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Q1) day 12 :

- Rule 1 (rain)

O(tomorrow is rain) = $\frac{0.5}{1-0.5}$ = 1

O(tomorrow is rain | today is rain) = LS x O(tomorrow is rain)
= 2.5 x 1 = 2.5

P(tom. is rain | today is rain) = $\frac{2.5}{1+2.5}$ = 0.71

- Rule 2

O(tom. is dry) = $\frac{0.5}{1-0.5}$ = 1

O(tom. is dry | today is dry) = NS x O(tom. is dry)
= 0.4 x 1 = 0.4

P(tom. is dry | today is dry) = $\frac{0.4}{1+0.4}$ = 0.29

→ tomorrow is rain = 0.71
tomorrow is dry = 0.29

- Rule 3 rainfall = 4.8 (high)

$O(\text{tom. is dry}) = \frac{0.29}{1-0.29} = 0.41$

$O(\text{tom. is dry} \mid \text{today is rain} \cap \text{rainfall is low}) = LN \times O(\text{dry})$
$= 1 \times 0.41 = 0.41$

$P(\text{tom. is dry} \mid \text{today is rain} \cap \text{rainfall is low}) = \frac{0.41}{1+0.41} = 0.29$

- Rule 4 temp. avg. $= \frac{5.9+10}{2} = 8$ (warm)

$O(\text{tom. is dry}) = \frac{0.29}{1-0.29} = 0.41$

$O(\text{tom. is dry} \mid \text{rain} \cap \text{low} \cap \text{clod}) = LN \times O(\text{tom. is dry})$
$= 1 \times 0.41 = 0.41$

$P(\text{tom. is dry} \mid \text{rain} \cap \text{low} \cap \text{clod}) = \frac{0.41}{1+0.41} = \boxed{0.29}$

- Rule 5

$O(\text{tom. is rain}) = \frac{0.71}{1-0.71} = 2.45$

$O(\text{tom. is rain} \mid \text{dry} \cap \text{warm}) = LN \times O(\text{tom. is rain})$
$= 0.9 \times 2.45 = 2.2$

$P(\text{tom. is rain} \mid \text{dry} \cap \text{warm}) = \frac{2.2}{1+2.2} = \boxed{0.69}$

→ tom. is rain = 0.69

- Rule 6 Sunshine = 7.1 (not overcast)

O(tom. is rain) = $\frac{0.69}{1-0.69}$ = 2.2

O(tom. is rain | dry ∩ warm ∩ overcast) = LN x O(rain)
= 1 x 2.2 = 2.2

P(tom. is rain | dry ∩ warm ∩ overcast) = $\frac{2.2}{1+2.2}$ = **0.69**

→ day 13 is rain = 0.69
day 13 is dry = 0.29
→ from table day 13 is dry.

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day 29 :

- Rule 1 (dry)

O(tom. is rain) = $\frac{0.5}{1-0.5}$ = 1

O(tom. is rain | today is rain) = LN x O(tom. is rain)
= 0.6 x 1 = 0.6

P(tom. is rain | today is rain) = $\frac{0.6}{1+0.6}$ = **0.375**

→ tom. is rain = 0.375

- Rule 2

$O(\text{tom. is dry}) = \frac{0.5}{1-0.5} = 1$

$O(\text{tom. is dry} \mid \text{today is dry}) = LS \times O(\text{tom. is dry})$
$= 1.6 \times 1 = 1.6$

$P(\text{tom. is dry} \mid \text{today is dry}) = \frac{1.6}{1+1.6} = \boxed{0.62}$

$\rightarrow$ tom. is dry $= 0.62$

- Rule 3 rain fall = 0 (low)

$O(\text{tom. is dry}) = \frac{0.62}{1-0.62} = 1.6$

$O(\text{tom. is dry} \mid \text{rain} \cap \text{low}) = LN \times O(\text{tom. is dry})$
$= 1 \times 1.6 = 1.6$

$P(\text{tom. is dry} \mid \text{rain} \cap \text{low}) = \frac{1.6}{1+1.6} = \boxed{0.62}$

- Rule 4 temp. avg. $= \frac{6.7+8.8}{2} = 7.75$ (warm)

$O(\text{tom. is dry}) = \frac{0.62}{1-0.62} = 1.6$

$O(\text{tom. is dry} \mid \text{rain} \cap \text{low} \cap \text{cold}) = LN \times O(\text{tom. is dry})$
$= 1 \times 1.6 = 1.6$

