Math 58B – Introduction to Biostatistics

Spring 2017

Jo Hardin

iClicker Questions

to go with **Investigating Statistical Concepts, Applications, and Methods**, Chance & Rossman

Inv 1.1

1. If 16 infants with no genuine preference choose 16 toys, what is the most likely number of “helping” toys that will be chosen?
2. 4
3. 7
4. 8
5. 9
6. 10

Inv 1.1

2. What percent of the time will the simulation flip exactly 8 heads?

1. 0-15%
2. 16-30%
3. 31-49%
4. 50%
5. 51-100%

Inv 1.1

3. What if we flipped a coin 160 times? What percent of the time will the simulation flip exactly 80 heads?

1. 0-15%
2. 16-30%
3. 31-49%
4. 50%
5. 51-100%

Inv 1.1

4. Is our actual result – under the null model –

1. Very surprising
2. Somewhat surprising
3. Not very surprising

Binomial Probability Applet

1. Given the 5 question quiz set-up, how many different ways can you get 1 success?

1. 1
2. 2
3. 3
4. 4
5. 5

Binomial Probability Applet

1. Given the 5 question quiz set-up, how many different ways can you get 2 successes?
2. 5
3. 7
4. 10
5. 15
6. 20

Professor Hardin’s office hours are:

(a) Tue & Thur mornings

(b) Tue & Thur afternoons

(c) Tue & Thur 2:30-5

(d) Tue morning and Thur afternoon

(e) Tue afternoon and Thur morning

Inv 1.5

1. In the kissing study, what is the variable of interest?
2. 124 pairs
3. Which direction they turn to kiss
4. The true probability of kissing to the right
5. Each couple
6. Each individual

Inv 1.5

1. Before Dr. Gunturkun’s study, the scientific community believes that ¾ of people kiss to the right. The **null hypothesis** is:
2. People are equally likely to kiss to the right as kiss to the left
3. People are more likely to kiss to the right
4. At least 74% the people kiss to the right
5. Not 74% of people kiss to the right
6. Exactly 74% of people kiss to the right

Inv 1.5

1. Before Dr. Gunturkun’s study, the scientific community believes that ¾ of people kiss to the right. The **alternative hypothesis** is:
2. People are equally likely to kiss to the right as kiss to the left
3. People are more likely to kiss to the right
4. At least 74% the people kiss to the right
5. Not 74% of people kiss to the right
6. Exactly 74% of people kiss to the right

Inv 1.5

1. For the kissing study, are our actual data (under the null model: π=.74)
2. Very surprising
3. Somewhat surprising
4. Not very surprising

Inv 1.5

1. For the kissing study, are our actual data (under the null model: π=2/3)

(a) Very surprising

(b) Somewhat surprising

(c) Not very surprising

Inv 1.5

7. Hypothesis: the number of hours that grade-school children spend doing homework predicts their future success on standardized tests.

(a) null, one sided

(b) null, two sided

(c) alternative, one sided

(d) alternative, two sided

Inv 1.5

8. Hypothesis: king cheetahs on average run the same speed as standard spotted cheetahs.

(a) null, one sided

(b) null, two sided

(c) alternative, one sided

(d) alternative, two sided

Inv 1.5

9. Hypothesis: the mean length of African elephant tusks has changed over the last 100 years.

(a) null, one sided

(b) null, two sided

(c) alternative, one sided

(d) alternative, two sided

Inv 1.5

10. Hypothesis: the risk of facial clefts is equal for babies born to mothers who take folic acid supplements compared with those from mothers who do not.

(a) null, one sided

(b) null, two sided

(c) alternative, one sided

(d) alternative, two sided

Inv 1.5

11. Hypothesis: caffeine intake during pregnancy affects mean birth weight.

(a) null, one sided

(b) null, two sided

(c) alternative, one sided

(d) alternative, two sided

Inv 1.7

1. How many hits out of 20 at bats would make you believe him?

1. 5
2. 6
3. 7
4. 8
5. 9

Inv 1.7

2. Type I error is

1. We give him a raise when he deserves it.
2. We don’t give him a raise when he deserves it.
3. We give him a raise when he doesn’t deserve it.
4. We don’t give him a raise when he doesn’t deserve it.

(a) At the end of the section (in text)

(b) On the ISCAM website under instructor resources

(c) Typically written by Professor Hardin following up on the Investigations

(d) Assigned periodically at the end of a section.

i. HW (Homework Problems)

ii. PP (Practice Problems)

iii. Lab write-up

iv. Section Summaries

Inv 1.7

3. Type II error is

1. We give him a raise when he deserves it.
2. We don’t give him a raise when he deserves it.
3. We give him a raise when he doesn’t deserve it.
4. We don’t give him a raise when he doesn’t deserve it.

