SET-A
MOCK 1 (2022-2023)

Section A

1. d) $7x \equiv 3 \pmod 5$ $\Rightarrow$ $7x-3$ is divisible by 5 when $x=4$, $28-3=25$ is divisible by 5
$\therefore x=4$ (d)

2. b) In figure, x is bounded we can see that $-3 \le x$ and $x \le 3$
$\Rightarrow -3 \le x \le 3 \Rightarrow |x| \le 3$ (b)

3. c) degrees of freedom (df)

4. c) $n=25$, $\bar{x}=14$, $S=4.32$, $\mu_0=12$ $\Rightarrow t = \dfrac{\bar{x}-\mu_0}{S/\sqrt{n}} = \dfrac{14-12}{4.32/\sqrt{25}} = \dfrac{10}{4.32} = 2.31$ (c)

5. a) $V=10$ km/h, $u=18$ km/h $\Rightarrow x = \dfrac{u+V}{2} = \dfrac{18+10}{2} = 14$ km/h (a)

6. d) Central Limit Theorem

7. a) When B runs 25 m, A runs = 22.5 m
" B runs 1 m, A runs = $\dfrac{22.5}{25}$ m, when B runs 1000 m, A runs = $\dfrac{225}{25} \times 1000 = 900$ m
Hence, B beats A by 100 m (a)

8. b) $\dfrac{5x}{200} = 2400 \Rightarrow \dfrac{1}{40}x = 2400 \Rightarrow x =$ ₹96,000 (b)

9. (d) @ $x=x_0$, $P=P_0=4$ $\Rightarrow 4 = 100-8x_0 \Rightarrow 8x_0 = 96 \Rightarrow \boxed{x_0=12}$ (d)

10. (a) least

11. b) $\frac{5000-1000}{5} = ₹800$ (b)

12. (c) $y\,dx - x\,dy = 0 \Rightarrow y\,dx = x\,dy \Rightarrow \int \frac{dx}{x} = \int \frac{dy}{y} \Rightarrow \log|x| = \log|y| + \log k$

$\Rightarrow \log\left|\frac{x}{y}\right| = \log k \Rightarrow \frac{x}{y} = k \Rightarrow y = \frac{x}{k} \Rightarrow \boxed{y = Cx}$ (c) where $\frac{1}{k} = c$

13. c) $CAGR = \left(\frac{FV}{PV}\right)^{1/n} - 1 \Rightarrow \left(\frac{32000}{20000}\right)^{1/5} - 1 \Rightarrow (1.6)^{1/5} - 1 \Rightarrow \sqrt[5]{1.6} - 1 \times 100$ (c)

14. c) @ $(0,4) \Rightarrow Z = 0 + 24 = 24$

@ $(0.6, 1.6) \Rightarrow Z = 2.4 + 9.6 = 12$ → Minimum

@ $(3,0) \Rightarrow Z = 12 + 0 = 12$

15. c) $3/8$ $\quad$ 1 (Pure copper)

$\frac{4}{9}$

$1 - \frac{4}{9} = \frac{5}{9}$ $\quad$ $\frac{4}{9} - \frac{3}{8} = \frac{5}{72}$

$\therefore \boxed{8:1}$

* Ratio of initial mixture to added copper = 8:1
* initial mixture = 400g

$\therefore$ Added copper $= 400 \times \frac{1}{8} = 50g$ (c)

16. b) Statistic

17. d) All of these

18. b) Sampling distribution

19. d) P(Win in one game) = P(Lose in one game) = $\frac{1}{2}$ i.e, $P = q = \frac{1}{2}$

$\Rightarrow$ P(India beating Pakistan in 4 out of 5 games) $= {}^5C_4 \left(\frac{1}{2}\right)^4 \left(\frac{1}{2}\right)^1 = 5 \cdot \frac{1}{32} = \boxed{15.625\%}$

$\therefore$ Assertion is False & reason is true (d)

20. a) Both the Assertion and Reason is true, and the reason is correct explanation for assertion.

