1.B

~~$n(I) = 184$~~

$n(E) = 100$

$n(G) = 82$

$n(F) = 45$

$n(S) = 28$

$n(G \cap F) = 0$

$n(G \cap S) = 0$

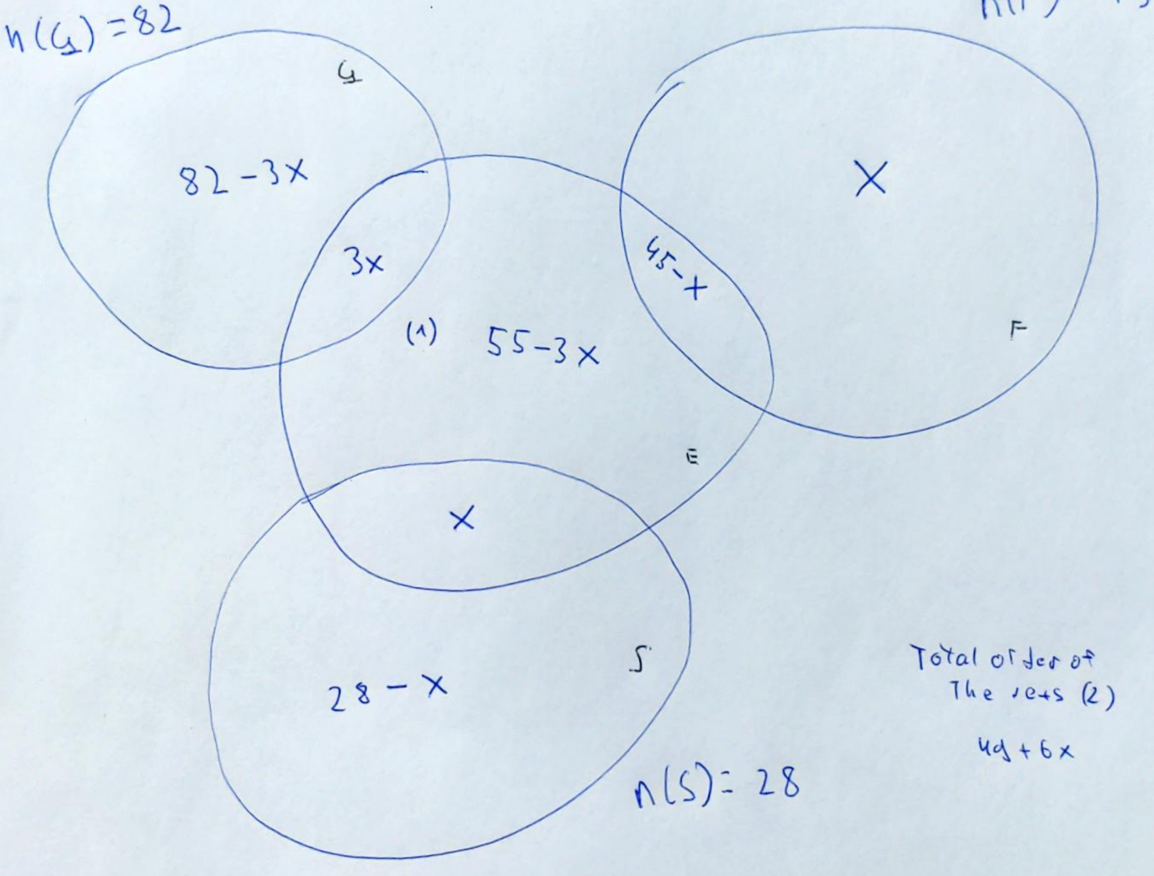
$n(F \cap S) = 0$

~~$n(E \cap$~~

$n(F) = x$

$n(S \cap E) = x$

$n(G \cap E) = 3x$



Total order of
The sets (2)
$49 + 6x$

1) $100 - 3x - x - 45 + x = 55 - 3x$

~~2) $184 - 82 + 3x - x - 28 + x - 55 + 3x = 49 + 6x$~~

2) 184 ~~$- [(82-3x) + (3x) + (x) + (45-3x) + (55-3x) + (x) + (28-x)] = -26 - 5x \Rightarrow x \in$~~

~~2) $184 - 82 + 3x - 3x - x - 47 + x$~~

$=$

2) $184 - 82 + 3x - x - 28 + x - 55 + 3x$

II Hence: $3x \leq 55 \Rightarrow x \leq 18$

$x > 0$

$184 \leq 49 + 6x$

2.B.II

$$P_0 = R_0 - C_0 \Rightarrow P_0 = \left[18\cdot\left(\tfrac{1}{3}\right)^0 + 20 + 8\cdot\left(\tfrac{1}{2}\right)^0\right] - \left[27\cdot\left(\tfrac{1}{3}\right)^0 + 12\cdot\left(\tfrac{1}{2}\right)^0 + 30\right]$$

$$= (-27+18)\cdot\left[\tfrac{1}{3}\right]^t + (8-12)\cdot\left[\tfrac{1}{2}\right]^t - 10 = -9\cdot\left(\tfrac{1}{3}\right)^t - 4\cdot\left(\tfrac{1}{2}\right)^t - 10$$

$$P_0 = -9\cdot\left(\tfrac{1}{3}\right)^0 - 4\left(\tfrac{1}{2}\right)^0 - 10 = -23$$
$$P_1 = -9\left(\tfrac{1}{3}\right)^1 - 4\cdot\left(\tfrac{1}{2}\right)^1 - 10 = -15$$
$$P_2 = -9\left(\tfrac{1}{3}\right)^2 - 4\left(\tfrac{1}{2}\right)^2 - 10 = -12$$