Inv 1.7

4. Power is the probability that:

1. We give him a raise when he deserves it.
2. We don’t give him a raise when he deserves it.
3. We give him a raise when he doesn’t deserve it.
4. We don’t give him a raise when he doesn’t deserve it.

Inv 1.7

5. The player is more worried about

1. A type I error
2. A type II error

6. The coach is more worried about

1. A type I error
2. A type II error

Inv 1.7

1. Increasing your sample size
2. Increases your power
3. Decreases your power
4. Making your significance level more stringent (α smaller)
5. Increases your power
6. Decreases your power
7. A more extreme alternative
8. Increases your power
9. Decreases your power

Inv 1.8

1. What are the observational units for your individual study?

1. Color of the candy
2. Piece of candy
3. Cup of candy
4. Hershey’s company
5. Proportion that are orange

Inv 1.8

2. What are the observational units for the class compilation (dotplot)?

1. Color of the candy
2. Piece of candy
3. Cup of candy
4. Hershey’s company
5. Proportion that are orange

Inv 1.8

3. How does the sampling distribution change as n changes (for a fixed π)?

1. The spread changes
2. The symmetry changes
3. The center changes
4. The shape changes

Inv 1.8

4. How does the sampling distribution change as π changes (for a fixed n)?

1. The spread changes
2. The symmetry changes
3. The center changes
4. The shape changes

Inv 1.8

5. The Central Limit Theorem says that the distribution of $\hat{p}$ will be approximately normal with what center:

(a) $\hat{p}$

(b) π

(c) 0.5

(d) 1

(e) $\sqrt{nπ(1-π) }$

Inv 1.8

6. The Central Limit Theorem applies to a binomial situation as long as (technical conditions):

(a) the trials are independent

(b) n is fixed

(c) the probability of success is constant for each trial

(d) each trial is a success or failure

(e) nπ ≥ 10 AND n(1-π) ≥10

Inv 1.9

1. The standardized score (z-score) counts:

(a) the number of standard deviations from the mean

(b) the number of standard deviations above the mean

(c) the number of standard deviations below the mean

(d) the distance from the mean

(e) the distance from the standard deviation

Inv 1.9

2. If the distribution is correct, we would expect our z-scores to be:

(a) within ± 2 of the mean

(b) within ± 3 of the mean

(c) within ± 2

(d) within ± 3

Inv 1.9

3. What is the difference between a z-score and z0?

(a) z0 assumes H0 and z-score uses pop

(b) z0 uses pop, and z-score assumes H0

(c) z0 assumes H0 and z-score uses any mean

(d) z0 uses any mean and z-score assumes H0

Inv 1.10

1. For the kissing data, let’s pretend n = 100 and we know π= 0.8 ($note: \sqrt{(0.8\*0.2)/100}=\frac{0.4}{10}=0.04).$

What is the maximum plausible distance between $\hat{p}$ and π ?

(a) 0.04

(b) 0.08

(c) 0.12

(d) 0.16

(e) 0.24

Inv 1.10

2. For the kissing data, let’s pretend n = 100 and we know π= 0.8 ($note: \sqrt{(0.8\*0.2)/100}=\frac{0.4}{10}=0.04).$

Which statement is true?

(a) 95% of $\hat{p}$ are between (0.76, 0.84)

(b) 95% of $\hat{p}$ are between (0.72, 0.88)

(c) 95% of $\hat{p}$ are between (0.68, 0.92)

(d) 95% of π are between (0.76, 0.84)

(e) 95% of π are between (0.72, 0.88)

What is the difference between ***iscamnormprob*** and ***iscaminvnorm***?

(a) ***iscamnormprob*** outputs a quantile and ***iscaminvnorm*** outputs probability

(b) ***iscamnormprob*** outputs probability and ***iscaminvnorm*** outputs a quantile

(c) ***iscamnormprob*** and ***iscaminvnorm*** have different model assumptions

(d) ***iscamnormprob*** can be used with small samples, but ***iscaminvnorm*** requires n ≥ 30

(e) ***iscamnormprob*** is for the Binomial distribution and ***iscaminvnorm*** is used for the Normal distribution

Inv 1.10

3. Let’s say we are making confidence intervals (not doing a hypothesis test), what is your best guess for SD($\hat{p}$)?

