DATA ANALYSIS & MATRIX OPERATIONS

$$A = \begin{bmatrix} 4 & 8 & 12 \\ 6 & 10 & 15 \\ 5 & 7 & 9 \\ 3 & 6 & 9 \end{bmatrix} \begin{matrix} A \\ B \\ C \\ D \end{matrix} \qquad \begin{matrix} A & B & C \end{matrix}$$

4 ROWS × 3 COLUMNS

ROWS = REGIONS

COLUMNS = PRODUCT.

PART I

(1) THE DATA IN THE MATRIX IS A DISCRETE DATA TYPE.

(2) PRODUCT A :

i, MEAN

$$\frac{4+6+5+3}{4} = \frac{18}{4} = 4.5_{//}$$

ii, MEDIAN

$$3\ \underline{4}\ \underline{5}\ 6 \quad \therefore \frac{4+5}{2} = \frac{9}{2} = 4.5_{//}$$

iii, STANDARD DEVIATION (S.D.)

$$\text{MEAN} = 4.5$$

$$\sqrt{\frac{(4-4.5)^2 + (6-4.5)^2 + (5-4.5)^2 + (3-4.5)^2}{4}}$$

$$= \sqrt{\frac{0.25 + 2.25 + 0.25 + 2.25}{4}}$$

$$= \sqrt{\frac{5}{4}} = \sqrt{1.25} = 1.118_{//}$$

PRODUCT B :

i, MEAN

$$\frac{8+10+7+6}{4} = \frac{31}{4} = 7.75_{//}$$

ii, MEDIAN

$$6\ 7\ \underline{8}\ \underline{10} \quad \therefore \frac{7+8}{2} = \frac{15}{2} = 7.5_{//}$$

iii, S.D.

$$\text{MEAN} = 7.75$$

$$\sqrt{\frac{(8-7.75)^2 + (10-7.75)^2 + (7-7.75)^2 + (6-7.75)^2}{4}}$$

$$= \sqrt{\frac{0.0625 + 5.0625 + 0.5625 + 3.0625}{4}}$$

$$= \sqrt{\frac{8.75}{4}} = \sqrt{2.1875} = 1.479_{//}$$

PRODUCT C :

i, MEAN

$$\frac{12+15+9+9}{4} = \frac{45}{4} = 11.25_{//}$$

ii, MEDIAN

$$9\ \underline{9}\ \underline{12}\ 15 \quad \therefore \frac{9+12}{2} = \frac{21}{2} = 10.5_{//}$$

iii, S.D.

$$\text{MEAN} = 11.25$$

$$\sqrt{\frac{(12-11.25)^2 + (15-11.25)^2 + (9-11.25)^2 + (9-11.25)^2}{4}}$$

$$= \sqrt{\frac{0.5625 + 14.0625 + 5.0625 + 5.0625}{4}}$$

$$= \sqrt{\frac{24.75}{4}} = \sqrt{6.1875} = 2.487_{//}$$

(3) PRODUCT A :

i, RANGE = MAX = 6, MIN 3

$$= 6 - 3 = 3_{//}$$

ii, VARIANCE

$$\text{MEAN} = 4.5$$

$$= \frac{(4-4.5)^2 + (6-4.5)^2 + (5-4.5)^2 + (3-4.5)^2}{4}$$

$$= 5/4 = 1.25_{//}$$

PRODUCT B :

i, RANGE = MAX = 10, MIN = 6

$$= 10 - 6 = 4$$

ii, VARIANCE

$$\text{MEAN} = 7.75$$

$$= \frac{(8-7.75)^2 + (10-7.75)^2 + (7-7.75)^2 + (6+7.75)^2}{4}$$

$$= \frac{0.0625 + 5.0625 + 0.5625 + 3.0625}{4}$$

$$= \frac{8.75}{4} = 2.1875_{//}$$

PRODUCT C :

i, RANGE = MAX = 15, MIN = 9

$$= 15 - 9 = 6$$

ii, VARIANCE

$$\text{MEAN} = 11.25$$

$$\frac{(12-11.25)^2+(15-11.25)^2+(9-11.25)^2+(9-11.25)^2}{4}$$

$$= \frac{0.5625+14.0625+5.0625+5.0625}{4}$$

$$= \frac{24.75}{4} = 6.1875$$

PART 2

1. $D^T = \begin{bmatrix} 4 & 6 & 5 & 3 \\ 8 & 10 & 7 & 6 \\ 12 & 15 & 9 & 9 \end{bmatrix}$

