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PERHITUNGAN MANUAL MENENTUKAN KECEPATAN PUTARAN MESIN CUCI DENGAN  
MENGUNAKAN METODE FUZZY TSUKAMOTO

Terdapat 3 variabel, yaitu: 2 variabel input, variabel pakaian, dan variabel kekotoran, sedangkan untuk output terdapat 1 variabel, yaitu: putaran.

- Variabel Pakaian memiliki 3 nilai linguistik, yaitu: sedikit, sedang dan banyak
- Variabel Kekotoran memiliki 4 nilai linguistik, yaitu: rendah, sedang, tinggi, sangat tinggi Sedangkan variabel produksi barang memiliki 2 nilai linguistik, yaitu: lambat dan cepat

Pakaian terendah =  
40 Pakaian sedang =  
60 Pakaian tertinggi  
= 80

Kekotoran terendah =  
40 Kekotoran sedang =  
50 Kekotoran tinggi =  
60 Kekotoran  
tertinggi = 70

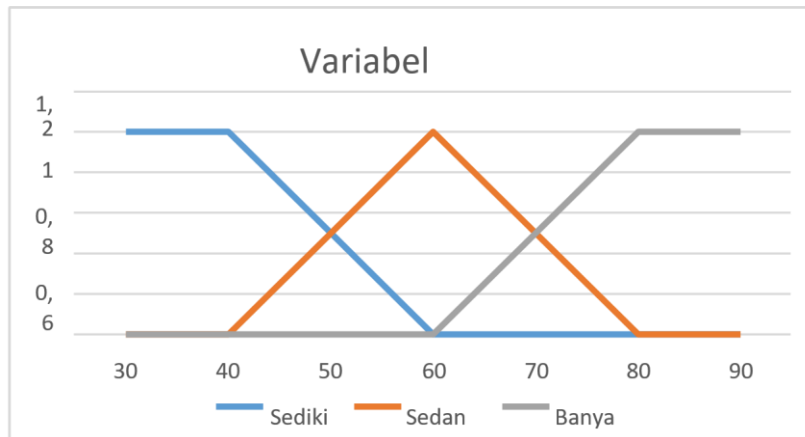
Contoh Soal:

Hitunglah kecepatan putaran mesin cuci dengan metode tsukamoto, Jika banyaknya pakaian adalah 65 dan tingkat kekotoran adalah 56.

Jawab:

## 1. Fuzifikasi

### 1. Variabel Pakaian



$$\text{a. } \text{sedikit}(x) = \begin{cases} 0 & ; x \geq 60 \\ \frac{60-x}{60-40} & ; 40 \leq x \leq 60 \\ 1 & ; x \leq 40 \end{cases}$$

$$\square\square\square\square\square\square(65) = 0$$

$$\text{b. } \text{sedang } x = \begin{cases} 0 & ; x \leq 40 \text{ or } x \geq 80 \\ \frac{x-40}{60-40} & ; 40 \leq x \leq 60 \\ \frac{80-x}{80-60} & ; 60 \leq x \leq 80 \end{cases}$$

$$\text{sedang}(65) = \frac{80-65}{80-60} = 0,75$$

$$\text{c. } \text{banyak}(x) = \begin{cases} 0 & ; x \leq 60 \\ \frac{x-60}{80-60} & ; 60 \leq x \leq 80 \\ 1 & ; x \geq 80 \end{cases}$$

$$\text{banyak}(65) = \frac{65-60}{80-60} = 0,25$$

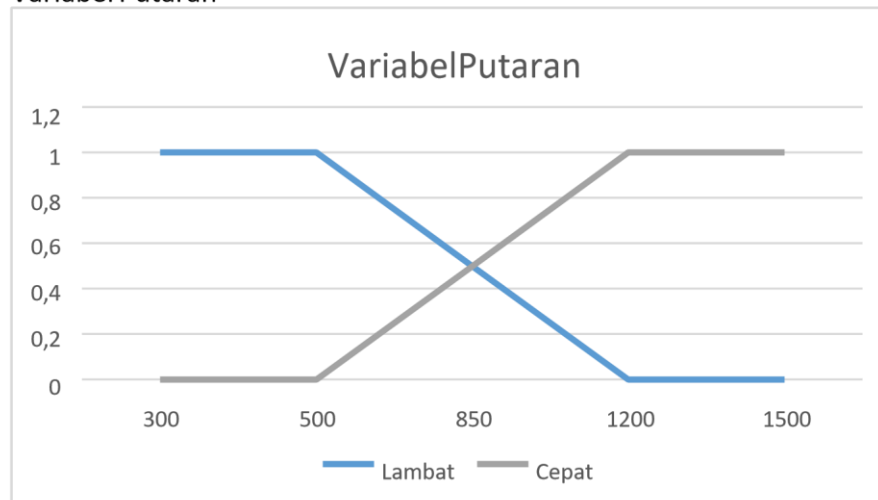
### 2. Variabel Kekotoran

a.

b.



