Testing Hypothesis

Professor Dr Abubakir M. Saleh

Biostatistics NUR304

Fall semester

6th week

23/11/2023

Outline

- Hypothesis testing
- Steps of hypothesis testing
  1. Assumption (Normal distribution)
  2. Hypothesis
  3. Levels of significance (alpha)
  4. The statistics
  5. P value *&* Statistical decision

Objectives

At the end of this lecture, students should be able to :

- Know the steps for testing hypothesis.
- Identify p-value and statistical decision.

Hypothesis Testing

- We used confidence interval to make allowance for sampling error in estimating the true mean/percentage

- In some cases, we are not interested in calculating a confidence interval, but rather we want to see whether our data confirm a specific hypothesis

- This type of inference is called **hypothesis testing**

Example

1. Mean haemoglobin level of 200 males and 200 females

Male: 14.2 Female: 12.1

Do males have a higher haemoglobin level than females?

2. Percentage of smokers in 400 persons in Erbil and 600 persons in Baghdad

Erbil: 25% Baghdad 35%

Does the rate of smoking higher among Baghdad people than Erbil people?

Hypothesis testing (significance test) shows the probability of getting the observed or more extreme results, if there is no actual difference (obtained by chance)

Steps of testing hypothesis

1. Assumption
2. Hypothesis
3. Levels of significance (alpha)
4. The statistics
5. P value & Statistical decision

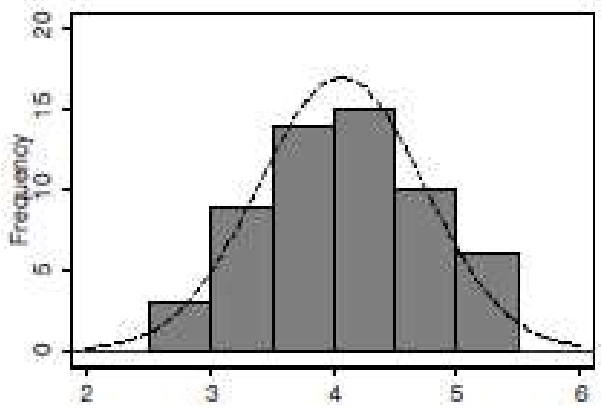
Steps of testing hypothesis (Cont.)

1. Assumption

   We assume that our population(s) are normally distributed.

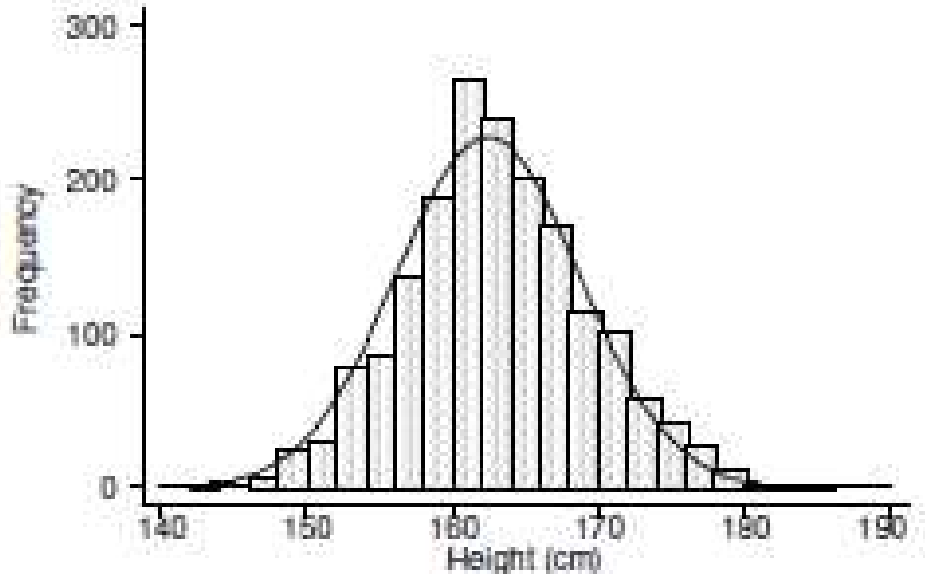
- Many statistical methods are only valid if we can assume that our data follow a **normal distribution**.

