**LEE HOCK LEONG**
**M.Sc. (Pure Maths) – CGPA 4**
**B.Sc with Ed. (1st Class Hons.)**

## PERAK (2006)
## MATHEMATICS T (PAPER 1)

1. Solve the given equation $\log_{10}(19x^2 + 4) = 2\log_{10} x + 2$. [4]

2. The function is defined by $f(x) = \begin{cases} (x-2)^2 & , x \le 2 \\ 2 - \frac{4}{x} & , x > 2 \end{cases}$.

   Determine if $f$ is continuous at $x = 2$. [5]

3. Show that $y^2 - 2y - 4x - 7 = 0$ is a parabola and state its vertex and focus.

   Sketch the parabola. [4]

4. Use the trapezium rule with five ordinates to find an approximation for

   $\int_2^3 \frac{1}{3 - \ln x}\,dx$ correct to two decimal places. [5]

5. Find the equations of the tangent to the curve $x^3 + xy^2 = 5$ at the point where $x = 1$. [7]

6. The straight line $y = m(x - 2)$ through the fixed point $(2, 0)$ meets the lines $x = 1$ and $y = 3$ at $P$ and $Q$ respectively. Given that $O$ is the origin and $A$ the point $(1, 0)$, find the equations of the lines $OP$, $AQ$ and the coordinate of their intersection $R$.

   Hence, find the locus of the point $R$ as m varies. [8]

7 (a) If $\alpha$ and $\beta$ are the roots of the equation $x^2 + 4x + 2 = 0$, find the quadratic equation whose roots are $\alpha - \frac{1}{\alpha}$ and $\beta - \frac{1}{\beta}$. [5]

   (b) If the equation $x^2 - 15 + m(2x + 8) = 0$ has equal roots, find the values of $m$. [3]

8. Given the cubic expression $P(x) = 2x^3 - 7x^2 - 14x - 5$, show that $2x + 1$ is a factor of $P(x)$.

   Hence, find the roots of the cubic equation $P(x) = 0$ and also, find the set of values of $x$ such that $P(x) \ge 0$. [9]

9. (a) Given the series $1(1) + 2(3) + 3(5) + 4(7) + \ldots + u_r$, find $\sum_{r=1}^{n} u_r$. [4]

   (b) Find the set of values of $x$ such that the series

   $$1 + \frac{x}{2+x} + \left(\frac{x}{2+x}\right)^2 + \left(\frac{x}{2+x}\right)^3 + \ldots \text{ converges.}$$

   Find the sum to infinity of this series when $x = 3$. [4]

10. A curve has equation $y = \frac{x^2}{x^2 - 5x + 4}$. Find the equations of the asymptotes and the coordinates of the stationary points. Sketch the curve.

    Determine the number of real roots for the equation $a(x-1)^2(x-4) = x^2$, where $a > 0$. [13]

11. (a) Using the substitution $x = u^2 + 2$, find $\int x\sqrt{x-2}\,dx$. [5]

    (b) Express $\frac{x^2}{4 - x^2}$ in the form $A + \frac{B}{2-x} + \frac{C}{2+x}$.

    Hence, show that $\int_0^1 \frac{x^2}{4 - x^2}\,dx = \ln m - n$, stating the values of $m$ and $n$. [9]

12. (a) Determine if $\mathbf{A} = \begin{pmatrix} 2 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 2 & 1 \end{pmatrix}$ is a singular matrix. [4]

    (b) A bakery sells three types of cakes namely marble cake, chocolate cake and Tiramisu cake. The profit from a 2 kg marble cake, a 1 kg chocolate cake and a 1 kg Tiramisu cake is RM 24. By letting the profits from a 1 kg marble cake, a 1 kg chocolate cake and a 1 kg Tiramisu cake be RM $x$, RM $y$ and RM $z$ respectively, obtain a matrix equation representing the information given.

