SAWA UNIVERSITY

SPSS - الاحصاء

المحاضرة التاسعة

Sawa University

College of health and medical techniques

Department of Medical Laboratories

. 2nd Stage

جامعـــــــة ســــــــاوة الاهلية

كليــــــة التقنيـــات الصحيـة والطبيـة

قسم تقنيات المختبرات الطبية

المرحلـــــــــــــة الثانية.

تدريسي المادة : م.م سلام النجيب

محاضرة رقم ٩ الجانب النظري

Lecture No. 9 Theoretical

Exercise 1: Blood Pressure Distribution

You are given the blood pressure measurements of a group of 4 patients. The measurements are recorded as follows (in mmHg):

Data (Systolic Blood Pressure):

120, 135, 140, 110, 125

Objective:

- Calculate the mean (μ).
- Calculate the standard deviation (σ).
- Calculate the Z-value for the measurement of 130 mmHg.
- Create a table that shows the values of x (blood pressure readings) and their corresponding f(x) values (probabilities).
- Plot the standard normal distribution curve based on this data.

Step 1: Calculate the Mean (μ)

The mean is calculated by summing all the values and dividing by the number of data points.

$$\mu = \frac{120 + 135 + 140 + 110 + 125}{5}$$

$$\mu = \frac{630}{5} = 126\,\text{mmHg}$$

Step 2: Calculate the Standard Deviation (σ)

The standard deviation shows how spread out the values are from the mean. The formula is:

$$\sigma = \sqrt{\frac{(x_1 - \mu)^2 + (x_2 - \mu)^2 + (x_3 - \mu)^2 + (x_4 - \mu)^2 + (x_5 - \mu)^2}{n}}$$

Where:

- $x_1 = 120$, $x_2 = 135$, $x_3 = 140$, $x_4 = 110$, $x_5 = 125$
- $\mu = 126$
- $n = 5$

Let's calculate each squared difference:

1. $(120 - 126)^2 = (-6)^2 = 36$
2. $(135 - 126)^2 = (9)^2 = 81$
3. $(140 - 126)^2 = (14)^2 = 196$
4. $(110 - 126)^2 = (-16)^2 = 256$
5. $(125 - 126)^2 = (-1)^2 = 1$

Now sum the squared differences:

$$\text{Sum} = 36 + 81 + 196 + 256 + 1 = 570$$

Step 2: Calculate the Standard Deviation (σ)

The standard deviation shows how spread out the values are from the mean. The formula is:

Now sum the squared differences:

$$\text{Sum} = 36 + 81 + 196 + 256 + 1 = 570$$

Next, divide by the number of data points (5):

$$\frac{570}{5} = 114$$

Finally, take the square root:

$$\sigma = \sqrt{114} \approx 10.68\,\text{mmHg}$$

Step 3: Calculate the Z-value for 130 mmHg

The Z-value tells us how many standard deviations the value x=130x = 130x=130 is from the mean.

The formula for the Z-value is:

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

For $x = 130$, $\mu = 126$, and $\sigma = 10.68$:

$$Z = \frac{130 - 126}{10.68} = \frac{4}{10.68} \approx 0.37$$

This means that 130 mmHg is approximately 0.37 standard deviations above the mean.

Step 4: Create the Table for x and f(x)

To compute the probability density for each value of x, we use the normal distribution formula:

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

Step 4: Create the Table for x and f(x)

PRESENTATION TITLE

For each blood pressure value $x_1 = 120$, $x_2 = 135$, $x_3 = 140$, $x_4 = 110$, and $x_5 = 125$, we can calculate $f(x)$.

Let's calculate the probability density for each value:

1. For $x_1 = 120$:

$$f(120) = \frac{1}{10.68\sqrt{2\pi}} e^{-\frac{(120-126)^2}{2\times 10.68^2}} \approx 0.037$$

2. For $x_2 = 135$:

$$f(135) = \frac{1}{10.68\sqrt{2\pi}} e^{-\frac{(135-126)^2}{2\times 10.68^2}} \approx 0.035$$

3. For $x_3 = 140$:

$$f(140) = \frac{1}{10.68\sqrt{2\pi}} e^{-\frac{(140-126)^2}{2\times 10.68^2}} \approx 0.023$$

