Biostatistics Tutorials: Morbidity Statistics

Introduction

Welcome to our series of **Biostatistics Tutorials** on **Morbidity Statistics**. These tutorials are designed to reinforce your understanding of key concepts through modified examples and step-by-step solutions. Let's dive into each tutorial, mirroring the engaging style of our lectures.

1 Tutorial 1: Calculating Incidence Rate

Problem

In 2020, a country reported **350** new cases of influenza among adults. The population of adults in the country was **7,500,000** in the middle of 2020. Calculate the incidence rate of influenza among adults for that year.

Solution

Let's calculate the **Incidence Rate** using **Formula 1**:

$$\text{Incidence Rate} = \left(\frac{\text{Number of new cases of disease during the year}}{\text{Number of population in the middle of the year}} \right) \times 1000 \tag{1}$$

Step 1: Identify the number of new cases and the population.

- **Number of new cases (Numerator):** 350
- **Population (Denominator):** 7,500,000

Step 2: Plug the values into the formula.

$$\text{Incidence Rate} = \left(\frac{350}{7,500,000} \right) \times 1000$$

Step 3: Perform the division.

$$\frac{350}{7,500,000} = 0.0000467$$

Step 4: Multiply by 1000 to standardize per 1,000 individuals.

$$0.0000467 \times 1000 = 0.0467\%$$

Interpretation

This means that for every **1,000 adults** in the population, **0.0467** new cases of influenza were reported in 2020.

2 Tutorial 2: Calculating Prevalence Rate

Problem

A city conducted a health survey in 2021 and found that **5,500** individuals were living with diabetes. The population of the city was **400,000** at that time. Calculate the prevalence rate of diabetes in the city.

Solution

We'll use **Formula 2** to calculate the **Prevalence Rate**:

$$\text{Prevalence Rate} = \left(\frac{\text{Number of cases in a period of time}}{\text{Number of population in that period}} \right) \times 1000 \tag{2}$$

Step 1: Identify the number of cases and the population.

- **Number of cases (Numerator):** 5,500
- **Population (Denominator):** 400,000

Step 2: Plug the values into the formula.

$$\text{Prevalence Rate} = \left(\frac{5,500}{400,000} \right) \times 1000$$

Step 3: Perform the division.

$$\frac{5,500}{400,000} = 0.01375$$

Step 4: Multiply by 1000 to standardize per 1,000 individuals.

$$0.01375 \times 1000 = 13.75\%$$

Interpretation

Out of every **1,000 residents** in the city, **13.75** individuals were living with diabetes in 2021.

3 Tutorial 3: Calculating Case Fatality Ratio

Problem

In 2019, there were **500** reported cases of a rare disease in a region. Out of these, **25** individuals succumbed to the disease. Calculate the case fatality ratio for this rare disease.

Solution

We will apply **Formula 3** to determine the **Case Fatality Ratio**:

$$\text{Case Fatality Ratio} = \left(\frac{\text{Number of deaths from the specific disease}}{\text{Number of cases of the disease}} \right) \times 1000 \tag{3}$$

Step 1: Identify the number of deaths and the number of cases.

- **Number of deaths (Numerator):** 25
- **Number of cases (Denominator):** 500

Step 2: Plug the values into the formula.

$$\text{Case Fatality Ratio} = \left(\frac{25}{500}\right) \times 1000$$

Step 3: Perform the division.

$$\frac{25}{500} = 0.05$$

Step 4: Multiply by 1000 to standardize per 1,000 cases.

$$0.05 \times 1000 = 50\%$$

Interpretation

For every **1,000** cases of the rare disease, **50** resulted in death. *(Note: Typically, ratios above 100% indicate data inconsistencies, but in this case, the ratio is within a plausible range.)*

4 Tutorial 4: Calculating Immaturity Ratio

Problem

In the 2019 population census of a town, it was found that **2,050** children were born with a weight less than **2,500 grams** out of a total of **6,200** live births. Calculate the immaturity ratio for that year.

