

Core – Data analysis

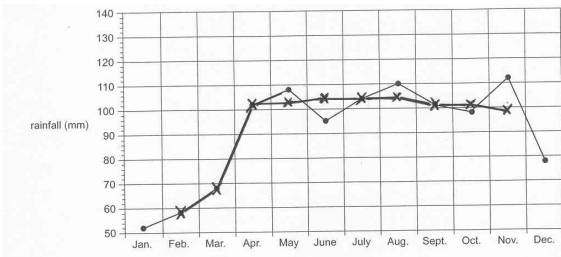
Q1a The dot above 14

Q1bi $\frac{15+16}{2} = 15.5$

Q1bii $\frac{11}{12} \times 100\% \approx 92\%$

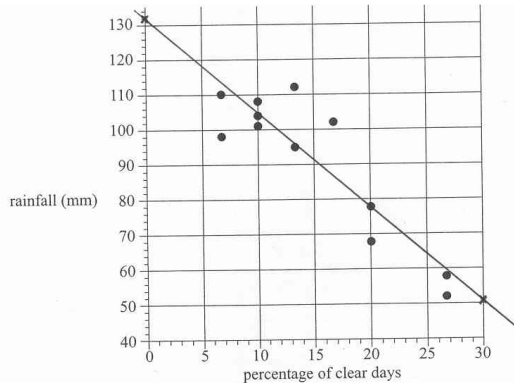
Q2a November

Q2b



Q2c Increases from Feb to April, and stays constant at April's rainfall up to Nov.

Q3a



Q3b rainfall = $131 - 2.68 \times 35 = 37.2$ mm

Q3ci About 81% of the variation in monthly rainfall can be explained by the variation in the monthly percentage of clear days in 2008.

Q3cii $r = -\sqrt{0.8081} = -0.899$

Q4a $4 - (0.78 + 1.05 + 1.07) = 1.10$

Q4b Deseasonalised value = $\frac{188}{0.78} \approx 241$ mm

Q4c Autumn rainfall is higher than the likely rainfall if there is no seasonal fluctuations by 5%.

Module 1: Number patterns

Q1a AP: $a = 28, d = 1, t_{10} = 28 + 9 = 37$ seats.

Q1b AP: $70 = 28 + (n-1)1, n = 43$ rows.

Q1c $S_{20} = \frac{20}{2}(2 \times 28 + 19) = 750$ seats.

Q1di GP: $a = 2800, r = 1.01, t_2 = 2800 \times 1.01 = \2828.00

Q1dii $t_9 = 2800 \times 1.01^8 = \3032.00

Q1e $S_{30} = \frac{2800(1.01^{30} - 1)}{1.01 - 1} \approx \97398

Q1f AP: $a = 28, d = 1, t_{26} = 28 + 25 = 53$ seats

GP: $a = 2800, r = 1.01, t_{26} = 2800 \times 1.01^{25} = \3590.81

Seat price in row 26 = $\frac{3590.81}{53} = \$67.75$

Q2a 2%

Q2b $R_{n+1} = 1.02R_n, R_n = \frac{R_{n+1}}{1.02}$

$R_6 = 2601, R_5 = \frac{2601}{1.02} = 2550, R_4 = \frac{2550}{1.02} = \2500

Q3a $T_{n+1} = 0.8T_n + 1000$

$T_1 = 12000$

$T_2 = 0.8 \times 12000 + 1000 = 10600$

$T_3 = 0.8 \times 10600 + 1000 = 9480$

Q3b $T_2 - T_1 = -1400, T_3 - T_2 = -1120$. The sequence has no common difference, it is not arithmetic.

Q3c $T_{10} = 5939.5$, week 10.

Q3d $t_n = ar^{n-1} + d \left(\frac{1-r^{n-1}}{1-r} \right)$

$t_n = 12000 \times 0.8^{n-1} + 1000 \left(\frac{1-0.8^{n-1}}{0.2} \right)$, which can be simplified

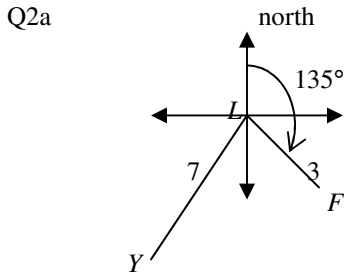
to $7000 \times 0.8^{n-1} + 5000$, and it is always > 5000 .
The performance season will continue.

Module 2: Geometry and trigonometry

Q1a Gradient = $\frac{50}{400} = 0.125$

Q1b Angle of elevation = $\tan^{-1}(0.125) \approx 7.1^\circ$

Q1c $FC = \sqrt{400^2 + 50^2} \approx 403.1$ m

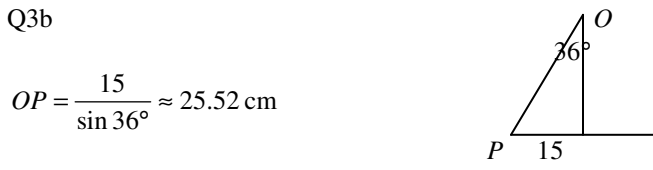


Q2b $\angle FLY = 210 - 135 = 75^\circ$

Q2c $FY = \sqrt{7^2 + 3^2 - 2 \times 7 \times 3 \cos 75^\circ} \approx 6.87$ km

Q2d $315^\circ T$

Q3a $\angle POQ = \frac{360}{5} = 72^\circ$



Q3c For each triangle, $s = \frac{30 + 25.52 + 25.52}{2} = 40.52$.

