SAWA UNIVERSITY

SPSS - الاحصاء

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Sawa University

College of health and medical techniques

Department of Medical Laboratories

. 2nd Stage

جامعـــــــة ســــــــــاوة الاهلية

كليـــــــة التقنيــــات الصحيـــة والطبيـــة

قسم تقنيات المختبرات الطبية

المرحلـــــــــــــة الثانية.

تدريسي المادة : م.م سلام النجيب

محاضرة رقم ١١

الجانب النظري

Lecture No. 11

Theoretical

Benefits of Using Regression Equations in Medicine with Exercises, Solutions, and Applications:

1. Predicting Health Indicators Based on Specific Factors

Exercise:

Assume you have the following data on weight (in kilograms) and blood sugar level (in mg/dL) for several patients:

Patient	Weight (x)	Blood Sugar Level (y)
1	60	90
2	65	95
3	70	105
4	75	110
5	80	115

find the simple regression equation that describes the relationship between weight and blood sugar level.

Solution:

1. **Calculate the means:**

$$\bar{x} = \frac{60 + 65 + 70 + 75 + 80}{5} = 70$$

$$\bar{y} = \frac{90 + 95 + 105 + 110 + 115}{5} = 103$$

2. **Calculate β_1 (slope coefficient):**

$$\beta_1 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Calculate the terms:

$$(x_i - \bar{x})(y_i - \bar{y}) = (60 - 70)(90 - 103) + (65 - 70)(95 - 103) + \dots$$

$$(x_i - \bar{x})^2 = (60 - 70)^2 + (65 - 70)^2 + \dots$$

We find that:

$$\beta_1 = 2.5$$

3. **Calculate β_0 (intercept):**

$$\beta_0 = \bar{y} - \beta_1\bar{x} = 103 - 2.5(70) = 103 - 175 = -72$$

Thus, the regression equation is:

$$y = -72 + 2.5x$$

where x is weight and y is the blood sugar level.

Application of the Equation: If we have a patient with a weight of 85 kg, we can predict their blood sugar level as follows:

$$y = -72 + 2.5(85) = -72 + 212.5 = 140.5$$

So, the expected blood sugar level for the patient will be 140.5 mg/dL.

2. Assessing the Impact of Different Factors on Patients

Exercise:

Suppose we have data for several patients measuring **age (in years)** and **blood pressure (in mm Hg)**:

Patient	Age (x)	Blood Pressure (y)
1	25	120
2	30	125
3	35	130
4	40	135
5	45	140

We need to find the regression equation that describes the relationship between **age** and **blood pressure**.

2. Assessing the Impact of Different Factors on Pa

Solution:

1. **Calculate the means:**

$$\bar{x} = \frac{25 + 30 + 35 + 40 + 45}{5} = 35$$

$$\bar{y} = \frac{120 + 125 + 130 + 135 + 140}{5} = 130$$

2. **Calculate β_1 (slope coefficient):**

$$\beta_1 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Calculate the terms:

$$(x_i - \bar{x})(y_i - \bar{y}) = (25 - 35)(120 - 130) + (30 - 35)(125 - 130) + \dots$$

$$(x_i - \bar{x})^2 = (25 - 35)^2 + (30 - 35)^2 + \dots$$

We find that:

$$\beta_1 = 2$$

2. Assessing the Impact of Different Factors on Patients

3. **Calculate β_0 (intercept):**

$$\beta_0 = \bar{y} - \beta_1 \bar{x} = 130 - 2(35) = 130 - 70 = 60$$

Thus, the regression equation is:

$$y = 60 + 2x$$

where x is age and y is blood pressure.

Application of the Equation: If we have a patient who is 50 years old, we can predict their blood pressure as follows:

$$y = 60 + 2(50) = 60 + 100 = 160$$

Thus, the expected blood pressure for the patient will be 160 mm Hg.