4. For $x_4 = 110$:

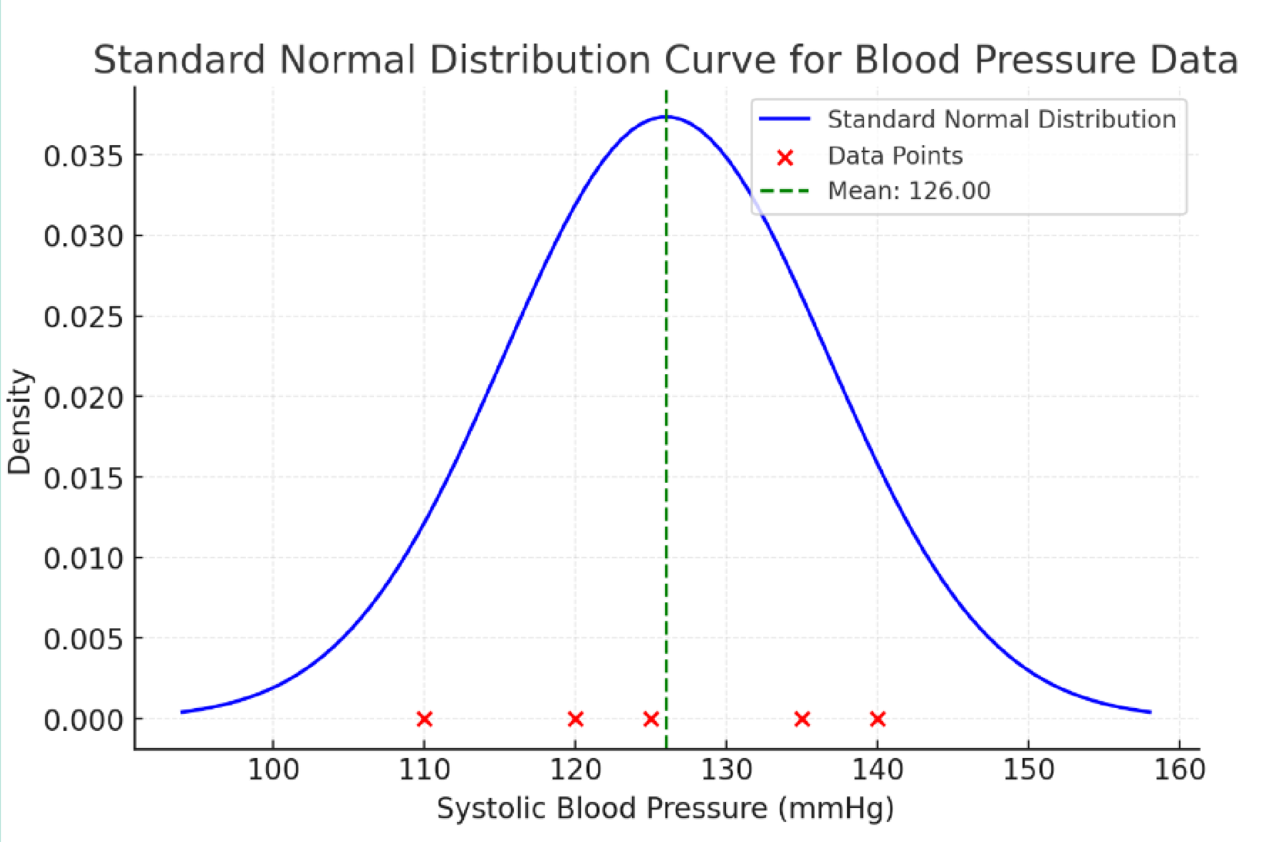
$$f(110) = \frac{1}{10.68\sqrt{2\pi}} e^{-\frac{(110-126)^2}{2\times 10.68^2}} \approx 0.012$$

5. For $x_5 = 125$:

$$f(125) = \frac{1}{10.68\sqrt{2\pi}} e^{-\frac{(125-126)^2}{2\times 10.68^2}} \approx 0.037$$

Step 4: Create the Table for x and f(x)

X Value	F(x)
110	0.0122
120	0.0319
125	0.0372
135	0.0262
140	0.0158



PRESENTATION TITLE

Exercise 2: Heart Rate Distribution

Given Data (Heart Rate Measurements in beats per minute): 60, 65, 70, 75, 80, 85, 90, 95, 100, 105