(a) $\sqrt{\frac{0.5\left(1-0.5\right)}{n}}$

(b) $\sqrt{\frac{π\left(1-π\right)}{n}}$

(c) $\sqrt{\frac{\hat{p}\left(1-\hat{p}\right)}{n}}$

(d) $\sqrt{\frac{X\left(1-X\right)}{n}}$

(e) $\sqrt{\frac{0.95\left(1-0.95\right)}{n}}$

Inv 1.10

4. If you want a 90% confidence interval for π, your z\* multiplier should be

(a) less than 1

(b) less than 2 (but greater than 1)

(c) equal to 2

(d) greater than 2 (but less than 3)

(e) greater than 3

Inv 1.10

5. Let’s say that the null hypothesis (e.g., π=0.47) is TRUE. My level of significance is 0.03. How often will I reject the null hypothesis?

(a) 1 % of the time

(b) 3% of the time

(c) 5 % of the time

(d) 95% of the time

(e) 97% of the time

Inv 1.10

6. Let’s say that the null hypothesis (e.g., π=0.47) is TRUE. My level of significance is 0.03. How often will π be in a 97% confidence interval?

(a) 1 % of the time

(b) 3% of the time

(c) 5 % of the time

(d) 95% of the time

(e) 97% of the time

Inv 1.12

1. Suppose that you take many samples (i.e., thousands) from a population and graph the distribution of the resulting sample statistics. If the distribution of sample **statistics is centered around the value of the population parameter** then is the sampling distribution of the statistic unbiased?

(a) Yes, definitely

(b) Maybe or maybe not

(c) No, definitely not

Inv 1.12

2. Suppose that you take many samples (i.e., thousands) from a population and graph the distribution of the resulting sample statistics. If the distribution of sample statistics **appears to be normally distributed** then is the sampling distribution of the statistic unbiased?

(a) Yes, definitely

(b) Maybe or maybe not

(c) No, definitely not

Inv 1.12

3. Suppose that you take many random samples (i.e., thousands) from a population and graph the distribution of the resulting sample statistics. If **most of the sample statistics are close to the value of the population parameter**, then is the sampling distribution of the statistic unbiased?

(a) Yes, definitely

(b) Maybe or maybe not

(c) No, definitely not

Inv 1.12

4. Suppose that you take many random samples (i.e., thousands) from a population and graph the distribution of the resulting sample statistics**. If the sampling method is biased, then will increasing the sample size reduce the bias?**

(a) Yes, definitely

(b) Maybe or maybe not

(c) No, definitely not

Inv 1.12

5. Suppose your population is 10 times larger. The SE of your statistic:

1. increases
2. stays the same
3. decreases

Inv 1.12

6. Which of the following are advantages of studies with a **larger sample size** (more than one may be right).

(a) Better represent the population (reduce sampling bias)

(b) More accurately estimate the parameter

(c) Decrease sampling variability of the statistics

(d) Make simulation results more accurate for the theoretical results given the sampling method at hand.

(e) other?

Inv 1.12

7. In conducting a simulation analysis, why might we take a **larger number of samples**? (more than one may be right).

(a) Better represent the population (reduce sampling bias)

(b) More accurately estimate the parameter

(c) Decrease sampling variability of the statistic

(d) Make simulation results more accurate for the theoretical results given the sampling method at hand.

(e) other?

Inv 2.4

1. The standard deviation of weights (mean = 167 lbs) is approximately

(a) 1

(b) 5

(c) 10

(d) 35

(e) 100

Inv 2.4

2. The standard deviation of average weights (mean = 167 lbs) in a sample of size 10 is approximately

(a) 1

(b) 5

(c) 10

(d) 35

(e) 100

Inv 2.4

3. The standard deviation of average weights (mean = 167 lbs) in a sample of size 50 is approximately

(a) 1

(b) 5

(c) 10

(d) 35

(e) 100

Inv 2.4

4. The standard deviation of average weights (mean = 167 lbs) in a sample of size 1000 is approximately

(a) 1

(b) 5

(c) 10

(d) 35

(e) 100

Inv 2.4

5. The sampling distribution of the mean will be

(a) centered below the data distribution

(b) centered at the same place as the data distribution

(c) centered above the data distribution

(d) unrelated to the center of the data distribution

Inv 2.4

6. The sampling distribution of the mean will be

(a) less variable than the data distribution

(b) the same variability as the data distribution

(c) more variable than the data distribution

(d) unrelated to the variability of the data distribution

Inv 2.4

7. Why did we switch from talking about total weight to talking about average weight?

(a) So that it is easier to infer from the sample to the population.

(b) Because the Coast Guard certifies vessels according to average weight.

(c) Because the average is less variable than the sum.

(d) Because the average has a normal distribution and the sum doesn’t.

