Human-Computer Interaction IS4300

1

T5b – Paper Prototyping *due*

- Recruit 3-5 users who are as close as possible to your target demographic.
- Be sure to record demographic information (age, gender, education, occupation, etc.) for your report.
- **Testing Users** When you run your prototype on a user, you should do the following things:
  - Obtain verbal consent for participation.
  - Brief the user.
  - Present one task.
  - Watch the user do the task. Take notes of your observations.
  - Repeat with the other tasks.
  - Interview users, take any measures you think are important.

2

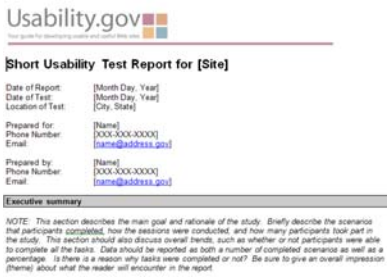
T5b – Paper Prototyping *due*

- **What to Post**
- Prototype photos. Digital photos of the pieces of your prototype. Try to show the prototype in an interesting state, not just a blank window.
- Briefing. The briefing you gave to users.
- Scenario tasks. The tasks you gave to users, exactly as you wrote them on the cards.
- Demographics of your test users, and description of the test scenario (time, place, equipment, etc).
- Observations. Usability problems you discovered from the testing, and possible solutions. Describe what users did. You must test at least 3 users.
- Results from interviews & other measures.

3

Olympic Messaging System

Problem



Usability.gov

Short Usability Test Report for [Site]

Date of Report: [Month Day, Year]
Date of Test: [Month Day, Year]
Location of Test: [City, State]

Prepared for: [Name]
Phone Number: [XXX-XXX-XXXX]
Email: [name@address.gov]

Prepared by: [Name]
Phone Number: [XXX-XXX-XXXX]
Email: [name@address.gov]

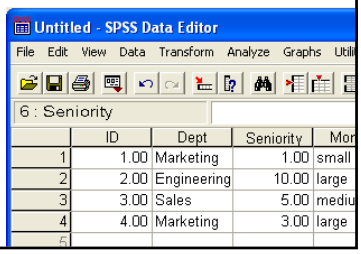
Executive summary

NOTE: This section describes the main goal and rationale of the study. Briefly describe the scenarios that participants completed, how the sessions were conducted, and how many participants took part in the study. This section should also discuss overall trends, such as whether or not participants were able to complete all the tasks. Data should be reported as both a number of completed scenarios as well as a percentage. Is there is a reason why tasks were completed or not? Be sure to give an overall impression (theme) about what the reader will encounter in the report.

Example: Paper Prototyping usability test.

Coding data

- Transcribe all interviews
- Code (data entry) all measures
  - Questionnaires
  - Metrics (times, errors)
  - Check for errors, missing data
  - Unstacked format typical
  - Excel ok for very simple analyses, recommend SPSS for more complex (and R if you are a hacker)
- Do asap, by people in the room



6 : Seniority

	ID	Dept	Seniority	Mor
1	1.00	Marketing	1.00	small
2	2.00	Engineering	10.00	large
3	3.00	Sales	5.00	mediu
4	4.00	Marketing	3.00	large
5				

Summarizing Data

- Qualitative
  - Problem analysis
  - Text analysis
- Quantitative
  - Descriptive statistics

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Problem ("usability defect") analysis Example: Optometrist website

- U1: Could not find SEARCH function. Failed to complete.
- U2: Spent long time finding contents of cart. Completed.
- U3: Spent long time finding SEARCH function. Completed.
- U4: No problems.
- U5: Could not find SEARCH function. Failed to complete.
- U6: Did not like colors on checkout page.

8

Summarizing Qualitative Data

Use with Interview & Think Aloud data

More on 11/1 with Barbara

9

Analytic Induction (Znaniecki)

Nonexperimental, Qualitative analogue to scientific method

1. Phenomenon tentatively defined
2. Hypothesis is developed
3. A single instance is considered to determine if hypothesis is confirmed
4. If hypothesis fails, then phenomenon or hypothesis is redefined
5. Additional cases are examined and, if the new hypothesis is repeatedly confirmed, some degree of certainty results
6. Each negative case requires that the hypothesis be reformulated until there are no exceptions

10

Summarizing Quantitative Data

Kinds of Measures

Primary source:

Bordens & Abbott, *Research Design and Methods*

11

Scales of Measurement

- *Nominal Scale*
  - Lowest scale of measurement involving variables whose values differ by category (e.g., male/female)
  - Values of variables have different names, but no ordering of values is implied
- *Ordinal Scale*
  - Higher scale of measurement than nominal scale
  - Different values of a variable can be ranked according to quantity (e.g., high, moderate, or low self-esteem)

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Scales of Measurement

- *Interval Scale*
  - Scale of measurement on which the spacing between values is known (e.g., rating a book on a scale ranging from 0 to 10)
  - No true zero point
- *Ratio Scale*
  - Similar to interval scale, but with a true zero point (e.g., number of lever presses, height)

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What kind is it?