SECTION B

21. Given that : R = ₹6000, $r = 6\%$, $i = \frac{6}{1200} = 0.005$, P = ? [½ m]

$$P = R + \frac{R}{i} \Rightarrow 6000 + \frac{6000}{0.005} \Rightarrow 6000 + 1200000 \Rightarrow P = ₹12,06,000$$ [1m]

Hence, the present value is ₹12,06,000. $\left[\frac{1}{2} m\right]$

22.

$$A = \begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & -1 \end{bmatrix} \Rightarrow A = A^T$$

i.e, $$\begin{bmatrix} 0 & 3 & 3a \\ 2b & 1 & 3 \\ -2 & 3 & -1 \end{bmatrix} = \begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & -1 \end{bmatrix}$$ $\left[\frac{1}{2} m\right]$

Given that A is symmetric

$\Rightarrow 2b = 3$ $\Rightarrow 3a = -2$ $\Rightarrow 2a - b$

$b = \frac{3}{2}$ $\left[\frac{1}{2}m\right]$ $a = -\frac{2}{3}$ $\left[\frac{1}{2}m\right]$ $2\left(\frac{-2}{3}\right) - \left(\frac{3}{2}\right) = \frac{-4}{3} - \frac{3}{2}$

$\Rightarrow \frac{-8-9}{6} \Rightarrow \frac{-17}{6}$ // $\left[\frac{1}{2}m\right]$

(OR)

$\begin{vmatrix} 3 & y \\ x & 1 \end{vmatrix} = \begin{vmatrix} 3 & 2 \\ 4 & 1 \end{vmatrix} \Rightarrow 3 - xy = 3 - 8 \Rightarrow 3 - xy = -5$

$\boxed{xy = 8}$ (1m)

i.e., If $x = 1,\ y = 8$ and $x = 2,\ y = 4$

$x = 8,\ y = 1$ $\left(\frac{1}{2}m\right)$ $x = 4,\ y = 2$ $\left(\frac{1}{2}m\right)$

23. Let the rate at which the stream is flowing be x km/h

Let the distance covered by the boat be y km/h [1/2 m]

$\Rightarrow \frac{3y}{5+x} = \frac{y}{5-x}$ $\left[\frac{1}{2}m\right]$ $\Rightarrow 3(5-x) = 5+x$

$\Rightarrow 15 - 3x = 5 + x$

$\Rightarrow 4x = 10$ $\therefore x = 2.5$ $\left[\frac{1}{2}m\right]$

The stream is flowing at the rate of 2.5 km/h. $\left[\frac{1}{2}m\right]$

(OR)

The distance covered by B, after A has finished the race i.e, distance covered by B in $48-36 = 12$ seconds [$\frac{1}{2}$m]

$$\text{Distance} = \frac{100}{48} \times 12 = 25 \text{ meters}$$ [1m] [$\frac{1}{2}$m] i.e., A beats B by 25 meters. [$\frac{1}{2}$m]

24. Let x units of food F_1 and y units of food F_2 be mixed and Z (in ₹) be the total cost of the food. [$\frac{1}{2}$m]

Minimize $Z = 5x + 6y$ (objective function) [$\frac{1}{2}$m]

$4x+3y \geq 80$ (Vitamin A Constraint)

$3x+6y \geq 100$ (Minerals Constraint)

$x \geq 0, y \geq 0$ (Non-negativity constraint) [1m]

25. Given: $r_{eff} = 5\%$ or 0.05 ; $n=4$

Compounded quarterly

$r = ?$

$$r_{eff} = \left(1+\frac{r}{100p}\right)^n - 1 \Rightarrow 0.05 = \left(1+\frac{r}{400}\right)^4 - 1 \Rightarrow 1+\frac{r}{400} = (1.05)^{\frac{1}{4}}$$ [1m]

$$r = 400\left((1.05)^{1/4} - 1\right) \Rightarrow 400(1.01227-1) \Rightarrow r = 400(0.1227) \Rightarrow r = 4.908\%$$ [$\frac{1}{2}$m]

$\therefore$ The nomial rate is 4.908%. [1m]