Inv 2.4

8. When the population is skewed right, the sampling distribution for the sample mean will be

(a) always skewed right

(b) skewed right if n is big enough

(c) always normal

(d) normal if n is big enough

Inv 2.4

9. What does the CLT say?

Dance of the p-values:

<https://www.youtube.com/watch?v=ez4DgdurRPg>

Inv 2.5

1. We use s instead of $σ$ because

(a) we know s and we don’t know $σ$

(b) s is a better estimate of the st dev

(c) s is less variable than $σ$

(d) we want our test statistic to vary as much as possible

(e) we like the letter t better than the letter z

Inv 2.5

2. The variability associated with $\overline{X}$ is

(a) less than the variability of X

(b) more than the variability of X

(c) the same as the variability of X

(d) unrelated to the variability of X

(e) some other function of X

Inv 2.5

3. When we use s instead of $σ$ in the CI for µ, but still keep z, the resulting CI has coverage

(a) LESS than the stated confidence level

(b) MORE than the stated confidence level

(c) OF the stated confidence level

Inv 2.6

4. The variability associated with predicting a new value, $X\_{n+1}$,

(a) is less than the variability of $\overline{X}$

(b) is more than the variability of $\overline{X}$

(c) is the same as variability of $\overline{X}$

(d) is less than the variability of X

(e) is more than the variability of X

Inv 2.6

5. Prediction intervals are

(a) smaller than confidence intervals

(b) about the same width as confidence intervals

(c) larger than confidence intervals

(d) unrelated to confidence intervals

Inv 2.6

6. Prediction intervals have

(a) the same technical conditions as CIs

(b) stricter technical conditions than CIs

(c) more lenient technical conditions than CIs

(d) technical conditions which are unrelated to CIs

Inv 2.9

1. What is the primary reason to find a bootstrap CI (instead of a CLT CI)?

(a) larger coverage probabilities

(b) narrower intervals

(c) more resistant to outliers

(d) can be done on statistics with unknown sampling distributions

Inv 2.9

2. You have a sample of size n = 50. You sample with replacement 1000 times to get 1000 bootstrap samples.

 What is the sample size of each bootstrap sample?

 (a) 50

 (b) 1000

Inv 2.9

3. You have a sample of size n = 50. You sample with replacement 1000 times to get 1000 bootstrap samples.

 How many bootstrap statistics will you have?

 (a) 50

 (b)1000

Inv 2.9 4. 

95% CI for the true median mercury:

(a) (0.025 mg/kg, 0.975 mg/kg)

(b) (0.469 mg/kg, 0.053 mg/kg)

(c) (0.053 mg/kg, 0.469 mg/kg)

(d) (0.34 mg/kg, 0.56 mg/kg)

Inv 3.1

1. Why did we use 0.173 for both groups in the simulation?

(a) the sample proportions in the two groups were the same (both 0.173)

(b) we didn’t like the proportion values in the two groups

(c) we were running a hypothesis test

(d) we were creating a confidence interval

Inv 3.1

2.When doing a hypothesis test for

 H0: π1 - π2 = 0

AND assuming H0 is true, our best guess for $π\_{1}$ is:

(a) $\hat{p\_{1}}= \frac{X\_{1}}{n\_{1}} $

$(b)$ $\hat{p\_{2}}= \frac{X\_{2}}{n\_{2}} $

(c) $\hat{p}= \frac{X\_{1}+ X\_{2}}{n\_{1}+ n\_{2}} $

(d) 0

Inv 3.2

1. Person A flips a coin 2 times, and person B flips a coin 2 times. What is the probability that the proportion of heads for A is greater than the proportion of heads for person B?

Use the BINOMIAL DISTRIBUTION!!

(a) 0.1

(b) 0.375

(c) 0.5

(d) 0.625

(e) .9

Inv 3.2

2. Based on the night light / myopia example, we can conclude:

(a) the p-value is small, so sleeping in a lit room makes it more likely that you are near-sighted.

(b) the p-value is small, so sleeping in a dark room makes it more likely that you are near-sighted.

(c) the p-value is small, so a higher proportion of children who sleep in light rooms are near-sighted than who sleep in dark rooms.

(d) because plit room = 188/307 = 0.612 and pdark = 18/172 = 0.105, we know that sleeping with the light on is bad for you.

Inv 3.2

3. A possible confounding variable for the night light study is:

(a) low birth weight

(b) race (70% of the children were Caucasian)

(c) region of the country where the clinic was located

Inv 3.3

1. A possible confounding variable for the handwriting study is:

(a) grade of the student (age)

(b) region of country where the SAT was taken

(c) academic ability of the student

(d) gender of the student

(e) number of siblings of the student.