    Hence, determine the profit from a 1 kg marble cake, a 1 kg chocolate cake and a 1 kg Tiramisu cake. [11]

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## PERAK (2006)
## MATHEMATICS T (PAPER 2)

1. The points $A(2, 0)$, $B(0, 3)$ and the variable point $C(h, 1)$ moves in the $x$–$y$ plane parallel to the $x$–axis. By considering the dot products of the vectors $AC$ and $BC$, find the possible values of $h$ when the angle of $ABC$ is $90^\circ$. [5]

2. In the quadrilateral $PQRS$, the midpoints of $PQ$, $PS$, $SR$ and $RQ$ are $K$, $L$, $M$ and $N$ respectively. Prove that $KN$ is Parallel to $LM$. [7]

3. Prove that $3\cos^2 x - 2\sin x\cos x - 5\sin^2 x \equiv 4\cos 2x - \sin 2x - 1$. [3]

   (a) By using the substitutions $t = \tan x$, solve the equation for $0^\circ < x < 360^\circ$. [4]

   (b) Solve the inequality $5\sin^2 x + 2\sin x\cos x - 3\cos^2 x < 1$, for $0^\circ < x < 360^\circ$ [7]

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4. The population of an island at time $t$ is $p$. The number of births per unit time is $b$, and the number of deaths per unit time is proportional to the population at that time. By taking $p$ as a continuous variable, show that

$$\frac{dp}{dt} = b - kp, \text{ where } k \text{ is a positive constant.}$$ [2]

Solve the differential equation with the condition that $p = \frac{b}{5k}$ when $t = 0$.

Express $p$ as a function of $t$. [5]

Find the time when the population of the island is $\frac{9b}{10k}$. [2]

Sketch the graph of $p$ versus $t$. [2]

5. A ship is moving at a constant speed of 10 km h$^{-1}$ in the direction of the unit vector $\underline{i}$. Initially, its position vector, relative to a fixed point, origin O, is $10(-\underline{i} + \underline{j})$, where $\underline{i}$ and $\underline{j}$ are perpendicular vectors of the length 1 km.
Find the position vector relative to the origin $t$ hours later. [2]

A second ship is moving with a constant speed of $10\sqrt{5}$ km h$^{-1}$ parallel to the vector $\underline{i} + 2\underline{j}$ and is initially at the origin.
Show that the shortest distance between the ships is 10 km. [6]

6. The table shows the relative frequencies for the number of books read by a group of students in a month.

| No. of books | 0 | 1 | 2 | 3 | 4 or more |
|---|---|---|---|---|---|
| Relative frequency | 0.06 | 0.34 | 0.20 | 0.28 | 0.12 |

(a) State the mode and median of the data. [2]

(b) If the mean for those who read four or more books in a month is 6.5, find the mean number of books read by this group of students in a month. [3]

7. Ahmad writes 6 letters, one each to $P$, $Q$, $R$, $S$, $T$ and $U$. Each letter is placed in a separate envelope and sealed. He then addresses the envelope, at random, one each to $P$, $Q$, $R$, $S$, $T$ and $U$. Find the probability that

(a) the letter to $P$ is in the correct envelope and the letter to $Q$ is in an incorrect envelope. [1]

(b) the letter to $P$ is in the correct envelope, given that the letter to $Q$ is in an incorrect envelope. [3]

(c) both the letters to $P$ and $Q$ are in the incorrect envelopes. [3]

8. In a study of women above 50 years old, it was found that 2% of them suffer from osteoporosis.

(a) If a sample of 10 women is selected randomly, determine the probability that

(i) exactly two women suffer from osteoporosis, [2]

(ii) at least two women suffer from osteoporosis. [3]

(b) A random sample of 200 women is obtained. Using a suitable approximation, determine the probability that at most two women suffer from osteoporosis. [3]

9. The random variable $X$ has the distribution function given by $F(x) = \begin{cases} 0 & , x < 0 \\ \frac{1}{81}x^2 & , 0 \le x \le 9 \\ 1 & , x > 9 \end{cases}$.

(a) Find the 9th percentile of $X$. [2]

(b) The continuous random variable $Y$ is defined by $Y = \sqrt{X}$.
Show that for $0 \le y \le 3$, $P(Y \le y) = \frac{1}{81}y^4$. [3]

(c) Find also the expectation and variance of $\sqrt{X}$. [6]

10. The discrete random variable $X$ has the probability function

$P(X = x) = \begin{cases} a & , x = 0, 2, 4 \\ b & , x = 1, 3, 5 \\ 0 & , \text{otherwise} \end{cases}$ and $2P(X \ge 2) = 3P(X < 3)$, where $a$ and $b$ are constants.

