# ASSIGNMENT - 1

1. Given the following data of Temperature (°c) and Power consumption (kWh):

(a) Derive a regression equation $Y = a + bX$. using the least squares method and calculate a (intercept) and b (slope). Also compute the value of $\Sigma x$, $\Sigma Y$, $\Sigma XY$.

(b) Using your predicted values ($\hat{Y}$). compute $R^2$.

| Temperature C° (X) | Power Consumption (kWh) (Y) |
|---|---|
| 10 | 300 |
| 12 | 310 |
| 14 | 320 |
| 16 | 330 |
| 18 | 345 |
| 20 | 360 |
| 22 | 370 |
| 24 | 390 |
| 26 | 420 |
| 28 | 450 |

(a) $\hat{Y} = a + bx$ → regression equation

$\Sigma X = 190$

$\Sigma Y = 3595$

$\Sigma X^2 = 3940$

$\Sigma XY = 70910$

Date : 18/10/25 $a+bx$ $(y-\hat{y})^2$ Page No. 2

| | X | Y | XY | $X^2$ | $\hat{y}$ | $SS_{res}$ | $SS_{tot}$ |
|---|---|---|---|---|---|---|---|
| | 10 | 300 | 3000 | 100 | 288.5 | 132.25 | 3540.25 |
| | 12 | 310 | 3720 | 144 | 304.28 | 32.718 | 2450.25 |
| | 14 | 320 | 4480 | 196 | 320.06 | 0.0036 | 1560.25 |
| | 16 | 330 | 5280 | 256 | 335.84 | 34.105 | 870.25 |
| | 18 | 345 | 6210 | 324 | 351.62 | 43.82 | 210.25 |
| | 20 | 360 | 7200 | 400 | 367.4 | 54.76 | 0.25 |
| | 22 | 370 | 8140 | 484 | 383.18 | 173.71 | 110.25 |
| | 24 | 390 | 9360 | 576 | 398.96 | 80.28 | 930.25 |
| | 26 | 420 | 10920 | 676 | 414.74 | 27.66 | 3660.25 |
| | 28 | 450 | 12600 | 784 | 430.52 | 379.47 | 8190.25 |
| $\Sigma$ | 190 | 3595 | 70910 | 3940 | | 958.77 | 21522.5 |

SS tot
$(300-359.5)^2$
$(310-359.5)^2$
$(320-359.5)^2$
$(330-359.5)^2$
$(345-359.5)^2$
$(360-359.5)^2$
$(370-359.5)^2$
$(390-359.5)^2$
$(420-359.5)^2$
$(450-359.5)^2$

SS res
$(300-288.5)^2$
$(310-304.28)^2$
$(320-320.06)^2$
$(330-335.84)^2$
$(345-351.62)^2$
$(360-367.4)^2$
$(370-383.18)^2$
$(390-398.96)^2$
$(420-414.74)^2$
$(450-430.52)^2$

$\hat{y}$
$209.6+7.89\times10$
$209.6+7.89\times12$
$209.6+7.89\times14$
$209.6+7.89\times16$
$209.6+7.89\times18$
$209.6+7.89\times20$
$209.6+7.89\times22$
$209.6+7.89\times24$
$209.6+7.89\times26$
$209.6+7.89\times28$

Computing slope b

$$b = \frac{n(\Sigma XY) - (\Sigma X)(\Sigma Y)}{n(\Sigma X^2) - (\Sigma X)^2}$$

$n = 10$, $\Sigma XY = 70910$

$\Sigma X = 190$, $\Sigma Y = 3595$, $\Sigma X^2 = 3940$

$(\Sigma X)^2 = 190^2 = 36100$

$$\therefore b = \frac{(10)(70910) - (190)(3595)}{(10)(3940) - 36100}$$

$$= \frac{709100 - 683050}{39400 - 36100} = \frac{521}{66} = 7.89$$

$\boxed{b = 7.89}$

Computing intercept a

$$a = \bar{y} - b\bar{x}$$

$\bar{x} = \frac{\Sigma x}{n}$ $\quad \bar{x} = \frac{190}{10} = 19$, $\quad \bar{y} = \frac{3595}{10} = 359.5$

$\bar{y} = \frac{\Sigma y}{n}$

$a = 359.5 - (7.89)(19)$

$= 359.5 - 149.91 = 209.59$

$\boxed{a = 209.6}$

Regression Equation $\longrightarrow \hat{Y} = 209.6 + 7.89X$

(b) Computing $R^2$

$$R^2 = 1 - \frac{SS_{res}}{SS_{tot}}$$

$SS_{residual} = \sum (Y - \hat{Y})^2$ $\quad \hat{Y}$ = predicted value

$SS_{total} = \sum (Y - \bar{Y})^2$ $\quad \bar{Y}$ = mean value.

See the values of $\hat{Y}$, $SS_{res}$, $SS_{tot}$ from table.

$SS_{res} = 958.77$

$SS_{tot} = 21522.5$

$$R^2 = 1 - \frac{958.77}{21522.5}$$

$= 1 - 0.044$

$= 0.956$ (equivalent to 1)

$\therefore \boxed{R^2 = 0.95}$

$\longrightarrow$ 95% of variation in power is explained by temperature

$\longrightarrow$ Perfect Linear relationship.

• Model fits data very well.

$\longrightarrow$ 2nd and 3rd answer are attached in .ipynb format.