EXERCISE 2.1

Q1. A bicycle company has two branches whose daily productions are given below:

	3 speed	5 speed	10 speed
Branch 1	40	120	150
Branch 2	60	175	100

Express the given information as a matrix. Using multiplication of a scalar times a matrix, find the new daily productions if production is to double.

Answer: A = $\begin{bmatrix} 40 & 120 & 150 \\ 60 & 175 & 100 \end{bmatrix}$

When production becomes double

2A = $\begin{bmatrix} 80 & 240 & 300 \\ 120 & 350 & 200 \end{bmatrix}$

Q2. A man buys 8 dozen mangoes, 10 dozen of apples and 4 dozen of bananas. Mangoes cost Rs 18 per dozen, apples Rs 15 per dozen and bananas Rs 12 per dozen. Represent the quantities bought by a row matrix and prices by a column matrix. Using matrix multiplication determines the total amount spent by the man.

Answer: Row Matrix

A = $\begin{bmatrix} 8 & 10 & 4 \end{bmatrix}$

Column matrix

B = $\begin{bmatrix} 18 \\ 15 \\ 12 \end{bmatrix}$

Total Amount Spent

A×B = $\begin{bmatrix} 8 & 10 & 4 \end{bmatrix} \times \begin{bmatrix} 18 \\ 15 \\ 12 \end{bmatrix}$ = $[144 + 150 + 48]$ = $[342]$

Q3. The Prices of three commodities A, B and C in a shop are Rs 5, Rs 6 and Rs 10 respectively. Customer X buy 8 unit of A, 7 unit of B and 8 unit of C. Customer Y buy 6 unit of A, 7 unit of B and 8 unit of C. show in a matrix notation, the price of the commodities, quantities bought and amount spent.

Answer: Price of the commodities P = $\begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} \mathbf{5} \\ \mathbf{6} \\ \mathbf{10} \end{bmatrix}$

Customer X and Y bought units (U) = $\begin{array}{cc} & \begin{array}{ccc} A & B & C \end{array} \\ \begin{array}{c} X \\ Y \end{array} & \begin{bmatrix} 8 & 7 & 8 \\ 6 & 7 & 8 \end{bmatrix} \end{array}$

Total Amount spends = $\begin{array}{c} X \\ Y \end{array}\begin{bmatrix} 8 & 7 & 8 \\ 6 & 7 & 8 \end{bmatrix} \times \begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} \mathbf{5} \\ \mathbf{6} \\ \mathbf{10} \end{bmatrix} = \begin{bmatrix} 40 + 42 + 80 \\ 30 + 42 + 80 \end{bmatrix} = \begin{bmatrix} 162 \\ 152 \end{bmatrix}$

Q4. A company has two plants. Plant 1 is capable of producing 5 items of A, 10 items of B and 3 items of C per hour of operation. Plant 2 is capable of producing 5 items of A, 6 items of B, 6 items of C per one hour of operation. Express this information in a 3 × 2 matrix. Using matrix multiplication, determine the total number of items A, B and C produced if Plant 1 is operated for 10 hours and Plant 2 is operated for 5 hours.

Answer: Plant1 Plant 2

$$P = \begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} 5 & 5 \\ 10 & 6 \\ 3 & 6 \end{bmatrix} \qquad Q = \begin{array}{c} Plant1 \\ Plant2 \end{array}\begin{bmatrix} 10 \\ 5 \end{bmatrix}$$

Total No. of items produced of A, B and C are

$$P \times Q = \begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} 5 & 5 \\ 10 & 6 \\ 3 & 6 \end{bmatrix} \times \begin{array}{c} Plant1 \\ Plant2 \end{array}\begin{bmatrix} 10 \\ 5 \end{bmatrix} = \begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} 50+25 \\ 100+30 \\ 30+30 \end{bmatrix} = \begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} 75 \\ 130 \\ 60 \end{bmatrix}$$

Q5. A company is considering which of the three method of production it should use in producing three goods A, B and C. The total amount of each goods produced by each method is shown in the matrix:

$$\text{Method } \begin{array}{c} I \\ II \\ III \end{array}\begin{bmatrix} 4 & 8 & 2 \\ 5 & 7 & 1 \\ 5 & 3 & 9 \end{bmatrix}$$

The matrix vector $[10 \quad 4 \quad 6]$ represents the profit per unit for the goods A, B, C in that order. Using matrix multiplication, find which method maximizes total profit.