A Sampling distribution is

(a) The true distribution of the data

(b) The estimated distribution of the data

(c) The distribution of the population

(d) The distribution of the statistic in repeated samples

(e) The distribution of the statistic from your one sample of data

Inv 3.4

1. The main reason we randomly assign the explanatory variable is:

(a) To get the smallest p-value possible

(b) To balance the expected causal mechanism across the two groups

(c) To balance every possible variable except the causal mechanism across the two groups

(d) So that our sample is representative of the population

(e) So that the sampling process is unbiased

Inv 3.4

2. The main reason we take random samples from the population is:

(a) To get the smallest p-value possible

(b) To balance the expected causal mechanism across the two groups

(c) To balance every possible variable except the expected causal mechanism across the two groups

(d) So that our sample is representative of the population

(e) So that the sampling process is unbiased

Inv 3.4

3. The “random” part in clinical trials typically comes from:

(a) random samples

(b) random allocation of treatment

Inv 3.4

4. The “random” part in polling typically comes from:

(a) random samples

(b) random allocation of treatment

Inv 3.4

5. Are there effects of second-hand smoke on the health of children?

(a) definitely obs study

(b) definitely experiment

(c) unhappily obs study

(d) unhappily experiment

Inv 3.4

6. Do people tend to spend more money in stores located next to food outlets with pleasing smells?

(a) definitely obs study

(b) definitely experiment

(c) unhappily obs study

(d) unhappily experiment

Inv 3.4

7. Does cell phone use increase the rate of automobile accidents?

(a) definitely obs study

(b) definitely experiment

(c) unhappily obs study

(d) unhappily experiment

Inv 3.4

8. Do people consume different amounts of ice cream depending on the size of bowl used?

(a) definitely obs study

(b) definitely experiment

(c) unhappily obs study

(d) unhappily experiment

Inv 3.4

9. Which is more effective: diet A or diet B?

(a) definitely obs study

(b) definitely experiment

(c) unhappily obs study

(d) unhappily experiment

Inv 3.6 (Dolphins)

1. What does “by random chance” (in calculating the p-value) mean here?

(a) random allocation

(b) random sample

Inv 3.6

2. “Our data or more extreme” is:

(a) fewer than 10

(b) 10 or fewer

(c) 10 or more

(d) more than 10

Inv 3.6

3. What is the mean value of the null sampling distribution for the number of dolphin therapy who showed substantial improvement?

(a) 0

(b) 6.5

(c) 10

(d) 15

p-values

RA Fisher (1929)

“… An observation is judged significant, if it would rarely have been produced, in the absence of a real cause of the kind we are seeking. It is a common practice to judge a result significant, if it is of such a magnitude that it would have been produced by chance not more frequently than once in twenty trials. This is an arbitrary, but convenient, level of significance for the practical investigator, but it does not mean that he allows himself to be deceived once in every twenty experiments. The test of significance only tells him what to ignore, namely all experiments in which significant results are not obtained. He should only claim that a phenomenon is experimentally demonstrable when he knows how to design an experiment so that it will rarely fail to give a significant result. Consequently, isolated significant results which he does not know how to reproduce are left in suspense pending further investigation.”

George Cobb (2014)

Q: Why do so many colleges and grad schools teach p = .05?

A: Because that's still what the scientific community and journal editors use.

Q: Why do so many people still use p = 0.05?

A: Because that's what they were taught in college or grad school.

Basic and Applied Social Psychology (2015)

With the banning of the NHSTP (null hypothesis significance testing procedures) from BASP, what are the implications for authors?

**Question 3.** *Are any inferential statistical procedures required?*

**Answer to Question 3.** No, because the state of the art remains uncertain. However, BASP will require strong descriptive statistics, including effect sizes. We also encourage the presentation of frequency or distributional data when this is feasible. Finally, we encourage the use of larger sample sizes than is typical in much psychology research, because as the sample size increases, descriptive statistics become increasingly stable and sampling error is less of a problem. However, we will stop short of requiring particular sample sizes, because it is possible to imagine circumstances where more typical sample sizes might be justifiable.

American Statistical Association’s Statement on p-values (2016)

<http://amstat.tandfonline.com/doi/pdf/10.1080/00031305.2016.1154108>

**Statisticians issue warning over misuse of *P* values (Nature, March 7, 2016)**

http://www.nature.com/news/statisticians-issue-warning-over-misuse-of-p-values-1.19503

1. P-values can indicate how incompatible the data are with a specified statistical model.

(a) TRUE

(b) FALSE

2. P-values do not measure the probability that the studied hypothesis is true, or the probability that the data were produced by random chance alone.

(a) TRUE

(b) FALSE

3. Scientific conclusions and business or policy decisions should not be based only on whether a p- value passes a specific threshold.