SECTION-C

26. $f(x) = x^4 - 8x^3 + 22x^2 - 24x + 21$

$f'(x) = 4x^3 - 24x^2 + 44x - 24$

$= 4(x^3 - 6x^2 + 11x - 6)$

$f'(x) = 4(x-1)(x-2)(x-3)$ (1m)

now $f'(x) = 0$

$\Rightarrow 4(x-1)(x-2)(x-3) = 0$

$x = 1,\ x = 2,\ x = 3$ (1m)

$-ve \quad +ve \quad -ve \quad +ve$

$-\infty \quad 1 \quad 2 \quad 3 \quad \infty$

$\therefore$ f is strictly increasing in $(1, 2) \cup (3, \infty)$

f is strictly decreasing in $(-\infty, 1) \cup (2, 3)$ (1m)

27. Sale matrix for A, B and C is

$$\begin{pmatrix} 25 & 10 & 30 \\ 20 & 15 & 30 \\ 25 & 18 & 35 \end{pmatrix}$$

Price matrix is $\begin{pmatrix} 20 \\ 15 \\ 10 \end{pmatrix}$ (1m)

Amount raised by school = $\begin{bmatrix} 25 & 10 & 30 \\ 20 & 15 & 30 \\ 25 & 18 & 35 \end{bmatrix} \begin{bmatrix} 20 \\ 15 \\ 10 \end{bmatrix} = \begin{bmatrix} 500+150+300 \\ 400+225+300 \\ 500+270+350 \end{bmatrix} = \begin{bmatrix} 950 \\ 925 \\ 1120 \end{bmatrix}$ (1m)

So amount raised by A is ₹ 950

" " " B is ₹ 925

" " " C is ₹ 1120 (1m)

28 $\int \frac{e^{2x}}{2+e^x}\,dx$ Let $e^x = t \Rightarrow e^x\,dx = dt \Rightarrow dx = \frac{dt}{e^x}$ (1m)

$\Rightarrow \int \frac{e^x \cdot e^x}{2+e^x}\,dx = \int \frac{t}{2+t}\,dt = \int \frac{2+t-2}{2+t}\,dt$ $\left(\frac{1}{2}m\right)$ $\Rightarrow \int \frac{2+t}{2+t}\,dt - \int \frac{2}{2+t}\,dt$ $\left(\frac{1}{2}m\right)$

$\Rightarrow \int dt - \int \frac{2}{2+t}\,dt \Rightarrow t - 2\log|2+t| + C$ $\left(\frac{1}{2}m\right)$ $\Rightarrow e^x - 2\log(2+e^x) + C$ $\left(\frac{1}{2}m\right)$

(OR)

$\int \underset{v}{(1+x)}\, \underset{u}{\log x}\,dx$

$\int uv\,dx = u\int dv - \int\left[\frac{d}{dx}u \cdot \int v\,dx\right]dx \Rightarrow \log x \int (1+x)\,dx - \int\left[\frac{d}{dx}\log x \cdot \int (1+x)\,dx\right]dx$ (1m)

$$= \log x \left(x+\frac{x^2}{2}\right) - \int \frac{1}{x}\cdot\left(x+\frac{x^2}{2}\right) dx$$

$$= \left(x+\frac{x^2}{2}\right)\log x - \int \left(1+\frac{1}{2}x\right) dx$$ (1m)

$$= \left(x+\frac{x^2}{2}\right)\log x - \left(x+\frac{1}{2}\cdot\frac{x^2}{2}\right) + C$$

$$= \left(x+\frac{x^2}{2}\right)\log x - x - \frac{x^2}{4} + C$$ (1m)

29. Let $C(x)$ be the total cost of x units of the product and MC be the marginal cost, then $MC = \frac{x}{\sqrt{x^2+400}}$

$C(x) = \int MC\, dx + k \Rightarrow C(x) = \int \frac{x}{\sqrt{x^2+400}} dx$

put $\sqrt{x^2+400} = t$

$x^2+400 = t^2$

$\cancel{2}x = \cancel{2}t \frac{dt}{dx}$

$x\,dx = t\,dt$

$C(x) \Rightarrow \int \frac{t}{t} dt = \int dt = t+k \Rightarrow \boxed{C(x) = \sqrt{x^2+400} + k}$ (1m)