- Age
- Gender
- Job Category (Engineer, Manager…)
- Efficiency (time to complete)
- School Year (Freshman…)
- Temperature (Celsius)
- Think aloud quotes / themes
- Monitor Size
- Weather (Rain, Snow, …)
- Debrief quotes / themes
- Productivity (wpd)
- Owns Pet (or not)

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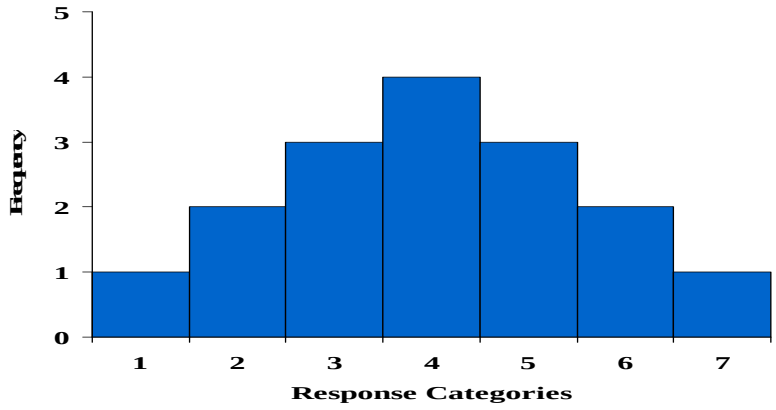
Descriptive Statistics Practically speaking

- You will decide on statistical methods depending on whether your measures are
  - Nominal, or
  - Numeric (Interval, Ratio)
- Ordinal values can sometimes be treated as numeric, sometimes as non-numeric.
- **Assume scale measures are ordinal**
- Text (structured qualitative data) should be subjected to other analyses first.