### 3. Variabel Putaran



$$lambat(z) = \begin{cases} 0 & ; z \geq 1200 \\ \frac{1200-x}{1200-500} & ; 500 \leq z \leq 1200 \\ 1 & ; z \leq 500 \end{cases}$$

a.

$$cepat(x) = \begin{cases} 0 & ; z \leq 500 \\ \frac{z-500}{1200-500} & ; 500 \leq z \leq 1200 \\ 1 & ; x \leq 500 \end{cases}$$

b.

## 2. Inferensi

Rumus z jika kecepatan putaran lambat =  $\square = \square - a * (\square - \square)$   
 Rumus z jika kecepatan putaran cepat =  $\square = \square(\square - \square) + \square$

1. If Pakaian sedikit and Kekotoran rendah then Kecepatan putaran lambat

$$\begin{aligned} \mu_1 &= \min(\mu_{[X]} \cap \mu_{[Y]}) \\ &= \min(1, 0.5) = 0.5 \quad (\text{from } [65]; [56]) \\ \mu_1 &= \min(0, 0) \\ \mu_1 &= 0 \\ \mu_1 &= 1200 - a1 * (1200 - 0) \\ \mu_1 &= 1200 \end{aligned}$$

2. If Pakaian sedikit and Kekotoran setengah then Kecepatan putaran lambat

$$\mu_2 = \min(\mu_{[X]} \cap \mu_{[Y]})$$

$$\begin{aligned} \mu_2 &= \text{min}(\text{max}(\mu_{X1}[65]; \\ &\quad \mu_{X2}[56]) \quad \mu_2 = \text{min} \\ &\quad (0; 0,4) \\ \mu_2 &= \\ &\quad 0 \end{aligned}$$

$$\begin{aligned} \mu_2 &= \text{max}(\mu_{X1} - \\ &\quad - a_2 * (\mu_{X2} - \\ \mu_2 &= 1200 - 0 \\ \mu_2 &= 1200 \end{aligned}$$

3. If Pakaian sedikit and Kekotoran tinggi then Kecepatan putaran lambat

$$\begin{aligned} \mu_3 &= \text{min}(\mu_{X1}[X] \cap \mu_{X2}[Y] \\ \mu_3 &= \text{min}(\text{max}(\mu_{X1}[65] \\ &\quad ; \mu_{X2}[56]) \\ \mu_3 &= \text{min}(0; \\ &\quad 0,6) \quad \mu_3 \\ &= 0 \\ \mu_3 &= \text{max}(\mu_{X1} - a_3 * (\mu_{X2} - \\ \mu_3 &= 1200 - -0 \quad \mu_{X2}) \\ \mu_3 &= 1200 \end{aligned}$$

4. If Pakaian sedikit and Kekotoran sangat tinggi then Kecepatan putaran cepat

$$\begin{aligned} \mu_4 &= \text{min}(\mu_{X1}[X] \cap \mu_{X2}[\text{Sangat Tinggi}]) \\ \mu_4 &= \text{min}(\text{max}(\mu_{X1}[65]; \mu_{X2}[56]) \\ \mu_4 &= \text{min}(0; 0) \\ \mu_4 &= 0 \\ \mu_4 &= \text{max}(\mu_{X1} - \mu_{X2}) + \mu_{X2} \\ \mu_4 &= 0(1200 - 500) + 500 \\ \mu_4 &= 500 \end{aligned}$$

5. If Pakaian sedang and Kekotoran rendah then Kecepatan putaran lambat

$$\begin{aligned} \mu_5 &= \text{min}(\mu_{X1}[X] \cap \mu_{X2}[h[Y]]) \\ &\quad \mu_5 = \text{min}(\text{max}(\mu_{X1}[65]; \mu_{X2}[56]) \\ \mu_5 &= \\ &\quad \text{min}(0,7 \\ &\quad 5; 0) \\ &\quad \mu_5 \\ &\quad 5 \\ &= 0 \\ \mu_5 &= \text{max}(\mu_{X1} - a_5 * (\mu_{X2} - \\ &\quad \mu_{X2}) \\ \mu_5 &= 1200 - 0 \\ \mu_5 &= 1200 \end{aligned}$$

6. If Pakaian sedang and Kekotoran setengah then Kecepatan putaran lambat

$$\square_6 = \square\square\square\square\square\square [X] \cap \square\square\square\square\square\square [Y]$$

$$\begin{aligned} \mu_6 &= \min(\mu_{\text{sedang}}[65]; \mu_{\text{tinggi}}[56]) \\ \mu_6 &= \min(0.75; 0.4) \\ \mu_6 &= 0.4 \\ \mu_6 &= 1200 - 0.4(1200 - 500) \\ \mu_6 &= 920 \end{aligned}$$