Answer: So, yes product will never be profitable at all because of negative Revenue function in condition of positive productions

2.A

let's

$S_t = m^t$

2.B.I

let's assume

$R_t = M^t$:

$t=0$ $6m^2 - 5m + 1 = 0 \Rightarrow \left(m - \frac{1}{3}\right)\left(m - \frac{1}{2}\right) = 0$

$x_t = A\left(\frac{1}{3}\right)^t + B\left(\frac{1}{2}\right)^t$

if $x_t = k$

$6k - 5k + k = 40$

$k = 20$

so, combine two solution parts:

General solution is

$X_t = A\left(\frac{1}{3}\right)^t + B\left(\frac{1}{2}\right)^t + 20$

$x_0 = 46$

$46 = A + B + 20$

$\begin{cases} A + B = 26 \\ 2A + 3B = 60 \end{cases}$

$B = 8$

$A = 18$

$x_1 = 30$

$30 = \frac{1}{3} \cdot A + \frac{1}{2} \cdot B + 20$

$60 = 2A + 3B$

complete solution is:

$x_t = 18\left(\frac{1}{3}\right)^t + 8 \cdot \left(\frac{1}{2}\right)^t$

4.1

$$P_n(t+\Delta t) = \lambda \Delta t P_{n-1}(t) + (1-\lambda \Delta t) \cdot P_n(t) + o(\Delta t)$$

So, rearranging and letting $\Delta t \to 0$

$$\frac{\partial P_n}{\partial t} = -\lambda P_{n-1} \quad \text{for } n \geq 1$$

$$\frac{\partial P_0 / \partial t}{P_0} = -\lambda$$

$$\frac{\partial P_1}{\partial t} = -\lambda P_1 + \lambda P_0 = -\lambda P_1 + \lambda e^{-\lambda t}$$

$$\frac{\partial P_1}{\partial t} = \lambda e^{-\lambda t}$$

$$e^{\int \lambda \partial t} = e^{\lambda t}$$

hense:

$$P_1 = e^{-\lambda t} \int \lambda e^{-\lambda t} e^{\lambda t} \partial t = \lambda t e^{-\lambda t}$$

Answer: Non often together and rate reasonably constant

Poisson should work well

u.B I $p_2 = p^2 \cdot (1-p) = 0{,}5^2(1-0{,}5) = 0{,}125$

u.B II $\lambda = \frac{0{,}1}{0{,}2-0{,}1} = 1$

5.

$$A = \begin{array}{cccc} P & Q & R & \\ \begin{pmatrix} 0.8 & 0.2 & 0.12 \\ 0 & 0 & 0.4 \\ 0.2 & 0.5 & 0.5 \end{pmatrix} & & & \begin{matrix} I \\ II \\ III \end{matrix} \end{array}$$

$$(E-A) = 0. \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} - A = \begin{matrix} 0.2 & -0.2 & -0.12 \\ 0 & 1 & -0.4 \\ -0.2 & -0.5 & 0.5 \end{matrix}$$

$$(E-A)^{-1}$$

$$\begin{pmatrix} 0.2 & -0.2 & -0.12 \\ 0 & 1 & -0.4 \\ -0.2 & -0.5 & 0.5 \end{pmatrix}$$

$$\Delta = 0.2 \cdot (1 \cdot 0.5 - (-0.5 \cdot (-0.4))) - 0(-0.2 \cdot 0.5 - (-12)) + (-0.2; (-0.2 \cdot (0.4) - 1 (0.11) =$$

$$= 0.02$$

$$B^T = \begin{pmatrix} 0.2 & 0 & -0.2 \\ -0.2 & 1 & -0.5 \\ -0.12 & -0.4 & 0.5 \end{pmatrix}$$

$$B^T_{1,1} = (-1)^{1+1} \begin{pmatrix} 1 & -0.5 \\ -0.4 & 0.5 \end{pmatrix}$$

$$\Delta_{11} = (1 \cdot 0.5 - (-0.4 \cdot (-0.5))) = 0.3$$

$$B^T_{1,2} = (-1)^{1+2} \begin{pmatrix} -0.2 & -0.5 \\ -0.12 & 0.5 \end{pmatrix}$$

