Mid Term Assignment

Course Code: CSE 6131

Course Title: Computational Intelligence

Section: M

Submitted by

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Question 1: Mr. Hasan is a Project Manager. He is managing an IT Project. In his Project, he wants to calculate the Percentage of risk. Mr. Hasan knows the Project Funding Amount and Staff Amount.

Here, Membership functions for Project Funding {Inadequate, Marginal, Adequate}, Staff {Small, Large}, Project Risk {Low, Normal, High}

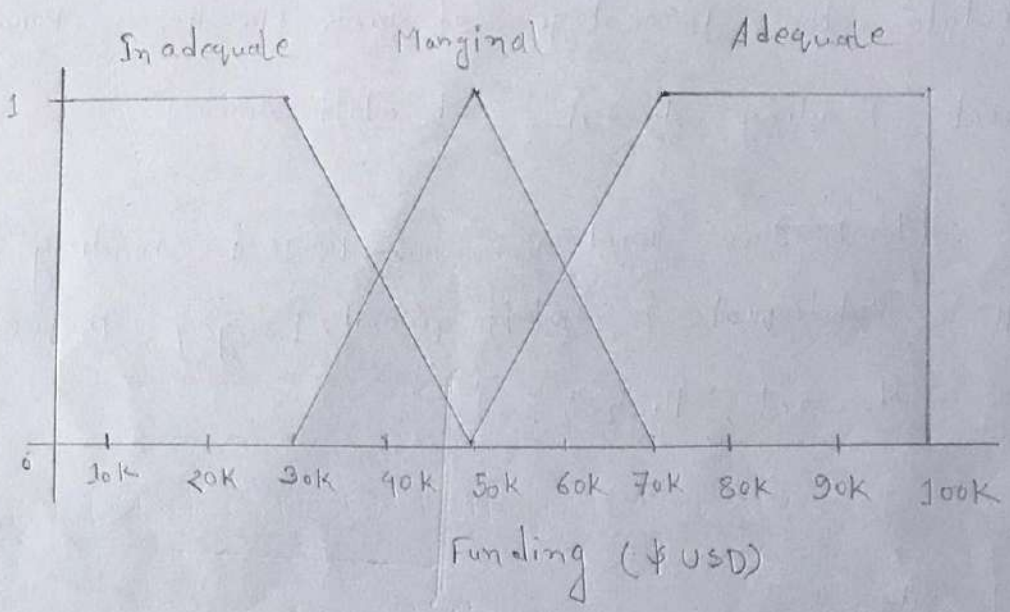
Fuzzy Rules

If Project Funding is Adequate or Project Staff is Small, then risk is Low [Rule 1]

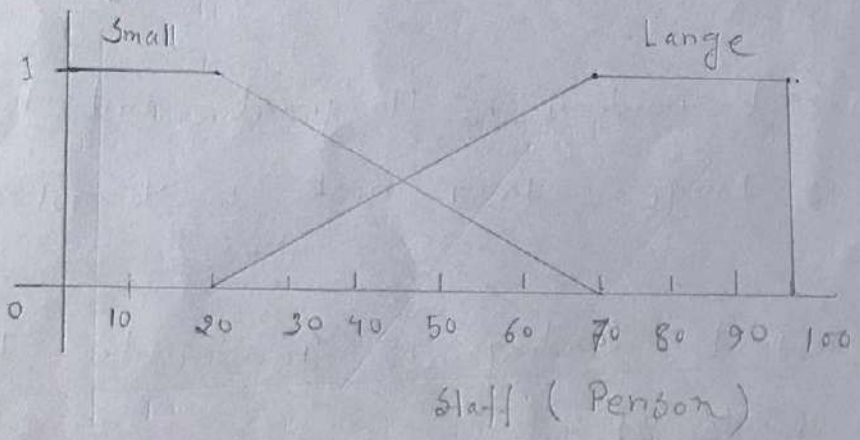
If Project Funding is Marginal, and the Project Staff is Large, then risk is Normal [Rule 2]

If Project Funding is Inadequate then risk is High [Rule 3]