$P(\text{tom. is dry} \mid \text{rain} \cap \text{low} \cap \text{cold}) = \frac{1.6}{1+1.6} = \boxed{0.62}$

- Rule 5

$O(\text{tom. is rain}) = \frac{0.375}{1-.375} = 0.6$

$O(\text{tom. is rain} \mid \text{dry} \cap \text{warm}) = LS \times O(\text{tom. is rain})$
$= 2 \times 0.6 = 1.2$

$P(\text{tom. is rain} \mid \text{dry} \cap \text{warm}) = \frac{1.2}{1+1.2} = \boxed{0.545}$

→ tom. is rain = 0.545

- Rule 6 Sunshine = 4.2 (overcast)

$O(\text{tom. is rain}) = \frac{0.545}{1-0.545} = 1.2$

$O(\text{tom. is rain} \mid \text{dry} \cap \text{warm} \cap \text{overcast}) = LS \times O(\text{rain})$
$= 5 \times 1.2 = 6$

$P(\text{tom. is rain} \mid \text{dry} \cap \text{warm} \cap \text{overcast}) = \frac{6}{1+6} = \boxed{0.86}$

→ day 30 is rain = 0.86
day 30 is dry = 0.62

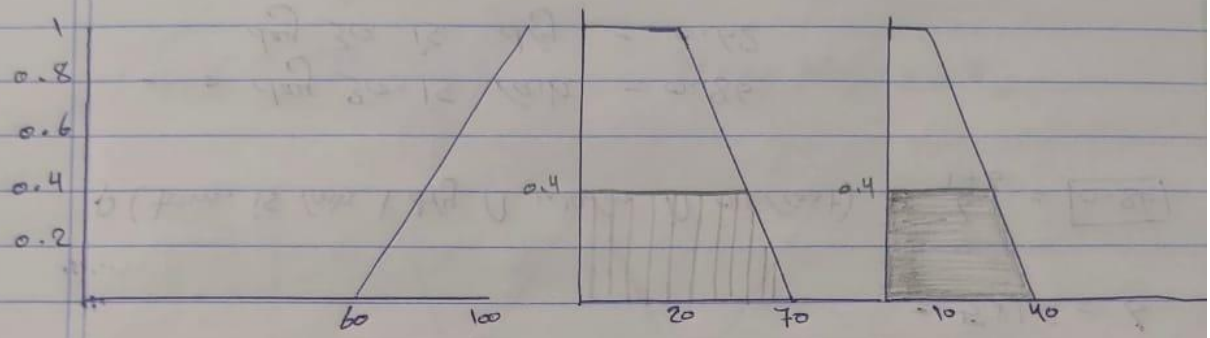
→ from table day 30 is rain

Q2) Project funding = 50% | Project staffing = 50%

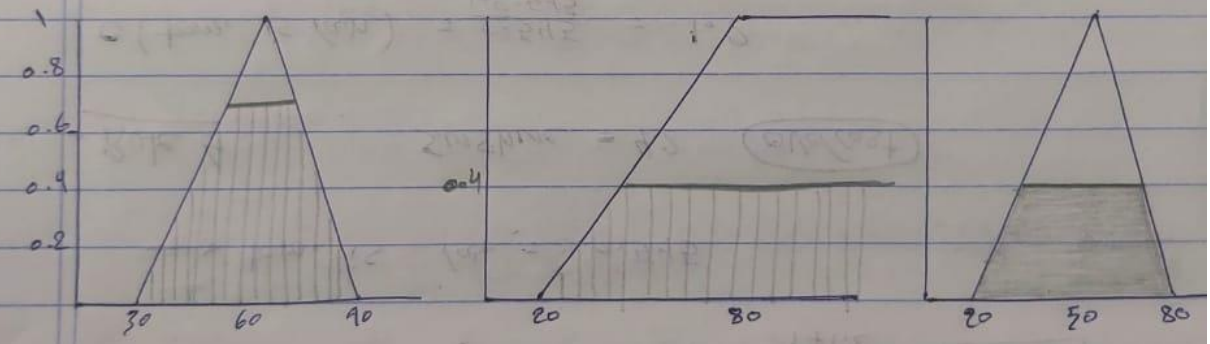
μ(low) = 0.4 | μ(small) = 0.4

μ(adequate) = 0.7 | μ(large) = 0.4

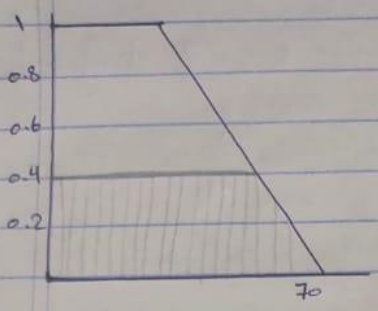
μ(high) = 0

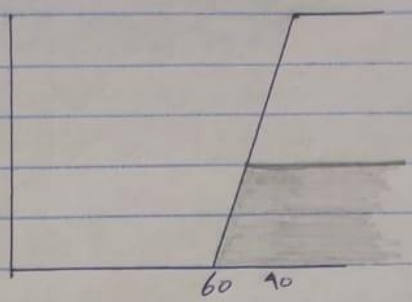


→ Rule 1 : μ(high) = 0 OR μ(small) = 0.4 risk low is 0.4

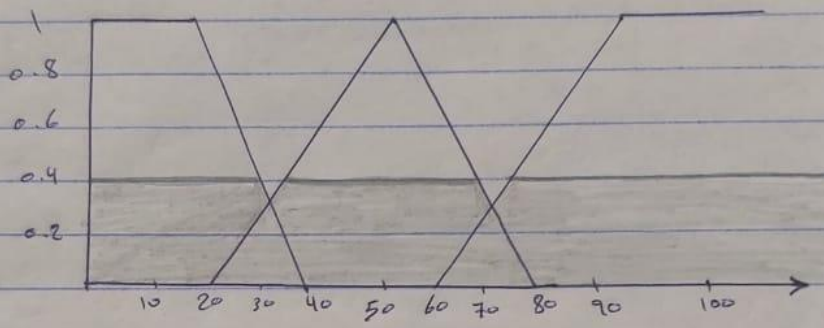


→ Rule 2 : μ(adequate) = 0.7 and μ(large) = 0.4 risk normal 0.4





→ Rule 3 ; μ(low) = 0.4 ~~*~~ risk high = 0.4



① Mamdani

$$COG = \frac{10+10+20+30+40+50+60+70+80+90+100}{11 \times 0.4} = \boxed{50}$$

② sugeno $K_1 = 20$, $K_2 = 50$, $K_3 = 80$

$$WA = \frac{20 \times 0.4 + 50 \times 0.4 + 80 \times 0.4}{0.4 + 0.4 + 0.4} = \boxed{50}$$