Given fixed cost = ₹1200,

when $x=0$, $C(x) = 1200$

$\Rightarrow 1900 = \sqrt{0^2+400} + k \Rightarrow 1900 = 20 + k \Rightarrow \boxed{k = 1180}$ $\left(\frac{1}{2}m\right)$

$\therefore C(x) = \sqrt{x^2+400} + 1180$ $\left(\frac{1}{2}m\right)$

Average Cost $\Rightarrow \dfrac{C(x)}{x} = \dfrac{\sqrt{x^2+400}}{x} + \dfrac{1180}{x}$ $(1m)$

[OR]

Given $p = D(x) = 26 - \dfrac{x^2}{100}$

@ equilibrium $D(x) = S(x)$

$p = S(x) = \dfrac{x^2}{400} + 6$

@ $x = x_0 \Rightarrow 26 - \dfrac{x_0^2}{100} = \dfrac{x_0^2}{400} + 6$ $\left(\frac{1}{2}m\right)$ $\Rightarrow \dfrac{5x_0^2}{400} = 20 \Rightarrow x_0^2 = 1600 \Rightarrow \boxed{x_0 = 40}$ $\left(\frac{1}{2}m\right)$

in $D(x)$, we get $P_0 = 26 - \dfrac{(40)^2}{100} \Rightarrow P_0 = 26 - 16 \Rightarrow \boxed{P_0 = 10}$ $\left(\frac{1}{2}m\right)$

$CS = \int_0^{x_0} D(x)\,dx - x_0 P_0$ $\left(\frac{1}{2}m\right)$

$CS = \int_0^{40} 26 - \dfrac{x^2}{100}\,dx - 40 \times 10 \Rightarrow \left[26x - \dfrac{x^3}{300}\right]_0^{40} - 400$ $\left(\frac{1}{2}m\right)$ $\Rightarrow 1040 - \dfrac{640}{3} - 400$

$CS = 640 - \dfrac{640}{3} = \dfrac{1280}{3} = 426.67$ i.e, $CS = 427$ (approx) $\left(\frac{1}{2}m\right)$

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30. Given : $P = 15,00,000 - 4,00,000 = ₹11,00,000$ (1m)

$r = 9\%$ $\quad i = \frac{9}{1200} = 0.0075$

$$EMI = \frac{P \times i}{1-(1+i)^{-n}} = \frac{11,00,000 \times 0.0075}{1-(1.0075)^{-120}} = \frac{8250}{1-0.4079}$$ (1m)

$$= \frac{8250}{0.5921}$$ ($\frac{1}{2}$m)

$EMI = ₹13933.5$ ($\frac{1}{2}$m)

31. $A = 50,000 - 5000 \Rightarrow A = ₹45,000$

$r = 8\%$ Compounded quarterly

$i = \frac{8}{400} = 0.02$ (1m)

$$A = R\left[\frac{(1+i)^n - 1}{i}\right]$$

$$45000 = R\left[\frac{(1+0.2)^{40}-1}{0.02}\right]$$ 1m $\Rightarrow 45000 = R\left[\frac{2.208-1}{0.02}\right] \Rightarrow R = \frac{900}{1.208}$ ($\frac{1}{2}$m) $= ₹745.03$

$\therefore$ The payment should be ₹745.03 for 10 yrs. ($\frac{1}{2}$m)

SECTION - D

32. (i) P(4 or fewer arrivals in first 10 minutes of an hour)

$= P(X \leq 4)$

$\Rightarrow P(X=0) + P(X=1) + P(X=2) + P(X=3) + P(X=4)$

wkt

$$P(X=r) = \frac{e^{-\lambda} \lambda^{r}}{r!}, \quad r = 0, 1, 2, 3, 4$$

$$\Rightarrow \frac{5^{0} e^{-5}}{0!} + \frac{5^{1} e^{-5}}{1!} + \frac{5^{2} e^{-5}}{2!} + \frac{5^{3} e^{-5}}{3!} + \frac{5^{4} e^{-5}}{4!}$$

$$= e^{-5} \left[1 + 5 + \frac{25}{2} + \frac{125}{6} + \frac{625}{24} \right]$$

$$= 0.0067 \times \frac{1569}{24} \qquad \{\because \text{given } e^{-5} = 0.0067\}$$

$= 0.438$

(ii) Given that number of arrivals in first 10 minutes is 8.

