



Design of Experiments

(Lecture II)

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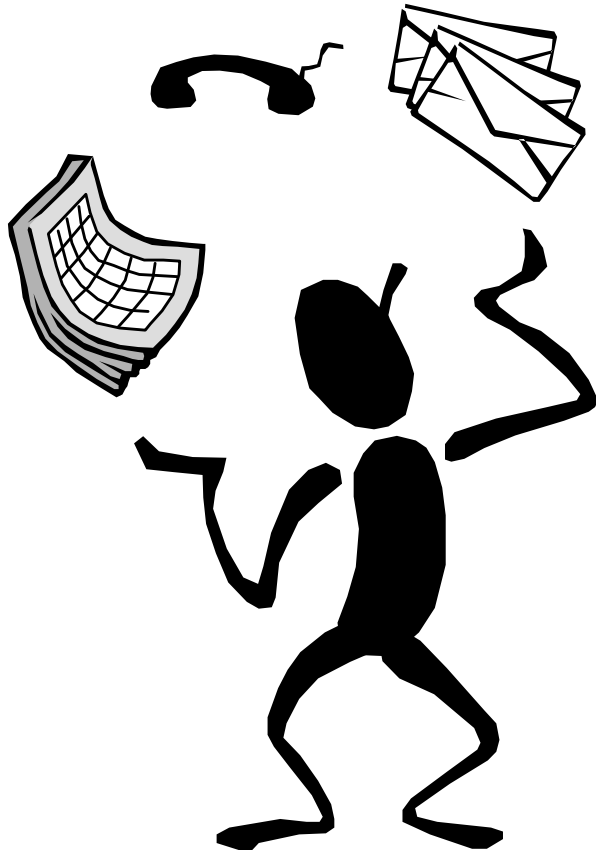
Outline

- Review of simple statistics



Objectives

- By the end of this lecture the student should be able to:
 - Recognize the applications of statistics in real life
 - Define the terms “Population” and “Sample”
 - Define and calculate different statistical variables (mean, standard deviation, median, etc.)
 - Prepare graphical representation for different set of data



- *Statistics* is the science of conducting studies to collect, organize, summarize, analyze, present, interpret and draw conclusions from *data*.

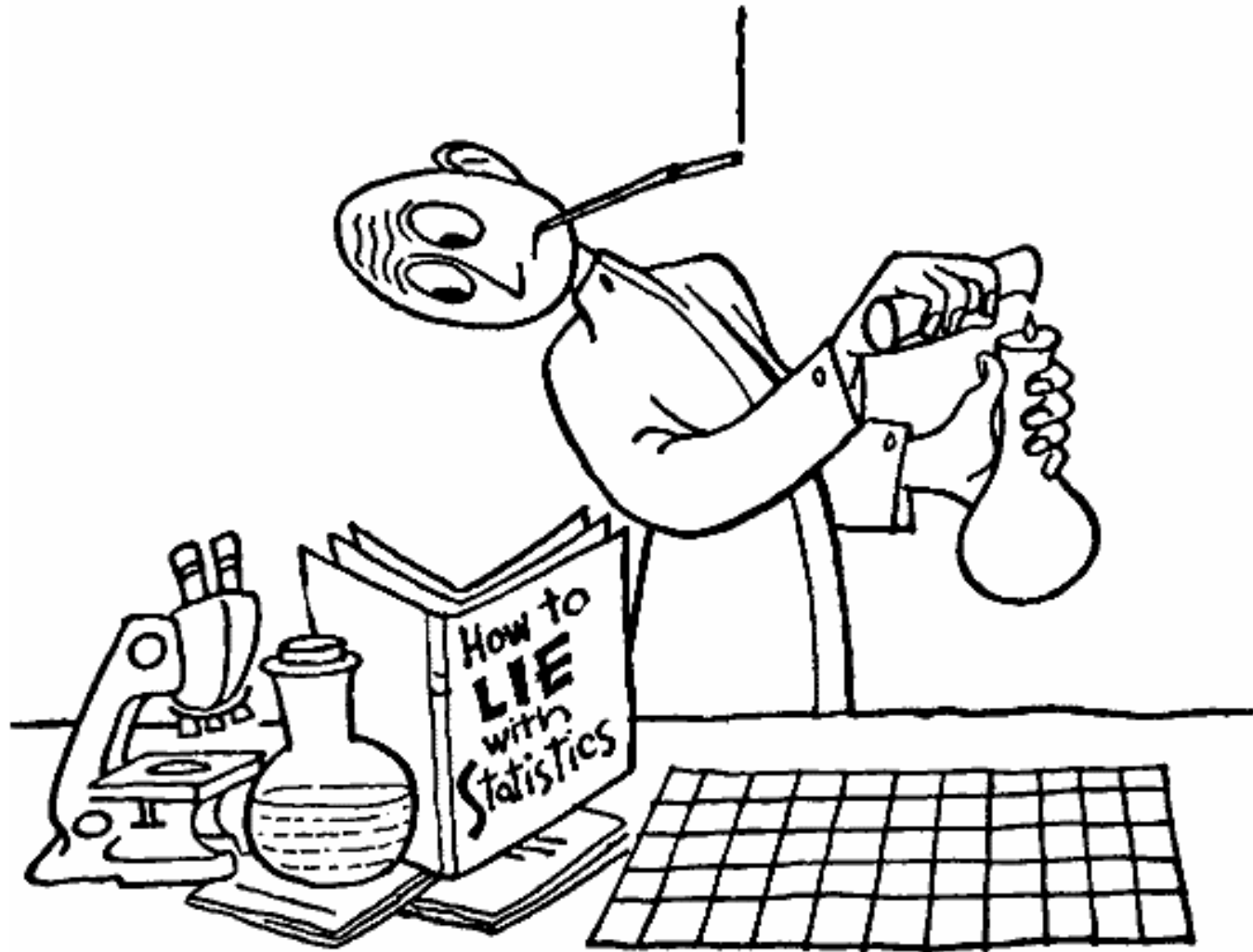
Any values (observations or measurements) that have been collected