Answer: Total profit = $\begin{array}{c} I \\ II \\ III \end{array}\begin{bmatrix} 4 & 8 & 2 \\ 5 & 7 & 1 \\ 5 & 3 & 9 \end{bmatrix} \times \begin{bmatrix} 10 \\ 4 \\ 6 \end{bmatrix} = \begin{bmatrix} 40+32+12 \\ 50+28+6 \\ 50+12+54 \end{bmatrix} = \begin{bmatrix} 82 \\ 84 \\ 114 \end{bmatrix}$

Method III maximizes maximum profit.

Q6. A company is to employ 60 laborers from either of the party A and B. comprising of persons in different age groups as under

Category	I (20-25 years)	II (26-30 years)	III (31-40 Years)
Party A	25	20	15
Party B	20	30	10

Rate of labour applicable to categories I, II and III are Rs 1200, Rs 1000 and Rs 600 respectively. Using matrix notation, find, which party is economically preferable over the other.

Answer: $A = \begin{array}{c} Party\ A \\ Party\ B \end{array}\begin{bmatrix} 25 & 20 & 15 \\ 20 & 30 & 10 \end{bmatrix} \qquad B = \begin{array}{c} I \\ II \\ III \end{array}\begin{bmatrix} 1200 \\ 1000 \\ 600 \end{bmatrix}$

$$A \times B = \begin{bmatrix} 25 & 20 & 15 \\ 20 & 30 & 10 \end{bmatrix} \times \begin{bmatrix} 1200 \\ 1000 \\ 600 \end{bmatrix} = \begin{bmatrix} 30000+20000+9000 \\ 24000+30000+6000 \end{bmatrix} = \begin{bmatrix} 59000 \\ 60000 \end{bmatrix}$$

Party A is more economical as compared to party B.

Q7. A factory produces 3 types of portable radio sets called Audio 1, Audio 2 and Audio 3. Audio 1 contains 1 transistor, 10 resistors and 5 capacitors, while Audio 2 contain 1 contains 2 transistor, 18 resistors and 7 capacitors Audio 3 contains 3 transistors, 24 resistors and 10 capacitors.

Represent this information in the form of a matrix. Using matrix multiplication, calculate the factory's weekly consumption of transistors, resistors and capacitors. If weekly output of sales is 100 of Audio 1, 250 of Audio 2 and 80 of Audio 3.

Answer: A = $\begin{array}{r} \\ transistors \\ resistors \\ capacitors \end{array}\begin{array}{c} Audio1 \quad Audio2 \quad Audio3 \\ \begin{bmatrix} 1 & 2 & 3 \\ 10 & 18 & 24 \\ 5 & 7 & 10 \end{bmatrix} \end{array}$ Sales (S) = $\begin{array}{r} Audio\ 1 \\ Audio\ 2 \\ Audio\ 3 \end{array}\begin{bmatrix} 100 \\ 250 \\ 80 \end{bmatrix}$

A × B = $\begin{array}{r} transistors \\ resistors \\ capacitors \end{array}\begin{bmatrix} 1 & 2 & 3 \\ 10 & 18 & 24 \\ 5 & 7 & 10 \end{bmatrix} \times \begin{bmatrix} 100 \\ 250 \\ 80 \end{bmatrix} = \begin{bmatrix} 100 + 500 + 240 \\ 1000 + 4500 + 1920 \\ 500 + 1750 + 800 \end{bmatrix} = \begin{bmatrix} 840 \\ 7420 \\ 3050 \end{bmatrix}$

Weekly consumption of transistors 840, resistors 7420 and capacitors 3050

Q8. Three persons buy cold drinks of different brands A, B and C. The first person buys 12 bottles of A, 5 bottles of B and 3 bottles of C. The second person buys 4 bottles of A, 6 bottles of B and 10 bottles of C. The third person buys 6 bottles of A, 7 bottles of B and 9 bottles of C.

Represent this information in the form of a matrix. If each bottle of brand A costs Rs 4, each bottle of B costs Rs 5 and each bottle of C cost Rs 6, then using matrix operation, find the total sum of money spent individually by the three persons for the purchase of cold drinks.