(a) Find the values of $a$ and $b$. [3]

(b) Find the probability that the sum of two independent observation, $X_1$ and $X_2$, from this distribution is greater than 8. [3]

11. The mass of a randomly chosen apple of variety $A$ has a normal distribution with mean 0.125 kg and standard deviation 0.02 kg. The mass of a randomly chosen apple of variety $B$ has normal distribution with mean 0.100 kg and standard deviation 0.03 kg. Find the probability that the total mass of 3 randomly chosen apples of variety $A$ is greater than the total mass of 4 randomly chosen apples of variety $B$. [7]

12. The table shows the cumulative frequency of the monthly expenditure in RM of 100 university students.

| Expenditure | No. of students |
|---|---|
| $x < 100$ | 0 |
| $x < 150$ | 15 |
| $x < 200$ | 25 |
| $x < 275$ | 70 |
| $x < 300$ | 92 |
| $x < 400$ | 100 |

(a) Draw a histogram to illustrate the information. [4]

(b) Use your histogram to find the mode. [2]

(c) Calculate the percentage of students who spend less than RM 2.50. [3]

(d) Calculate the semi-interquartile range. [3]

PERAK 2006

MT1

No.: ..... Date: .....

1. $\log_{10}(19x^2+4) = 2\log_{10}x + 2$

$\lg(19x^2+4) = \lg[x^2 . 10^2]$

$19x^2+4 = 100x^2 \Rightarrow x^2 = \frac{4}{81}$

$\therefore x = \frac{2}{9}, [\because x>0]$ *

2. $f(2) = (2-2)^2 = 0$

$\lim_{x\to 2^+} f(x) = 2 - \frac{4}{2} = 0$

$\lim_{x\to 2^-} f(x) = (2-2)^2 = 0$

$\therefore \lim_{x\to 2^-} f(x) = f(2) = \lim_{x\to 2^+} f(x)$

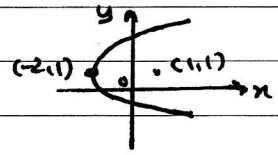
$\Rightarrow f$ is continuous at $x=2$ *

3. $y^2-2y-4x-7=0 \Rightarrow (y-1)^2-4x-8=0$

$\therefore (y-1)^2 = 4(x+2)$

$\therefore$ Vertex $= (-2,1)$

focus $= (1,1)$ *




4. $\int_2^3 \frac{1}{3-\ln x}dx \approx \frac{1}{2}(\frac{1}{4})[\frac{1}{3-\ln 2} + 2(\frac{1}{3-\ln 2.25} + \frac{1}{3-\ln 2.5} + \frac{1}{3-\ln 2.75}) + \frac{1}{3+\ln 3}] = 0.48$ (2dp) *

5. $x^3+xy^2=5$: $x=1$: $y^2=4 \Rightarrow y=\pm 2$

$3x^2+y^2+x(2y\frac{dy}{dx})=0 \Rightarrow \frac{dy}{dx} = -\frac{3x^2+y^2}{2xy}$

$(1,2)$: $m_t = \frac{3+4}{4} = -\frac{7}{4}$

$\therefore$ tangent: $\frac{y-2}{x-1} = -\frac{7}{4} \Rightarrow 4y+7x=15$

$(1,-2)$: $m_t = \frac{3+4}{-4} = \frac{7}{4}$

$\therefore$ tangent: $\frac{y+2}{x-1} = \frac{7}{4} \Rightarrow 4y=7x-15$ *

6. $x=1$: $y=-m$, $P(1,-m)$

$y=3$: $x = \frac{3}{m}+2$, $Q(\frac{3}{m}+2, 3)$

OP: $y=-mx$ * —①

AQ: $\frac{y-0}{x-1} = \frac{3-0}{\frac{3}{m}+2-1}$

$\therefore y = \frac{3m}{3+m}(x-1)$ * —②

For R: $-mx = \frac{3m}{3+m}(x-1)$ $[\because m\neq 0]$

$-3mx-m^2x = 3mx-3m \Rightarrow x = \frac{3}{6+m}$

$\therefore R(\frac{3}{6+m}, \frac{-3m}{6+m})$ *

①→②: $y(3-\frac{y}{x}) = 3(-\frac{y}{x})(x-1)$ $[\because y\neq 0]$

$\therefore y = 6x-3$ * [locus of R]