Area of pentagon
 $= 5 \times \sqrt{40.52(40.52 - 30)(40.52 - 25.52)(40.52 - 25.52)} \approx 1548$ cm²

Q4a $V = \pi r^2 h + \frac{1}{2} \times \frac{4}{3} \pi r^3 = \pi 12^2 \times 30 + \frac{1}{2} \times \frac{4}{3} \pi 12^3 \approx 17191$ cm³

Q4b Fraction of oil remaining = $\left(\frac{20}{50}\right)^3 = \frac{64}{1000}$.

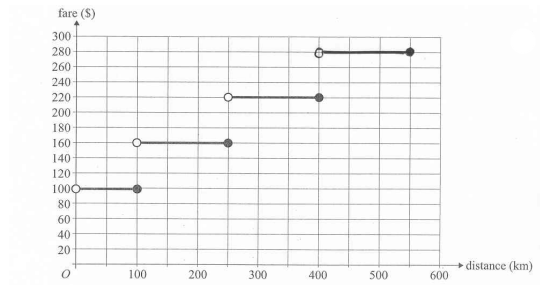
Fraction of oil removed = $1 - \frac{64}{1000} = \frac{936}{1000}$.

% removed = $\frac{936}{1000} \times 100\% = 93.6\%$

Module 3: Graphs and relations

Q1a 250 km

Q1b



Q1c fare = $40 + 0.5 \times 300 = 190$, saving $220 - 190 = \$30$

Q1d $40 + 0.5 \times \text{distance} = 220$, distance = 360 km

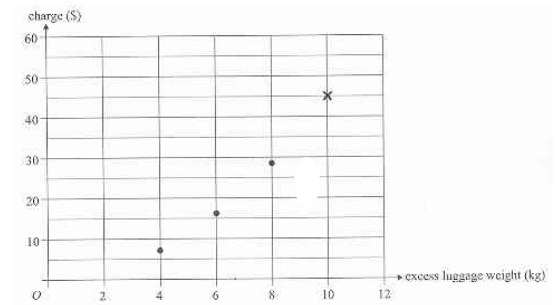
Q1e Pick two convenient points: (100,100) and (400,220).

$b = \text{gradient} = \frac{220 - 100}{400 - 100} = 0.4$

fare = $a + 0.4 \times \text{maximum distance}$

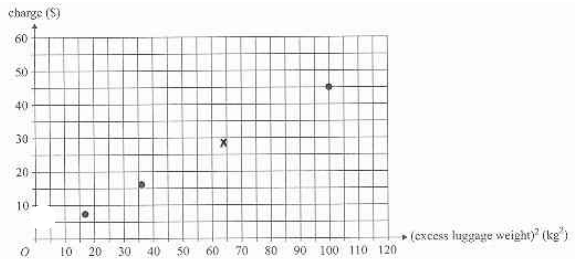
$100 = a + 0.4 \times 100$, $a = 60$

Q2a



Q2b

64



Q2c $45.00 = k \times 100$, $k = 0.45$

Q2d charge = $0.45 \times 12^2 = \$64.80$

Q3 fare = $20 + 0.47 \times 450 = 231.50$.

charge = $299 - 231.50 = 67.50$.

$\therefore 67.50 = m \times 15^2$, $m = 0.3$

Q4 profit = $1300x + 2100y$

At (2,7), maximum total profit = $1300 \times 2 + 2100 \times 7 = \17300 .

Module 4: Business-related mathematics

Q1a $500 - 120 = \$380$

Q1b $\frac{120}{500} \times 100\% = 24\%$

Q2a $250 \times \frac{1.5}{100} = \3.75

Q2b $\frac{6 \times 12}{250} \times 100\% = 28.8\%$

Q3a $\frac{4.4\%}{4} = 1.1\%$

Q3b $A = PR^n = 3400 \times 1.011^{12} = \3876.97

Q3c $A = 3400 \times 1.011^{24} = 4420.86$
Interest = $4420.86 - 3400 = \$1020.86$

Q4a Depreciation = $\frac{22000 \times 12 \times 4}{100} = 10560$

Depreciated value = $22000 - 10560 = \$11440$

Q4b Depreciated value = $22000 \times 0.84^4 = \$10953.17$

Q4c Reducing balance method will give a lower depreciated value than that of the flat rate method. \therefore reducing balance method will give a greater depreciation amount of $22000 - 10953.17 = \$11046.83$

Q5a TVM Solver: $\$151133.38$

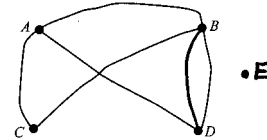
Q5b Total of monthly payments = $1500 \times 60 = 90000$
Reduction in loan amount = $200000 - 151133.38 = 48866.62$
Interest = $90000 - 48866.62 = \$41133.38$

Q5c TVM Solver: $\$1825.03$

Module 5: Networks and decision mathematics

Q1a E is isolated from the other suburbs by water.