Answer: Three persons buy cold rinks Cost of cold drinks

P = $\begin{array}{r} \\ P1 \\ P2 \\ P3 \end{array}\begin{array}{c} A \quad B \quad C \\ \begin{bmatrix} 12 & 5 & 3 \\ 4 & 6 & 10 \\ 6 & 7 & 9 \end{bmatrix} \end{array}$ C = $\begin{array}{r} A \\ B \\ C \end{array}\begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix}$

The total sum of money spent individually by the three persons for the purchase of cold drinks.

P × C = $\begin{array}{r} P1 \\ P2 \\ P3 \end{array}\begin{bmatrix} 12 & 5 & 3 \\ 4 & 6 & 10 \\ 6 & 7 & 9 \end{bmatrix} \times \begin{array}{r} A \\ B \\ C \end{array}\begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix} = \begin{bmatrix} 48 + 25 + 18 \\ 16 + 30 + 60 \\ 24 + 35 + 54 \end{bmatrix} = \begin{bmatrix} 91 \\ 106 \\ 113 \end{bmatrix}$

Q9. The annual sale volumes of three products X, Y, Z whose sale prices per unit are Rs 3.50, Rs 2.75, Rs 1.50 respectively, in two different markets I and II are shown below:

Market	X	Y	Z
I	**6000**	**9000**	**13000**
II	**12000**	**6000**	**17000**

Find the total revenue in each market with help of matrix.

Answer: A = $\begin{array}{r} I \\ II \end{array}\begin{bmatrix} 6000 & 9000 & 13000 \\ 12000 & 6000 & 17000 \end{bmatrix}$ B = $\begin{array}{r} X \\ Y \\ Z \end{array}\begin{bmatrix} 3.50 \\ 2.75 \\ 1.50 \end{bmatrix}$

Total revenue of each market A × B = $\begin{bmatrix} 6000 & 9000 & 13000 \\ 12000 & 6000 & 17000 \end{bmatrix} \times \begin{bmatrix} 3.50 \\ 2.75 \\ 1.50 \end{bmatrix}$

$= \begin{bmatrix} 21000 + 24750 + 19500 \\ 42000 + 16500 + 25500 \end{bmatrix} = \begin{bmatrix} 65250 \\ 84000 \end{bmatrix}$

Revenue OF Market (I) = Rs 65,250 Revenue Of Market (II) = Rs 84000

Q10. There are two families X and Y. Family X has 2 men, 3 women and 1 child, while family Y has one man, one woman and two children. Their individual daily requirement is as follows:

Man : 2400 calories and 55 gms protein, Woman : 1900 calories and 45 gms protein, Child : 1800 calories and 33 gms protein.

Present the above information in the form of matrices. Using matrix multiplication calculates the total daily requirement of calories and protein of each of the two families.

Answer:

Matrix A = $\begin{array}{c c} & \begin{array}{ccc} Man & Woman & child \end{array} \\ \begin{array}{c} calories \\ protien \end{array} & \begin{bmatrix} 2400 & 1900 & 1800 \\ 55 & 45 & 33 \end{bmatrix} \end{array}$

Matrix B = $\begin{array}{c c} & \begin{array}{cc} X & Y \end{array} \\ \begin{array}{c} Man \\ Woman \\ Child \end{array} & \begin{bmatrix} 2 & 1 \\ 3 & 1 \\ 1 & 2 \end{bmatrix} \end{array}$

Total daily requirement B × A = $\begin{bmatrix} 2 & 3 & 1 \\ 1 & 1 & 2 \end{bmatrix} \times \begin{bmatrix} 2400 & 55 \\ 1900 & 45 \\ 1800 & 33 \end{bmatrix} = \begin{bmatrix} 4800 + 5700 + 1800 & 110 + 135 + 33 \\ 2400 + 1900 + 3600 & 55 + 45 + 66 \end{bmatrix}$

$= \begin{bmatrix} 12{,}300 & 278 \\ 7900 & 166 \end{bmatrix}$

Family X : 12,300 calories and 278 gms protein

Family Y : 7900 calories and 166 gms protein

Q11. A student has 4 places where he can have lunch. The college canteen charges Rs 9 for a cold drink, Rs 6 for cutlet and Rs 5 for a sandwich. The coffee house charges Rs 10, Rs 8 and Rs 9 for the same items, while fast food joint charges Rs 12, Rs 15, Rs 15 and restaurant charges Rs 15, Rs 25 and Rs 20 for the above items respectively. The student wants to have one cold drink, two cutlets and one sandwich. Where should he have his lunch so that the lunch cost him the least?