7.(a) $x^2+4x+2=0$ (roots $=\alpha,\beta$)

$\alpha+\beta=-4$, $\alpha\beta=2$

Roots $= \alpha-\frac{1}{\alpha}, \beta-\frac{1}{\beta}$:

Sum $= \alpha+\beta-\frac{\alpha+\beta}{\alpha\beta} = -4-\frac{(-4)}{2} = -2$

Product $= \alpha\beta+\frac{1}{\alpha\beta}-[\frac{\alpha}{\beta}+\frac{\beta}{\alpha}]$

$= 2+\frac{1}{2}-[\frac{\alpha^2+\beta^2}{\alpha\beta}] = \frac{5}{2}-[\frac{(-4)^2-2(2)}{2}] = -\frac{7}{2}$

$\therefore$ QE: $y^2+2y-\frac{7}{2}=0$ *

(b) $x^2-15+m(2x+8)=0 \Rightarrow x^2+2mx+8m-15=0$

For equal roots: $b^2-4ac=0$

$4m^2-4(1)(8m-15)=0$

$\therefore m^2-8m+15=0 \Rightarrow (m-3)(m-5)=0$

$\therefore m=3$ or $5$ *

8. $P(-\frac{1}{2}) = 2(-\frac{1}{8})-\frac{7}{4}+7-5=0$

$\therefore (2x+1)$ is a root of $P(x)$ *

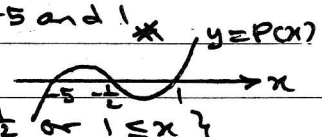
$P(x) = 2x^3-7x^2-14x-5$

$\equiv (2x+1)(x^2+4x-5) = (2x+1)(x+5)(x-1)$

$P(x)=0$: $x=-\frac{1}{2}$ or $-5$ or $1$

$\therefore$ roots $= -\frac{1}{2}, -5$ and $1$ *

For $P(x)\geq 0$




$\{x: -5\leq x\leq -\frac{1}{2}$ or $1\leq x\}$ *

9.(a) $\sum_{r=1}^{n} 4r = \sum_{r=1}^{n} r(2r-1)$

$= 2\sum_{r=1}^{n} r^2 - \sum_{r=1}^{n} r = 2(\frac{n}{6})(n+1)(2n+1)-\frac{n}{2}(n+1)$

$= \frac{n}{6}(n+1)[4n+2-3] = \frac{n}{6}(n+1)(4n-1)$ *

(b) For series converges: $|\frac{x}{2+x}|<1$

$x^2<(2+x)^2 \Rightarrow x^2<4+4x+x^2$

$\therefore \{x: x>-1\}$ *

$x=3$: $1+\frac{3}{5}+(\frac{3}{5})^2+\ldots = \frac{1}{1-\frac{3}{5}}$

$= \frac{5}{2}$ *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10. $y = \frac{x^2}{x^2-5x+4} = 1 + \frac{5x-4}{x^2-5x+4}$

asymptotes: $y=1$, $x=1$, $x=4$

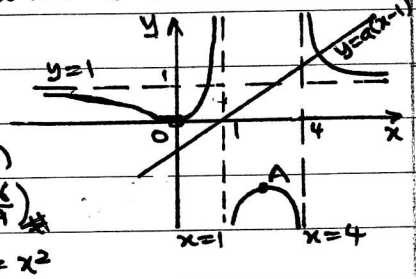
$\frac{dy}{dx} = \frac{(x^2-5x+4)(5)-(5x-4)(2x-5)}{(x^2-5x+4)^2}$

$\frac{dy}{dx}=0$: $5x^2-25x+20-(10x^2-33x+20)=0$

$\therefore x(8-5x)=0$

$\therefore x=0$ or $\frac{8}{5}$

$\therefore$ Stat. points $=(0,0)$, $A\left(\frac{8}{5},-\frac{16}{9}\right)$ ✱




$a(x-1)^2(x-4)=x^2$

$\therefore a(x-1) = \frac{x^2}{x^2-5x+4}$

No. of real roots $=1$ ✱ ($\because$ 1 int. point)