Q1bi and ii



Q2a F, K

Q2b $KJH \quad KMJH \quad KFJH$

Q3a 4

Q3bi P , because there are only 2 odd-degree vertices, N and P .

Q3bii 5

Q3ci $SRQPONUT$

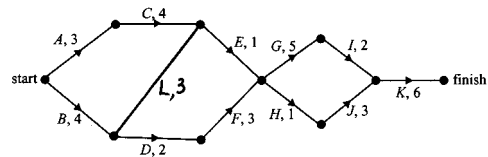
Q3cii $SRQPONTU \quad SRQPUNTO \quad SRUTNOPQ$

Q4a 7

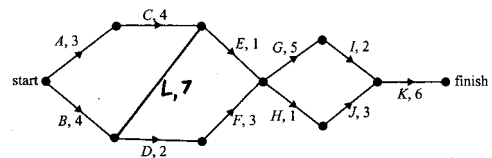
Q4b $BDFGIK$

Q4c A 1 week, C 1 week, E 1 week, H 3 weeks, J 3 weeks.
Longest float time is 3 weeks.

Q4d



Q4e



Now the critical path is $BLEGIK$.

Total overall time to complete = $4 + 7 + 1 + 5 + 2 + 6 = 25$ weeks

Module 6: Matrices

Q1a 2×3

Q1bi

$$W = PQ = \begin{bmatrix} 6.80 & 5.30 & 6.20 \\ 7.30 & 4.90 & 6.15 \end{bmatrix} \begin{bmatrix} 8 \\ 11 \\ 3 \end{bmatrix} = \begin{bmatrix} 131.30 \\ 130.75 \end{bmatrix}$$

Q1bii Safeworth

Q2a

35

2

Q2b

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 283 & 28 & 5 \\ 35 & 4 & 2 \\ 84 & 3 & 7 \end{bmatrix}^{-1} \begin{bmatrix} 8712 \\ 1143 \\ 2609 \end{bmatrix} = \begin{bmatrix} 27 \\ 32 \\ 35 \end{bmatrix}$$

Cost of a teacher ticket = \$32

Q3a $160 + 120 + 220 = 500$ students

Q3bi

25

Q3bii 5%

Q3biii $0.85 \times 160 + 0.40 \times 120 + 0.10 \times 220 = 206$ students

Q3c

$$S_1 = \begin{bmatrix} 0.85 & 0.35 & 0.60 \\ 0.10 & 0.40 & 0.30 \\ 0.05 & 0.25 & 0.10 \end{bmatrix} \begin{bmatrix} 160 \\ 120 \\ 220 \end{bmatrix} = \begin{bmatrix} 310 \\ 130 \\ 60 \end{bmatrix}$$

Q3d

$$S_3 = \begin{bmatrix} 0.85 & 0.35 & 0.60 \\ 0.10 & 0.40 & 0.30 \\ 0.05 & 0.25 & 0.10 \end{bmatrix}^3 \begin{bmatrix} 160 \\ 120 \\ 220 \end{bmatrix} = \begin{bmatrix} 361 \\ 91.1 \\ 47.9 \end{bmatrix}$$

361 'yes' students

Q4a

$$L_2 = \begin{bmatrix} 0.85 & 0.25 \\ 0.15 & 0.75 \end{bmatrix} \begin{bmatrix} 95 \\ 97 \end{bmatrix} - \begin{bmatrix} 5 \\ 7 \end{bmatrix} = \begin{bmatrix} 100 \\ 80 \end{bmatrix}$$

$$L_3 = \begin{bmatrix} 0.85 & 0.25 \\ 0.15 & 0.75 \end{bmatrix} \begin{bmatrix} 100 \\ 80 \end{bmatrix} - \begin{bmatrix} 5 \\ 7 \end{bmatrix} = \begin{bmatrix} 100 \\ 68 \end{bmatrix}$$

68 students attending the extra singing rehearsals in week 3.

Q4b

$$L_4 = \begin{bmatrix} 0.85 & 0.25 \\ 0.15 & 0.75 \end{bmatrix} \begin{bmatrix} 100 \\ 68 \end{bmatrix} - \begin{bmatrix} 5 \\ 7 \end{bmatrix} = \begin{bmatrix} 97 \\ 59 \end{bmatrix}$$

Number of students not expected to return = $(100 + 68) - (97 + 59) = 12$.

Please inform mathline@itute.com re conceptual, mathematical and/or typing errors