Answer: Same as question number 10.

Q12. In a certain city there are 5 colleges and 20 schools. Each school has 3 peons, 1clerk and 1 head clerk, whereas a college has 5 peons, 3 clerks, 1 head clerk and an additional staff as a caretaker. The monthly salary of each of them is follows:

Peon – Rs 1100, Clerk – Rs 1700, Head Clerk – Rs 3000 and Caretaker – Rs 2500

Using matrix method, find

(i) The total number of posts of each kind in schools and colleges taken together,

(ii) The total monthly salary bill of each school and college, and

(iii) The total monthly salary bill of all the schools and colleges taken together.

Answer: Matrix of colleges and schools A = $[5 \quad 20]$

$$\begin{array}{cc} College & School \end{array}$$

Matrix of posts B = $\begin{array}{r} Peon \\ Clerk \\ Head\ clerk \\ Caretaker \end{array}\begin{bmatrix} 5 & 3 \\ 3 & 1 \\ 1 & 1 \\ 1 & 0 \end{bmatrix}$

Matrix of salary (S) = $\begin{array}{r} Peon \\ Clerk \\ Head\ clerk \\ Caretaker \end{array}\begin{bmatrix} 1100 \\ 1700 \\ 3000 \\ 2500 \end{bmatrix}$

(i) Total number of posts each college and school B × A = $\begin{array}{r} Peon \\ Clerk \\ Head\ clerk \\ Caretaker \end{array}\begin{bmatrix} 5 & 3 \\ 3 & 1 \\ 1 & 1 \\ 1 & 0 \end{bmatrix} \times \begin{bmatrix} 5 \\ 20 \end{bmatrix} = \begin{bmatrix} 25+60 \\ 15+20 \\ 5+20 \\ 5+0 \end{bmatrix} = \begin{bmatrix} 85 \\ 35 \\ 25 \\ 5 \end{bmatrix}$

Peons : 85 Clerk : 35 Head clerk = 25 Caretaker = 05

(ii) Monthly salary bill of each School and each college

B × S = $\begin{array}{r} College \\ School \end{array}\begin{bmatrix} 5 & 3 & 1 & 1 \\ 3 & 1 & 1 & 0 \end{bmatrix} \times \begin{bmatrix} 1100 \\ 1700 \\ 3000 \\ 2500 \end{bmatrix} = \begin{bmatrix} 5500+5100+3000+2500 \\ 3300+1700+3000+0 \end{bmatrix} = \begin{bmatrix} 16{,}100 \\ 8000 \end{bmatrix}$

Monthly Salary bill of each School : Rs 8000 and for each college : Rs 16,100

(iii) Total monthly salary bill of all the schools and college taken together is Rs 2,40,500

$= \begin{bmatrix} 16{,}100 \\ 8000 \end{bmatrix} \times \begin{bmatrix} 5 \\ 20 \end{bmatrix} = [80{,}500 + 1{,}60{,}000] = [2{,}40{,}500]$

Q13. In a certain city are 25 colleges and 100 schools. Each school and college has 5 peons, 2 clerks and 1 cashier. Each college, in addition has 1 accountant and 1 head clerk. The monthly salary of each of them is as follows:

Peon – Rs 625, Clerk – Rs 740, Cashier – Rs 760, Accountant – Rs 1200, Head Clerk – Rs 1250

Using matrix method, find

(i) The total number of posts of each kind in schools and colleges taken together

(ii) The total monthly salary bill of all the schools and colleges taken together.