2. SINCE EACH ROW OF D REPRESENTS QUANTITIES SOLD IN EACH CATEGORY, AND P IS THE UNIT PRICE PER CATEGORY, MATRIX MULTIPLICATION WOULD BE CARRIED OUT AS: $D \times P^T$

$$P^T = \begin{bmatrix} 5 \\ 10 \\ 15 \end{bmatrix}$$

$$D \times P^T = \begin{bmatrix} 4\times5 & 8\times10 & 12\times15 \\ 6\times5 & 10\times10 & 15\times15 \\ 5\times5 & 7\times10 & 9\times15 \\ 3\times5 & 6\times10 & 9\times15 \end{bmatrix}$$

$$= \begin{bmatrix} 20+80+180 \\ 30+100+225 \\ 25+70+135 \\ 15+60+135 \end{bmatrix}$$

$$= \begin{bmatrix} 280 \\ 355 \\ 230 \\ 210 \end{bmatrix}$$

3. REVENUE PER REGION = $D \times P^T$ ∴
I, REGION 2 GENERATES THE HIGHEST REVENUE OF 355.

II, TOTAL QUANTITY PER PRODUCTS MULTIPLIED BY PRICES:

PRODUCT A - 4 + 6 + 5 + 3 = 18
B - 8 + 10 + 7 + 6 = 31
C - 12 + 15 + 9 + 9 = 46

PRICES A - 5
B - 10
C - 15

∴
PRODUCT A = 18 × 5 = 90
B = 31 × 10 = 310
C = 45 × 15 = 675

PART 3

(1) I, MEAN (A) - 4.5
(B) - 7.75
(C) - 11.25

- PRODUCT C HAS THE HIGHEST AVERAGE SALES OF 11.25 UNITS, INDICATING IT IS THE MOST COMMON SOLD PRODUCT.
- PRODUCT A HAS THE LOWEST AVERAGE SALES OF 4.5 UNITS, INDICATING IT IS NOT HAVE ALOT OF DEMAND COMPARED TO PRODUCT B AND C.

II, COEFFICIENT OF VARIATION
$$= \frac{\text{STANDARD DEVIATION}}{\text{MEAN}} \times 100\%$$

PRODUCT A = $\frac{1.118}{4.5} \times 100 = 24.84\%$

B = $\frac{1.479}{7.75} \times 100 = 19.09\%$

C = $\frac{2.487}{11.25} \times 100 = 22.09\%$

- THE LOWER THE COEFFICIENT OF VARIATION, THE MORE CONSISTENT THE SALES.
- PRODUCT B HAS THE LOWEST C.V. INDICATING ITS SALES ARE MORE CONSISTENT ACROSS REGIONS
- PRODUCT A HAS A SLIGHTLY HIGHER C.V. INDICATING MORE FLUCTUATION IN HOW WELL IT SELLS FROM REGION TO REGION.
- ALTHOUGH PRODUCT C HAS THE HIGHEST AVERAGE SALES, ITS C.V. SHOWS MODERATE VARIATION WHICH MAY REFLECT DIFFERING REGIONAL PREFERENCES OR PROMOTIONS.

(2) MATRIX MULTIPLICATION IS THE ENGINE BEHIND AI, ANALYTICS AND AUTOMATION. IT ALLOWS FOR EFFICIENT AND SCALABLE COMPUTATION ACROSS LARGE DATASETS.

SOME REAL WORLD APPLICATIONS INCLUDE:

a, AUTOMATED REVENUE TRACKING, BUDGETING

b, PERSONALISED PRODUCT/MOVIE/MUSIC SUGGESTIONS

c, MODEL TRAINING & PREDICTION

d, OBJECT DETECTION, MEDICAL IMAGING

e, CHATBOTS, SEARCH ENGINES, TRANSLATION