Math 107 Exam 1

Prof. Adam Loy

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Instructions:

- This exam is closed book and closed notes.
- No copying, cheating, collaborations, computers, or cell phones (or similar devices) are allowed.
- You may use a scientific or graphing calculator.
- Show your work.
- Write complete and coherent answers.
- Incorrect answers unaccompanied by supporting reasoning will receive no partial credit.
- Please write as clearly and neatly as possible. If I cannot read your answers, I cannot give you any credit.
- If you want any work done on scratch paper to be graded, mention where to look (make this obvious by using big letters with a box around them) on the page with the question.

After you have completed the exam, please *reaffirm the Lawrence University Honor Code* in the space provided below, then print and sign your name.

Reaffirmation:

Name: _____

Signature: _____

Formulas:

$$\overline{x} = \frac{\sum x_i}{n}$$

$$s_x = \sqrt{\frac{\sum (x_i - \overline{x})^2}{n-1}}$$

$$z = \frac{x - \overline{x}}{s}$$

$$\text{range} = \max - \min$$

$$\text{IQR} = Q_3 - Q_1$$

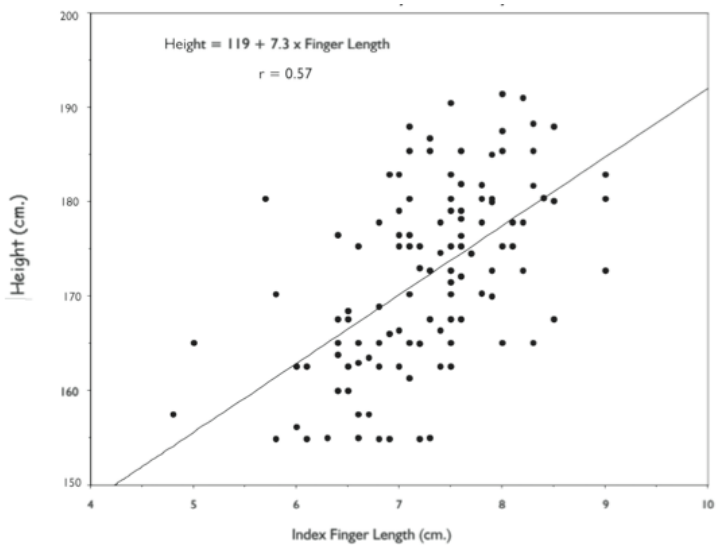
$$Q_1 - 1.5 \times \text{IQR}$$

$$Q_3 + 1.5 \times \text{IQR}$$

$$r = \frac{1}{n-1} \sum \left(\frac{x_i - \overline{x}}{s_x} \right) \left(\frac{y_i - \overline{y}}{s_y} \right)$$

$$e = y - \widehat{y}$$

1. In 2008, the article "Giving the Finger to Dating Services" appeared in *Chance* magazine. The article was motivated by a report that online dating sites were asking members for the length of their index fingers. The authors believed there were two possible explanations: either index finger length was a proxy for height, or that recording index finger length was meant to distract one's attention from other, more meaningful questions. In order to explore their first explanation (hypothesis), the authors gathered heights and index finger lengths (in cm) from 121 students at the University of Pennsylvania. The scatterplot below displays their results, along with the fitted least squares regression line.



   (a) (3 pts) The correlation coefficient was found to be $r = 0.57$. Write a sentence or two explaining what the correlation means for these data. Write about index finger lengths and heights rather than about correlation coefficients.

2. "The Effect of Deliberative Practice in the Acquisition of Expert Performance" is a famous study that was published in *Psychological Review* (Ericsson, Krampe, and Tesch-Romer, 1993), and led to the now-conventional wisdom that 10,000 hours of deliberate practice are necessary to achieve expert performance in skills such as music and athletics. The researchers in this study asked violin students at the Music Academy of West Berlin to keep a diary indicating how they spent their time. The researchers also asked the students' professors to indicate which were the top students with the potential for careers as international soloists, which were good violinists but not among the best, and which were studying to become music teachers. It was found that those in the top two groups devoted much more time per week to individual practice than did those in the group studying to become music teachers.

   (a) (1 pt) Identify the cases.

   (b) (1 pt) Identify the quantitative variable.

   (c) (1 pt) Identify the categorical variable.

   (d) (2 pts) Is this an example of an experimental or observational study? Explain.

3. Is there an association between political party affiliation and beliefs about human evolution? A survey of 1,834 randomly selected U.S. adults by *The Pew Center for People and the Press*, conducted in March–April 2013, recorded each participant's political party affiliation and belief about human evolution. Below is a two-way table displaying the results:

		Political party affiliation			
		Republican	Democrat	Independent	Total
Belief about human evolution	Humans have evolved over time	196	472	438	1106
	Humans have existed in present form	218	190	189	597
	Don't know	41	43	47	131
	Total	455	705	674	1834

(a) (1 pt) Identify the population.