Statistics in Our Life

- Finance
- Crimes and legal system
- Medical
- Quality
- Etc.

Statistical Lies

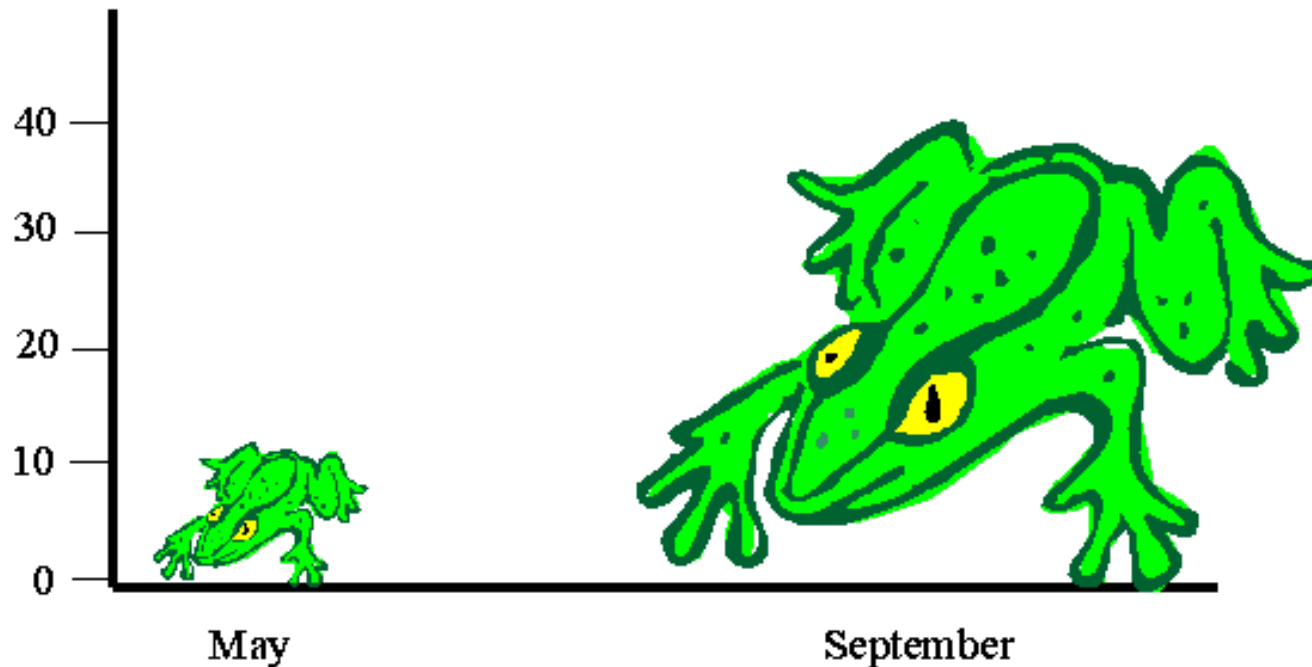


<http://www.physics.csbsju.edu/stats/display.html>

Statistical Lies

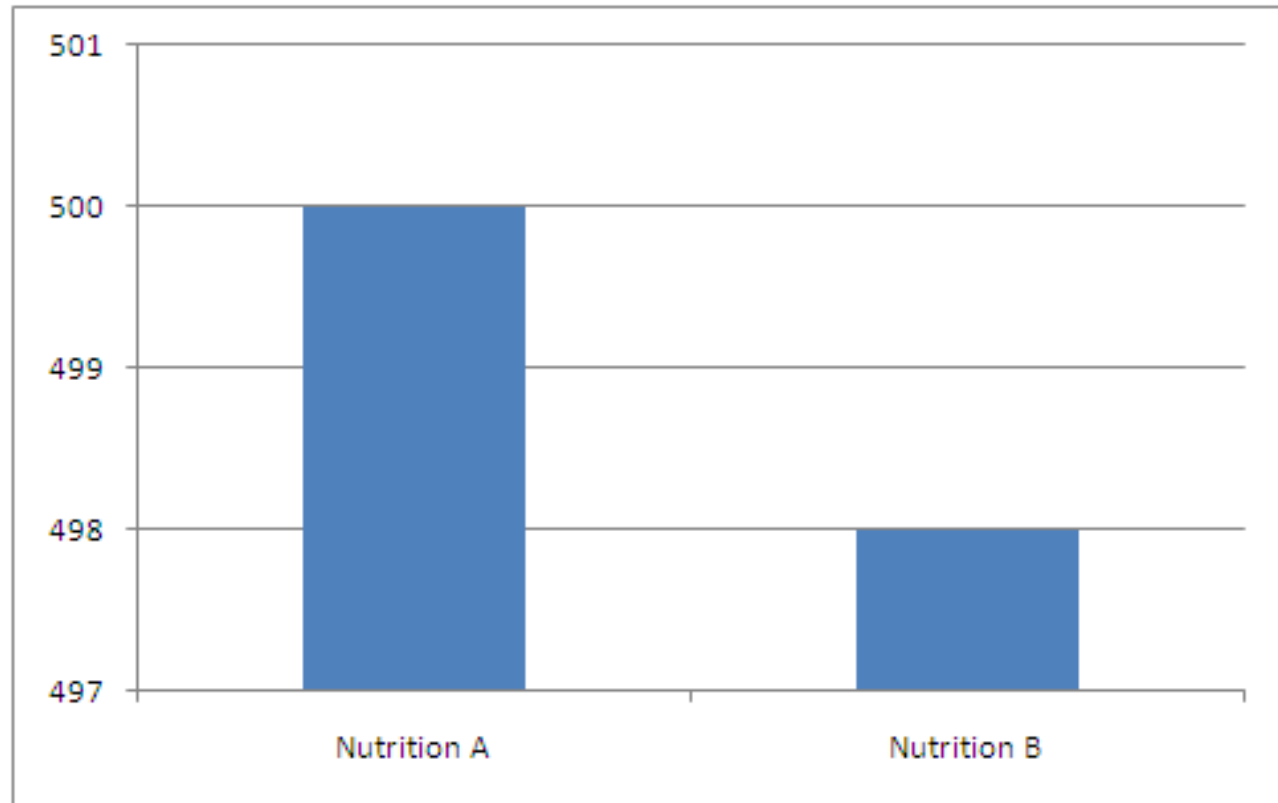


Number of Adult Frogs in South Pond





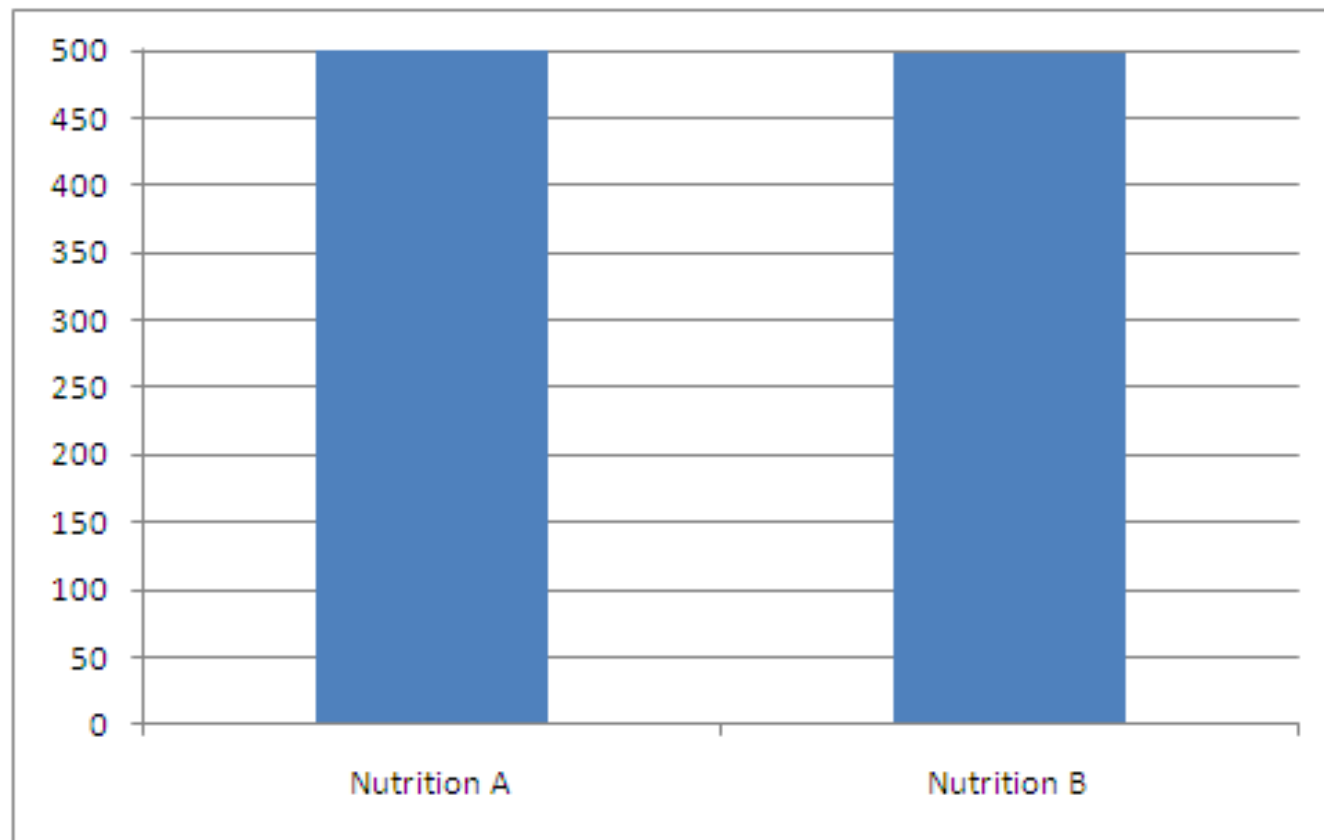
Statistical Lies



Weight gained by babies after two weeks of usage (Grams)



Statistical Lies



**Weight gained by babies after two weeks of
usage (Grams)**



Samples and Populations

All the next slides are from William Navidi's instructor's manual



Sampling

Definitions:

- A **population** is the entire collection of objects or outcomes about which information is sought.
- A **sample** is a subset of a population, containing the objects or outcomes that are actually observed.
