STA 321
Spring 2014

Lecture 1

Thursday, January 16

WELCOME to STA 321!

- Syllabus: on the course website
  http://polytopes.net/courses/STA321S14/
- Class Instructor: Dr. Ruriko Yoshida
- ruriko.yoshida@uky.edu
- Office Hours: 14:00-14:50 on Mon/Wed
  (No OH on the next week)
- 325D Multi-disciplinary Sciences Building
- Note: Course material on the course website–usually not handouts in class

Course Information

- Lecture in *TPC 101*
  Tuesday & Thursday, 14:00 – 15:15

- Grading
  There will be two in-class exams, graded homeworks, and a final exam: these will count 40%, 30%, and 30% of your grade, respectively.

Topics

- Hypothesis testing
- Analysis of categorical data
- Regression and correlation
- Analysis of variance
- Nonparametric methods

Three Important Concepts

- Sampling Distribution
- Confidence Interval
- P-value of a Statistical Test

Grade Calculation

- Midterm Exams (Feb 27/April 24)…… **40%**
- Final Exam (May 8)…….. **30%**
- Weekly Homework Assignments.... **30%**

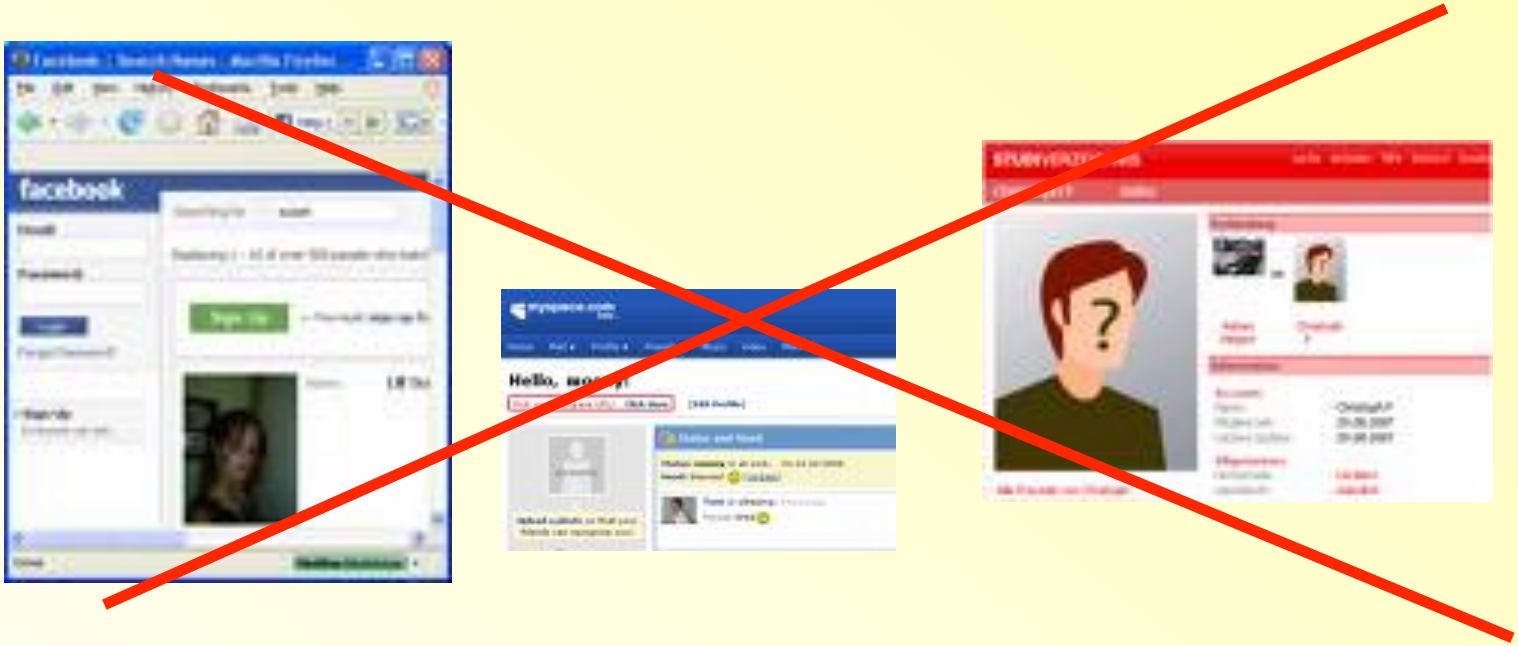
Letter Grades

A: 90-100%, **B:** 80-89%, **C:** 70-79%,

D: 60-69%, **E:** 0-59%

Please...

