

UNIT 1.1

HYPOTHESIS TESTING

1

Introduction to Statistics

2

- *Statistics is the science of data: designing collection of data, exploring data, and drawing conclusions from data. (Petruccelli, et al. p3)*

2

Example – Draw conclusion from data

3

- Suppose the water supply in a community was a blend coming from several sources. Depending on the location of the residence, there would be different amounts of water from each source. One of the water sources was found to be contaminated. From the time of contamination until the discovery of the contamination there were 20 live births in the community. Two babies were born with congenital abnormalities. The amount of water going to each mother's residence during her pregnancy had been recorded. The two birth defect babies came from residences in which the amount of contaminated water delivered to the households ranked highest and fourth highest.

- Zelen M. Encyclopedia of Biostatistics. Vol. 3, 1998:2034-46.

- Discuss it in groups. If you were to make a conclusion based solely on the data presented, what conclusion would you make? What was the criteria you used? (You do not need any sophisticated mathematical formula.)

3

Null Hypothesis (H_0) and Alternative Hypothesis (H_1)

4

- The *null hypothesis* (H_0) is a statement that the value of a population parameter is equal to some postulated value.
- The *alternative hypothesis* (H_A) is the statement that the null hypothesis is not true.

4

P-value

5

- **P-value** is the probability of obtaining a sample at least as extreme as the observed one assuming H_0 is true.
- If p-value is exceptionally small, we conclude that the assumption is probably not correct.
- How small is small?
 - ▣ We 'reject' the null hypothesis if $p\text{-value} \leq 0.05$ (or 0.01 or 0.1).
 - ▣ These arbitrary cutoffs are called 'level of significance'.
 - ▣ *We are rejecting H_0 knowing that there is a probability that we would do so even if H_0 is true.*

5

Hypothesis (Significance) Testing

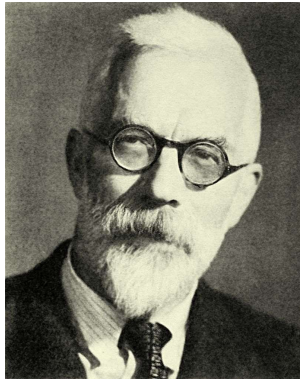
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- Fisher argued that our conclusion has to be one of the following:
 1. Reject the null hypothesis.
 2. Fail to reject the null hypothesis.
 - ▣ We cannot "accept the null hypothesis" based on the observation. We can only conclude that "the evidence is not strong enough to warrant rejection".
- Scientific significance and statistical significance are two different and important qualities.

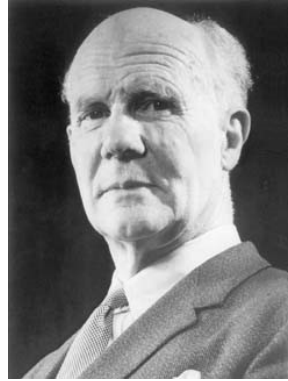
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Hypothesis (Significance) Testing

7



RA Fisher (1890-1962)



Egon Pearson (1895-1980)



Jerzy Neyman (1894-1981)

7

We will take a long detour.

8

- Not every hypothesis can be tested by counting.

- We will come back to *Hypothesis Testing* after we learn about ...
 - ▣ Probability
 - ▣ Probability Distributions
 - ▣ Sampling Theory

8

□ Reference

- ▣ Principles of Biostatistics (Pagano and Gauvreau)
- ▣ *Elementary Statistics* by Triola, 10th edition.
- ▣ *Applied Statistics for Engineers and Scientists* by Petrucci et al.

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