Answer: A = $\begin{array}{c} College \\ School \end{array}\begin{bmatrix} 25 \\ 100 \end{bmatrix}$

B = $\begin{array}{cc} & \begin{array}{ccccc} Peon & Clerk & Cashier & Accountnt & H.C \end{array} \\ \begin{array}{c} College \\ School \end{array} & \begin{bmatrix} 5 & 2 & 1 & 1 & 1 \\ 5 & 2 & 1 & 0 & 0 \end{bmatrix} \end{array}$

S = $\begin{array}{c} Peon \\ Clerk \\ Cashier \\ Accountant \\ H.C \end{array}\begin{bmatrix} 625 \\ 740 \\ 760 \\ 1200 \\ 1250 \end{bmatrix}$

B × A = $\begin{array}{c} Peon \\ Clerk \\ Cashier \\ Accountant \\ H.C \end{array}\begin{bmatrix} 5 & 5 \\ 2 & 2 \\ 1 & 1 \\ 1 & 0 \\ 1 & 0 \end{bmatrix} \times \begin{bmatrix} 25 \\ 100 \end{bmatrix} = \begin{bmatrix} 125+500 \\ 50+200 \\ 25+100 \\ 25+0 \\ 25+0 \end{bmatrix} = \begin{bmatrix} 625 \\ 250 \\ 125 \\ 25 \\ 25 \end{bmatrix}$

Peons : 625, Clerks : 250, Cashiers : 125, Accountants : 25, Head Clerks : 25

(ii) Total monthly salary bill = $[625 \quad 740 \quad 760 \quad 1200 \quad 1250] \times \begin{bmatrix} 625 \\ 250 \\ 125 \\ 25 \\ 25 \end{bmatrix}$

= $[3{,}90{,}625 + 1{,}85{,}000 + 95{,}000 + 30{,}000 + 31{,}250]$

= $[7{,}31{,}875]$

Q14. There are three electric dealers in a pure competition market who ell Radios, Tape recorders and Television sets. A sells weekly 48 radios, 20 tape recorders and 12 television; B sells weekly 57 radios, 17 tape recorders and 15 television sets, and C sells weekly 35 radios, 22 tape recorders and 18 television sets. Using matrices, calculate their individual profits, if the net revenue on a radio is Rs 50, on a tape recorder Rs 75 and on a television set Rs 250.

Answer: S = $\begin{array}{cc} & \begin{array}{ccc} Radio & Tape & Television \end{array} \\ \begin{array}{c} A \\ B \\ C \end{array} & \begin{bmatrix} 48 & 20 & 12 \\ 57 & 17 & 15 \\ 35 & 22 & 18 \end{bmatrix} \end{array}$

R = $\begin{array}{c} Radio \\ Tape \\ Television \end{array}\begin{bmatrix} 50 \\ 75 \\ 250 \end{bmatrix}$

Individual Profit = $\begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} 48 & 20 & 12 \\ 57 & 17 & 15 \\ 35 & 22 & 18 \end{bmatrix} \times \begin{bmatrix} 50 \\ 75 \\ 250 \end{bmatrix} = \begin{array}{c} A \\ B \\ C \end{array}\begin{bmatrix} 2400+1500+3000 \\ 2850+1275+3750 \\ 1750+1650+4500 \end{bmatrix} = \begin{bmatrix} 6900 \\ 7875 \\ 7900 \end{bmatrix}$

A's profit = Rs 6900, B's profit = Rs 7875, C's profit = Rs 7900

Q15. Two television companies TV_1 and TV_2 both televise both televise documentary programmes and variety programmes. TV_1 has two transmitting stations and TV_2 has three transmitting stations, all stations transmit different programmes. On an average each TV_1 station broadcasts 1 hour of documentary transmit and 3 hours of verity programmes each day, whereas each TV_2 station broadcast 2 hours of documentary and $1\frac{1}{2}$ hours of variety programmes each day. The transmission of documentary and variety programmes costs approximately Rs 50 and Rs 200 per hour respectively. Express in matrix form and hence evaluate:

(i) The daily cost of transmission from each TV_1 and TV_2 station.

(ii) The total number of hours which are devoted daily to documentary and to variety programmes by both campanies.

(iii) The total daily cost of transmission incurred by both companies.

Answer: Transmitting Stations (A) = $\begin{array}{c} \text{TV1} \\ \text{TV2} \end{array}\begin{bmatrix} 2 \\ 3 \end{bmatrix}$

$$\text{Programmes (P)} = \begin{array}{c} \\ \text{TV1} \\ \text{TV2} \end{array}\begin{array}{c} \begin{array}{cc} Doc. & Var. \end{array} \\ \begin{bmatrix} 1 & 3 \\ 2 & 1.5 \end{bmatrix} \end{array}$$

$$\text{Cost (C)} = \begin{array}{c} \text{Doc.} \\ \text{Var.} \end{array}\begin{bmatrix} 50 \\ 200 \end{bmatrix}$$