- This is a continuous, symmetrica unimodal distribution

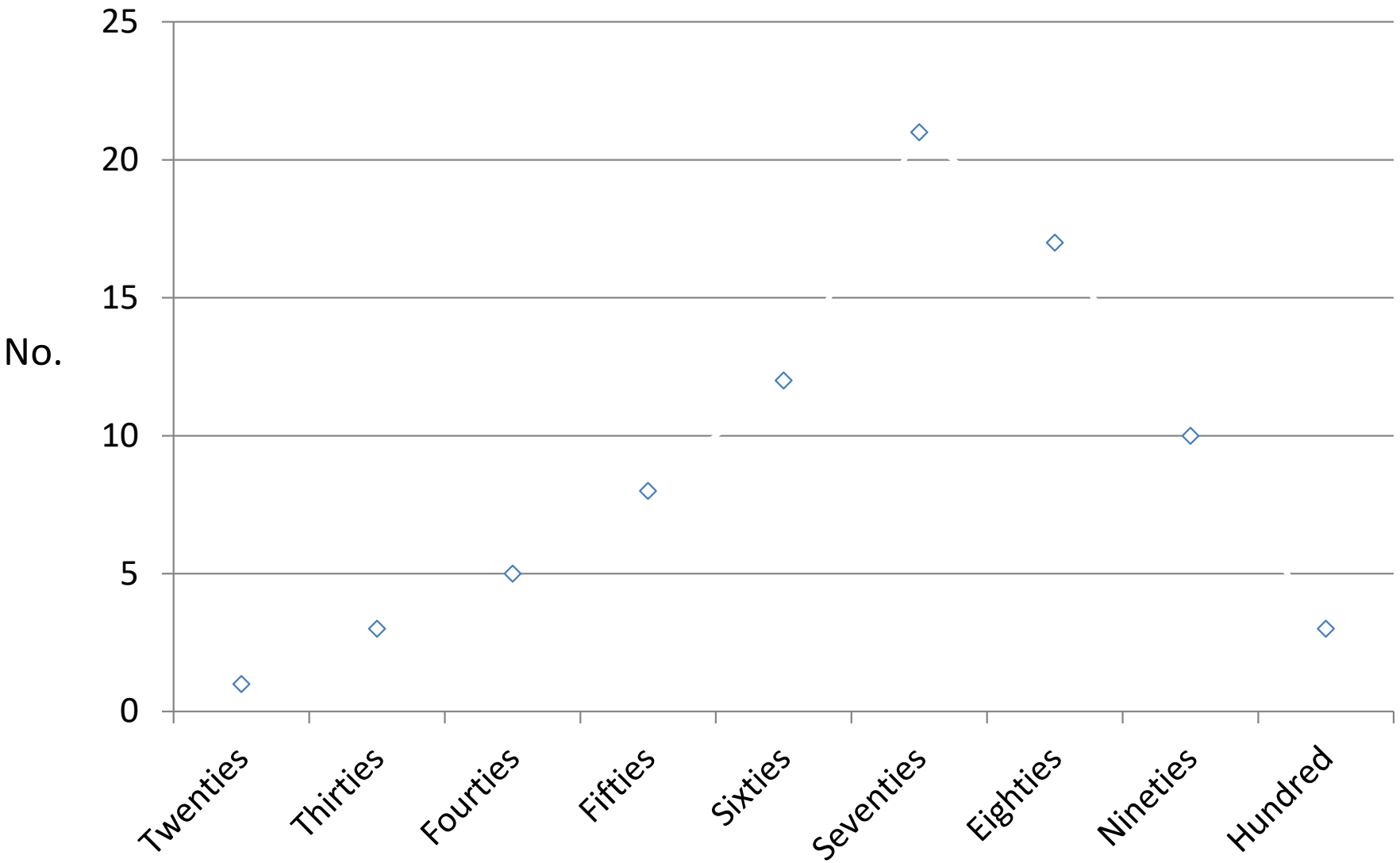


Normal Distribution

- The Normal distribution is important as many natural variables follow it quite closely
-



Last year students' marks



Steps of testing hypothesis

1. **Assumption**

   We assume that our population(s) are normally distributed.