11(a) $x=u^2+2$: $\frac{dx}{du}=2u$

$\int x\sqrt{x-2}\,dx = \int (u^2+2)(u)(2u\,du)$

$= \int (2u^4+4u^2)\,du = \frac{2}{5}u^5+\frac{4}{3}u^2+c$

$= \frac{2}{5}(x-2)^{5/2}+\frac{4}{3}(x-2)^{3/2}+c$ ✱

(b) (i) $\frac{x^2}{4-x^2} = \frac{4}{4-x^2}-1 = \frac{1}{2-x}+\frac{1}{2+x}-1$ ✱

(ii) $\int_0^1 \frac{x^2}{4-x^2}\,dx = \int_0^1\left[\frac{1}{2+x}+\frac{1}{2-x}-1\right]dx$

$=\left[\ln\left(\frac{2+x}{2-x}\right)-x\right]_0^1 = \ln 3-1$ ✱, $\begin{pmatrix} m=3 \\ n=1\end{pmatrix}$

12. (a) $\det A = 2(1)(1-2)+1(-1)(1-2)+2(1)(1-1)$

$=-1\ (\neq 0)$

$\therefore$ A is not a singular matrix ✱

(b) $\left.\begin{array}{l} 2x+y+z=20 \\ x+y+z=18 \\ 2x+2y+z=24 \end{array}\right\}$ $A\begin{pmatrix}x\\y\\z\end{pmatrix}=\begin{pmatrix}20\\18\\24\end{pmatrix}$ —①

$(c_{ij})_A = \begin{pmatrix}-1&1&0\\1&0&-2\\0&-1&1\end{pmatrix}$, $A^{-1}=\frac{1}{-1}(c_{ij})^T$

①: $\begin{pmatrix}x\\y\\z\end{pmatrix}=(-1)\begin{pmatrix}-1&1&0\\1&0&-1\\0&-2&1\end{pmatrix}\begin{pmatrix}20\\18\\24\end{pmatrix}=\begin{pmatrix}2\\4\\12\end{pmatrix}$

$\therefore x=2$, $y=4$, $z=12$ ✱

1. (a) Mode $=1$ ✱, $m=2$ ✱

(b) $\bar{x} = 0(0.06)+1(0.34)+2(0.2)$

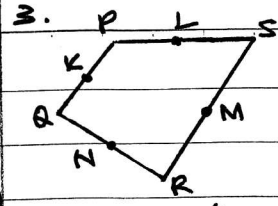
$+3(0.28)+6.5(0.12)=2.36$ ✱

2. $\angle ACB=90°$: $\overrightarrow{AC}\cdot\overrightarrow{BC}=0$

$\begin{pmatrix}h-2\\1\end{pmatrix}\cdot\begin{pmatrix}h\\-2\end{pmatrix}=0 \Rightarrow h^2-2h-2=0$

$h=\frac{1}{2}\left[2\pm\sqrt{4+8}\right]=1\pm\sqrt{3}$ ✱

3.




$\overrightarrow{KN}=\overrightarrow{KQ}+\overrightarrow{QN}$

$=\frac{1}{2}[\overrightarrow{PQ}+\overrightarrow{QR}]=\frac{1}{2}\overrightarrow{PR}$

$=\frac{1}{2}[\overrightarrow{PS}+\overrightarrow{SR}]=\overrightarrow{LS}+\overrightarrow{SM}$

$=\overrightarrow{LM}$

$\therefore KN \parallel LM$ ✱

4. $3\cos^2x-2\sin x\cos x-5\sin^2x$

$=3\left(\frac{1}{2}\right)(1+\cos 2x)-\sin 2x-5\left(\frac{1}{2}\right)(1-\cos 2x)$