Also Please...



Why Statistics?

- Research in the sciences is getting more quantitative (look at research journals)
- Computers make even complex statistical methods easier to use
  - danger of using inappropriate methods
  - vital to understand a method before using it
- Job market: Most graduates need to be familiar with basic statistical methodology
- *"Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write."*

  Herbert George Wells (1866–1946)

Why Statistics? (contd)

- Everyday Newspaper, advertising, surveys, internet and other media:

  Many statements contain statistical arguments or techniques

- Recent examples…

http://www.bls.gov/news.release/empsit.t01.htm

What does it take to understand the STA 321 material?

- Logical thinking
- Perseverance
- …+ see Syllabus

  (attend lectures and labs, obtain material when absent, do homework yourself, etc.)
- Don’t procrastinate ☺

What is Statistics?

Methods for Collecting, Describing, Analyzing, and Drawing Conclusions from Data

These methods are used for…

Design
- Planning research studies
- How best to obtain the required data

Description
- Summarizing data
- Exploring patterns in the data
- Extract/condense information
- Graphical pictures of the data

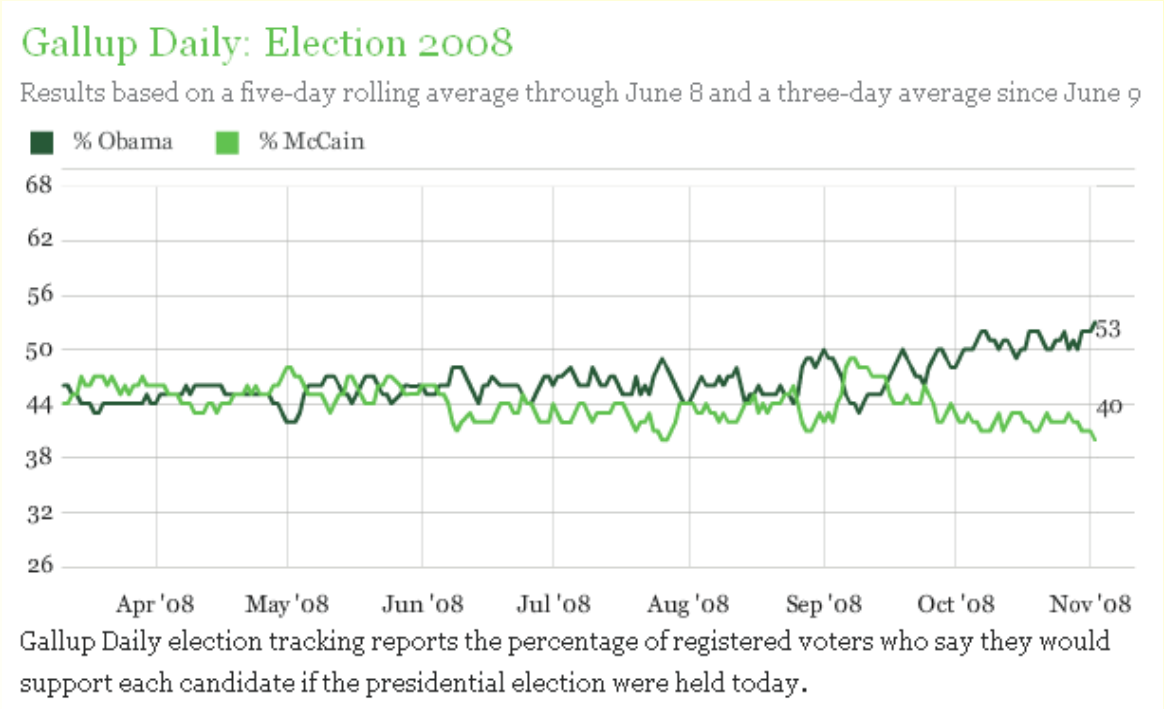
Inference
- Make predictions based on the data
- "Infer" from sample to population
- Generalize

Descriptive Statistics, e.g.

