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MATA KULIAH : KECERDASAN BUATAN

PERHITUNGAN MANUAL MENENTUKAN KECEPATAN PUTARAN MESIN CUCI DENGAN MENGGUNAKAN 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

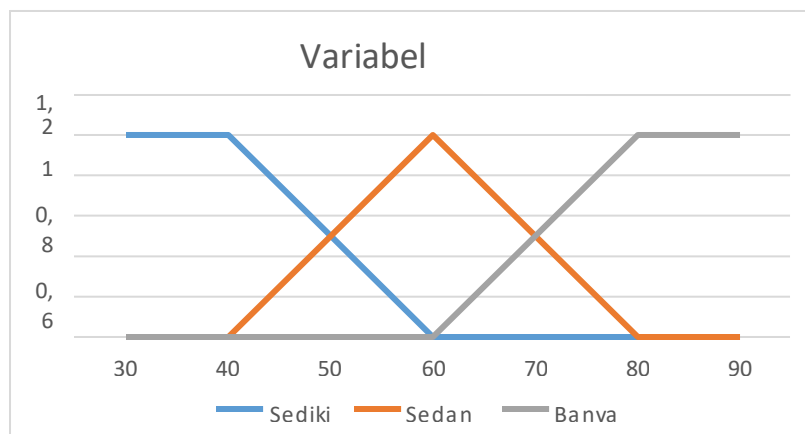
Contoh Soal:

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

Jawab:

1. Fuzifikasi

1. Variabel Pakaian



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

$$\text{sedikit}(65) = 0$$

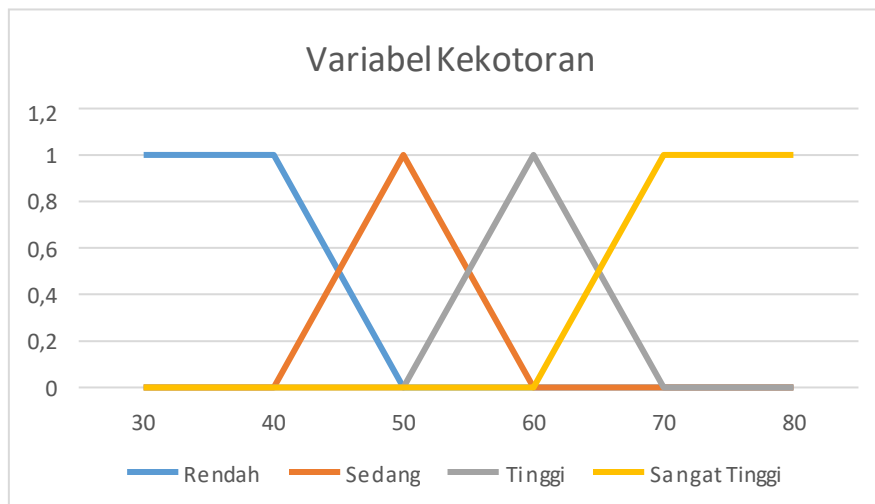
$$b. \text{sedang } x = \begin{cases} 0 & ; x \leq 40 \text{ or } x \geq 80 \\ \frac{x-40}{60-40} & ; 40 \leq x \leq 60 \\ \frac{80-x}{80-60} & ; 60 \leq x \leq 80 \end{cases}$$

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

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

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

2. Variabel Kekotoran



$$a. \text{rendah}(x) = \begin{cases} 0 & ; x \geq 50 \\ \frac{50-x}{50-40} & ; 40 \leq x \leq 50 \\ 1 & ; x \leq 40 \end{cases}$$

$$\text{rendah}(56) = 0$$

$$\text{b. } \textit{sedang}(x) = \begin{cases} 0 & ; x \leq 40 \text{ or } x \geq 60 \\ \frac{x-40}{50-40} & ; 40 \leq x \leq 50 \\ \frac{60-x}{60-50} & ; 50 \leq x \leq 60 \end{cases}$$