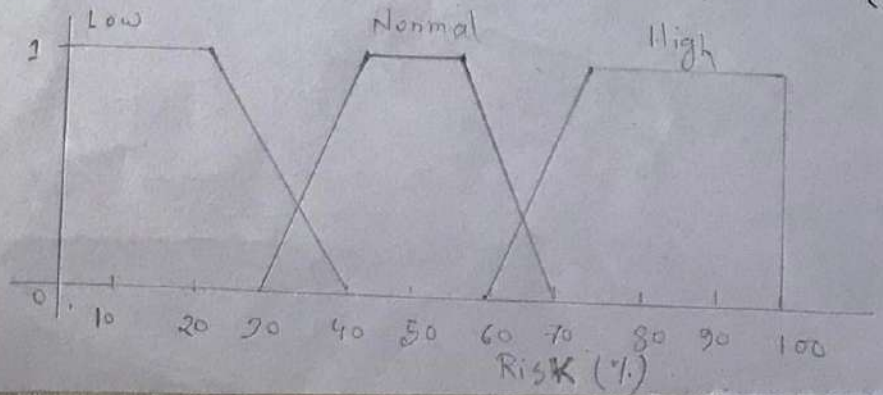
Membership function for Project Funding {Inadequate, Marginal, Adequate}



Membership Function for Project Staff {Small, Large}



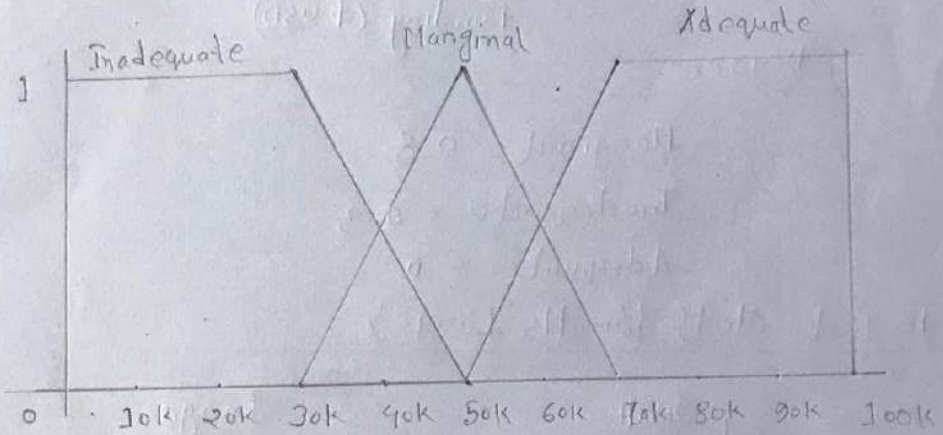
Membership function for Risk {Low, Normal, High}

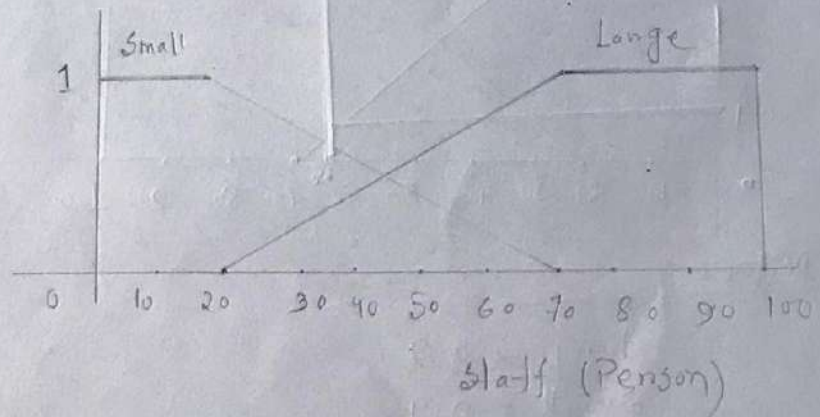


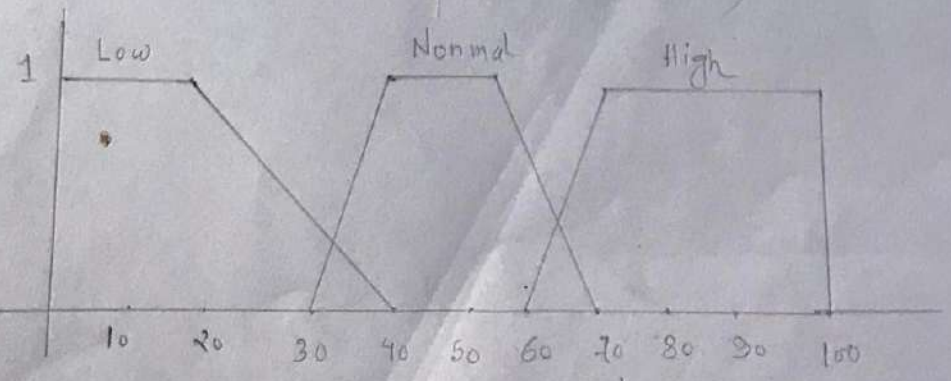
Based on these ; Find Risk Percentage when Funding is $45k and Staff amount is 65 Person. Use Centroid Defuzzification Method.

