

Lampiran 1

Respirasi

1. Rata-rata

$$(\bar{X}) = \frac{\sum X(n)}{n}$$

Keterangan :

\bar{X} = nilai rata-rata

X = hasil nilai ukur

n = banyak jumlah pengukuran

$$(\bar{X})_1 = \frac{21+24+18+12+12+12}{6} = 16,5$$

$$(\bar{X})_2 = \frac{18+12+24+18+18+16}{6} = 17,666667$$

$$(\bar{X})_3 = \frac{24+20+18+16+18+18}{6} = 19$$

$$(\bar{X})_4 = \frac{18+18+18+20+20+18}{6} = 18,666667$$

$$(\bar{X})_5 = \frac{16+12+18+18+20+18}{6} = 17$$

2. Standart Deviasi

$$STD = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

Keterangan :

SD = standart deviasi

\bar{Y} = rata-rata

X₁,...,X_n = nilai data

n = banyak data (1,2,3n)

$$\begin{aligned}
 \mathbf{STD1} &= \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}} \\
 &= \sqrt{\frac{(21 - 16,5)^2 + (24 - 16,5)^2 + (18 - 16,5)^2 + (12 - 16,5)^2 + (12 - 16,5)^2 + (12 - 16,5)^2}{(6 - 1)}} \\
 &= 5,28204506
 \end{aligned}$$

$$\begin{aligned}
 \mathbf{STD2} &= \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}} \\
 &= \sqrt{\frac{(18 - 17,7)^2 + (12 - 17,7)^2 + (24 - 17,7)^2 + (18 - 17,7)^2 + (18 - 17,7)^2 + (16 - 17,7)^2}{(6 - 1)}} \\
 &= 3,88158043
 \end{aligned}$$

$$\begin{aligned}
 \mathbf{STD3} &= \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}} \\
 &= \sqrt{\frac{(24 - 19)^2 + (20 - 19)^2 + (18 - 19)^2 + (16 - 19)^2 + (18 - 19)^2 + (18 - 19)^2}{(6 - 1)}} \\
 &= 2,75680975
 \end{aligned}$$

$$\begin{aligned}
 \mathbf{STD4} &= \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}} \\
 &= \sqrt{\frac{(18 - 18,7)^2 + (18 - 18,7)^2 + (18 - 18,7)^2 + (20 - 18,7)^2 + (20 - 18,7)^2 + (18 - 18,7)^2}{(6 - 1)}} \\
 &= 1,03279556
 \end{aligned}$$

$$\begin{aligned}
 \mathbf{STD5} &= \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}} \\
 &= \sqrt{\frac{(16 - 17)^2 + (12 - 17)^2 + (18 - 17)^2 + (18 - 17)^2 + (20 - 17)^2 + (18 - 17)^2}{(6 - 1)}} \\
 &= 2,75680975
 \end{aligned}$$

3. Ketidakpastian

$$UA = \frac{SD}{\sqrt{n}}$$

Keterangan :

Ua = ketidakpastian

SD = standart deviasi

n = banyaknya data

$$UA1 = \frac{SD}{\sqrt{n}} = \frac{5,28204506}{\sqrt{6}} = 2,15638587$$

$$UA2 = \frac{SD}{\sqrt{n}} = \frac{3,88158043}{\sqrt{6}} = 1,58464858$$

$$UA3 = \frac{SD}{\sqrt{n}} = \frac{2,75680975}{\sqrt{6}} = 1,12546287$$

$$UA4 = \frac{SD}{\sqrt{n}} = \frac{1,03279556}{\sqrt{6}} = 0,42163702$$

$$UA5 = \frac{SD}{\sqrt{n}} = \frac{2,75680975}{\sqrt{6}} = 1,12546287$$

4. Error

$$Error\% = \frac{\bar{Y} - \bar{X}}{\bar{Y}} \times 100\%$$

Dimana :

\bar{Y} = rata-rata data pembanding

\bar{X} = rata-rata data modul

$$Error\%(1) = \frac{16,833 - 16,5}{16,833} \times 100\% = 1,98 \%$$

$$Error\%(2) = \frac{18,667 - 17,667}{18,667} \times 100\% = 5,357 \%$$

$$Error\%(3) = \frac{18,5 - 19}{18,5} \times 100\% = 2,703 \%$$

$$Error\%(4) = \frac{18,667 - 18,667}{18,667} \times 100\% = 0\%$$

$$Error\%(5) = \frac{17,667 - 17}{17,667} \times 100\% = 3,774 \%$$

Suhu

1. Rata-rata

$$(\bar{X}) = \frac{\sum X(n)}{n}$$

Keterangan :