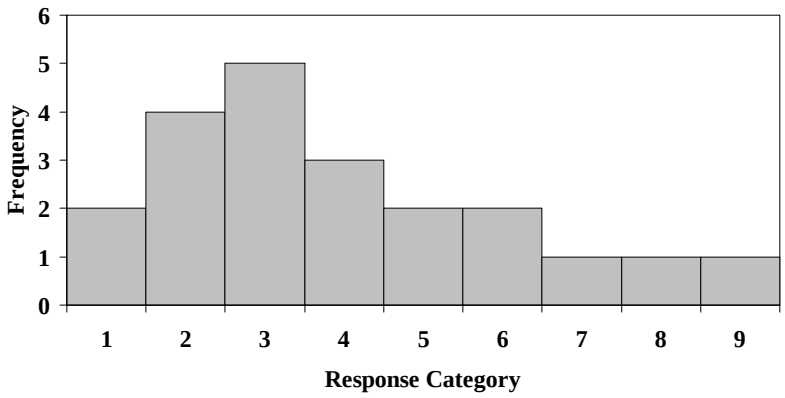
16

Histogram Showing a Normal Distribution



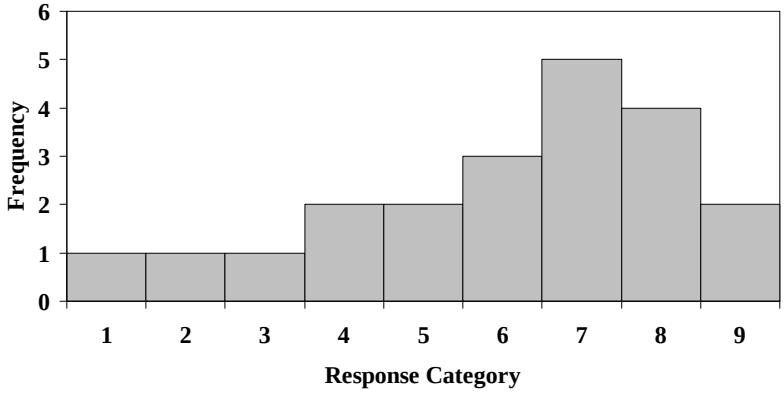
17

Histogram Showing a Positive Skew



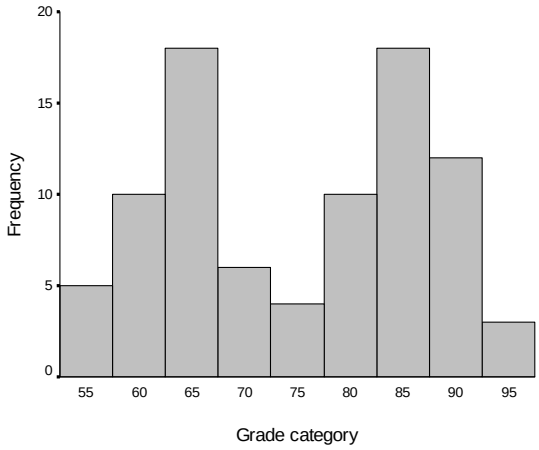
18

Histogram Showing a Negative Skew



19

A Bimodal Distribution



20

Measures of Center

- Mean
- Median
- Mode

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Measures of Center: Characteristics and Applications

- *Mode*
  - Most frequent score in a distribution
  - Simplest measure of center
  - Scores other than the most frequent not considered
  - Limited application and value
- *Median*
  - Central score in an ordered distribution
  - More information taken into account than with the mode
  - Relatively insensitive to outliers
  - Prefer when data is skewed
  - Used primarily when the mean cannot be used

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Decision rule

- If nominal, use mode
- Else if interval or ratio and approximately normal and no outliers, use mean
- Else, use median

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Measures of Spread

- Std Deviation
- Inter-quartile range
- Range

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Measures of Spread: Characteristics

- *Range*
  - Subtract the lowest from the highest score in a distribution of scores
  - Simplest and least informative measure of spread
  - Scores between extremes are not taken into account
  - Very sensitive to extreme scores
- *Interquartile Range*
  - Less sensitive than the range to extreme scores
  - Used when you want a simple, rough estimate of spread

26

Measures of Spread: Characteristics

- *Variance*
  - Average squared deviation of scores from the mean
- *Standard Deviation*
  - Square root of the variance
  - Most widely used measure of spread

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Decision rule

- If nominal, stop (no statistic)
- If interval or ratio and approximately normal and no outliers, use stddev
- Else use inter-quartile range

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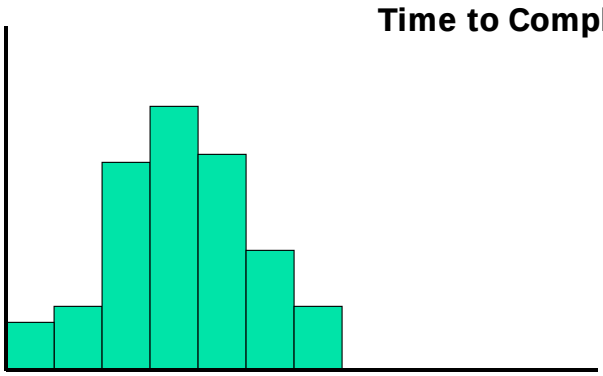
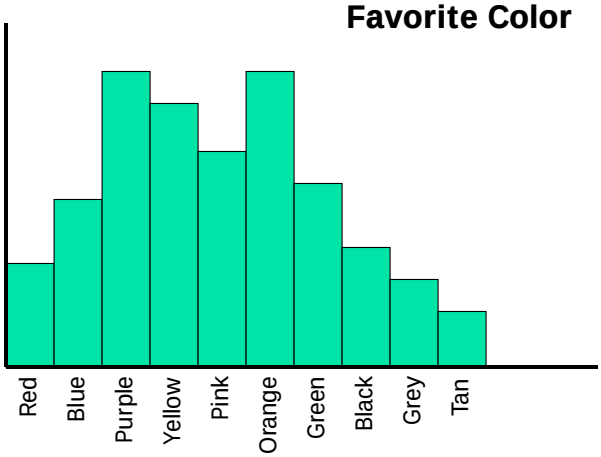
Which measures of center and spread?



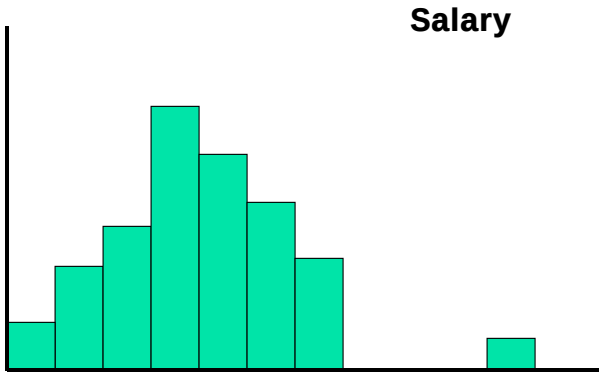
29

Which measures of center and spread?