Ans To The Q. No- 01

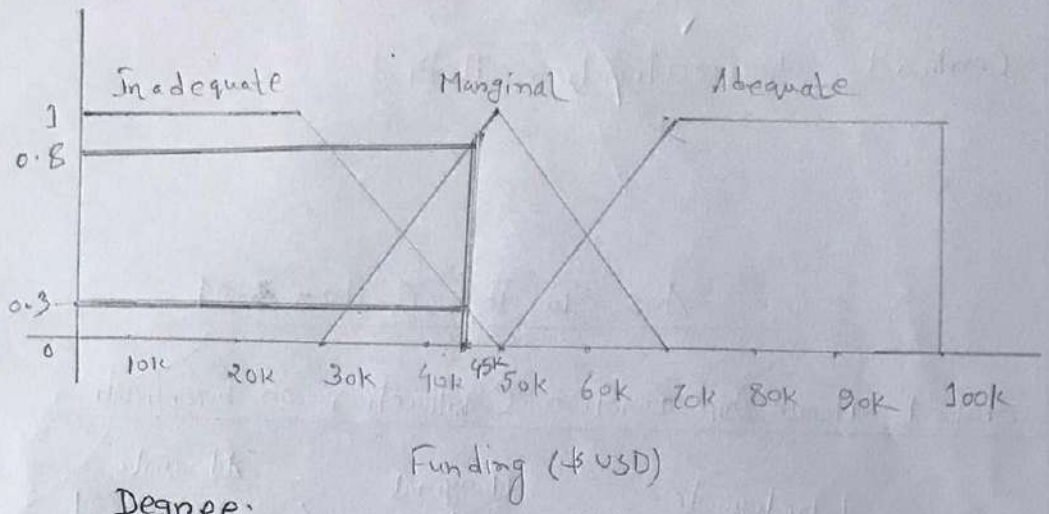
Step 1: Membership Function Construction on fuzzification







Project funding {Inadequate, Manginal, Adequate}



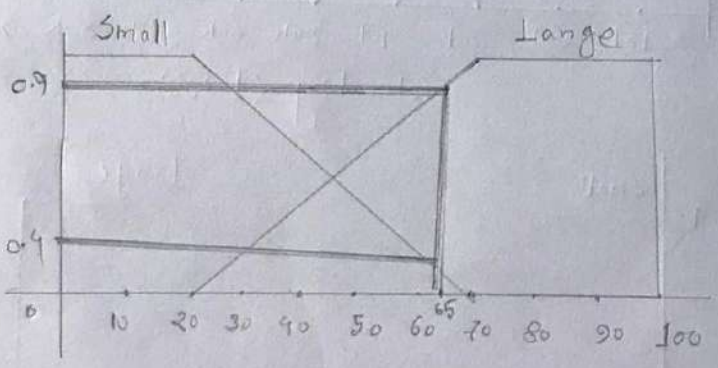
Degree:

Manginal = 0.8

Inadequate = 0.3

Adequate = 0

Project staff {Small, Large}



Degree:

Large = 0.9

Small = 0.4

Step 2: Applying Fuzzy Rules

Rule 1:

If Project Funding is Adequate or Project Staff is Small, then risk is Low.

Rule 2:

If Project Funding is Marginal and the Project Staff is Large, then risk is normal

Rule 3:

If Project Funding is Inadequate then risk is High.

According to Rule 1

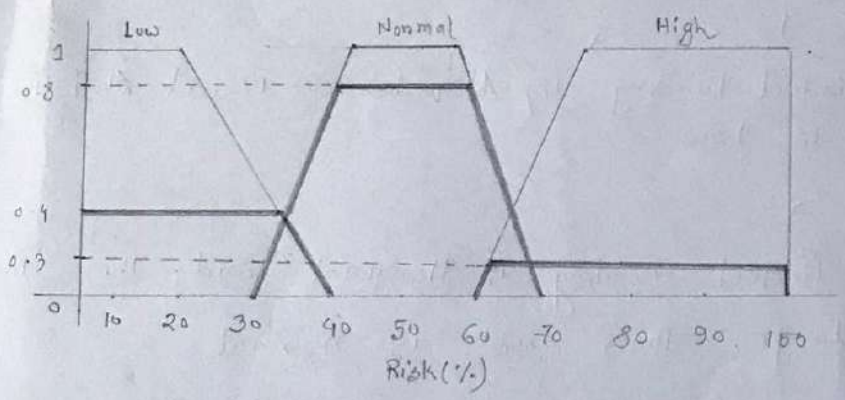
$$\text{Adequate} \vee \text{Small} = 0 \vee 0.4$$
$$= \max(0, 0.4)$$
$$= 0.4 \text{ (Low)}$$