7. If Pakaian sedang and Kekotoran tinggi then Kecepatan putaran cepat

$$\begin{aligned} \mu_7 &= \mu_{\text{sedang}}[X] \cap \mu_{\text{tinggi}}[Y] \\ \mu_7 &= \min(\mu_{\text{sedang}}[65]; \mu_{\text{tinggi}}[56]) \\ \mu_7 &= \min(0.75; 0.6) \\ \mu_7 &= 0.6 \\ \mu_7 &= 0.6(1200 - 500) + 500 \\ \mu_7 &= 920 \end{aligned}$$

8. If Pakaian sedang and Kekotoran sangat tinggi then Kecepatan putaran cepat

$$\begin{aligned} \mu_8 &= \mu_{\text{sedang}}[X] \cap \mu_{\text{sangat tinggi}}[Y] \\ \mu_8 &= \min(\mu_{\text{sedang}}[65]; \mu_{\text{sangat tinggi}}[56]) \\ \mu_8 &= \min(0.75; 0) \\ \mu_8 &= 0 \\ \mu_8 &= 0(1200 - 500) + 500 \\ \mu_8 &= 500 \end{aligned}$$

9. If Pakaian banyak and Kekotoran rendah then Kecepatan putaran lambat

$$\begin{aligned} \mu_9 &= \mu_{\text{banyak}}[X] \cap \mu_{\text{rendah}}[Y] \\ \mu_9 &= \min(\mu_{\text{banyak}}[65]; \mu_{\text{rendah}}[56]) \\ \mu_9 &= \min(0.25; 0) \\ \mu_9 &= 0 \\ z_9 &= z_{\text{max}} - \mu_9 * (z_{\text{max}} - z_{\text{min}}) \\ z_9 &= 1200 - 0(1200 - 500) \\ z_9 &= 1200 \end{aligned}$$

10. If Pakaian banyak and Kekotoran setengah then Kecepatan putaran cepat

$$a_{10} = \mu_{\text{banyak}}[X] \cap \mu_{\text{setengah}}[Y]$$

$$a_{10} = \min(\mu_{\text{banyak}}[65]; \mu_{\text{setengah}}[56])$$

$$a_{10} = \min(0.25; 0.4)$$

$$a_{10} = 0.25$$

$$z_{10} = a_{10}(z_{\text{max}} - z_{\text{min}}) + z_{\text{min}}$$

$$z_{10} = 0.25(1200 - 500) + 500$$

$$z_{10} = 675$$

11. If Pakaian banyak and Kekotoran tinggi then Kecepatan putaran cepat

$$a_{11} = \mu_{\text{banyak}}[X] \cap \mu_{\text{tinggi}}[Y]$$

$$a_{11} = \min(\mu_{\text{banyak}}[65]; \mu_{\text{tinggi}}[56])$$

$$a_{11} = \min(0.25; 0.6)$$

$$a_{11} = 0.25$$

$$z_{11} = a_{11}(z_{\text{max}} - z_{\text{min}}) + z_{\text{min}}$$

$$z_{11} = 0.25(1200 - 500) + 500$$

$$z_{11} = 675$$

12. If Pakaian banyak and Kekotoran sangat tinggi then Kecepatan putaran cepat

$$a_{12} = \mu_{\text{banyak}}[X] \cap \mu_{\text{sangat_tinggi}}[Y]$$

$$a_{12} = \min(\mu_{\text{banyak}}[65]; \mu_{\text{sangat_tinggi}}[56])$$

$$a_{12} = \min(0.25; 0.0)$$

$$a_{12} = 0$$

$$z_{12} = a_{12}(z_{\text{max}} - z_{\text{min}}) + z_{\text{min}}$$

$$z_{12} = 0(1200 - 500) + 500$$

$$z_{12} = 500$$

### 3. Defuzzifikasi

$$Z = \frac{a_1 * z_1 + a_2 * z_2 + a_3 * z_3 + a_4 * z_4 + a_5 * z_5 + a_6 * z_6 + a_7 * z_7 + a_8 * z_8 + a_9 * z_9 + a_{10} * z_{10} + a_{11} * z_{11} + a_{12} * z_{12}}{a_1 + a_2 + a_3 + a_4 + a_5 + a_6 + a_7 + a_8 + a_9 + a_{10} + a_{11} + a_{12}}$$

$$Z = \frac{(0 * 1200) + (0 * 1200) + (0 * 1200) + (0 * 500) + (0 * 1200) + (0.4 * 920.0) + (0.6 * 920.0) + (0 * 500) + (0 * 1200) + (0.25 * 675.0) + (0.25 * 675.0) + (0 * 500)}{0 + 0 + 0 + 0 + 0 + 0.4 + 0.6 + 0 + 0 + 0.25 + 0.25 + 0}$$

$$Z = \frac{1257.5}{1.5} = 838.334$$

### Hasil

Jika banyaknya pakaian adalah 65 dan tingkat kekotoran adalah 56 maka kecepatan putaran mesin cuci adalah □□□. □□□