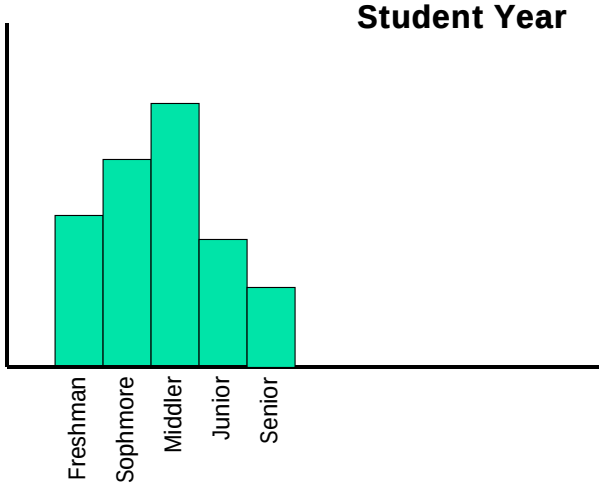
30

Which measures of center and spread?



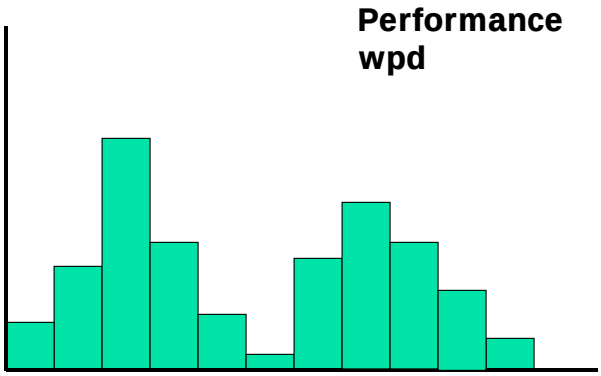
31

Which measures of center and spread?



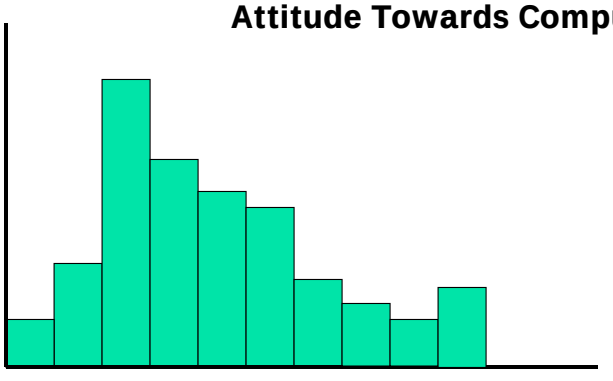
32

Which measures of center and spread?



33

Which measures of center and spread?



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Recent controversy over analysis of scale measures

- Historically, have been treated as interval if they appear normal (i.e., with mean, stdev, and t-test)
- Some statisticians say NEVER. They are ordinal measures – must use median, no meaningful range measures, and non-parametric inferential statistics (e.g., Mann-Whitney)
- See
  - "Stats: We're Doing It Wrong" on ACM.ORG

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Inferential Analyses for Quantitative "Metric" studies

Users performed the set of standardized tasks in a significantly shorter time using interface FOO compared to interface BAR, $t(27)=3.4$, $p<.05$

36

Samples & Populations

- Population = everyone you care about
  - E.g., all of your primary stakeholders, all of your customers, all gamers in the US, etc
- Sample = everyone in your study

- Usually |Sample|<<|Population|
- Inferential statistics let us make claims about the Population based on data from one or more Samples.
- If you could experiment on everyone in the population you would not need inferential statistics.

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Typical case

- You are trying to demonstrate there is a difference between two metrics
  - E.g., performance with interface FOO vs. performance with interface BAR

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Type of Errors in Inferential Statistics

Research Hypothesis: There is a difference
(e.g., FOO better than BAR)

	"The Truth"	
	No diff	**Diff**
Conclude diff	**Type I Error**	**Correct Decision**
Conclude no diff	**Correct Decision**	**Type II Error**

'p' = Probability of Type I Error
The likelihood the difference observed is not real.