So, expected number of arrivals in next 50 minutes i.e., $\frac{5}{6}$ hours is $30 \times \frac{5}{6} = 25$

So, for next 50 minutes, $\lambda = 25$

Now, P(10 or more arrivals in a hour given that there are 8 arrivals in the first 10 minutes of that hour)

$= P(X \geq 2)$

$\Rightarrow 1 - [P(X=0) + P(X=1)]$

$\Rightarrow 1 - \left[\frac{25^0 e^{-25}}{0!} + \frac{25^1 e^{-25}}{1!}\right]$

$\Rightarrow 1 - 26e^{-25}$ (OR)

(i) Let X denote the marks scored in the district exam

Given $\mu = 700$, $\sigma = 180$, then $Z = \frac{X - \mu_0}{\sigma} \Rightarrow Z = \frac{X - 700}{180}$

$P(X < 420) = P\left(Z < \frac{420 - 720}{180}\right) = P(Z < -1.56) = F(-1.56) = 0.0594$

$\therefore$ Number of students who scored less than 420 marks $= 300 \times 0.0594$

$= 17.82$ i.e., 18

Hence, we can say that Sudha did better than 18 students.

(ii) Given that Abhay has done better than 44.83 students, then Z-score corresponding to 44.83 % i.e, 0.4483 in the table = −0.13

$$\Rightarrow -0.13 = \frac{X - 700}{180}$$

$$\Rightarrow X - 700 = -23.4$$

$$\Rightarrow X = 676.6 \text{ i.e, } 677$$

Hence, Abhay has scored approximately 677 marks out of 100.

33. The cost of material of producing x items = ₹ $30x$

Overhead cost = ₹1600

Labour cost of producing x items = ₹ $\frac{x^2}{100}$

∴ Total cost of producing x items, $C(x) = ₹\left(1600 + 30x + \frac{x^2}{100}\right)$

∴ Average cost, $AC = \frac{C(x)}{x} = ₹\left(\frac{1600}{x} + 30 + \frac{x}{100}\right)$

then $\frac{d}{dx}(AC) = \frac{-1600}{x^2} + \frac{1}{100}$

$\frac{d(AC)}{dx} = 0 \Rightarrow x^2 = 160000 \Rightarrow \boxed{x = 400}$, −400 but $x > 0$ (Not possible)

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$$\frac{d^2}{dx^2}(AC) = -1600(-2)x^{-3} = \frac{3200}{x^3}$$

$$\left.\frac{d^2 AC}{dx^2}\right]_{x=400} = \frac{3200}{(400)^3} > 0$$

Hence, the average cost in minimum when $x = 400$.

(OR)

Given: $x = \frac{600 - P}{8} \Rightarrow p = 600 - 8x$; $C(x) = x^2 + 78x + 2500$

So, $R(x) = px \Rightarrow (600-8x)(x) = 600x - 8x^2$

$P(x)$ profit function $= R(x) - C(x)$

$= 600x - 8x^2 - x^2 - 78x - 2500$

$\Rightarrow P(x) = 522x - 9x^2 - 2500$ (2m)

$\frac{d}{dx}P(x) = 522 - 18x$ (1m)

$\frac{d}{dx}P(x) = 0 \Rightarrow 522 - 18x = 0 \Rightarrow \boxed{x = 29}$ (1m)

$\frac{d^2}{dx^2}P(x) = -18 < 0$ ($\frac{1}{2}$m)

$\therefore$ The profit is maximum when $x = 29$. ($\frac{1}{2}$m)

Date ....