According to Rule 2

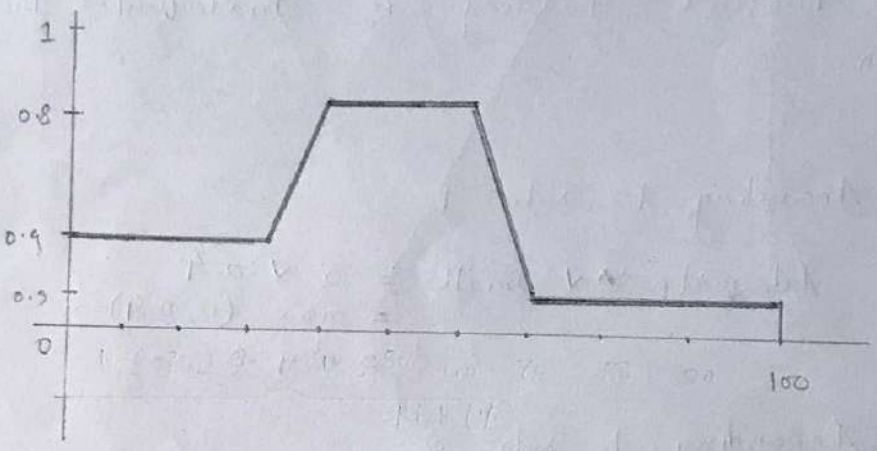
$$\text{Marginal} \wedge \text{Large} = 0.8 \wedge 0.9$$
$$= \min(0.8, 0.9)$$
$$= 0.8 \text{ (Normal)}$$

According to Rule 3

$$\text{Inadequate} = 0.3 \text{ (High)}$$

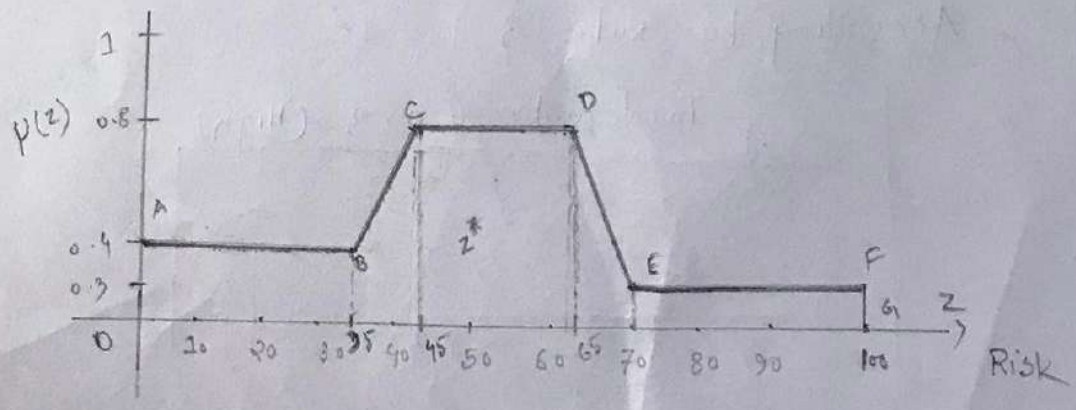


After ORing Operation



Step 3: Defuzzification Technique

Applying Centroid Defuzzification Technique



Here

$A \equiv (0, 0.4)$	$C \equiv (45, 0.8)$	$E \equiv (70, 0.3)$	$G \equiv (100, 0)$
$B \equiv (35, 0.4)$	$D \equiv (65, 0.8)$	$F \equiv (100, 0.3)$	

Equation of AB:

AB is Parallel to x axis,

so, $\mu(z) = 0.4$

Equation of BC:

$$\frac{x - x_1}{x_1 - x_2} = \frac{y - y_1}{y_1 - y_2}$$

$$\Rightarrow \frac{z - 35}{35 - 45} = \frac{\mu(z) - 0.4}{0.4 - 0.8}$$

$$\Rightarrow \frac{z - 35}{-10} = \frac{\mu(z) - 0.4}{-0.4}$$

$$\Rightarrow \frac{z - 35}{10} = \frac{\mu(z) - 0.4}{0.4}$$

$$\Rightarrow 10\{\mu(z) - 0.4\} = 0.4\,(z - 35)$$

$$\Rightarrow \mu(z) - 0.4 = \frac{0.4\,(z - 35)}{10}$$

$$\Rightarrow \mu(z) = \frac{0.4\,(z - 35)}{10} + 0.4$$

$$\Rightarrow \mu(z) = \frac{0.4z - 14 + 4}{10}$$

$$\Rightarrow \mu(z) = \frac{0.4z - 10}{10}$$

Equation of CD:

CD is Parallel to x axis

so,

$$\mu(z) = 0.8$$

Equation of DE:

$$\frac{x - x_1}{x_1 - x_2} = \frac{y - y_1}{y_1 - y_2}$$

$$\frac{z - 65}{65 - 70} = \frac{\mu(z) - 0.8}{0.8 - 0.3}$$

$$\Rightarrow \frac{z - 65}{-5} = \frac{\mu(z) - 0.8}{0.5}$$

$$\Rightarrow 0.5\,(z - 65) = -5\,\mu(z) + 4$$

$$\Rightarrow 0.5z - 32.5 = -5\,\mu(z) + 4$$

$$\Rightarrow 5\,\mu(z) = 4 + 32.5 - 0.5z$$

$$\Rightarrow \mu(z) = \frac{36.5 - 0.5z}{5}$$

Equation of EF:

EF is Parallel to x axis

so

$$\mu(z) = 0.3$$

Equation of FG:

$$\frac{x - x_1}{x_1 - x_2} = \frac{y - y_1}{y_1 - y_2}$$

$$\Rightarrow \frac{x - 100}{100 - 100} = \frac{y - 0.3}{0.3 - 0}$$

$$\Rightarrow \frac{x - 100}{0} = \frac{y - 0.3}{0.3 - 0}$$

$$\Rightarrow \frac{z - 100}{0} = \frac{N(z) - 0.3}{0.3 - 0}$$

From this equation, the value of $N(z)$ can not be solved. So in z^* Part, we won't consider FG Portion.

Now,

$$z^* = \frac{\int N(z)\, z\, dz}{\int N(z)\, dz}$$

$$= \frac{\int AB \cdot z\, dz + \int BC\, z\, dz + \int CD\, z\, dz + \int DE\, z\, dz + \int EF\, z\, dz}{\int AB \cdot dz + \int BC\, dz + \int CD\, dz + \int DE\, dz + \int EF\, dz}$$

$$= \frac{\int_0^{35} 0.4z\, dz + \int_{35}^{45} \frac{0.4z - 10}{10} z\, dz + \int_{45}^{65} 0.8\, z\, dz + \int_{65}^{70} \frac{36.5 - 0.5z}{5} z\, dz + \int_{70}^{100} 0.3z\, dz}{\int_0^{35} 0.4\, dz + \int_{35}^{45} \frac{0.4z - 10}{10} dz + \int_{45}^{65} 0.8\, dz + \int_{65}^{70} \frac{36.5 - 0.5z}{5} dz + \int_{70}^{100} 0.3\, dz}$$

$$= \frac{245 + 243.33 + 880 + 184.58 + 765}{14 + 6 + 16 + 2.75 + 9}$$

$$= \frac{2317.91}{50.75}$$

$$= 45.67$$

So, The Project Risk is 45.67 %.

Answer: 45.67 %.

Question 2: Suppose Mr. ABC went to a restaurant. After finishing the food Mr. ABC wants to give tips to the waiter. But Mr. ABC loves fuzzy computing. He decides based on Food Quality & Service Quality, he will Pay tips to the waiter.

So, for Food Quality & Service Quality Mr. ABC defined the scale from 1 to 10. Membership functions for Food Quality {Bad, Medium, Good}, Service Quality {Poor, Average, Excellent} & Tips {Small, Big}.

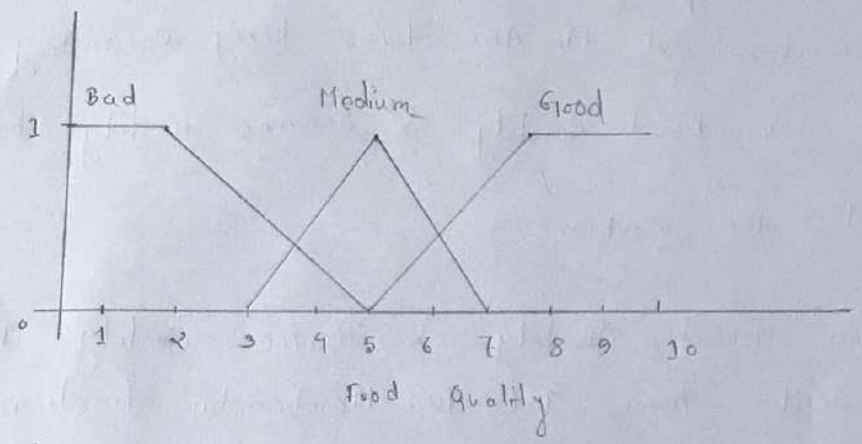
How Big will be the amount of the tip, if the restaurant's Service Quality is 6.5 & the Food Quality is 7?

