ASSIGNMENT - 2

MATH_564-Regression

3. (6 points) For this question, write your answer on paper, scan it, and submit the scanned document along with your HTML file (for Question 2, 4, and 5). Alternatively, you can use LaTeX, Word, or another word processing application to write your answer, but ensure that it is saved as a PDF before submission.

In statistics, we have the follow:

- Sum of squares of deviations of x values

$$s_{xx} = \sum_{i=1}^{n}(x_i - \bar{x})^2$$

- Sum of squares of deviations of y values

$$s_{yy} = \sum_{i=1}^{n}(y_i - \bar{y})^2$$

- Sum of the product of deviations of x and y values

$$s_{xy} = \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

Prove that these sum of squares can also be written as

(i)

$$s_{xx} = \sum_{i=1}^{n} x_i^2 - n\bar{x}^2$$

(ii)

$$s_{yy} = \sum_{i=1}^{n} y_i^2 - n\bar{y}^2$$

(iii)

$$s_{xy} = \sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}$$

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Due September 13th 2024, Friday, 11:59pm

③ Sum of squares of deviations of x values

$$S_{xx} = \sum_{i=1}^{n} (x_i - \bar{x})^2$$

(i) To Prove these sum of squares

$$S_{xx} = \sum_{i=1}^{n} x_i^2 - n\bar{x}^2$$

Proof :-

$$S_{xx} = \sum_{i=1}^{n} (x_i - \bar{x})^2$$

$$\Rightarrow \sum_{i=1}^{n} (x_i^2 - 2x_i\bar{x} + \bar{x}^2)$$

$$\Rightarrow \sum_{i=1}^{n} (x_i)^2 - \sum_{i=1}^{n} (2x_i\bar{x}) + \sum_{i=1}^{n} (\bar{x})^2$$

We know that $\boxed{\sum_{i=1}^{n} x_i = n\bar{x}}$

$$\Rightarrow \sum_{i=1}^{n} (x_i)^2 - 2\bar{x}(n\bar{x}) + n(\bar{x})^2$$

$$\Rightarrow \sum_{i=1}^{n} x_i^2 - 2n\bar{x}^2 + n\bar{x}^2$$

$$\Rightarrow \boxed{\sum_{i=1}^{n} x_i^2 - n\bar{x}^2}$$

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(ii)

Sum of squares of deviations of y

$$S_{yy} = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

To prove the SUM of square can be as

$$S_{yy} = \sum_{i=1}^{n} y_i^2 - n\bar{y}^2$$

Proof :-

$$S_{yy} = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

$$\Rightarrow \sum_{i=1}^{n} \left(y_i^2 - 2y_i\bar{y} + \bar{y}^2\right)$$

$$\Rightarrow \sum_{i=1}^{n} y_i^2 - 2\bar{y}\sum_{i=1}^{n} y_i + \sum_{i=1}^{n} \bar{y}^2$$

$$- \boxed{\sum_{i=1}^{n} y_i = n\bar{y}} \rightarrow \text{we know that}$$

$$\Rightarrow \sum_{i=1}^{n} y_i^2 - 2\bar{y}.n\bar{y} + n\bar{y}^2$$

$$\Rightarrow \sum_{i=1}^{n} y_i^2 - 2n\bar{y}^2 + n\bar{y}^2$$

$$\boxed{\Rightarrow \sum_{i=1}^{n} y_i^2 - n\bar{y}^2}$$

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(iii)

Sum of product of deviations of x & y values

$$S_{xy} = \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})$$

To prove the sum of squares can be as.

$$S_{xy} = \sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}$$

<u>**Proof**</u> :- $S_{xy} = \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})$

$$S_{xy} \Rightarrow \sum_{i=1}^{n} (x_i y_i - x_i \bar{y} - \bar{x} y_i + \bar{x}\bar{y})$$

$$S_{xy} \Rightarrow \sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \bar{y} - \sum_{i=1}^{n} \bar{x} y_i + \sum_{i=1}^{n} \bar{x}\bar{y}$$

$$\boxed{\sum_{i=1}^{n} x_i = n\bar{x}} \text{ and } \boxed{\sum_{i=1}^{n} y_i = n\bar{y}}$$

$$S_{xy} \Rightarrow \sum_{i=1}^{n} x_i y_i - n\bar{y}\bar{x} - n\bar{x}\bar{y} + n\bar{x}\bar{y}$$

$$\boxed{S_{xy} \Rightarrow \sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}$$

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