Risk = 50%

Q2) The code:

```
!pip install scikit-fuzzy

import numpy as np
import skfuzzy as fuzz
from skfuzzy import control as ctrl

project_funding = ctrl.Antecedent(np.arange(0, 101, 1), 'project_funding')
project_staffing = ctrl.Antecedent(np.arange(0, 101, 1), 'project_staffing')
risk = ctrl.Consequent(np.arange(0, 101, 1), 'risk')

project_funding['low'] = fuzz.trapmf(project_funding.universe, [0, 0, 20, 70])
project_funding['adequate'] = fuzz.trimf(project_funding.universe, [30, 60, 90])
project_funding['high'] = fuzz.trapmf(project_funding.universe, [60, 100, 100, 100])

project_staffing['small'] = fuzz.trapmf(project_staffing.universe, [0, 0, 20, 70])
project_staffing['large'] = fuzz.trapmf(project_staffing.universe, [30, 80, 100, 100])

risk['low'] = fuzz.trapmf(risk.universe, [0, 0, 10, 40])
risk['normal'] = fuzz.trimf(risk.universe, [20, 50, 80])
risk['high'] = fuzz.trapmf(risk.universe, [60, 90, 100, 100])

project_funding.view()
project_staffing.view()
risk.view()

rule1 = ctrl.Rule(project_funding['high'] | project_staffing['small'], risk['low'])