$$\textit{sedang}(56) = \frac{60-56}{60-50} = 0.4$$

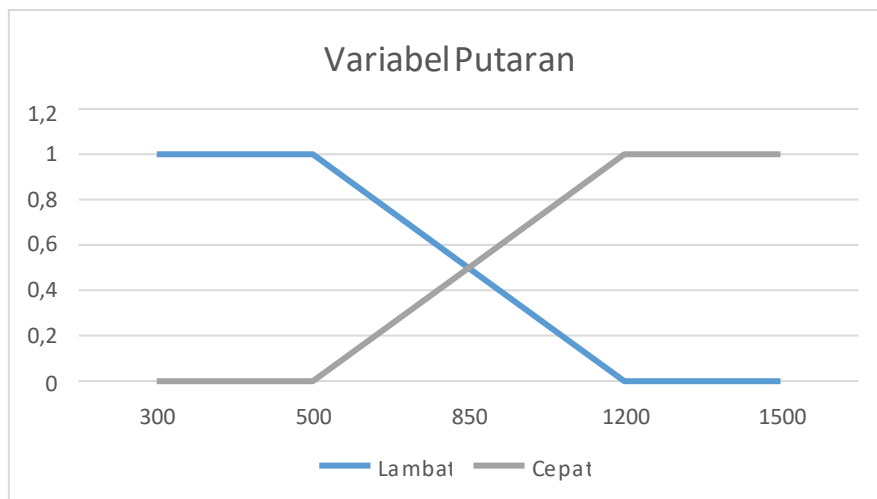
$$\text{c. } \textit{tinggi}(x) = \begin{cases} 0 & ; x \leq 50 \text{ or } x \geq 70 \\ \frac{x-50}{60-50} & ; 50 \leq x \leq 60 \\ \frac{70-x}{70-60} & ; 60 \leq x \leq 70 \end{cases}$$

$$\textit{tinggi}(56) = \frac{56-50}{60-50} = 0.6$$

$$\text{d. } \textit{sangat_tinggi}(x) = \begin{cases} 0 & ; x \leq 60 \\ \frac{x-60}{70-60} & ; 60 \leq x \leq 70 \\ 1 & ; x \geq 70 \end{cases}$$

