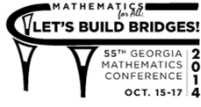



## Research and Randomization: Tools for Meaningful Statistics

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## What's In Store


- ◎ Research Projects
  - Learn by doing
- ◎ Randomization
  - Logic of statistical inference
  - Alternative to theoretical tests
  - Improve research project learning outcomes






## Authentic Research Projects

Student tasks

- ◎ Identify research questions
- ◎ Define suitable variables, including how to quantify and measure variables
- ◎ Submit project proposal and obtain approval
- ◎ Collect data
  - Design unbiased data collection method
  - Address sampling issues
- ◎ Analyze and interpret data
- ◎ Write a report on methods and results
- ◎ Present research and findings to class




## Sources of Data: 3 Categories

- ◎ Administer surveys
  - Student constructs a survey and has people fill it out
- ◎ Find data on the Internet
 
- ◎ Physically go out and record data
  - e.g., measure items, time events with a stopwatch, look at prices, look at nutrition labels

## Available Resources

- ◎ Student Guide
- ◎ Instructor Guide
- ◎ Technology Guide
- ◎ Appendices
  - A – E: for students and instructors
  - T1 – T3: for instructors



◎ Available online:  
<http://faculty.ung.edu/DJSpence/NSF/materials.html>

## Surveys

**A *construct* to measure stress**



Please mark each statement that is true about you.

- If I could stop worrying so much, I could accomplish a lot more.
- Currently, I have a high level of stress.
- In this point in my life I often feel like I am overwhelmed.
- I have a lot to do, but I just feel like I can't get ahead or even sometimes keep up.
- I often worry that things won't turn out like they should.
- I have so much going on right now, sometimes I just feel like I want to scream.

Score "1" for each checked box. Range is 0 to 6, with higher numbers indicating higher levels of stress.



### Internet Data Sources

#### I. Government/Community


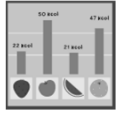
- ◎ Census Bureau:  
<http://www.census.gov/> 
- ◎ Bureau of Justice Statistics:  
<http://bjs.ojp.usdoj.gov/index.cfm?ty=daa>
- ◎ City Data Site:  
<http://www.city-data.com/> 
- ◎ State and county statistics sites
- ◎ State and national Dept.'s of Education
- ◎ County tax assessment records

### Internet Data Sources

#### II. Restaurants: Nutrition Info




[Applebee's Nutrition Guide](#)  
[Arby's Nutrition Guide](#)  
[Burger King Nutrition Guide](#)  
[IHOP Nutrition Guide](#)  
[KFC Nutrition Guide](#)  
[Longhorn Nutrition Guide](#)  
[McDonald's Nutrition Guide](#)  
[Olive Garden Nutrition Guide](#)  
[Ruby Tuesday's Nutrition Guide](#)  
[Subway Nutrition Guide](#)  
[Taco Bell Nutrition Guide](#)

Google YOUR favorite place to eat!




### Internet Data Sources

#### III. Sports Data

- ◎ Sports Statistics Data Resources (Gateway)  
<http://www.amstat.org/sections/SIS/Sports Data Resources/>
- ◎ General Sports Reference Site  
[www.sports-reference.com](http://www.sports-reference.com) 
- ◎ NFL Historical Stats:  
<http://www.nfl.com/history>  
- ◎ Individual team sites


### Internet Data Sources

#### IV. Retail/Consumer (General)

- ◎ Cost/Prices   
e.g., Kelley Blue Book: <http://www.kbb.com/>
- ◎ Consumer Report ratings   
<http://www.consumerreports.org/cro/index.htm>
- ◎ Product Specifications   
• e.g., size measurements,  
time/speed measurements,  
MPG for cars

### Assessment

- ◎ Weight of projects
- ◎ Scoring rubrics
  - ◎ Advantages – consistency, manageability, communication of expectations
  - ◎ See Appendix T3
- ◎ Team member grades
  - ◎ Accountability of individual members




### Sample Student Projects

(See Appendix D)

- ◎ Matched Pairs t-Test:
  - ◎ 2-tailed:  $H_a$  predicting that on average, students' rating of Coke and Pepsi would be different.
  - ◎ t statistic = 2.62
  - ◎ P value = 0.0116 (2-tailed)
  - ◎ Conclusion: Evidence that on average, students rated the two drinks differently (Coke was rated higher)

|             |      |       |
|-------------|------|-------|
| Participant | Coke | Pepsi |
| #1          | 8    | 9     |
| #2          | 7    | 5     |

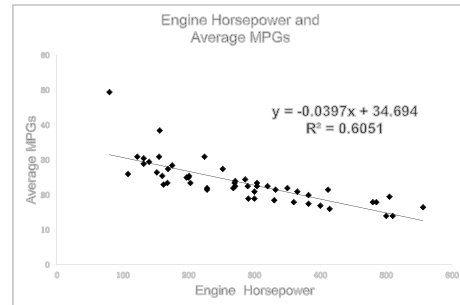


## Sample Student Projects

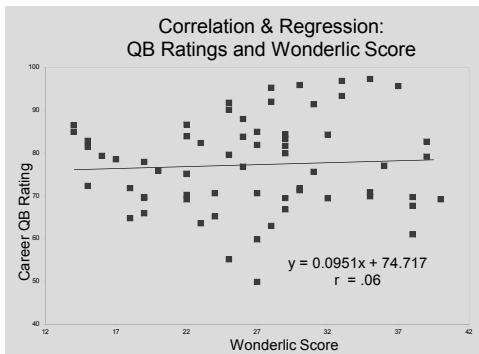
- ⊙ t-Test for 2 independent samples:
  - ⊙ 1-tailed:  $H_a$  predicting that on average fruit drinks have higher sugar content per ounce than fruit juices
  - ⊙ t statistic = -0.14
  - ⊙ P value = 0.5555
  - ⊙ Conclusion: Sample data did not support  $H_a$ . No evidence that on average, fruit drinks have more sugar than fruit juices.



## Sample Student Projects



## Sample Student Projects



## Randomization: Resources

- ⊙ Some case studies taken from [Rice Virtual Stats Lab](#)
- ⊙ Some activities drawn from materials by Rossman & Chance; see Rossman and Chance, [Teaching Introductory Statistics with Activities and Data](#)
- ⊙ Some activities drawn from materials by Tintle, Chance, Cobb, Rossman, Roy, Swanson, & VanderStoep; see Tintle et al., [Introduction to Statistical Investigations](#)

### ⊙ Randomization Applet Sources

- [Rossman & Chance](#)
- [StatKey](#) ("Lock 5")
- [JMP](#)

## Randomization: Examples



- ⊙ Scenario #1: Babies' reactions to toys



- ⊙ Scenario #2: Alex the Parrot
- ⊙ Scenario #3: Dolphin Therapy
- ⊙ Scenario #4: Magnets & Pain Relief
- ⊙ Scenario #5: A Correlation Study

## Discussion / Q&A

