SAWA UNIVERSITY

SPSS - الاحصاء

المحاضرة الثامنة

Sawa University

College of health and medical techniques

Department of Medical Laboratories

. 2nd Stage

جامعـــــــة ســـــــــاوة الاهلية

كليـــــة التقنيـــات الصحيـة والطبيـة

قسم تقنيات المختبرات الطبية

المرحلـــــــــــــــة الثانية.

تدريسي المادة : م.م سلام النجيب

محاضرة رقم ٨ الجانب النظري

Lecture No. 8 Theoretical

Normal Distribution in Biostatistics

The **normal distribution** is a cornerstone of biostatistics, widely used in medical and biological research.

Its bell-shaped curve is fundamental for analyzing data, interpreting results, and making predictions in the health sciences.

This lecture focuses on understanding the role and applications of the normal distribution in biostatistics.

PRESENTATION TITLE

What is Normal Distribution?

The normal distribution is a continuous probability distribution characterized by:

- **Symmetry**: The curve is symmetric about the mean (μ\muμ).
- Parameters used:
  - μ\Mean, representing the center of the distribution.
  - σ\Standard deviation, indicating the spread or variability of data.

The equation used in the Normal Distribution

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$Z = \frac{X - \mu}{\sigma}$$

How solve the exercises about the Normal Distribution

- Calculate the mean (μ).
- Calculate the standard deviation (σ).
- Calculate the Z-value for each the measurement
- Calculate the f(x) for each the measurement
- Create a table that shows the values of x (and their corresponding f(x) values (probabilities).
- Plot the standard normal distribution curve based on this data.

Characteristics of the Normal Distribution

- **Symmetry**: The curve is symmetric around the mean.
- **Bell-shaped**: Most data points cluster around the mean, with fewer observations as you move farther away.
- **Mean = Median = Mode**: In a perfect normal distribution, these three measures of central tendency are identical.
- **Empirical Rule (68-95-99.7 Rule)**:
  - 68% of data lies within 1 standard deviation (σ) of the mean.
  - 95% of data lies within 2 standard deviations of the mean.
  - 99.7% of data lies within 3 standard deviations of the mean

Z-Score

- **The Z-score** (also called the standard score) measures how many standard deviations (σ) a data point (X) is away from the mean (μ) in a normal distribution.
- It is calculated using the formula:

$$Z = \frac{X - \mu}{\sigma}$$

- X: The data point.
- μ: The mean of the dataset.
- σ: The standard deviation of the dataset.

Benefits of Z-Score in Medicine

- The Z-score is a versatile tool in medical statistics, allowing for better interpretation and comparison of individual results within a population.
- Below are the main benefits

1. Comparing Individual Results to Population Norms

Benefit: Z-scores standardize test results, enabling direct comparison of a patient's measurement to the population average, regardless of the unit or scale.

Benefits of Z-Score in Medicine

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1. Comparing Individual Results to Population Norms

Benefit: Z-scores standardize test results, enabling direct comparison of a patient's measurement to the population average, regardless of the unit or scale.

2. Identifying Outliers

Benefit: Z-scores help identify extreme values (outliers) that might indicate health risks or abnormalities.

Benefits of Z-Score in Medicine

3. Standardizing Test Results Across Different Units

Benefit: Z-scores allow comparison of different tests by converting results into a common scale, regardless of their original units.

4. Assessing Risk Levels

Benefit: Z-scores quantify how far a measurement deviates from normal, helping clinicians assess the severity of a patient's condition.

How to Read Probability Values from the Cumulative Distribution Function (CDF) Table

Steps to Read Probability from the Table

1. Determine the Z-score:

The Z-score represents the number of standard deviations (σ) a value X is away from the mean μ. Calculate Z using the formula:

$$Z = \frac{X - \mu}{\sigma}$$

How to Read Probability Values from the Cumulative Distribution Function (CDF) Table

Steps to Read Probability from the Table

2. Split the Z-score into two parts:

The first part is the integer and the first decimal place (e.g., 1.2).

The second part is the second decimal place (e.g., 0.03).

Example: For $Z=1.23$:

The main value is 1.2.

The additional value is 0.03.

How to Read Probability Values from the Cumulative Distribution Function (CDF) Table

Steps to Read Probability from the Table

3. Find the row for the main value:

Look for the 1.2 in the leftmost column of the table.

This corresponds to all Z-scores starting with 1.2.

4. Find the column for the additional value:

Locate the 0.03 in the header row of the table.

This corresponds to the second decimal place of Z.

How to Read Probability Values from the Cumulative Distribution Function (CDF) Table

Steps to Read Probability from the Table

3. Read the cumulative probability:

Find the intersection of the row for 1.2 and the column for 0.03.

The value at this intersection is $\Phi(Z=1.23)$, the cumulative probability up to $Z=1.23$.

How to Read Probability Values from the Cumulative Distribution Function (CDF) Table

Handling Negative Z-scores

The standard normal table usually only lists positive Z-scores. For negative Z-scores:

$$\Phi(Z) = 1 - \Phi(|Z|)$$