34 Let x, y be the number of products A and B respectively,

Maximize $Z = 48x + 40y$ (objective function)

$2x + y \leq 90$ (teak wood Constraint)

$x + 2y \leq 80$ ([illegible]wood ")

$x + y \leq 50$ (rosewood Constraint)

$x \geq 0, y \geq 0$ (non-negativity ")

$2x+y=90$			$x+2y=80$			$x+y=50$		
x	0	45	x	0	80	x	0	50
y	90	0	y	40	0	y	50	0

Check for inequality @ (0,0)

$0 \leq 90$, $0 \leq 80$, $0 \leq 50$ } Towards origin

(T) (T) (T)

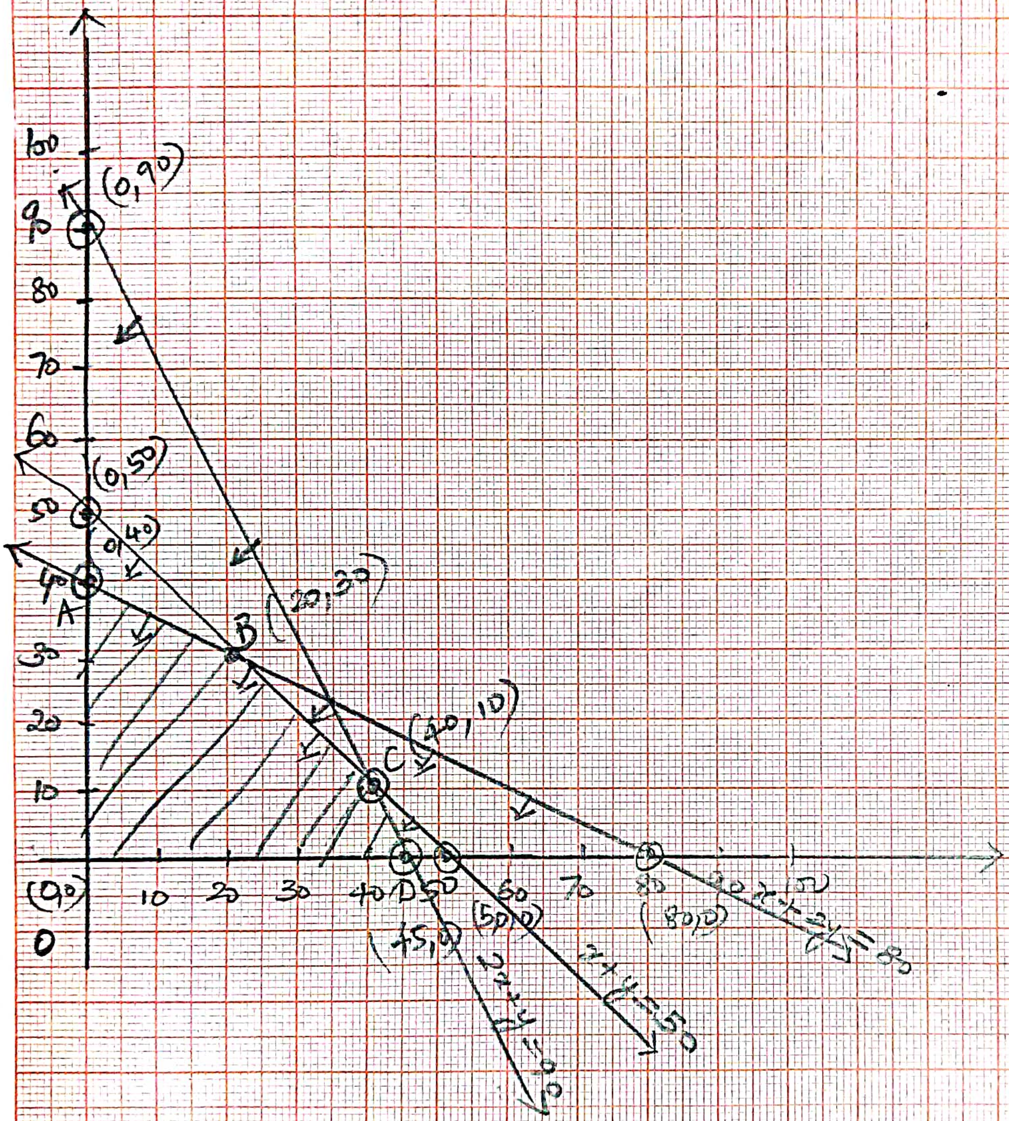
Corner points	$Z = 48x + 40y$ (Max)
A (0,0)	0
B (0,40)	1600
C (20,30)	2160
D (40,10)	2320 → Maximum
E (45,0)	2160

Hence, maximum revenue is ₹2320 when 40 units of product A and 10 units of product B are produced and sold.