1. **Calculate the Mean (μ)** using the same formula as in Exercise 1.
2. **Calculate the Standard Deviation (σ)** using the same formula as in Exercise 1.
3. **Calculate the Z-value** for a given heart rate xxx using the same formula as in Exercise 1.
4. **Calculate f(x) values** for each heart rate measurement using the normal distribution formula.
5. **Plot the Standard Distribution Curve**:

Z-Score Exercises and Solutions

1. Comparing Individual Results to Population Norms

Exercise:

A patient's fasting blood sugar level is $X = 110$ mg/dL. The population mean is $\mu = 100$ mg/dL, and the standard deviation is $\sigma = 15$ mg/dL

1. Calculate the Z-score.
2. Determine whether this value is above, below, or within the normal range ($Z = \pm 2$).

Z-Score Exercises and Solutions

1. Comparing Individual Results to Population Norms

PRESENTATION

Solution:

1. **Calculate Z-score:**

$$Z = \frac{X - \mu}{\sigma} = \frac{110 - 100}{15} = \frac{10}{15} = 0.67$$

2. **Interpretation:**

- The Z-score $Z = 0.67$ indicates that the blood sugar level is 0.67 standard deviations above the mean.
- Since $|Z| < 2$, the value is within the normal range.

PRESENTATION TITLE

2. Identifying Outliers

Exercise:

The systolic blood pressure of a patient is $X=150$ mmHg. The population mean is $\mu=120$ **mmHg**, with a standard deviation of $\sigma=10$ mmHg$\sigma=10$mmHg.

1. Calculate the Z-score.
2. Is this blood pressure value considered abnormal?

2. Identifying Outliers

Solution:

1. **Calculate Z-score**:

$$Z = \frac{X - \mu}{\sigma} = \frac{150 - 120}{10} = \frac{30}{10} = 3$$

2. **Interpretation**:

   - The Z-score $Z = 3$ means the blood pressure is 3 standard deviations above the mean.
   - Since $Z > 2$, this value is considered abnormal and indicates potential hypertension.

3. Standardizing test Results across different units

Exercise: A patient's cholesterol level is $X1=240$ mg/dL, ($\mu=200, \sigma=30$), and their BMI is $X2=27$ kg/m2 ($\mu=25, \sigma=2\mu=25, \sigma=2$).

1. **Calculate the Z-scores for both results.**
2. **Which result deviates more from the population mean?**

3. Standardizing test Results across different units

PRESENTATION TITLE

Solution:

1. **Cholesterol Z-score**:

$$Z_1 = \frac{X_1 - \mu}{\sigma} = \frac{240 - 200}{30} = \frac{40}{30} = 1.33$$

2. **BMI Z-score**:

$$Z_2 = \frac{X_2 - \mu}{\sigma} = \frac{27 - 25}{2} = \frac{2}{2} = 1$$

3. **Interpretation**:

- The cholesterol Z-score $Z_1 = 1.33$ indicates a greater deviation from the mean than the BMI Z-score $Z_2 = 1$.
- The cholesterol result is more concerning compared to the population norm.

4. Assessing Risk Levels

Exercise:

A patient's triglyceride level is X=250 mg/dL, with $\mu=150$ mg/dL, $\sigma=40$ mg/dL.

1. Calculate the Z-score.
2. What percentage of the population has a triglyceride level higher than this patient?

4. Assessing Risk Levels

Solution:

1. **Calculate Z-score**:

$$Z = \frac{X - \mu}{\sigma} = \frac{250 - 150}{40} = \frac{100}{40} = 2.5$$

2. **Find probability using the Z-table**:
   From the Z-table, $\Phi(Z = 2.5) = 0.9938$.

3. **Calculate percentage above this value**:

$$P(X > 250) = 1 - \Phi(Z) = 1 - 0.9938 = 0.0062$$

- This means only 0.62% of the population has a triglyceride level higher than this patient.

4. **Interpretation**:

- A Z-score of $Z = 2.5$ is well above the normal range, indicating a high risk of cardiovascular disease.
- The patient's triglyceride level is higher than 99.38% of the population.