3. predicting Treatment Response Based on Other Factors

Exercise:

Assume we have data for several patients on **weight (in kilograms)** and **heart rate (beats per minute)**:

Patient	Weight (x)	Heart Rate (y)
1	55	72
2	60	75
3	65	78
4	70	80
5	75	85

the regression equation is:

$$y = -19.5 + 1.5x$$

Find the heart rate of a patient if his weighing is 80 kg.

Applications correlation coefficient (r) in Medicine

Formula

The correlation coefficient is calculated using:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \cdot \sum(y_i - \bar{y})^2}}$$

Applications correlation coefficient (r) in Medicine

PRESENTATION TITLE

Exercise 1: **Correlation Between Age and Blood Pressure**

Scenario: You are analyzing data on patients to determine the relationship between age and systolic blood pressure (SBP).

Problem

A dataset contains the ages (in years) and systolic blood pressure (SBP in mmHg) for 6 patients:

Age (X)	SBP (Y)
25	120
35	130
45	140
55	150
65	160
75	170

Calculate the Pearson correlation coefficient (r) and interpret its value.

Applications correlation coefficient (r) in Medicine

Solution

1. Compute the means of X and Y:

$$\bar{X} = \frac{\sum X}{n} = \frac{25 + 35 + 45 + 55 + 65 + 75}{6} = 50$$

$$\bar{Y} = \frac{\sum Y}{n} = \frac{120 + 130 + 140 + 150 + 160 + 170}{6} = 145$$

2. Calculate deviations from the means, square deviations, and cross-products:

$$\text{For each pair: } (X - \bar{X}), (Y - \bar{Y}), (X - \bar{X})(Y - \bar{Y})$$

X	Y	$X - \bar{X}$	$Y - \bar{Y}$	$(X - \bar{X})^2$	$(Y - \bar{Y})^2$	$(X - \bar{X})(Y - \bar{Y})$
25	120	-25	-25	625	625	625
35	130	-15	-15	225	225	225
45	140	-5	-5	25	25	25
55	150	5	5	25	25	25
65	160	15	15	225	225	225
75	170	25	25	625	625	625

Applications correlation coefficient (r) in Medicine

$$\sum(X-\bar{X})^2 = 1750, \quad \sum(Y-\bar{Y})^2 = 1750, \quad \sum(X-\bar{X})(Y-\bar{Y}) = 1750$$

3. Compute the correlation coefficient (r):

$$r = \frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2 \cdot \sum(Y-\bar{Y})^2}} = \frac{1750}{\sqrt{1750 \cdot 1750}} = 1$$

Interpretation

The correlation coefficient $r = 1$ indicates a perfect positive linear relationship between age and systolic blood pressure.

Applications correlation coefficient (r) in Medicine

Exercise 2: **Evaluating Drug Effectiveness on Recovery Time**

Scenario: A clinical trial measures the recovery time (in days) of patients under two conditions: with Drug A and without it (placebo).

Problem

The following data summarizes recovery times for 5 patients under each condition:

Patient	Drug A (X)	Placebo (Y)
1	7	10
2	6	9
3	5	8
4	4	7
5	3	6

Calculate the correlation coefficient and explain whether Drug A is associated with shorter recovery times.

Applications correlation coefficient (r) in Medicine

Solution

Follow similar steps to calculate r. After computations, you find:

$$r = -1$$

Interpretation

The correlation coefficient $r = -1$ implies a perfect negative linear relationship, indicating that as recovery time decreases with Drug A, it consistently increases with the placebo. This suggests Drug A is effective in reducing recovery time.

Applications correlation coefficient (r) in Medicine

Exercise 3: **Correlation in Epidemiology: Smoking and Lung Function**

Scenario: You study the relationship between smoking (cigarettes/day) and forced expiratory volume (FEV, liters/second).

Problem

For 6 individuals:

Smoking (X)	FEV (Y)
0	4.5
5	4.2
10	3.9
15	3.5
20	3.0
25	2.5

Calculate r and assess the relationship.