$

E. $\begin{bmatrix} 2 & -3 & 0 \\ 3 & 2 & 0 \\ 1 & -1 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 5 \\ 1 \\ 2 \end{bmatrix}$

Question 5

A possible $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ is

A. $\begin{bmatrix} -1 \\ 1 \\ 11 \end{bmatrix}$

B. $\begin{bmatrix} -1 \\ 1 \\ 101 \end{bmatrix}$

C. $\begin{bmatrix} 1 \\ -1 \\ 111 \end{bmatrix}$

D. $\begin{bmatrix} -2 \\ 2 \\ 1 \end{bmatrix}$

E. $\begin{bmatrix} 2 \\ -2 \\ 11 \end{bmatrix}$

Question 6

The price $ per kilogram of apples, bananas and carrots sold in three fruit and vegetable shops *P*, *Q* and *R* are shown in the following table.

	P	*Q*	*R*
apples	2.30	2.10	2.20
bananas	3.10	3.20	3.30
carrots	1.20	1.30	1.10

Which one of the following products of matrices will give the total cost of buying 2 kg of apples, 3 kg of bananas and 1 kg of carrots from each shop?

A. $\begin{bmatrix} 2.30 & 2.10 & 2.20 \\ 3.10 & 3.20 & 3.30 \\ 1.20 & 1.30 & 1.10 \end{bmatrix}\begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$

B. $\begin{bmatrix} 2 & 3 & 1 \end{bmatrix}\begin{bmatrix} 2.30 & 2.10 & 2.20 \\ 3.10 & 3.20 & 3.30 \\ 1.20 & 1.30 & 1.10 \end{bmatrix}$

C. $\begin{bmatrix} 2 & 3 & 1 \end{bmatrix}\begin{bmatrix} 2.30 & 3.10 & 1.20 \\ 2.10 & 3.20 & 3.30 \\ 2.20 & 1.30 & 1.10 \end{bmatrix}$

D. $\begin{bmatrix} 2.30 & 3.10 & 1.20 \\ 2.10 & 3.20 & 3.30 \\ 2.20 & 1.30 & 1.10 \end{bmatrix}\begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}$

E. $\begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}\begin{bmatrix} 2.30 & 3.10 & 1.20 \\ 2.10 & 3.20 & 3.30 \\ 2.20 & 1.30 & 1.10 \end{bmatrix}$

The following information relates to Questions 7, 8 and 9

The following table shows the consumer preferences in shopping at three centres *X*, *Y* and *Z*.

one week

following week	*X*	*Y*	*Z*
X	90%	1%	5%
Y	5%	95%	10%
Z	5%	4%	85%

For example, of the *Y* customers in one week, 95% will return to *Y*, 1% will shop at *X* and 4% will shop at *Z* in the following week.

In the third week of June 2013, 5200 shopped at *X*, 4000 shopped at *Y* and 4800 shopped at *Z*. Assume the total number of shoppers is constant in the following questions.

Question 7

The state matrix for the fourth week of June 2013 is closest to

A. $\begin{bmatrix} 4524 \\ 5422 \\ 4054 \end{bmatrix}$

B. $\begin{bmatrix} 4734 \\ 5011 \\ 4255 \end{bmatrix}$

C. $\begin{bmatrix} 4960 \\ 4540 \\ 4500 \end{bmatrix}$

D. $\begin{bmatrix} 0.90 & 0.01 & 0.05 \\ 0.05 & 0.95 & 0.10 \\ 0.05 & 0.04 & 0.85 \end{bmatrix}$

E. $\begin{bmatrix} 0.8130 & 0.0205 & 0.0885 \\ 0.0975 & 0.9070 & 0.1825 \\ 0.0895 & 0.0725 & 0.7290 \end{bmatrix}$

Question 8

The number of customers shopping at Z in the first week of June 2013 is closest to

A. 4420

B. 4820

C. 5220

D. 5620

E. 6020

Question 9

If the same trend continues into the future, the percentage of shoppers shopping at Y will be closest to

A. 70

B. 60

C. 50

D. 40

E. 30

End of Exam 1