(a) TRUE

(b) FALSE

4. Proper inference requires full reporting and transparency.

(a) TRUE

(b) FALSE

5. A p-value, or statistical significance, does not measure the size of an effect or the importance of a result.

(a) TRUE

(b) FALSE

6. By itself, a p-value does not provide a good measure of evidence regarding a model or hypothesis.

(a) TRUE

(b) FALSE

Dance of the p-values:

<https://www.youtube.com/watch?v=5OL1RqHrZQ8>

Your own p-value:

<https://www.openintro.org/stat/why05.php?stat_book=os>

Inv 3.9

1. Relative Risk is

(a) the difference of two proportions

(b) the ratio of two proportions

(c) the log of the ratio of two proportions

(d) the log of the difference of two proportions

Inv 3.9

2. One reason we should be careful interpreting relative risks is if:

(a) we don’t know the difference in proportions

(b) we don’t know the SE of the relative risk

(c) we might be dividing by zero

(d) we don’t know the baseline risk

Inv 3.9

3. In finding a CI for π1/π2, why is it okay to exponentiate the end points of the interval for ln(π1/π2)?

(a) Because if ln(π1/π2) is in the original interval, π1/π2 will be in the exponentiated interval.

(b) Because taking the natural log of the RR makes the distribution approximately normal.

(c) Because the natural log compresses values that are bigger than 1 and spreads values that are smaller than 1.

(d) Because we can get exact p-values using Fisher’s Exact Test.

Inv 3.9

4. In order to find a CI for the true RR, our steps are:

1. ln(RR)

2. add ± z\* sqrt( 1/A - 1/(A+B) + 1/C - 1/(C+D) )

3. find exp of the endpoints

(a) because the sampling distribution of RR is normal

(b) because RR is typically greater than 1

(c) because the ln transformation makes the sampling distribution almost normal

(d) because RR is invariant to the choice of explanatory or response variable

Inv 3.10

1. When we randomly select individuals based on the explanatory variable, we cannot accurately measure

(a) the proportion of people in the population in each explanatory category

(b) the proportion of people in the population in each response group

(c) anything about the population

(d) confounding variables

 Inv 3.10

2. The odds ratio is invariant to which variable is explanatory and which is response means:

(a) we always put the bigger odds in the numerator

(b) we must collect data so that we can estimate the response in the population

(c) which variable is called the explanatory changes the value of the OR

(d) which variable is called the explanatory does not change the value of the OR

Inv 3.10

3. In order to find a CI for the true OR, our steps are:

1. ln(OR)

2. add ± z\* sqrt( 1/A + 1/B + 1/C + 1/D )

3. find exp of the endpoints

(a) because the sampling distribution of OR is normal

(b) because OR is typically greater than 1

(c) because the ln transformation makes the sampling distribution almost normal

(d) because OR is invariant to the choice of explanatory or response variable

Inv 3.9

4. In order to find a CI for the true RR, our steps are:

1. ln(RR)

2. add ± z\* sqrt( 1/A - 1/(A+B) + 1/C - 1/(C+D) )

3. find exp of the endpoints

(a) because the sampling distribution of RR is normal

(b) because RR is typically greater than 1

(c) because the ln transformation makes the sampling distribution almost normal

(d) because RR is invariant to the choice of explanatory or response variable

Inv 4.1

1. Which samples of size 3 are “more extreme” than what we observed?

(a) 53, 56, 64

(b) 55, 55, 56

(c) 55, 55, 64

(d) 55, 56, 64

Inv 4.1

2. What is the expected center of the null sampling distribution of the differences in means:

(a) 0 years

(b) 16.86 years

(c) -16.86 years

(d) 46.2 years (average age of the 10)

(e) 47 years

Inv 4.1

3. Assuming we believe the result to be significant, do we think that there was age discrimination?

(a) yes, the p-value was small

(b) yes, the p-value was big

(c) no, the p-value was big

(d) yes, there could be confounding variables

(e) no, there could be confounding variables

Inv 4.2

1. which is more variable?
2. The population(s)
3. The sample(s)
4. Which is more variable?
5. Distribution of the population(s)
6. Distribution of the sample mean(s)

Inv 4.2

1. Which is more variable?
2. Distribution of the sample mean(s)
3. Distribution of the differences in sample means

Inv 4.2 & 4.3

3. SE($\overbar{X}\_{1}- \overbar{X}\_{2})$is

 (a) $\sqrt{\frac{σ\_{1}^{2}}{n\_{1}} + \frac{σ\_{2}^{2}}{n\_{2}}}$

(b) $\sqrt{\frac{σ\_{1}^{2}}{n\_{1}} - \frac{σ\_{2}^{2}}{n\_{2}}}$

(c) $\sqrt{\frac{s\_{1}^{2}}{n\_{1}} + \frac{s\_{2}^{2}}{n\_{2}}}$

(d) $\sqrt{\frac{s\_{1}^{2}}{n\_{1}}- \frac{s\_{2}^{2}}{n\_{2}}}$

(e)$ \sqrt{s\_{1}^{2}- s\_{2}^{2}}$

Inv 4.2 & 4.3

4. If we use the SE and the z-curve (instead of t) to find the p-value (assuming x-bar values are reasonably different)

(a) the p-value will be too small

(b) the p-value will be too big

(c) the p-value will be just right

(d) the p-value is unrelated to the curve

(e) we should use the SD instead

Inv 4.3

5. Are the two samples (lefties and righties) independent?

(a) yes

(b) no

(c) we can’t tell

Inv 4.3

6.