Fuzzy Rules

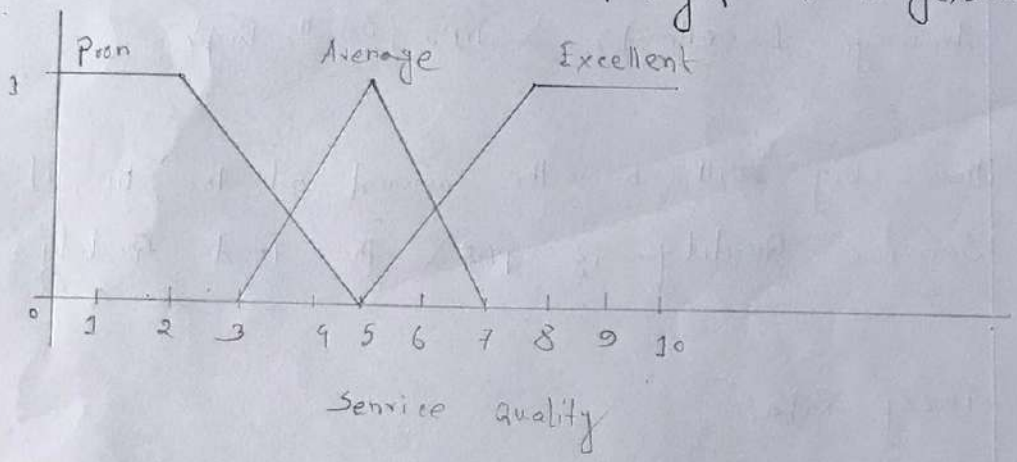
If Food Quality is Good & Service Quality is Excellent, the tip will be Big [Rule 1]

If Food Quality is ~~Bad~~ Medium & Service Quality is Average, the tip will be Small [Rule 2]

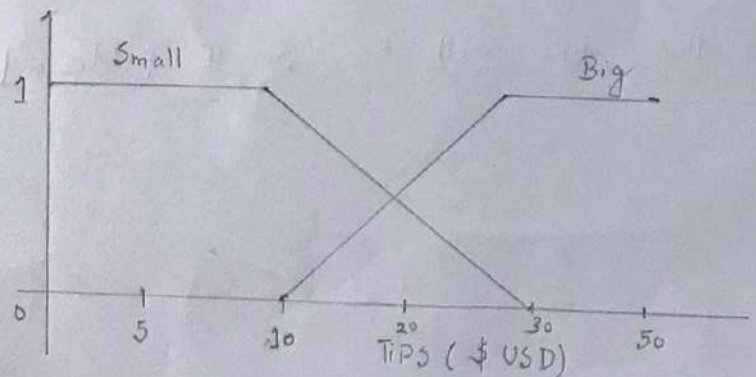
Membership function for Food Quality {Bad, Medium, Good}:



Membership function for Service Quality {Poor, Average, Excellent}



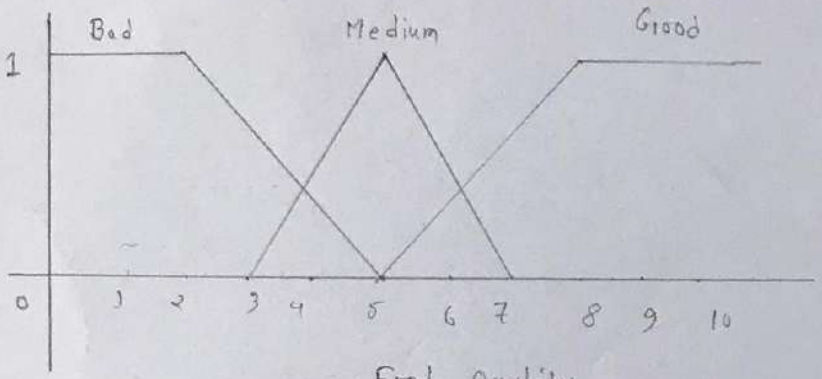
Membership function for Tips {Small, Big}