- A **simple random sample (SRS)** of size n is a sample chosen by a method in which each collection of n population items is equally likely to comprise the sample, just as in the lottery.



Independent Items

- The items in a sample are **independent** if knowing the values of some of the items does not help to predict the values of the others.
- Items in a simple random sample may be treated as independent in most cases encountered in practice. The exception occurs when the population is finite and the sample comprises a substantial fraction (more than 5%) of the population.



Types of Data

- **Numerical or quantitative** if a numerical quantity is assigned to each item in the sample.
 - Height
 - Weight
 - Age
- **Categorical or qualitative** if the sample items are placed into categories.
 - Gender
 - Hair color
 - Zip code



Summary Statistics

- **Sample Mean:**

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

- **Sample Variance:**

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2 = \frac{1}{n-1} \left(\sum_{i=1}^n X_i^2 - n\bar{X}^2 \right)$$

- **Sample standard deviation** is the square root of the sample variance.



Definition of a Median

The **median** is another measure of center, like the mean. To find it:

- If n is odd, the sample median is the number in

$$\text{position } \frac{n+1}{2}.$$

- If n is even, the sample median is the average

$$\text{of the numbers in positions } \frac{n}{2} \text{ and } \frac{n}{2} + 1.$$



Summary

- Importance of statistics.
- Population versus sample.
- Mean, median and standard deviation.