(i) Which p-value is smaller?

(a) scenario 2

(b) scenario 3

(ii) Which p-value is smaller?

(a) scenario 3

(b) scenario 4

Inv 4.4

1. We typically compare means instead of medians because

(a) we don’t know the SE of the difference of medians

(b) means are inherently more interesting than medians

(c) the randomization applet (or R code) doesn’t work with medians

(d) the Central Limit Theorem doesn’t apply for medians.

Inv 4.4

2. The randomization test represents which repeated activity (assuming, of course, that the null hypothesis is true):

(a) random sampling

(b) random allocation

Inv 4.5

3. We use the t-distribution because:

(a) the CLT makes the test statistic normal

(b) the CLT makes the numerator of the test statistic normal

(c) the variability in the denominator makes the test statistic more variable

(d) the variability in the denominator makes the test statistics less variable

Inv 4.5

4. How does each affect the power?

(i) increasing the sample sizes of both groups

(a) increases the power

(b) doesn’t change the power

(c) decreases the power

(ii) increasing the variability within the groups

(a) increases the power

(b) doesn’t change the power

(c) decreases the power

(iii) increasing the difference in actual (population) group means

(a) increases the power

(b) doesn’t change the power

(c) decreases the power

Inv 5.1

1. null hypothesis: H0: π1 = π2 = π3 = π4 = π5 = π6 = π7

What is the alternative hypothesis?

(a) Ha: π1 = π2 = π3 = π4 = π5 = π6 = π7 = 0.5

(b) Ha: π1 ≠ π2 ≠ π3 ≠ π4 ≠ π5 ≠ π6 ≠ π7 (all probabilities are unequal)

(c) Ha: π1 = π2 = π3 = π4 = π5 = π6 ≠ π7 (one probability is different)

(d) Ha: at least one probability is different

Inv 5.1

2. If the null hypothesis is true, the observed counts should equal the expected counts.

(a) True

(b) False

Inv 5.1

3. To reject the null hypothesis we want to see

(a) a small X2 value

(b) a big X2 value

Inv 5.1

4. A chi-square test is

(a) one-sided alt hypothesis, and we only consider the upper end of the sampling distribution

(b) one-sided alt hypothesis, and we consider both ends of the sampling distribution

(c) two-sided alt hypothesis, and we only consider the upper end of the sampling distribution

(d) two-sided alt hypothesis, and we consider both ends of the sampling distribution

Inv 5.3

1. For the newspaper setting, which variable is the explanatory variable?

(a) type of newspaper

(b) believability score

(c) year

(d) individual person

Inv 5.3

2. If we sample randomly from a population, the conclusions we can make are about:

(a) causation

(b) population characteristics

Inv 5.3

3. homogeneity of proportions means

(a) the proportion of obs units who have some response (e.g., believe = 4) is the same across all explanatory variables.

(b) each response is equally likely for any explanatory variable

(c) the variables are independent

(d) a & c

(e) b & c

Inv 5.3

4. Independence between two categorical variables means:

(a) one does not cause the other

(b) knowledge of one variable does not tell us anything about the probability associated with the other variable

(c) as one variable increases, the other variable increases

(d) as one variable increases, the other variable decreases

Inv 5.4

1. In order to tell whether the differences in sample means are significant, we need to ALSO know:

(a) how variable the observations are

(b) the distribution of the observations

(c) the sample sizes

(d) all of the above

(e) some of the above

Inv 5.4

2. In the ANOVA setting, the null hypothesis is always:

H0: µ1 = µ2 = µ3 = … = µk

What is the alternative hypothesis?

(a) Ha: at least one µi is different

(b) Ha: µ1 ≠ µ2 ≠ µ3 ≠ … ≠ µk

(c) Ha: µ1 = µ2 = µ3 = … = µk = µ (for some µ value)

(d) Ha: at least one µi is substantially different

Inv 5.4

3. We reject the null hypothesis if:

(a) the between group variability is much bigger than the within group variability

(b) the within group variability is much bigger than the between group variability

(c) the within group variability and the between group variability are both quite large

(d) the within group variability and the between group variability are both quite small

Inv 5.4

4. What types of values will the F-ratio have when the null hypothesis is false, that is, when the population means are not all equal?