$$\Delta_{1,2} = (-0.2 \cdot 0.5 - (-0.12 (-0.5)) = 0.16$$

$$\Delta_{1,3} = (-0.2 \cdot (0.4) - (0.12 \cdot 1) = 0.2$$

$$\Delta_{2,1} = (0.06 - (-0.4 \cdot -0.1)) = 0.08$$

$$\Delta_{2,2} = 0.076$$

$$\Delta_{2,3} = 0.08$$

$$\Delta_{3,1} = 0.2$$

$$\Delta_{3,2} = 0.14$$

$$\Delta_{3,3} = 0.2$$

$$B^{-1} = \frac{1}{0.02}\begin{pmatrix} 0.3 & 0.16 & 0.2 \\ 0.08 & 0.076 & 0.08 \\ 0.2 & 0.14 & 0.2 \end{pmatrix}$$

$$B^{-1} = \begin{pmatrix} 15 & 8 & 10 \\ 4 & 3,8 & 4 \\ 10 & 7 & 10 \end{pmatrix}$$

system of basis equtions

$$0,2x_1 - 0.2x_2 - 0.12x_3 = y_1$$

$$0x_1 + 1x_2 - 0.4x_3 = y_2$$

$$-0.2x_1 - 0.3x_2 + 0.5x_3 = y_3$$

$$X = (B^{-1} \cdot Y) = \begin{pmatrix} 15 & 8 & 10 \\ 4 & 3,8 & 4 \\ 10 & 7 & 10 \end{pmatrix}\begin{pmatrix} 20 \\ 10 \\ 20 \end{pmatrix} = \begin{matrix} 580 \\ 198 \\ 470 \end{matrix}$$

production

$580 - (464 + 0 + 116) = 0$

$198 - (39.6 + 0 + 99) = 59.4$

$470 - (56.4 + 188 + 335) = -9.4$

inter-industry

industry	consuming industry	Final product	gross Domestic product	2	3
1	464	39.6	56.4	20	380
2	0	0	188	10	198
3	116	99	335	20	470
Net product	0	59.4	-9.4	50	
gross domestic	580	198	470		1248

6 A.I

Day	Alpha=0.3 % Humidity	Forecast	Error	$Error^2$	Absolute error
1	23				
2	22,5	23	-0,5	0.25	-0.5
3	22	22,35	-0,35	0,1225	-0.3
4	23	22,3	0,7	0.49	0.7
5	24	23,3	0.7	0.49	~~1.8~~ 0.7
6	26,5	24,75	1,75	3.0625	~~-1.1~~ 1.8
7	25	26,05	-0.7	1.1025	~~-0.7~~ -1.1
8	24	24,7		0.49	-0.7
9		16,8			

$\alpha_1 = 0.3$

RMSE = 0.9263

MAE = 0,55/7 = 0,078

DAY	Alpha= 0.5 % Humidity	Folecast	Error	Error^2	Absolute Error
1	23				
2	22,5	23	-0,5	0,25	-0,5
3	22	22,25	-0,25	0,0625	-0,3
4	23	22,5	0,5	0,25	+0,5
5	24	23,5	0,5	0,25	0,5
6	26,5	25,25	1,25	1,5625	1,3
7	25	25,75	-0,75	0,5625	-0,8
8	24	24,5	-0,5	0,25	-0,5
9		12			
		Total		3,1875	0,25

RMSE= 0,6748

MAE =0,25/7= 0,0357

Answer:

I

Alpha= 0.3
Forecast: 16,8
RMSE = 0,0263
MAE = 0,078

Apha= 0.5
Forecast = 12
RMSE= 0.6748
MAE= 0.0357

6.1.II

The lowed the MaE => the better => Alpha= 0,5 is optimal Value

	MAE
$\alpha_1 = 0.3$	0,079
$\alpha_2 = 0,5$	0,036
$\alpha_3 = 0,4$	1,087
$\alpha_4 = 0,6$	1,091
$\alpha_5 = 0,7$	1,128

3.

	2019 N cust	GMV	AVG GMV	$w \times (P/P_0)$
I	580	600	1.03	597.4
II	600	540	0.9	486
III	50	90	1.8	
IV	40	8	0.20	
Total	1270	1238		

$$Laspeyres_{2019} = \frac{\cancel{1270}}{\cancel{123}} \; \frac{1238}{1270} = 0.974$$

~~Laspeyre~~

2020		GMV
I	580	600
II	600	540
III	50	90
IV	40	8

$$s(t) = c_1 \cdot e^{-4t} \cdot \cos(2t) + c_2 \cdot e^{-4t} \cdot \sin(2t)$$

Particalr solution:

$$\frac{d^2 s(t)}{d^2} + 8 \frac{ds(t)}{dt} + 20\, s(t) = 10 e^{-3t}$$

$$s_p(t) = a_1 \cdot e^{-3t}$$

General solution:

$$s(t) = 2 \cdot e^{-3t} + c_1 \cdot e^{-4t} \cdot \cos(2t) + c_2 \cdot e^{-4t} \cdot \sin(2t)$$

$t = 0 \Rightarrow$

$$s(0) = 2 \cdot 1 + c_1 \cdot 1 + c_2 \cdot 0 = 10$$

$$\underline{c_1 = 8}$$

1.1

$A = \{0; 2; 4\}$

$W = \{1; 3; 4\}$

De Morgan's Law:

$$(A \cap B)^c = A^c \cup B^c$$
$$(A \cup B)^c = A^c \cap B^c$$

$(A \cap W) = 4$

A