$$\textit{sangat_tinggi}(56) = 0$$

3. Variabel Putaran



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

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

2. Inferensi

Rumus z jika kecepatan putaran lambat = $z = z_{max} - a * (z_{max} - z_{min})$

Rumus z jika kecepatan putaran cepat $z = a(z_{max} - z_{min}) + z_{min}$

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

$$a1 = \mu_{sedikit}[X] \cap \mu_{rendah}[Y]$$

$$a1 = \min(\mu_{sedikit}[65]; \mu_{rendah}[56])$$

$$a1 = \min(0; 0)$$

$$a1 = 0$$

$$z1 = z_{max} - a1 * (z_{max} - z_{min})$$

$$z1 = 1200 - 0$$

$$z1 = 1200$$

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

$$a2 = \mu_{sedikit}[X] \cap \mu_{setengah}[Y]$$

$$a2 = \min(\mu_{sedikit}[65]; \mu_{setengah}[56])$$

$$a2 = \min(0; 0,4)$$

$$a2 = 0$$

$$z2 = z_{max} - a2 * (z_{max} - z_{min})$$

$$z2 = 1200 - 0$$

$$z2 = 1200$$

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

$$a3 = \mu_{sedikit}[X] \cap \mu_{tinggi}[Y]$$

$$a3 = \min(\mu_{sedikit}[65]; \mu_{tinggi}[56])$$

$$a3 = \min(0; 0,6)$$

$$a3 = 0$$

$$z3 = z_{max} - a3 * (z_{max} - z_{min})$$

$$z3 = 1200 - 0$$

$$z3 = 1200$$

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

$$a4 = \mu_{sedikit}[X] \cap \mu_{sangat_tinggi}[Y]$$

$$a4 = \min(\mu_{sedikit}[65]; \mu_{sangat_tinggi}[56])$$

$$a4 = \min(0; 0)$$

$$a4 = 0$$

- $$z4 = a4(zmax - zmin) + zmin$$
- $$z4 = 0(1200 - 500) + 500$$
- $$z4 = 500$$
5. If Pakaian sedang and Kekotoran rendah then Kecepatan putaran lambat
- $$a5 = \mu_{sedang}[X] \cap \mu_{rendah}[Y]$$
- $$a5 = \min(\mu_{sedang}[65]; \mu_{rendah}[56])$$
- $$a5 = \min(0.75; 0)$$
- $$a5 = 0$$
- $$z5 = zmax - a5 * (zmax - zmin)$$
- $$z5 = 1200 - 0$$
- $$z5 = 1200$$
6. If Pakaian sedang and Kekotoran setengah then Kecepatan putaran lambat
- $$a6 = \mu_{sedang}[X] \cap \mu_{sedang}[Y]$$
- $$a6 = \min(\mu_{sedang}[65]; \mu_{sedang}[56])$$
- $$a6 = \min(0.75; 0.4)$$
- $$a6 = 0.4$$
- $$z6 = zmax - a6 * (zmax - zmin)$$
- $$z6 = 1200 - 0.4(1200 - 500)$$
- $$z6 = 920$$
7. If Pakaian sedang and Kekotoran tinggi then Kecepatan putaran cepat
- $$a7 = \mu_{sedang}[X] \cap \mu_{tinggi}[Y]$$
- $$a7 = \min(\mu_{sedang}[65]; \mu_{tinggi}[56])$$
- $$a7 = \min(0.75; 0.6)$$
- $$a7 = 0.6$$
- $$z7 = a7(zmax - zmin) + zmin$$
- $$z7 = 0.6(1200 - 500) + 500$$
- $$z7 = 920$$
8. If Pakaian sedang and Kekotoran sangat tinggi then Kecepatan putaran cepat
- $$a8 = \mu_{sedang}[X] \cap \mu_{sangat_tinggi}[Y]$$
- $$a8 = \min(\mu_{sedang}[65]; \mu_{sangat_tinggi}[56])$$
- $$a8 = \min(0.75; 0)$$
- $$a8 = 0$$
- $$z8 = a8(zmax - zmin) + zmin$$
- $$z8 = 0(1200 - 500) + 500$$
- $$z8 = 500$$

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

$$a9 = \mu_{\text{banyak}}[X] \cap \mu_{\text{rendah}}[Y]$$

$$a9 = \min(\mu_{\text{banyak}}[65]; \mu_{\text{rendah}}[56])$$

$$a9 = \min(0.25; 0)$$

$$a9 = 0$$

$$z9 = z_{\text{max}} - a9 * (z_{\text{max}} - z_{\text{min}})$$

$$z9 = 1200 - 0(1200 - 500)$$

$$z9 = 1200$$

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

$$a10 = \mu_{\text{banyak}}[X] \cap \mu_{\text{setengah}}[Y]$$

$$a10 = \min(\mu_{\text{banyak}}[65]; \mu_{\text{setengah}}[56])$$

$$a10 = \min(0.25; 0.4)$$

$$a10 = 0.25$$

$$z10 = a10(z_{\text{max}} - z_{\text{min}}) + z_{\text{min}}$$

$$z10 = 0.25(1200 - 500) + 500$$

$$z10 = 675$$

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

$$a11 = \mu_{\text{banyak}}[X] \cap \mu_{\text{tinggi}}[Y]$$

$$a11 = \min(\mu_{\text{banyak}}[65]; \mu_{\text{tinggi}}[56])$$

$$a11 = \min(0.25; 0.6)$$

$$a11 = 0.25$$

$$z11 = a11(z_{\text{max}} - z_{\text{min}}) + z_{\text{min}}$$

$$z11 = 0.25(1200 - 500) + 500$$

$$z11 = 675$$

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

$$a12 = \mu_{\text{banyak}}[X] \cap \mu_{\text{sangat_tinggi}}[Y]$$

$$a12 = \min(\mu_{\text{banyak}}[65]; \mu_{\text{sangat_tinggi}}[56])$$

$$a12 = \min(0.25; 0.0)$$

$$a12 = 0$$

$$z12 = a12(z_{\text{max}} - z_{\text{min}}) + z_{\text{min}}$$

$$z12 = 0(1200 - 500) + 500$$

$$z12 = 500$$

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 **838.334**