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Assignment - 1

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

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) Derive the regression equation $Y = a + bx$, using least squares method and calculate a (intercept) and b (slope). Also compute the value of ΣX, ΣY, ΣXY.

no. of obersvations $n = 10$

$\Sigma X = 10 + 12 + 14 + 16 + 18 + 20 + 22 + 24 + 26 + 28$
$= 190$

$\Sigma Y = 300 + 310 + 320 + 330 + 345 + 360 + 370 + 390 + 420 + 450$
$= 3595$

$\Sigma XY = 10 \times 300 + 12 \times 310 + 14 \times 320 + 16 \times 330 +$
$18 \times 345 + 20 \times 360 + 22 \times 370 + 24 \times 390 +$
$26 \times 420 + 28 \times 450$
$= 70910$

$\Sigma x^2 = 10^2 + 12^2 + 14^2 + 16^2 + 18^2 + 20^2 + 22^2 + 24^2$
$+ 26^2 + 28^2$

$= 3940$

Least squares formula =

slope :-

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

$$= \frac{10 \times 70910 - 190 \times 3595}{10 \times 3940 - 190^2}$$

$b \approx 7.89394$

Intercept

$$a = \frac{\Sigma Y - b \Sigma X}{n}$$

$$= \frac{3,595 - b(190)}{10}$$

$a \approx 209.51515$

Regression equation :-

$\hat{Y} = 209.51515 + 7.89394 X$

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

X	Y	Predicted ($\hat{Y}$)
10	300	$\hat{Y} = 209.51 + 7.89(10) = 288.45$
12	310	$\hat{Y} = 209.51 + 7.89(12) = 304.24$
14	320	$\hat{Y} = 209.51 + 7.89(14) = 320.03$
16	330	$\hat{Y} = 209.51 + 7.89(16) = 335.81$
18	345	$\hat{Y} = 209.51 + 7.89(18) = 351.60$
20	360	$\hat{Y} = 209.51 + 7.89(20) = 367.39$
22	370	$\hat{Y} = 209.51 + 7.89(22) = 383.18$
24	390	$\hat{Y} = 209.51 + 7.89(24) = 398.96$
26	420	$\hat{Y} = 209.51 + 7.89(26) = 414.75$
28	450	$\hat{Y} = 209.51 + 7.89(28) = 430.54$

To compute R^2.

$$R^2 = 1 - \frac{\Sigma(Y_i - \hat{Y}_i)^2}{\Sigma(Y_i - \bar{Y})^2}$$

$\Sigma Y = 3595$

$\bar{Y} = \frac{3595}{10} = 359.5$

mean $(\bar{Y}) = 359.5$

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SSE (Sum of squared Errors (residuals) = $\Sigma(Y_i - \hat{Y}_i)^2$
↓
Errors between actual & predicted values.

SST – Total sum of squares = $\Sigma(Y_i - \bar{Y})^2$
↓
Total variation in Y from its mean

$Y-\hat{Y}$	$(Y-\hat{Y})^2$	$Y-\bar{Y}$	$(Y-\bar{Y})^2$
11.55	133.26	−59.5	3540.25
5.76	33.15	−49.5	2450.25
−0.03	0.00	−39.5	1560.25
−5.82	33.88	−29.5	870.25
−6.61	43.70	−14.5	210.25
−7.39	54.61	0.5	0.25
−13.18	~~54.61~~ 173.68	10.5	110.25
−8.97	~~173.68~~ 80.53	30.5	930.25
5.24	27.46	60.5	3660.25
19.45	378.44	90.5	8190.25

SSE = 958.79

SST = 21,522.5

$$R^2 = 1 - \frac{SSE}{SST} = \frac{958.79}{21,522.5}$$

$$R^2 = 1 - 0.04455 = 0.95545$$

$R^2 = 0.95545$ or 95.5%