Scale

In x axis 1cm = 10 unit

In y axis 1cm = 10 unit



35. $A = \begin{bmatrix} 3 & 2 & 1 \\ 4 & -1 & 2 \\ 7 & 3 & -3 \end{bmatrix}$

$|A| = 62 \neq 0$ $\therefore$ The system of equation is consistent & has a unique solutions

$A^{-1} = \frac{1}{|A|} \operatorname{adj} A$

$A^{-1} = \frac{1}{62} \begin{bmatrix} -3 & 9 & 5 \\ 26 & -16 & -2 \\ 19 & 5 & -11 \end{bmatrix}$

given that $3x + 4y + 7z = 14$

$2x - y + 3z = 4$

$x + 2y - 3z = 0$

$AX = B$

$\begin{bmatrix} 3 & 4 & 7 \\ 2 & -1 & 3 \\ 1 & 2 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 14 \\ 4 \\ 0 \end{bmatrix}$

$X = A^{-1} B$

$X = (A^{-1})^T B$

$\begin{bmatrix} x \\ y \\ z \end{bmatrix} \Rightarrow \frac{1}{62} \begin{bmatrix} -3 & 26 & 19 \\ 9 & -16 & 5 \\ 5 & -2 & -11 \end{bmatrix} \begin{bmatrix} 14 \\ 4 \\ 0 \end{bmatrix}$

$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{62} \begin{bmatrix} 62 \\ 62 \\ 62 \end{bmatrix} \Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$

$\therefore$ $x = 1$, $y = 1$ and $z = 1$

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SECTION – E

36. Case I :

(a) Pipe C empties 1 tank in 15 hours $\Rightarrow \frac{3}{5}$th tank in $\frac{3}{5} \times 15 = 9$ hours

(b) Part of tank filled in 1 hour $= \frac{1}{12} + \frac{1}{8} - \frac{1}{15} = \frac{17}{120}$

$\Rightarrow$ time taken to fill tank completely $= \frac{120}{17} = 7\frac{1}{17}$ hours

(c) Let the tank be completely filled in 't' hours

$\Rightarrow$ Pipe A is opened for 't' hours

Pipe B is opened for 't-3' hours

Pipe C is opened for 't-4' hours

$\Rightarrow$ In one hour, part of tank filled by pipe A $= \frac{t}{12}$th

" " " " " pipe B $= \frac{t-3}{8}$th

" " " " " pipe C $= \frac{t-4}{15}$th

$\therefore \frac{t}{12} + \frac{t-3}{8} - \frac{(t-4)}{15} = 1 \Rightarrow t = \frac{133}{17} = 7.82$ i.e., 7hr 49 mins to fill the tank

(OR)

5 am, Pipe C is opened to empty ½ filled tank, Time to empty $\frac{15}{2}$ hrs, Time to clean 1 hr

Part of tank filled by pipes A & B in 1 hr $= \frac{1}{12} + \frac{1}{8} = \frac{5}{24}$ $\therefore$ Time Taken to fill the tank completely $= \frac{24}{5}$ hrs.

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$\therefore$ Total time taken in the process $= \frac{15}{2} + \frac{24}{5} + 1 = 13$ hr 18 mins

37. Case II :-

a)

Year (t)	y	$x = t_i - 2014$	x^2	xy
2012	80	-2	4	-160
2013	90	-1	1	-90
2014	92	0	0	0
2015	83	1	1	83
2016	94	2	4	188
	439		10	21

(OR)