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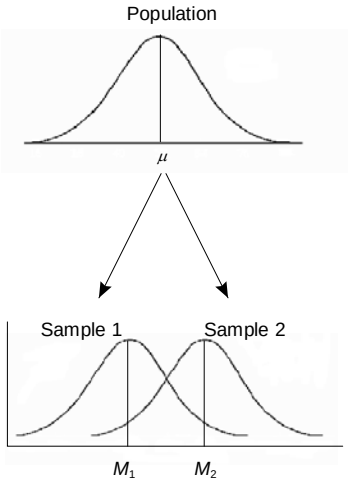
Relationship Between Population and Samples When a Treatment Had No Effect



'p' = Likelihood of this happening.

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Inferential Analyses

- Correlational
- Demonstrative
- Experimental
  - Between-subjects
    - Single factor, two-level
    - Single factor, N-level (for N>2)
    - Two factor, N-level (for N>=2)
  - Within-subjects
    - Single factor, two-level

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t-test for independent means

- Two samples, interval or ratio
- No other information about comparison distribution
- Assumptions:
  - Sample randomly selected from population.
  - The sampling distribution of means is normal
  - Variances of the two populations (whether they are the same or different) are the same.

42

Excel T.TEST, returns 'p'

Syntax

```
T.TEST(array1,array2,tails,type)
```

The T.TEST function syntax has the following arguments:

- **Array1** Required. The first data set.
- **Array2** Required. The second data set.
- **Tails** Required. Specifies the number of distribution tails. If tails = 1, T.TEST uses the one-tailed distribution. If tails = 2, T.TEST uses the two-tailed distribution.
- **Type** Required. The kind of t-Test to perform.

Parameters

If type equals	This test is performed
1	Paired
2	Two-sample equal variance (homoscedastic)
3	Two-sample unequal variance (heteroscedastic)

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t-test

- If assumptions are followed, T.TEST returns 'p'
  - Likelihood of differences observed being due to chance, or error
  - Probability of Type I error
- If p<threshold (conventionally 0.05), we say there is a significant difference
- If p>=threshold, we conclude nothing (experiment was inconclusive)

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Reporting results

- Significant results, scientific articles
  t(df)=*tscore*, p<*sig*
  e.g., t(38)=4.72, p<.05
- Non-significant results
  e.g., t(38)=4.72, n.s.
- Informal usability reports:
  - t-test for independent means indicated that performance with FOO was significantly better than performance with BAR, p<.05
  - t-test for independent means for performance with FOO vs. BAR failed to yield significant results.

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Example t-test

User	UI	Time
1	FOO	5.1
2	FOO	3.5
3	FOO	4.2
4	FOO	1.7
5	FOO	4.9
6	FOO	6.4
7	BAR	2.1
8	BAR	4.1
9	BAR	1.1
10	BAR	2.8
11	BAR	3.2
12	BAR	1.4

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Another note about "Power"

- For small, informal, qualitative, debugging usability tests
  - 5 users gets 80% of "usability defects"
- For quantitative usability experiments
  - Should do a "Power Analysis"
    - See online "Power Analysis Calculator"
    - Parameters: anticipated α, β (or power=1- β), effect size, tails
    - A "pilot study" with 12 users/condition will let you estimate effect size