rule2 = ctrl.Rule(project_funding['adequate'] & project_staffing['large'], risk['normal'])
rule3 = ctrl.Rule(project_funding['low'], risk['high'])

risk_ctrl = ctrl.ControlSystem([rule1, rule2, rule3])
risk_sim = ctrl.ControlSystemSimulation(risk_ctrl)

risk_sim.input['project_funding'] = 50
risk_sim.input['project_staffing'] = 50

risk_sim.compute()
```

```
Collecting scikit-fuzzy
  Downloading scikit_fuzzy-0.5.0-py2.py3-none-any.whl.metadata (2.6 kB)
Downloading scikit_fuzzy-0.5.0-py2.py3-none-any.whl (920 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 920.8/920.8 kB 19.3 MB/s eta 0:00:00
Installing collected packages: scikit-fuzzy
Successfully installed scikit-fuzzy-0.5.0
percent of RISK is  50.00000000000009
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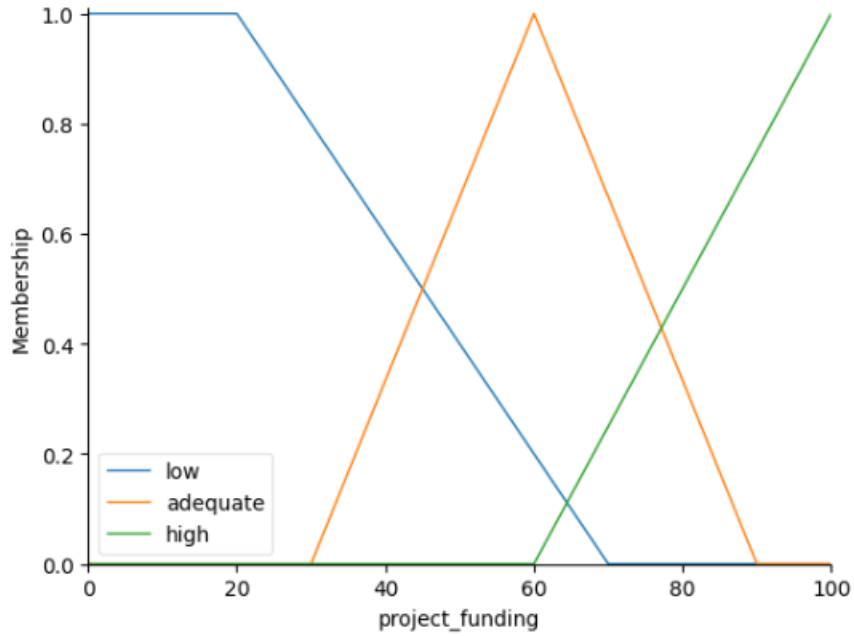

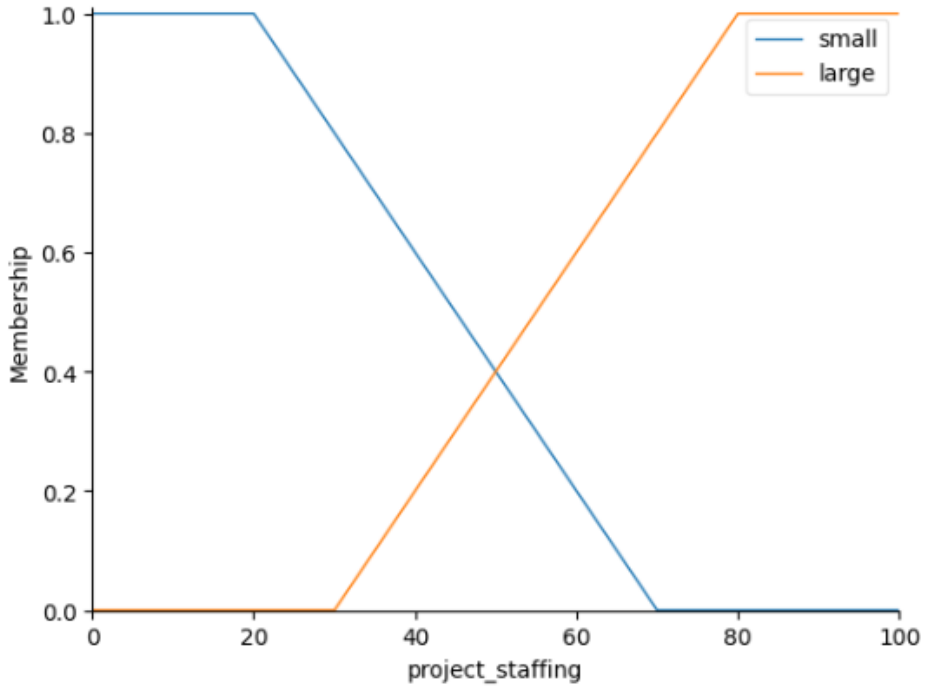

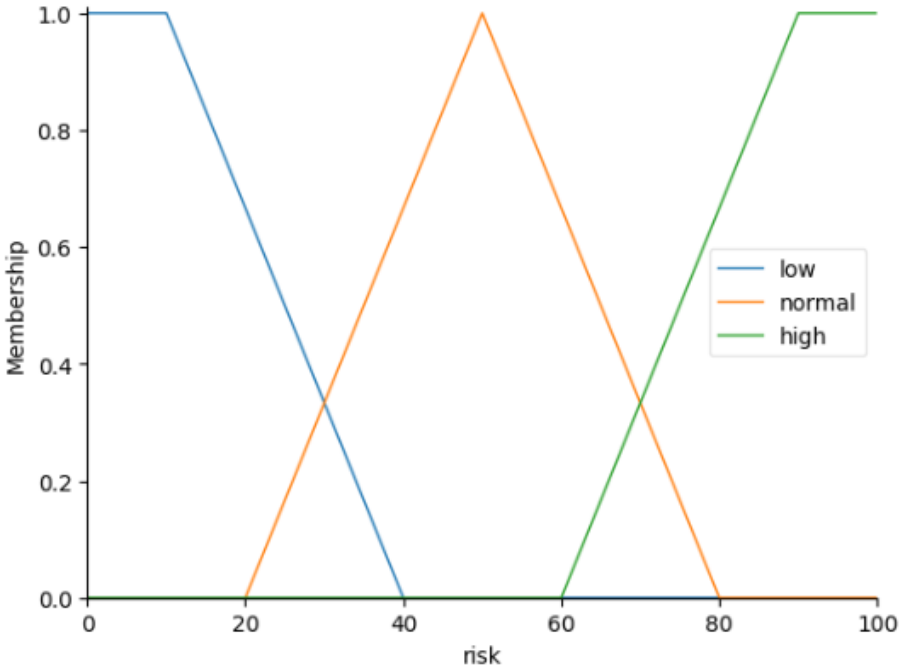

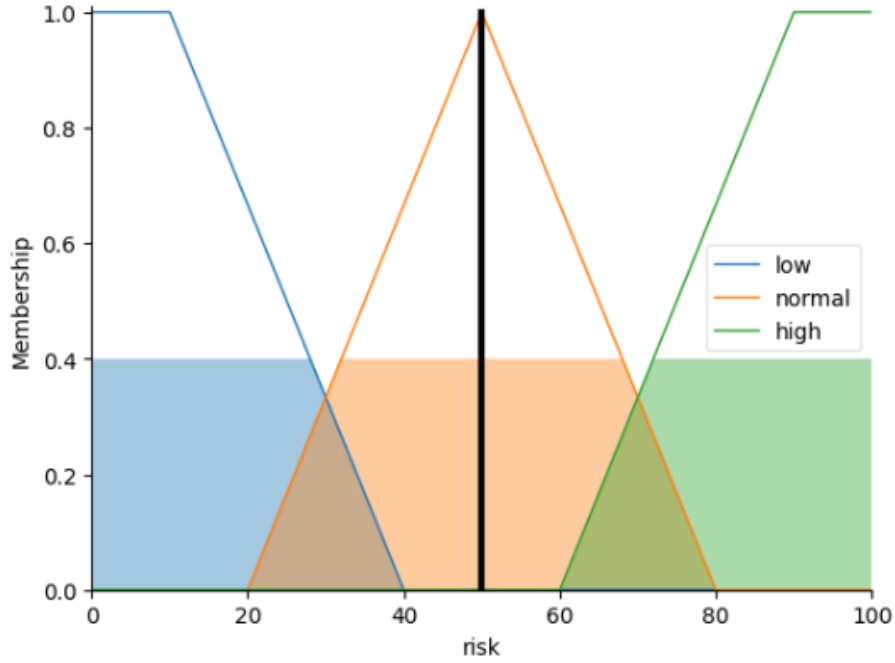

The link:

https://colab.research.google.com/drive/1QGqKvnivx7IJJSuQLzM7l7gZtq5Nv-og?usp=sharing