(i) The daily cost of transmission (P × C) = $\begin{bmatrix} 1 & 3 \\ 2 & 1.5 \end{bmatrix} \times \begin{bmatrix} 50 \\ 200 \end{bmatrix} = \begin{bmatrix} 50+600 \\ 100+300 \end{bmatrix} = \begin{bmatrix} 650 \\ 400 \end{bmatrix}$

The daily cost of transmission from TV_1 = Rs 650

The daily cost of transmission from TV_2 = Rs 400

(ii) The total number of hours (P × A) = $\begin{array}{c} Doc. \\ Var. \end{array}\begin{bmatrix} 1 & 2 \\ 3 & 1.5 \end{bmatrix} \times \begin{array}{c} \text{TV1} \\ \text{TV2} \end{array}\begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 2+6 \\ 6+4.5 \end{bmatrix} = \begin{bmatrix} 8 \\ 10.5 \end{bmatrix}$

The total number of hours devoted documentary prog. = 8 hours

The total number of hours devoted variety prog. = 10.5 hours

(iii) The total daily cost of transmission = $\begin{bmatrix} 8 & 10.5 \end{bmatrix} \times \begin{bmatrix} 50 \\ 200 \end{bmatrix} = [400 + 2100] = [2500]$

The total daily cost of transmission is Rs 2500.

Q16. A firm produces three products P_1**,** P_2 and P_3 requiring the mix up of four materials M_1, M_2, M_3 and M_4. The matrix below gives the amount of material needed for each product:

$$A = \begin{array}{c} \\ P1 \\ P2 \\ P3 \end{array}\begin{array}{c} \begin{array}{cccc} M1 & M2 & M3 & M4 \end{array} \\ \begin{bmatrix} 2 & 3 & 1 & 12 \\ 7 & 9 & 5 & 20 \\ 8 & 12 & 6 & 15 \end{bmatrix} \end{array}$$ using matrix notations, find

(i) The total requirement of each material if the firm produces 70 units of P_1, 120 units of P_2 and 50 units of P_3 .

(ii) The per unit cost of production of each product if the per unit costs of materials M_1, M_2, M_3 and M_4 are Rs 10, Rs 12, Rs 15 and Rs 20 respectively.

(iii) The total cost of production.

Answer: (I)

The total requirement of each material = $\begin{array}{c|c} & \begin{array}{ccc} P1 & P2 & P3 \end{array} \\ \begin{array}{c} M1 \\ M2 \\ M3 \\ M4 \end{array} & \begin{bmatrix} 2 & 7 & 8 \\ 3 & 9 & 12 \\ 1 & 5 & 6 \\ 12 & 20 & 15 \end{bmatrix} \end{array} \times \begin{bmatrix} 70 \\ 120 \\ 50 \end{bmatrix} = \begin{bmatrix} 140+840+400 \\ 210+1080+600 \\ 70+600+300 \\ 840+2400+750 \end{bmatrix} = \begin{bmatrix} 1380 \\ 1890 \\ 970 \\ 3990 \end{bmatrix}$

M1 = 1380, M2 = 1890, M3 = 970, M4 = 3990

(ii) The per unit cost of production of each product = = $\begin{array}{c} P1 \\ P2 \\ P3 \end{array} \begin{bmatrix} 2 & 3 & 1 & 12 \\ 7 & 9 & 5 & 20 \\ 8 & 12 & 6 & 15 \end{bmatrix} \times \begin{bmatrix} 10 \\ 12 \\ 15 \\ 20 \end{bmatrix}$

$= = \begin{array}{c} P1 \\ P2 \\ P3 \end{array} \begin{bmatrix} 20+36+15+240 \\ 84+108+75+400 \\ 80+144+90+300 \end{bmatrix} = = \begin{array}{c} P1 \\ P2 \\ P3 \end{array} \begin{bmatrix} 311 \\ 653 \\ 614 \end{bmatrix}$

(iii) The total cost of production = $[70 \quad 120 \quad 50] \times \begin{array}{c} P1 \\ P2 \\ P3 \end{array} \begin{bmatrix} 311 \\ 653 \\ 614 \end{bmatrix} = [21,770 + 78,360 + 30,700] = [1,30,830]$

The total cost of production is Rs 1,30,830