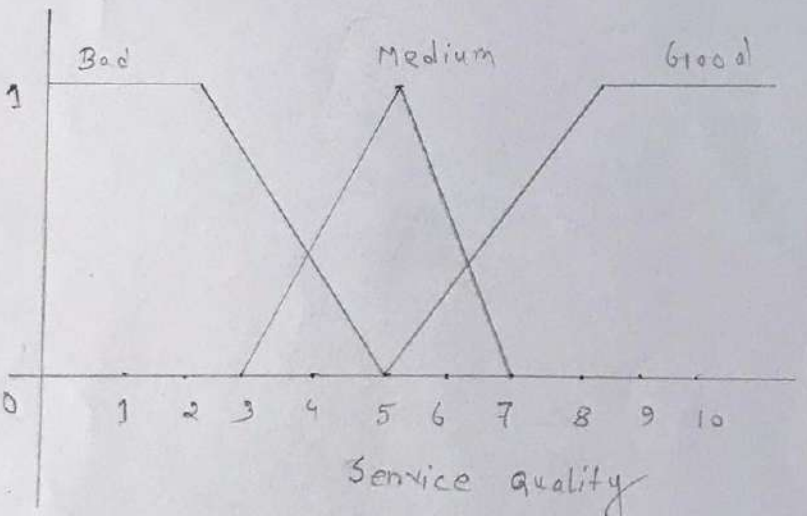


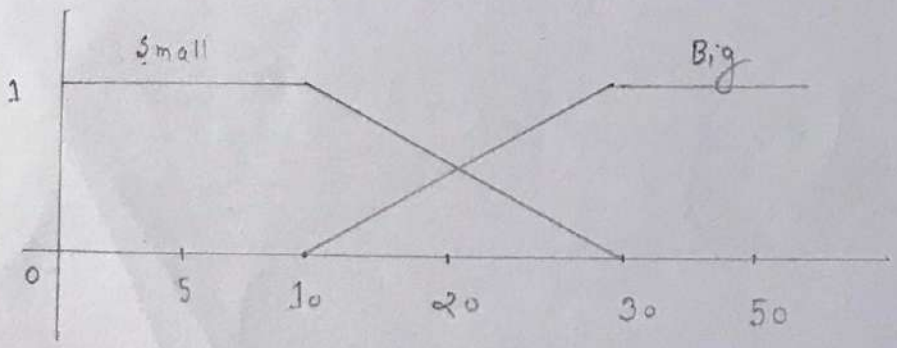
Use Weighted Average Defuzzification & Find Output.

Ans To The Q. No - 02

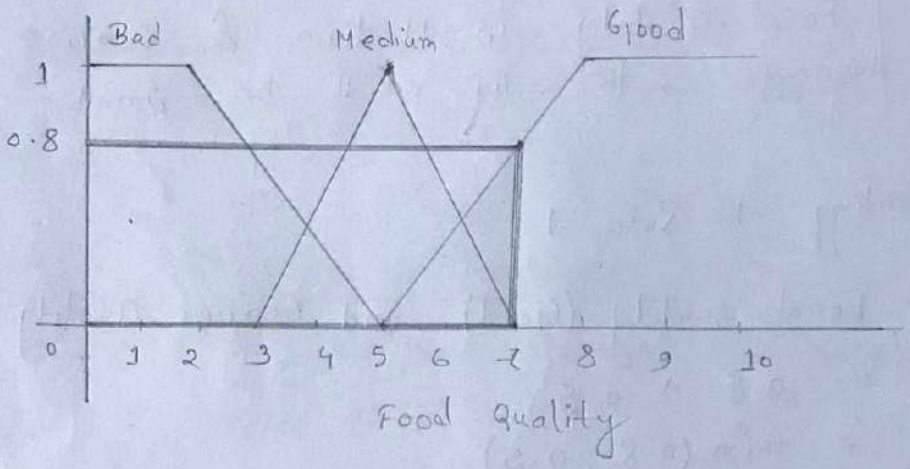
step 1: Membership Function Construction / Fuzzification







