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Test 1 Review

Suggestions

- Work problems
(**especially from textbook Chapter Exercises**)
- Review the "What have I learned?" sections at the end of each chapter
- Review problems on Reading Quizzes and Learning Catalytics
- Make 1 page of notes (both sides)
- Work the Sample Test (using your page of notes)
- Don't stay up all night!!

What to bring

- ID
- 1 page of notes (both sides)
- Pencils
- No calculator, no tables, no phone
- Access to R Resources pages will be allowed
- Blank paper will be provided

Test 1 covers chapters 1 - 5

Skip the following:

- Transforming Skewed Data (Section 3.11)
- Regression to the mean and non-linear relationships (in Chapter 4)
- Probability trees and Bayes' rule (in Chapter 5)

Data

- Variables and Cases
- Variables can be categorical or quantitative
Data can be cross sectional or time series
- Distributions describe the values of the variable and how often they occur

Categorical variables

- Graph with bar charts and pie charts
`plot` or `pie`
- Contingency tables
`table`
- Joint, marginal, and conditional distributions
`prop.table` and `margin.table`
`barplot` and `mosaicplot`

Quantitative Data

- Histograms

`hist`

- Look for overall pattern and deviations from that pattern
- **Describe:** center, spread, and shape
 - Symmetric, skewed, modes
 - Outliers

Numerical Descriptions

- **Center:** mean and median
- **Spread or variability:**
 - Range
 - Quartiles and IQR
 - Variance
 - Standard deviation

mean, median, sd
tapply

Numerical Descriptions

- Five number summary

`fivenum`

- Boxplots

`boxplot`

Examining Relationships

- Explanatory and response variables
Independent and dependent variables
- Scatterplots `plot(x,y)`
 - Positive or negative association
 - Outliers
 - Linear patterns
- Correlation `cor`
 - Measures strength and direction of a linear relationship
 - $-1 \leq r \leq +1$
 - $r = \pm 1$ only for perfect linear relationships
 - Correlation does not imply a cause and effect relationship

Regression

- Least squares regression `lm(y ~ x)`
- Regression coefficients and their interpretation
- Standard error of the estimate
- Percentage of variation explained: R^2
- Residual plots `plot(x, residuals(model))`

Randomness and Probability

- **Random** - individual outcomes are uncertain but there is a regular distribution of outcomes in the long term.
- Probability of a random phenomenon
- Empirical (relative frequency) probabilities
Personal or subjective probabilities

Probability Models

- Sample Spaces
- Probability Rules
 - $0 \leq P(A) \leq 1$ for any event A
 - $P(S) = 1$
 - $P(A^C) = 1 - P(A)$
 - Addition rule for disjoint events
General addition rule
 - Multiplication rule for independent events
General multiplication rule
- Discrete vs Continuous models

General Probability Rules

- Additional rule for disjoint events
P(at least one of events A, B, C,... occurs)
 $= P(A) + P(B) + P(C) + \dots$
- General addition rule
 $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
- Multiplication rule for independent events
 $P(A \text{ and } B) = P(A)P(B)$
- General multiplication rule
 $P(A \text{ and } B) = P(A)P(B|A)$
Conditional probability: $P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$