(a) large, positive

(b) large, negative

(c) small, positive

(d) small, negative

Inv 5.7

1. Suppose that we record the midterm exam score and the final exam score for every student in a class. What would the value of the correlation coefficient be if every student in the class scored **ten points higher on the final than on the midterm:**

(a) r = -1

(b) -1 < r < 0

(c) r = 0

(d) 0 < r < 1

(e) r = 1

Inv 5.7

2. Suppose that we record the midterm exam score and the final exam score for every student in a class. What would the value of the correlation coefficient be if every student in the class scored **five points lower on the final than on the midterm:**

(a) r = -1

(b) -1 < r < 0

(c) r = 0

(d) 0 < r < 1

(e) r = 1

Inv 5.7

3. Suppose that we record the midterm exam score and the final exam score for every student in a class. What would the value of the correlation coefficient be if every student in the class scored **twice as many points on the final than on the midterm:**

(a) r = -1

(b) -1 < r < 0

(c) r = 0

(d) 0 < r < 1

(e) r = 1

Inv 5.7

4. Suppose you guessed every value correctly (guess the correlation applet), what would be the value of the correlation coefficient between your guesses and the actual correlations?

(a) r = -1

(b) -1 < r < 0

(c) r = 0

(d) 0 < r < 1

(e) r = 1

Inv 5.7

5. Suppose each of your guesses was too high by 0.2 from the actual value of the correlation coefficient, what would be the value of the correlation coefficient between your guesses and the actual correlations?

(a) r = -1

(b) -1 < r < 0

(c) r = 0

(d) 0 < r < 1

(e) r = 1

Inv 5.7

6. A correlation coefficient equal to 1 indicates that you are a good guesser.

(a) TRUE

(b) FALSE

5.7

7. Perfect Correlation … if not for a single outlier

1 obs in top left, 25 each in bottom right.

r (correlation) is:



1. -1 < r < -.9
2. -.9 < r < -.5
3. -.5 < r < .5
4. .5 < r < .9
5. .9 < r < 1

Inv 5.8

1. The sum of the residuals from the mean: ∑ (Yi - $\overbar{Y}$)

(a) is positive

(b) is negative

(c) is zero

(d) is different for every dataset

Inv 5.8

2. A good measure of how well the prediction fits the data is:

(a) ∑ (Yi - $\overbar{Y}$)

(b) ∑ (Yi - $\overbar{Y}$)2

(c) ∑ |(Yi - $\overbar{Y}$)|

(d) median (Yi - $\overbar{Y}$)

(e) median |(Yi - $\overbar{Y}$)|

Inv 5.8

3. What math is used to find the value of m that minimizes:

∑ (Yi - m)2

(a) combinatorics

(b) derivative

(c) integral

(d) linear algebra

Inv 5.8

4. Which will influence the model more?

(a) an outlier in the x-direction

(b) an outlier in the y-direction

Inv 5.10

1. When writing the regression equation, why do we put a hat ( ^) on the response variable?

(a) because the prediction is an estimate

(b) because the prediction is an average

(c) because the prediction may be due to extrapolation

(d) (a) & (b)

(e) all of the above

Inv 5.10

2. If there is no relationship in the population (true correlation = 0), then r=0

(a) TRUE

(b) FALSE

Inv 5.10

3. If there is no relationship in the population (true slope = 0), then b1=0

(a) TRUE

(b) FALSE

Inv 5.10

4. The regression technical assumptions include:

(a) The Y variable is normally distributed

(b) The X variable is normally distributed

(c) The residuals are normally distributed

(d) The slope coefficient is normally distributed

(e) The intercept coefficient is normally distributed

Inv 5.10

5. A smaller variability around the regression line (σ):

(a) increases the variability of b1.

(b) decreases the variability of b1.

(c) doesn’t necessarily change the variability of b1.

Inv 5.10

6. A smaller variability in the explanatory variable (SD(X) = sx):

(a) increases the variability of b1.

(b) decreases the variability of b1.

(c) doesn’t necessarily change the variability of b1.

Inv 5.10

7. A smaller sample size (n):

(a) increases the variability of b1.

(b) decreases the variability of b1.

(c) doesn’t necessarily change the variability of b1.

Inv 5.12

1. The technical conditions do not include:

(a) normal residuals

(b) normal response

(c) normal explanatory variable

(d) constant variance

(e) independence

Inv 5.13

2. Prediction intervals and confidence intervals have the same technical conditions:

(a) TRUE

(b) FALSE

(c) sort of

Inv 5.13

5. We transform our variables…

(a) … to find the highest r^2 value.

(b) … when the X variable is not normally distributed.

(c) … to make the model easier to interpret.

(d) … so that the technical conditions are met.