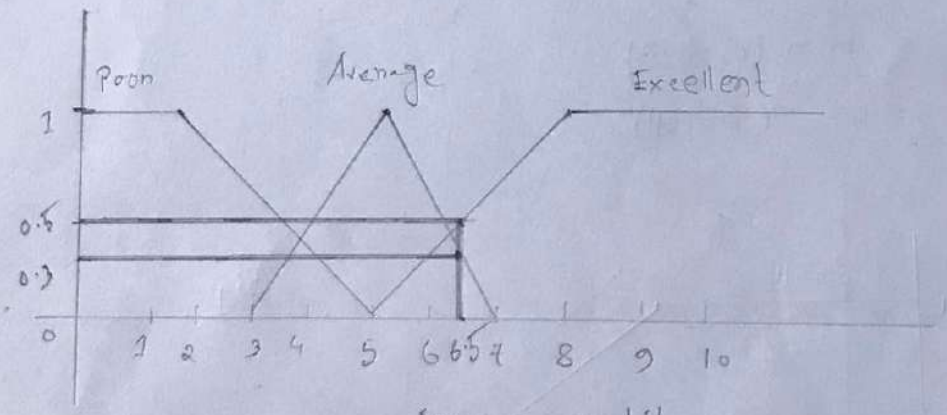
Food Quality {Bad, Medium, Good}



Degree:

Good = 0.8
Medium = 0

Service Quality {Poor, Average, Excellent}



Degree

Average = 0.3
Excellent = 0.5

Step 2: Applying Fuzzy Rules.

Rule 1:

If Food Quality is Good & Service Quality is Excellent; the tip will be Big

Rule 2:

If Food Quality is Medium & Service Quality is Average, the tip will be Small.

According to Rule 1:

Food Quality (Good) and Service Quality (Excellent)

$= 0.8 \wedge 0.5$

$= \min(0.8, 0.5)$

$= 0.5$ (Big)

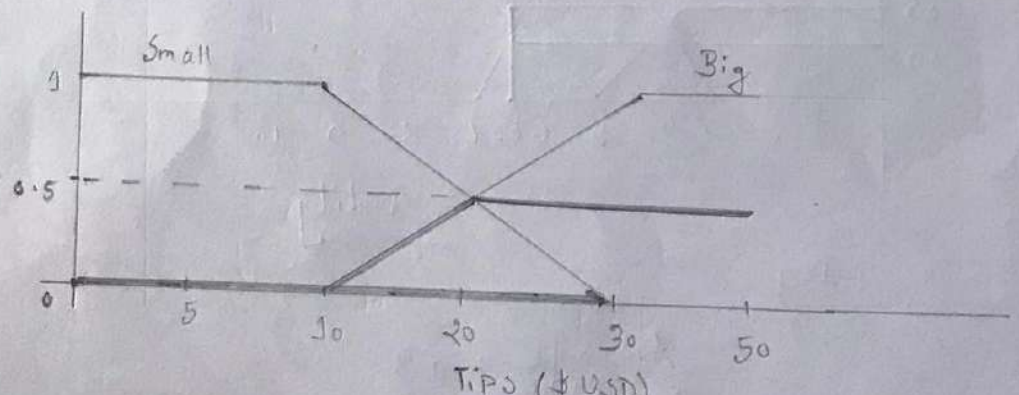
According to Rule 2:

Food Quality (Medium) and Service Quality (Average)

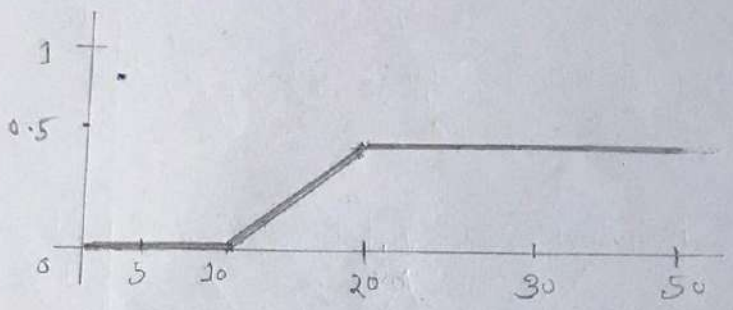
$= 0 \wedge 0.3$

$= \min(0, 0.3)$

$= 0$ (Small)



After ORing Operation



Step 3 : Defuzzification Technique

Applying Weighted Average De-fuzzification Technique.

Here

$$\mu_1 = 0 \; ; \; \mu_2 = 0.5$$

$$W_1 = \frac{0+10}{2} = \frac{10}{2} = 5$$

$$W_2 = \frac{20+50}{2} = \frac{70}{2} = 35$$

$$\text{Calculated Tip Amount} = \frac{\mu_1 W_1 + \mu_2 W_2}{\mu_1 + \mu_2}$$

$$= \frac{0 \times 5 + 0.5 \times 35}{0 + 0.5}$$

$$= \frac{0 + 17.5}{0.5}$$

$$= \frac{17.5}{0.5}$$

$$= 35 \text{ USD}$$

So, Mr. ABe will give $35 tip to the waiters.

Answer: $35