Solution

We'll use **Formula 4** to calculate the **Immaturity Ratio**:

$$\text{Immaturity Ratio} = \left(\frac{\text{Number of children born with weight} < 2500\text{g during the year}}{\text{Total number of children born in the middle of the year}}\right) \times 1000 \quad (4)$$

Step 1: Identify the number of low-weight births and the total number of births.

- **Number of low-weight births (Numerator):** 2,050
- **Total number of births (Denominator):** 6,200

Step 2: Plug the values into the formula.

$$\text{Immaturity Ratio} = \left(\frac{2,050}{6,200}\right) \times 1000$$

Step 3: Perform the division.

$$\frac{2,050}{6,200} \approx 0.3306$$

Step 4: Multiply by 1000 to standardize per 1,000 live births.

$$0.3306 \times 1000 = 330.6\%$$

Interpretation

Out of every **1,000** live births in the town, **330.6** children weighed less than **2,500 grams** in 2019.

5 Tutorial 5: Advanced Calculation of Immaturity Ratio

Problem

In 2022, a city recorded **7,800** live births. Among these, **1,950** children weighed less than **2,500 grams**. If the population of the city in mid-2022 was **150,000**, calculate the immaturity ratio.

Solution

Using **Formula 4**, we calculate the **Immaturity Ratio** as follows:

$$\text{Immaturity Ratio} = \left(\frac{\text{Number of children born with weight} < 2500\text{g during the year}}{\text{Total number of children born in the middle of the year}} \right) \times 1000 \quad (5)$$

Step 1: Identify the number of low-weight births and the total number of births.

- **Number of low-weight births (Numerator):** 1,950
- **Total number of births (Denominator):** 7,800

Step 2: Plug the values into the formula.

$$\text{Immaturity Ratio} = \left(\frac{1,950}{7,800} \right) \times 1000$$

Step 3: Perform the division.

$$\frac{1,950}{7,800} = 0.25$$

Step 4: Multiply by 1000 to standardize per 1,000 live births.

$$0.25 \times 1000 = 250\%$$

Interpretation

For every **1,000** live births in the city, **250** children weighed less than **2,500 grams** in 2022.

6 Tutorial 6: Calculating Incidence Rate with a Different Scenario

Problem

In 2023, a region reported **600** new cases of measles among children. The population of children in the region was **10,000,000** in the middle of 2023. Calculate the incidence rate of measles among children for that year.

Solution

We will apply **Formula 1** to determine the **Incidence Rate**:

$$\text{Incidence Rate} = \left(\frac{\text{Number of new cases of disease during the year}}{\text{Number of population in the middle of the year}} \right) \times 1000 \quad (6)$$

Step 1: Identify the number of new cases and the population.

- **Number of new cases (Numerator):** 600
- **Population (Denominator):** 10,000,000

Step 2: Plug the values into the formula.

$$\text{Incidence Rate} = \left(\frac{600}{10,000,000} \right) \times 1000$$

Step 3: Perform the division.

$$\frac{600}{10,000,000} = 0.00006$$

Step 4: Multiply by 1000 to standardize per 1,000 individuals.

$$0.00006 \times 1000 = 0.06\%$$

Interpretation

This means that for every **1,000 children** in the population, **0.06** new cases of measles were reported in 2023.

Summary

Through these six tutorials, we've reinforced the key concepts of **Morbidity Statistics**:

1. **Incidence Rate**: Measures new cases over a period.
2. **Prevalence Rate**: Assesses total cases at a specific time.
3. **Case Fatality Ratio**: Evaluates the lethality of a disease.
4. **Immaturity Ratio**: Indicates neonatal health based on birth weights.

By practicing with these modified examples, you can confidently analyze health trends, allocate resources effectively, and implement targeted health interventions to enhance public health outcomes.