Stat 204
Exam 2 4/10/18 **Name:** SOLUTIONS

1. Here are some definitions from chapters 3 through 7. For each definition, fill in the blank(s) with the word(s) being defined.

   (a) The standard error is an estimate of the standard deviation of a statistic that is based on data.

   (b) The relative risk is the ratio of conditional proportions for two groups.

   (c) The goal of randomization is to produce groups that are as similar as possible in all respects except for the treatment being studied.

   (d) For a quantitative variable, 25% of the data lie below the lower quartile, and 25% lie above the upper quartile.

   (e) Segmented bar graphs provide a graphical display of conditional proportions for two categorical variables.

   (f) Half the width of a confidence interval is its margin of error.

   (g) A 2x2 table or 2-way table is a tabular summary of two categorical variables.

   (h) Well-designed studies are designed to determine how the response variable depends on the explanatory variable.

   (i) A boxplot is a visual display of the 5-number summary of a quantitative variable.

   (j) An experiment is a study in which researchers actively assign subjects to treatment groups.

1 pt. each
12

2. Here are the lengths (numbers of words) of 29 randomly selected sentences from John Grisham's book *Theodore Boone: Kid Lawyer*.

3	4	4	7	7	8	11	11	12	12	13	13	14	14	14
15	16	16	17	19	19	20	20	20	22	25	29	30	47	

Determine the five-number summary for these sentence lengths and compute the interquartile range.

6

minimum = 3

lower quartile = 11

median = 14

upper quartile = 20

maximum = 47

IQR = 20 − 11 = 9

3. What must happen in a study to be able to determine cause and effect?

2

Eligible subjects must be randomly assigned to treatment groups.

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4. To investigate whether the average human body temperature is 98.6° F, consider data collected from 65 healthy female volunteers aged 18 to 40 who were participating in vaccine trials. This sample has an average body temperature of 98.39° F and a standard deviation of 0.743° F. Assume that this sample is representative of the population of healthy adult females.

(a) State the relevant null and alternative hypotheses.

$H_0: \mu = 98.6$ (1)

$H_a: \mu \neq 98.6$ (2-sided) (1)

(b) What are the observed statistics? Provide their values using correct notation.

$\bar{x} = 98.39$ (1), $s = 0.743$ (1)

(c) Using this data and an appropriate applet, compute the relevant p-value.

theory-based inference: $p = 0.026 = 2.6\%$ (1)

(d) Using this data and an appropriate applet, compute the relevant 95% confidence interval.

same applet: $98.2059 \leq \mu \leq 98.5741$ (1) (1)

(e) Your confidence interval and p-value should be consistent. What do you conclude from them?

reject the null (1)

5. The silhouette illusion is a moving image of a dancer who appears to be spinning; some people see her spinning clockwise and some see her spinning counterclockwise. In a simple random sample of 50 college students, 30 see the dancer spinning clockwise.

(a) What is the observed statistic? Provide its value using correct notation.

$\hat{p} = \frac{30}{50} = .6 = 60\%$. (1)

(b) Based on this sample, is there evidence that 50% of college students will see the dancer spinning clockwise? State the relevant null and alternative hypotheses, then use this data and an appropriate applet to compute the relevant p-value.

$H_0: \pi = .50$. (1)

$H_a: \pi \neq .50$. (1)

Theory-based inference: $p = 0.1573 = 15.73\%$. (1)

(c) Using this data and an appropriate applet, compute a 95% confidence interval for the proportion of college students who see the dancer spinning clockwise.

95% CI: (1) $.4642 \leq \pi \leq .7358$ (1)

(includes .50 !)

(d) Your confidence interval and p-value should be consistent. Check that, then provide your conclusion regarding the question in part (b).

Cannot reject null. (2)

6. To investigate whether a short delay between seeing a list of words and being asked to recall them hinders memorization, researchers showed subjects a list of words for 1 minute and then gave them 1 minute to recall as many words as they could. Each subject did this once with no delay and once with a 30-second wait between memorizing and recall; the order of the two conditions was randomized. The resulting data are available online in the book's **MemorizationDelay** dataset.

(a) Identify the explanatory and response variables.

① explanatory: delay (categorical)

① response: number of words memorized (quantitative)

(b) State the relevant null and alternative hypotheses.

$H_0: \mu_d = 0$ ①

$H_a: \mu_d \neq 0$ ①

(c) What is the observed statistic? Provide its value using correct notation.

$\bar{x}_d = 1.8$ ② (① ①)

(d) Using this data and an appropriate applet, compute the relevant p-value.

Matched pairs: simulated $p \approx .02 = 2\%$ ①

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(e) Using this data and an appropriate applet, compute the relevant 95% confidence interval.

Matched pairs: 95% CI

(f) Your confidence interval and p-value should be consistent. What do you conclude from them?

reject null ①

7. To compare the effectiveness of surgery versus observation in the treatment of prostate cancer, researchers identified 731 men with localized prostate cancer who volunteered to participate in their study. 364 men were randomly assigned to receive surgery, and the remaining 367 were merely observed. After 10 years, 21 of the surgery recipients died from prostate cancer, and 31 of the observation recipients died from prostate cancer.

(a) What is the primary purpose of random assignment in this type of study?

To create 2 groups that differ only by treatment

(1)

(b) State the relevant null and alternative hypotheses.

(1) $H_0: \pi_1 = \pi_2$

$H_a: \pi_1 \neq \pi_2$

π_1 = % of men being observed who die

π_2 = % who receive surgery that die

(c) What is the observed statistic? Provide its value using correct notation.

(2) observed: $\hat{p}_1 - \hat{p}_2 = -.027$ or $\hat{p}_1 - \hat{p}_2 = +.027$

(depends on ordering)

(d) Using this data and an appropriate applet, compute the relevant p-value.

(1) The proportions applet: $p \approx .2150 = 20.5\%$

(e) Using this data and an appropriate applet, compute the relevant 95% confidence interval.

(2) 95% CI: $-.0640 \leq \pi_1 - \pi_2 \leq .0104$

(contains 0!)

(f) Your confidence interval and p-value should be consistent. What do you conclude from them?

(1) cannot reject null — surgery &

8. Many are worried about rising mercury levels in fish. To analyze this issue, data were collected on random samples of Albacore and Yellowfin tuna; the data are available online in the book's **Tuna** dataset. Use this data to answer the following questions.

(a) Identify the explanatory and response variables, and identify each as categorical or quantitative.

① explanatory: type/species of tuna (categorical)

① response: mercury level (quantitative)

(b) State the relevant null and alternative hypotheses.

① $H_0: \mu_1 = \mu_2$

$H_a: \mu_1 \neq \mu_2$

(c) What is the observed statistic? Provide its value using correct notation.

① $\bar{x}_1 - \bar{x}_2 = .007$ (or $-.007$ if ordered the other way)

(d) Using this data and an appropriate applet, compute the relevant p-value.

Multiple means: $p \approx .9725 = 97.25\%$ (!)

①

(e) Using this data and an appropriate applet, compute the relevant 95% confidence interval.

① ①

95% CI: $-.0484 \leq \mu_1 - \mu_2 \leq .0547$

(contains 0!)

(f) Your confidence interval and p-value should be consistent. What do you conclude from them?

① cannot reject null — on average, these species have same mercury levels