\bar{X} = nilai rata-rata

X = hasil nilai ukur

n = banyak jumlah pengukuran

$$(\bar{X})1 = \frac{34+35+36+36+36+36}{6} = 35,5$$

$$(\bar{X})2 = \frac{34+34+34+35+36+36}{6} = 34,833333$$

$$(\bar{X})3 = \frac{33+34+34+35+36+36}{6} = 34,666667$$

$$(\bar{X})4 = \frac{32+33+34+34+35+36}{6} = 34$$

$$(\bar{X})5 = \frac{32+33+34+35+35+36}{6} = 34,166667$$

2. Standart Deviasi

$$STD = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

Keterangan :

SD = standart deviasi

\bar{Y} = rata-rata

X1,...,Xn = nilai data

n = banyak data (1,2,3n)

$$STD1 = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

$$= \sqrt{\frac{(34 - 35,5)^2 + (35 - 35,5)^2 + (36 - 35,5)^2 + (36 - 35,5)^2 + (36 - 35,5)^2 + (36 - 35,5)^2}{(6 - 1)}}$$

$$= 0,83666003$$

$$\mathbf{STD2} = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

$$= \sqrt{\frac{(34 - 34,8)^2 + (34 - 34,8)^2 + (34 - 34,8)^2 + (35 - 34,8)^2 + (36 - 34,8)^2 + (36 - 34,8)^2}{(6 - 1)}}$$

$$= 0,98319208$$

$$\mathbf{STD3} = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

$$= \sqrt{\frac{(33 - 34,7)^2 + (34 - 34,7)^2 + (34 - 34,7)^2 + (35 - 34,7)^2 + (36 - 34,7)^2 + (36 - 34,7)^2}{(6 - 1)}}$$

$$= 1,21106014$$

$$\mathbf{STD4} = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

$$= \sqrt{\frac{(32 - 34)^2 + (33 - 34)^2 + (34 - 34)^2 + (34 - 34)^2 + (35 - 34)^2 + (36 - 34)^2}{(6 - 1)}}$$

$$= 1,41421356$$

$$\mathbf{STD5} = \sqrt{\frac{(X_1 - \bar{Y})^2 + (X_2 - \bar{Y})^2 + \dots + (X_5 - \bar{Y})^2}{(n - 1)}}$$

$$= \sqrt{\frac{(32 - 34,2)^2 + (33 - 34,2)^2 + (34 - 34,2)^2 + (35 - 34,2)^2 + (35 - 34,2)^2 + (36 - 34,2)^2}{(6 - 1)}}$$

$$= 1,47196014$$

3. Ketidakpastian

$$UA = \frac{SD}{\sqrt{n}}$$

Keterangan :

Ua = ketidakpastian

SD = standart deviasi

n = banyaknya data

$$UA1 = \frac{SD1}{\sqrt{n}} = \frac{0,83666003}{\sqrt{6}} = 0,30731815$$

$$UA2 = \frac{SD2}{\sqrt{n}} = \frac{0,98319208}{\sqrt{6}} = 0,40138649$$

$$UA3 = \frac{SD3}{\sqrt{n}} = \frac{1,21106014}{\sqrt{6}} = 0,49441323$$

$$UA4 = \frac{SD4}{\sqrt{n}} = \frac{1,41421356}{\sqrt{6}} = 0,57735027$$

$$UA5 = \frac{SD5}{\sqrt{n}} = \frac{1,47196014}{\sqrt{6}} = 0,60092521$$

4. Error

$$Error(1) = 35,83 - 35,5 = 0,33^{\circ}C$$

$$Error(2) = 35 - 34,83 = 0,17^{\circ}C$$

$$Error(3) = 34,83 - 34,67 = 0,17^{\circ}C$$

$$Error(4) = 34,33 - 34 = 0,33^{\circ}C$$

$$Error(5) = 34,33 - 34,17 = 0,17^{\circ}C$$