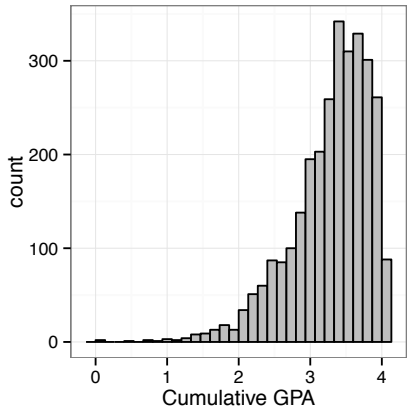
(b) (1 pt) Identify the sample.

(c) (3 pts) Identify the explanatory and response variables. Also, identify whether each is categorical or quantitative.

(d) (3 pts) Do these data provide any indication of an association between political party affiliation and beliefs about human evolution? Justify your answer statistically.

(e) (3 pts) Can you generalize your results from part (b) back to the population? Explain.

4. Below is a histogram of cumulative GPAs from a small midwestern liberal arts college for all students enrolled in Spring 2011.



(a) (1 pt) The values of two possible measures of center are calculated to be 3.41 and 3.28. Which one of these is the mean, and which is the median?

mean = _____ median = _____

(b) (3 pts) Suppose that students on strict probation are those with cumulative GPAs below 0.5 (there are three such students in this dataset). If we remove the students on strict probation from the dataset, how would the following statistics change, if at all? Circle the best answer for each statistic.

Mean:	DECREASE	STAY THE SAME	INCREASE
Median:	DECREASE	STAY THE SAME	INCREASE
Standard deviation:	DECREASE	STAY THE SAME	INCREASE

5. (2 pts each) TRUE (T) or FALSE (F): Identify which of the following statements are valid.

(a) **T** **F** You can tell how steep the least squares regression line is from the correlation.

(b) **T** **F** Larger samples are always better than smaller samples, regardless of how the sample was collected.

(c) **T** **F** Non-random samples are always biased.

6. (2 pts) Which of the following is the primary purpose of randomly assigning subjects to treatments in an experiment?

A. To produce a representative sample so results can be generalized to a larger population.

B. To give each subject a 50/50 chance of obtaining a successful outcome.

C. To produce similar (experimental) groups so any differences in the response variable can be attributed to the explanatory variable.

D. To simulate what would happen in the long run.

E. Both A and C.

7. (2 pts) Which of the following is true of randomized experiments?

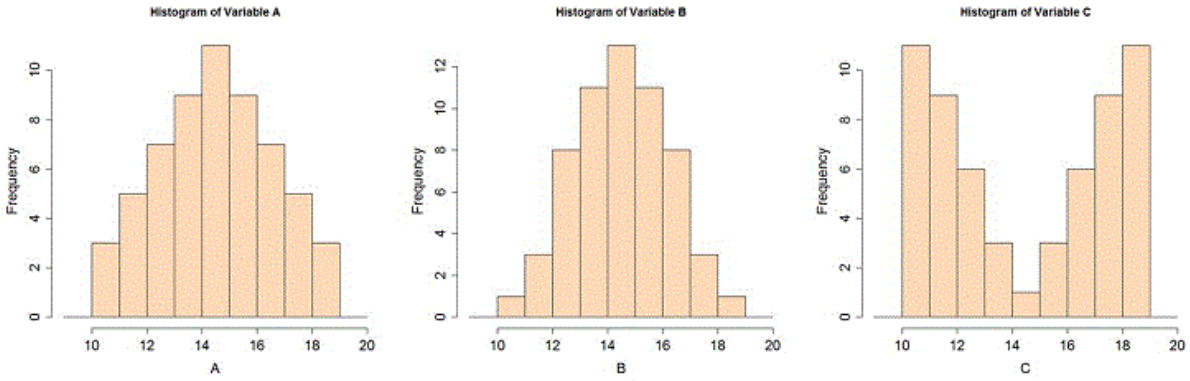
A. The researchers assign the explanatory variable to the subjects.

B. The researchers assign the response variable to the subjects.

C. The researchers assign both the explanatory and response variables to the subjects.

D. The researchers assign neither the explanatory nor response variable to the subjects.

8. (2 pts) Each of the variables displayed in the histograms below has a mean of 14.5, a range of 8, and 59 observations. Rank the three variables according to their standard deviations, from the smallest to the largest.



A. A, B, C B. B, A, C C. C, B, A D. A, C, B

9. (2 pts) Choose the best plot to compare the number of points scored for all games played in a season for all football teams in the Big 10 conference.

A. bar chart

B. segmented bar chart

C. histogram

D. side-by-side boxplots

E. scatterplot

10. (2 pts) Choose the best plot to investigate the number of Facebook friends for the students in Math 107.

A. bar chart

B. segmented bar chart

C. histogram

D. side-by-side boxplots

E. scatterplot

11. (2 pts) Choose the best plot to investigate the favorite type of music (country, rock, classical, etc.) for the students in Math 107.

A. bar chart

B. segmented bar chart

C. histogram

D. side-by-side boxplots

E. scatterplot