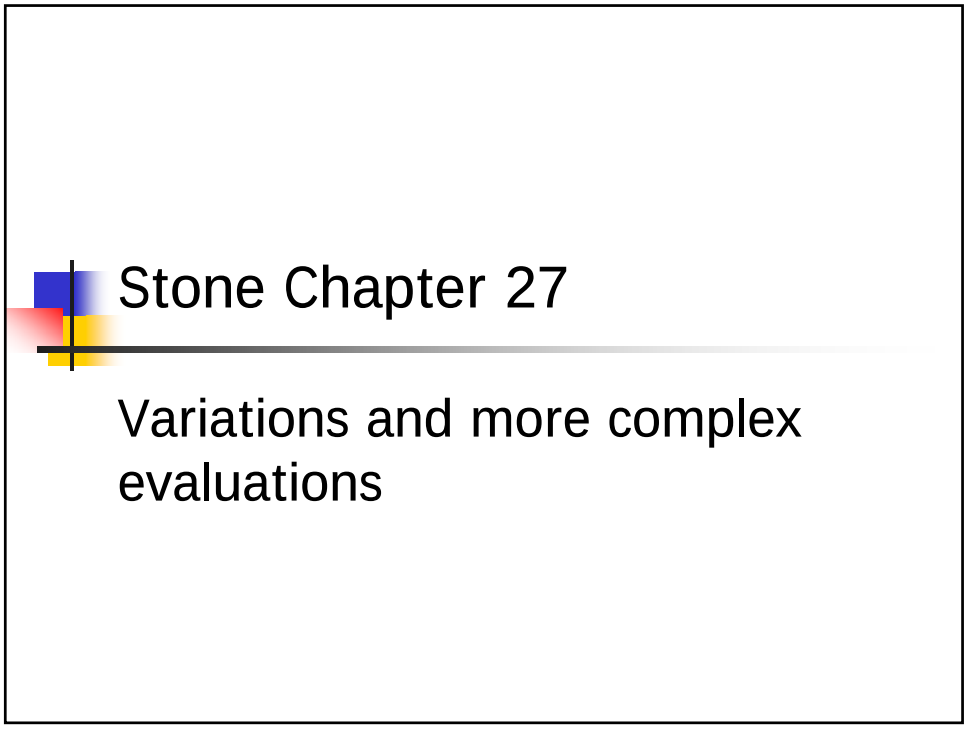
48

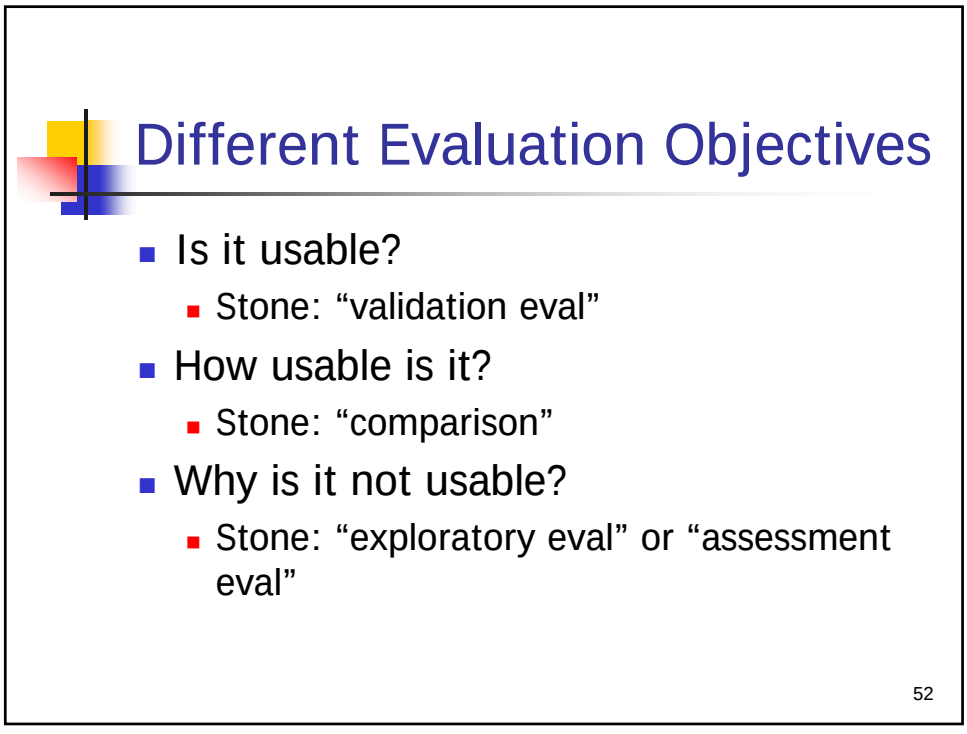
Type of Errors in Inferential Statistics

Research Hypothesis: There is a difference
(e.g., FOO better than BAR)

	"The Truth"	
	No diff	**Diff**
Conclude diff	**Type I Error**	**Correct Decision**
Conclude no diff	**Correct Decision**	**Type II Error**

49


Stone Chapter 27
Variations and more complex evaluations


Different Evaluation Objectives
Is it usable?
Stone: “validation eval”
How usable is it?
Stone: “comparison”
Why is it not usable?
Stone: “exploratory eval” or “assessment eval”
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Other terms

- Formative vs. Summative
- Qualitative vs. Quantitative
- Between subjects vs. Within subjects (comparison studies)

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Types of Experimental Designs
Between-Subjects Design

-
  - Different groups of subjects are randomly assigned to the levels of your independent variable
  - Data are averaged for analysis
  - Use t-test for independent means
  - Simplest: “single factor, two-level, between subjects” designs.

55

Types of Experimental Designs
Within-Subjects Design

- A single group of subjects is exposed to all levels of the independent variable
- Data are averaged for analysis
- aka “repeated measures design”, “crossover design”
- Use t-test for dependent means aka “paired samples t-test”
- Simplest: “single factor, two-level, within subjects” designs.
- Note: If interval or ratio measures and approximately normal, use “t-test for dependent means” aka “paired samples t-test” to analyze.