2. **Hypothesis**

   We put null hypothesis (Ho) & alternative hypothesis (H_A).

Null and Alternative Hypotheses

- **Null** Hypothesis (H_0) - an assumption that there is **no effect or no change** in the population

  E.g. no difference between haemoglobin level of males and females.

  The reported difference was due to chance only.

- **Alternative** hypothesis (H_a) - there is a **real difference or real change** in the population

  E.g. there is difference between males and females of haemoglobin level and the difference was not due to chance.

Example: Hemoglobin Level

- **Null Hypothesis**:
  - Sex has no effect on haemoglobin level, so males Hb should be the same as females Hb
  - **H_0: *14.2* = 12.1**
- **Alternative Hypothesis**:
  - Sex did have an effect on the Hb level
  - **H_a: *14.2* ≠ 12.1**
- **Our aim is to test which hypothesis to reject and which one to accept**

Steps of testing the statistical hypothesis

1. **Assumption**

   We assume that our population(s) are normally distributed.

2. **Hypothesis**

   We put null hypothesis (Ho) & alternative hypothesis (H_A).

3. **Levels of significance (alpha)**

3. Levels of significance (alpha)

Alpha = the probability of rejecting a true null hypothesis.

Usually, alpha = **0.05** or 0.01

Steps of testing the statistical hypothesis

1. **Assumption**
2. **Hypothesis**
3. **Levels of significance (alpha)**
4. **The statistics**

5. Test Statistic

- The test statistic measures the difference between the **observed data** and the **null hypothesis**

- Depending on the type of data, an appropriate test will be used.

- Generally speaking, data are either numerical or categorical data.

Numerical data (mean & standard deviation):

- In order to test whether there is a significant difference between **two means**, we use the **student (t) test**.
  - E.g. mean hemoglobin between pregnant and non-pregnant women

- To compare between **several means**; we use the analysis of variance (**ANOVA**, or called the F test)

Categorical data

- To compare between two or more percentages, **Chi square test** will be used

E.g. In a sample of population;

- Percentage of smokers among male = 30%
- Percentage of smokers among female = 20%

Q. Is there a real difference between these two proportions or this result was obtained by chance?

Steps of testing the statistical hypothesis

1. **Assumption**
2. **Hypothesis**
3. **Levels of significance (alpha)**
4. **The statistics**
5. **Statistical decision and P value**

Statistical decision (significance)

- Whether to reject or not to reject Ho.

- If the p-value is smaller than α, we say the data are **statistically significant at level α**

- The most common α-level to use is $\alpha = 0.05$ or 5%

- The α-level is used as a threshold ***for rejecting the null hypothesis***

- If the p-value < α (0.05), we reject the null hypothesis that there is no change or difference

Probability values (p-values)

- ***P-value*** is the probability of getting the observed or more extreme results, given that the null hypothesis is true

- The smaller the p-value is, the more unrealistic our null hypothesis appears

P-value

- P value is obtained from specials tables depending on the results of “Statistics Test” and degree of freedom

- The table and the degree of freedom are different according to type of test (type of data)

Summary

- Hypothesis testing or significance test is another way of allowance for sampling error or expressing uncertainty of an estimate
- Different methods are used according to the type of data (numerical vs categorical), but the principle is the same
- Next sessions are related to hypothesis testing for different types of data

References

- Essential Medical Statistics, by Betty Kirkwood & Jonathan Sterne
  (Published by Blackwell)

  Statistics Without Tears, a Primer for Non-mathematicians, by Derek Rowntree
  (Published by Penguin)

Questions?