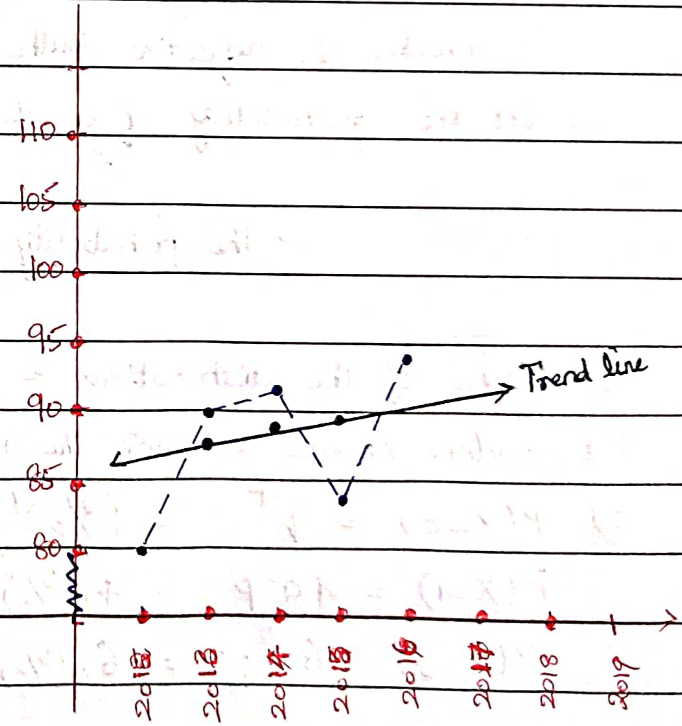
Year	y	3yr Moving total	3yr Moving average
2012	80	-	-
2013	90	262	87.33
2014	92	265	88.33
2015	83	269	89.66
2016	94	-	-

$\Sigma y = 439, \ \Sigma x^2 = 10, \ \Sigma xy = 21$

$a = \frac{\Sigma y}{n} = \frac{439}{5} = 87.8$, wkt, $y_t = a + bx$

$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{21}{10} = 2.1$

$\boxed{y_t = 87.8 + 2.1x}$



b) $y_t = a + bx \Rightarrow y_t = 87.8 + 2.1x \Rightarrow y_{2018} = 87.8 + 2.1(4) = 96.2$ tonnes

$\Rightarrow$ the estimated production for the year 2018 is 96.2 metric tonnes

c) $y_t = 103 \Rightarrow 103 = 87.8 + 2.1(x) \Rightarrow 15.2 = 2.1(x) \Rightarrow x = \frac{15.2}{2.1} \Rightarrow x = 7.23$

$x \sim 7$ approx

$\therefore$ Production will be 103 tonnes in year $(2014 + 7) = 2021$ year

38 Case III :-

Total number of bulbs in the lot = 15

number of defective bulbs = 5

a) Let the probability of a defective bulb drawn be p, then $p = \frac{5}{15} = \frac{1}{3}$

$\Rightarrow$ the probability of a good bulb be q, then $q = 1 - p = 1 - \frac{1}{3} = \frac{2}{3}$

b) Mean of the distribution $= E(X) = np = 4 \times \frac{1}{3} = \frac{4}{3}$

Let random variable X denote the number of defective bulbs drawn, then X can take values 0, 1, 2, 3, 4

c) $P(X=0) = q^4 = (2/3)^4 = 16/81$

$P(X=1) = 4q^3p = 4.(2/3)^3(1/3) = 32/81$

$P(X=2) = 6q^2p^2 = 6.(2/3)^2(1/3)^2 = 24/81$

$P(X=3) = 4qp^3 = 4\left(\frac{2}{3}\right)\left(\frac{1}{3}\right)^3 = 8/81$

$P(X=4) = p^4 = \left(\frac{1}{3}\right)^4 = 1/81$

$\therefore$ The probability distribution of X is $\begin{pmatrix} 0 & 1 & 2 & 3 & 4 \\ 16/81 & 32/81 & 24/81 & 8/81 & 1/81 \end{pmatrix}$

(OR)

Probability of atleast 2 defective bulbs $\Rightarrow P(X=2) + P(X=3) + P(X=4)$

$$\Rightarrow \frac{24}{81} + \frac{8}{81} + \frac{1}{81}$$

$$= \frac{33}{81} = \frac{11}{27}$$