$=4\cos 2x-\sin 2x-1$ ✱

(a) $3\cos^2x-2\sin x\cos x-5\sin^2x=3$

$\therefore 3-2\tan x-5\tan^2x=3(1+\tan^2x)$

$4t^2+t=0 \Rightarrow t(4t+1)=0$

$\therefore \tan x=0$ or $-\frac{1}{4}$

$\therefore x=180°, 166.0°, 346.0°$ ✱

(b) $5\sin^2x+2\sin x\cos x-3\cos^2x<1$

$\therefore \sin 2x<4\cos 2x$ —①

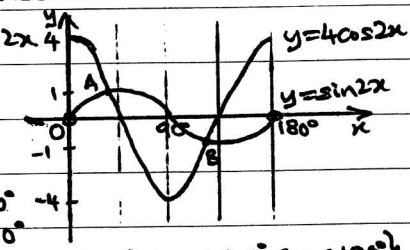
For A, B:

$\sin 2x=4\cos 2x$

$\tan 2x=4$

$2x=76.0°, 256.0°$

$\therefore x=38.0°, 128.0°$




For ①: $\{x: 0<x<38.0° \text{ or } 128.0°<x<180°\}$ ✱

5. birth: $\frac{dp}{dt}=b$

death: $-\frac{dp}{dt}\propto p \Rightarrow \frac{dp}{dt}=-kp$, $(k>0)$

$\therefore \frac{dp}{dt}=b-kp$

$\int \frac{k}{b-kp}\,dp=\int k\,dt$

$\therefore \ln(b-kp)=-kt+c$ —①

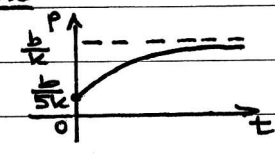
$t=0$: $\ln\frac{4b}{5}=c$ —②

① − ②: $\ln\left[\frac{5(b-kp)}{4b}\right]=-kt$

$\therefore \frac{5}{4b}(b-kp)=e^{-kt} \Rightarrow kp=b-\frac{4b}{5}e^{-kt}$

$\therefore p=\frac{b}{5k}\left[5-4e^{-kt}\right]$

$p=\frac{9b}{10k}$: $t=-\frac{1}{k}\ln\left(\frac{5}{4b}\right)\left(\frac{b}{10}\right)=\frac{3}{k}\ln 2$

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6. (a) Prob. $= \frac{1}{6}\left(\frac{4}{5}\right) = \frac{2}{15}$, $[= P(P \cap Q')]$

(b) $P(P|Q') = \frac{P(P\cap Q')}{P(Q')} = \frac{2}{15} \Big/ \frac{5}{6} = \frac{4}{25}$

(c) $P(P' \cap Q') = \left(\frac{1}{6}\right)\left(\frac{5}{5}\right) + \left(\frac{4}{6}\right)\left(\frac{4}{5}\right) = \frac{7}{10}$

7. $X$ = no. of women suffer osteoporosis

(a) $X \sim B(10, 0.02)$:

(i) $P(X=2) = {}^{10}C_2 (0.02)^2 (0.98)^8 = 0.0153$

(ii) $P(X \geq 2) = 1 - [0.98^{10} + 10(0.02)(0.98)^9]$

$= 0.0162$

(b) $X \sim B(200, 0.02) \rightarrow X \sim P_o(4)$

$P(X \leq 2) = e^{-4}\left[1 + 4 + \frac{4^2}{2!}\right] = 0.2381$

8. (a) $F(k) = 0.09$ : $\frac{1}{81}x^2 = 0.09$

$\therefore x^2 = 7.29 \Rightarrow x = 2.7$, $[\because 0 \leq x \leq 9]$

(b) $P(Y \leq y) = P(\sqrt{X} \leq y) = P(X \leq y^2)$

$= \frac{1}{81}(y^2)^2$, for $0 \leq y^2 \leq 9$

$= \frac{y^4}{81}$, for $0 \leq y \leq 3$, $[\because y \geq 0]$

(c) $f(x) = \frac{d}{dx}[F(x)] = \begin{cases} \frac{2}{81}x & 0 \leq x \leq 9 \\ 0 & \text{otherwise} \end{cases}$

$E(\sqrt{X}) = \int_0^9 \frac{2}{81} x\sqrt{x}\,dx = \frac{2}{81}\left[\frac{2}{5}x^{5/2}\right]_0^9$