56

Excel T.TEST, returns ‘p’

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- **Type** Required. The kind of t-Test to perform.

Parameters

If type equals	This test is performed
1	Paired
2	Two-sample equal variance (homoscedastic)
3	Two-sample unequal variance (heteroscedastic)

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Within-Subjects Designs Benefits

- Can ask users to directly compare interfaces.
  - "Which did you like better?"
- More Power! *Why?*
  - Controls for all inter-subject variability
  - Randomized between-subjects design just balances the effects between groups

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Within-Subjects Designs Disadvantages

- More demanding on subjects, especially in complex designs
- Subject attrition is a problem
- *Carryover effects:* Exposure to a previous treatment affects performance in a subsequent treatment

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Carryover Example

- Embodied Conversational Agents to Promote Health Literacy for Older Adults

Brochure Computer

T0 → T1 → T2

Diabetes Knowledge Assessment	Diabetes Knowledge Assessment	Diabetes Knowledge Assessment

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Some Sources of Carryover

- *Learning*
  - Learning a task in the first treatment may affect performance in the second
- *Fatigue*
  - Fatigue from earlier treatments may affect performance in later treatments
- *Habituation*
  - Repeated exposure to a stimulus may lead to unresponsiveness to that stimulus
- *Sensitization*
  - Exposure to a stimulus may make a subject respond more strongly to another
- *Contrast*
  - Subjects may compare treatments, which may affect behavior
- *Adaptation*
  - If a subject undergoes adaptation (e.g., dark adaptation), then earlier results may differ from later ones

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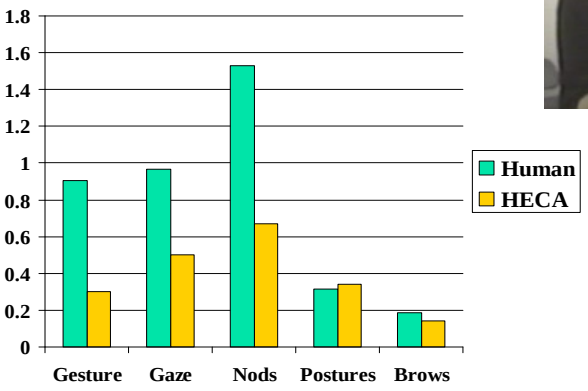
Example Study: Handheld ECAs



Example – Best Design?

- You've developed a new web-based help system for your email client. You want to compare your system to the old printed manual.

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Example – Best Design?

- You've just developed the "Matchmaker" – a handheld device that beeps when you are in the vicinity of a compatible person who is also carrying a Matchmaker.
- You evaluate the number of users who are married after six months of use compared to a non-intervention control group.