Frequency Distribution

STA 321 Grade	Frequency
A	31
B	37
C	10
E	2

Time Plot



Basic Terminology I

- **Population**
  - total set of all subjects of interest
  - the entire group of people, animal or things about which we want information
- **Elementary Unit**
  - any individual member of the population
- **Sample**
  - subset of the population from which the study actually collects information
  - used to draw conclusions about the whole population

Basic Terminology II

- **Variable**
  - a characteristic of a unit that can vary among subjects in the population/sample
  - Examples: gender, nationality, age, income, hair color, height, disease status, company rating, grade in STA 321, state of residence
- **Sampling Frame**
  - listing of all the units in the population
- **Parameter**
  - numerical characteristic of the **p**opulation
  - calculated using the whole population
- **Statistic**
  - numerical characteristic of the **s**ample
  - calculated using the sample

Statistic vs. Parameter

- **Statistics are based on a sample**

  (even if they are used to describe a population)
- **Parameters are calculated using the whole population**

Data Collection and Sampling Theory

Why not measure all of the the units in the population? Why not take a census?

Problems:

- *Accuracy:* May not be able to list them all—
  may not be able to come up with a ***frame***.
- *Time:* Speed of Response
- *Expense:* Cost
- *Infinite Population*
- *Destructive Sampling or Testing*

Flavors of Statistics

- **Descriptive Statistics**
  - Summarizing the information in a collection of data
- **Inferential Statistics**
  - Using information from a sample to make conclusions/predictions about the population

Example 1

- University Health Services at UK conducts a survey about alcohol abuse among students.
- 200 of the 30,000 students are sampled and asked to complete a questionnaire.
- One question is “have you regretted something you did while drinking”?
- What is the population? Sample?
- For the 30,000 students, of interest is the percentage who would respond “yes”.

  This value is computed for the students sampled.

  Is this a parameter or a statistic?

Example 2

- Polls in the United Kingdom, France, and Germany indicated that (Gallup, July 23, 2008) majorities of citizens in these countries preferred Obama over McCain.
- In the U.K., 60% of those surveyed favored Obama, 15% favored McCain, and 25% did not know or refused to answer this question.
- France: 64%, 4%, 32%
- Germany: 62%, 10%, 27%
- Are these numbers statistics or parameters?
- The report says that the percentage of all adults in the U.K. who favored Obama was at least 57%, but no greater than 63%.
- Is this an example of descriptive or inferential statistics?

Univariate vs Multivariate

- Univariate data set
  - Consists of observations on a single attribute
- Multivariate data
  - Consists of observations on several attributes
- Special case: Bivariate data
  - Two attributes collected per observation

Scales of Measurement

- Qualitative and Quantitative
- Nominal and Ordinal
- Discrete and Continuous

- **Recall:**
  - A **Variable** is a characteristic of a unit that can vary among subjects in the population/sample

Qualitative Variables (=Categorical Variables) **Nominal** or Ordinal

- **Nominal**: gender, nationality, hair color, state of residence
- Nominal variables have a **scale of unordered categories**
- It does not make sense to say, for example, that green hair is greater/higher/better than orange hair

Qualitative (Categorical) Variables Nominal or **Ordinal**

- **Ordinal:** Disease status, company rating, grade in STA 321
- Ordinal variables have a scale of ordered categories. They are often treated in a quantitative manner (A=4.0, B=3.0,…)
- One unit can have more of a certain property than does another unit

Quantitative Variables

- **Quantitative:** age, income, height
- Quantitative variables are measured numerically, that is, for each subject, a number is observed
- The scale for quantitative variables is called **interval scale**

Example 1

- Vigild “Oral hygiene and periodontal conditions among 201 institutionalized elderly”, Gerodontics, 4:140-145
- Variables measured
  - Nominal: Requires Assistance from Staff?

    Yes / No
  - Ordinal: Plaque Score

    No Visible Plaque - Small Amounts of Plaque - Moderate Amounts of Plaque - Abundant Plaque
  - Interval: Number of Teeth

Example 2

- The following data are collected on newborns as part of a birth registry database
- Ethnic background: African-American, Hispanic, Native American, Caucasian, Other
- Infant's Condition: Excellent, Good, Fair, Poor
- Birthweight: in grams
- Number of prenatal visits

- What are the appropriate scales?

Why is it important to distinguish between different types of data?

- Some statistical methods only work for quantitative variables, others are designed for qualitative variables.

Nominal - Ordinal - Interval

Qualitative (Categorical)

Quantitative

Lowest level

Highest Level
- most information
- best statistical methods

You **can not** use statistical methods for quantitative data to analyze qualitative data.
You **can** treat variables in a less quantitative manner.

- Example.
  - Height: Quantitative variable, interval scale, *measured in cm (or ft/in)*
  - Can be treated as ordinal

    short, average, tall
  - Can even be treated as nominal

    180cm-200cm, all others

- Try to measure variables at the highest possible level
- Higher-level variables can be analyzed with a greater variety of methods

Caution: Sometimes, ordinal variables are treated as quantitative