$= \frac{4}{405}[243 - 0] = 2.4$

$E(X) = \int_0^9 \frac{2}{81}x^2\,dx = \frac{2}{243}[x^3]_0^9$

$= \frac{2}{243}[729 - 0] = 6$

$\therefore Var(\sqrt{X}) = 6 - 2.4^2 = 0.24$

9. (a) $2P(X \geq 2) = 3P(X < 3)$

$2[a + b + a + b] = 3[a + b + a] \rightarrow b = 2a$

$\Sigma P(X=x) = 1$ : $3a + 3b = 1 \Rightarrow a = \frac{1}{9}, b = \frac{2}{9}$

(b) $P(X_1 + X_2 > 8) = P(5,5) + P(4,5) + P(5,4)$

$= \left(\frac{2}{9}\right)^2 + \left(\frac{1}{9}\right)\left(\frac{2}{9}\right)(2) = \frac{8}{81}$

10. $A \sim N(0.125, 0.02^2)$, $B \sim N(0.1, 0.03^2)$

Let $T = (A_1 + A_2 + A_3) - (B_1 + B_2 + B_3 + B_4)$

$T \sim N(3(0.125) - 4(0.1), 3(0.02)^2 + 4(0.03^2))$

$\therefore T \sim N(-0.025, 0.0048)$

$P(T > 0) = P\left(Z > \frac{0 + 0.025}{\sqrt{0.0048}}\right)$

$= P(Z > 0.3608) = 0.3591$

11. $S_1 = 10\begin{pmatrix}-1\\1\end{pmatrix} + t\begin{pmatrix}10\\0\end{pmatrix} = \begin{pmatrix}-10+10t\\10\end{pmatrix}$

$S_2 = \begin{pmatrix}0\\0\end{pmatrix} + t(10\sqrt{5})\left[\frac{1}{\sqrt{5}}\begin{pmatrix}1\\2\end{pmatrix}\right] = \begin{pmatrix}10t\\20t\end{pmatrix}$

$S_{12} = S_1 - S_2 = \begin{pmatrix}-10\\20t-10\end{pmatrix} = 10\begin{pmatrix}-1\\2t-1\end{pmatrix}$

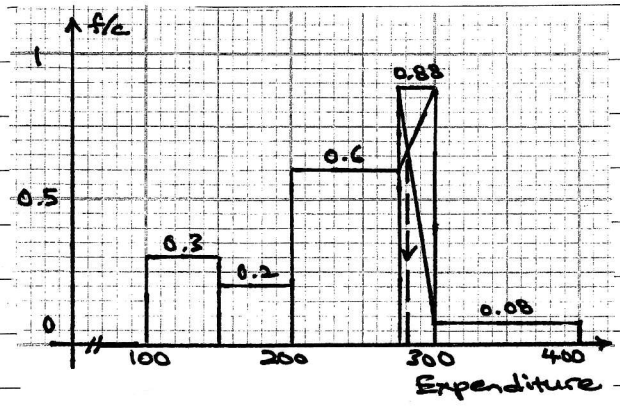
$\therefore |S_{12}| = 10\sqrt{(2t-1)^2 + 1}$

$\therefore |S_{12}|_{min}$ when $t = \frac{1}{2}$

$\therefore$ Shortest distance $= 10(1) = 10$ km

12. (a)

| $x$ | $f$ | $c$ | $f/c$ |
|---|---|---|---|
| $100 \leq x < 150$ | 15 | 50 | 0.3 |
| $150 \leq x < 200$ | 10 | 50 | 0.2 |
| $200 \leq x < 275$ | 45 | 75 | 0.60 |
| $275 \leq x < 300$ | 22 | 25 | 0.88 |
| $300 \leq x < 400$ | 8 | 100 | 0.08 |




(b) Mode $= 280$

(c) $250 = 200 + \left(\frac{k - 25}{45}\right)(75)$

$\therefore k = 55$

$\therefore$ Percentage (< RM250) $= \frac{55}{100} \times 100\%$

$= 55\%$

(d) $Q_1 = x_{25} = 200$

$Q_3 = x_{75} = 275 + \left(\frac{75 - 70}{22}\right)(25)$

$= 280.68$

$\therefore SIQR = \frac{1}{2}[280.68 - 200] = 40.34$

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