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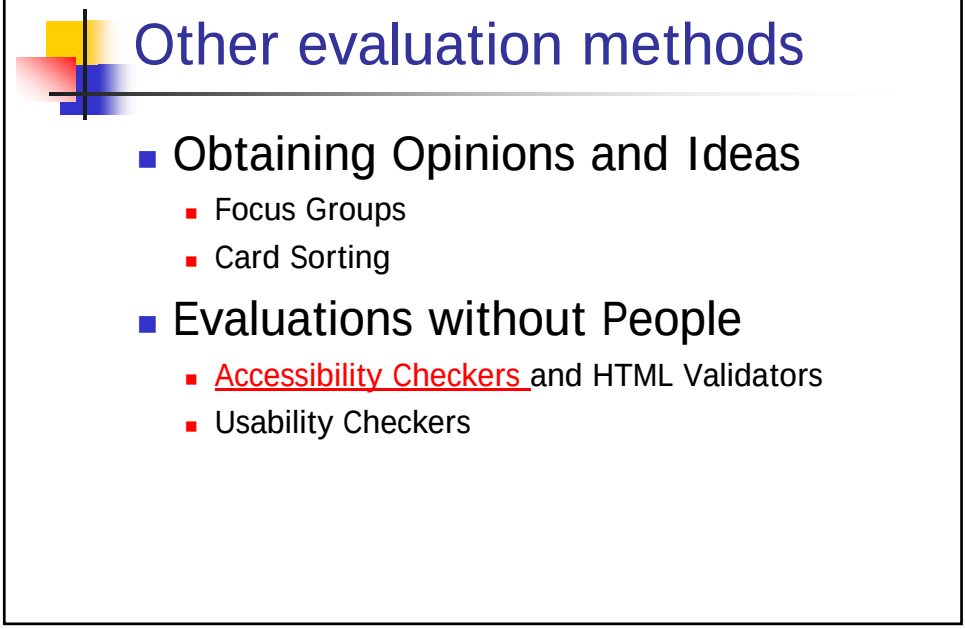
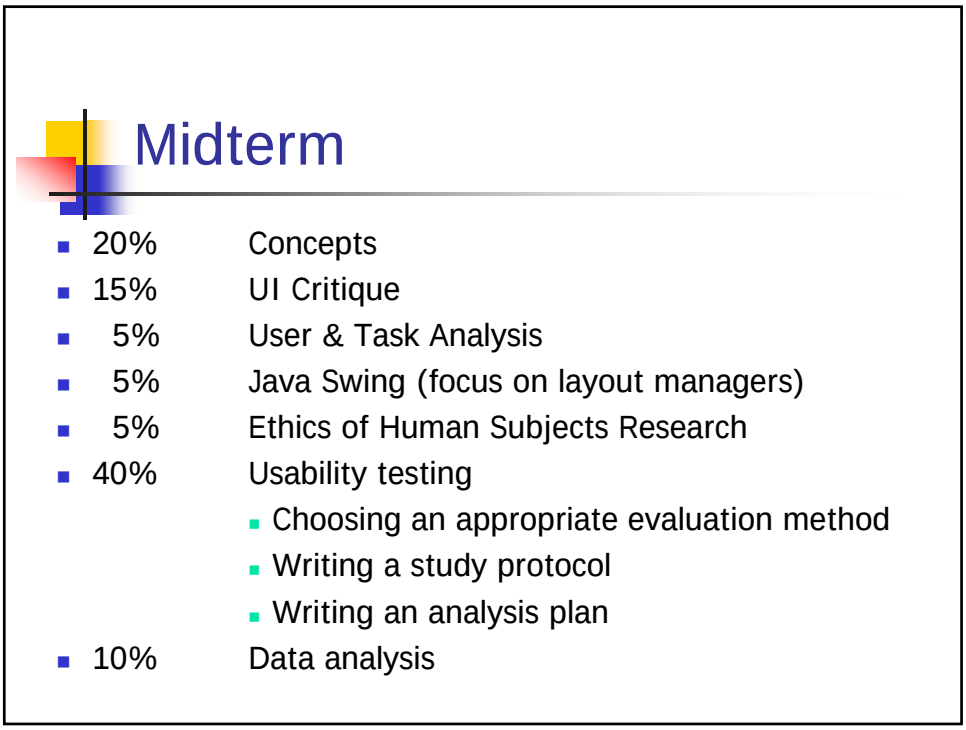
Example – Best Design?

- You've just developed "Reado Speedo" that reads print books using OCR and speaks them to you at twice your normal reading rate. You want to evaluate your product against the old fashioned way on reading rate, comprehension and satisfaction.

65


Other evaluation methods
Obtaining Opinions and Ideas
Focus Groups
Card Sorting
Evaluations without People
Accessibility Checkers and HTML Validators
Usability Checkers


Midterm
20% Concepts
15% UI Critique
5% User & Task Analysis
5% Java Swing (focus on layout managers)
5% Ethics of Human Subjects Research
40% Usability testing
Choosing an appropriate evaluation method
Writing a study protocol
Writing an analysis plan
10% Data analysis

Usability testing (40%)

- You want to evaluate an early prototype of a PC game. Write the usability test plan.
- You want to conduct an ethnographic study of Pixar animators. Write the interview guide.
- You want to compare your new iPhone app against the competitor's, using time to complete a set of standardized tasks for naïve users. Write the analysis plan.
- Given situation X, what usability testing method would you use? Why?

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Concepts - usability

- Define X.
- Give an example of Y.
- Given the situation Z, which of Nielsen's usability concepts does this relate to?
- What is a interface metaphor?

- *Heavily sampled from Nielsen's book.*

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Concepts - other

- What is a ‘p’ value in comparison eval?
- Given a comparison study description, would you use between or within subjects?
- You invite a user to join your design team – what do you call this?

72

UI Critique (15%)

- Critique the following UI, using concepts from Nielsen, plus internal/external consistency, simplicity, etc.

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Data Analysis (10%)

- Describe the type of a measure (nominal, ordinal, etc)
- Given a description of a measure and its frequency distribution, what descriptive stat(s) would you use?

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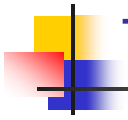

To Do

- Prep for Midterm!
- ~1 hour
- Closed book, closed notes, closed devices

75