Study Guide for Exam #1
Spring 2020

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STAT 210: Exam #1
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In 1967, the U.S. Supreme Court heard the case of *Whitus vs. Georgia.* The petitioners claimed that blacks were being discriminated against on grand and petit juries in Georgia. In one situation under consideration, out of 90 persons selected for the petit jury 7 were black. An independent source later determined that 27.1% of the eligible petit jurors were black.

Research Question: Is there statistical evidence to suggest that the State of Georgia discriminated against blacks in the selection of the petit jury in the situation under review?

1. Identify the smallest possible value, largest possible value, location of the reference distribution, and the outcome from the study for this situation on the number line below.

- Smallest possible value
- Largest possible value
- Location of pyramid
- Outcome from study

Study Outcome

Reference Distribution 27.1%

Label: # Blacks Selected for Petit Jury
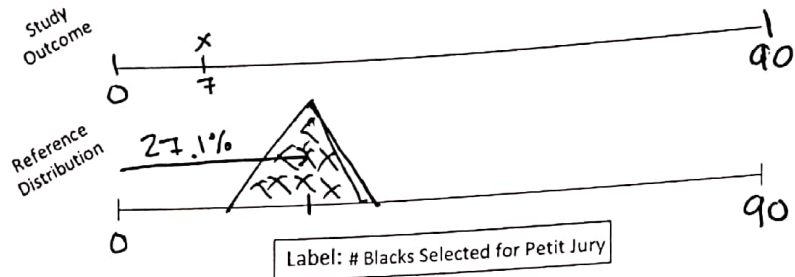
2. Next, provide details for the setup of a simulation in StatKey that would allow us to investigate the research question stated above.

Identify the following

- Sample size
- Null Hypothesis value

Edit data

Please select values for count and sample size.

count: NA

sample size: 90

Null hypothesis: $p =$ .271

Next, consider the procedure / function used in JMP to get the binomial probabilities.

Binomial Probability$\left[\; p\;,\; n\;,\; k\;\right]$

.271   90

# Blacks	Binomial Probability
0	4.420563e-13
1	1.478978e-11
2	2.446604e-10
3	2.667883e-9
4	2.1570877e-8
5	1.3792342e-7
6	7.2635252e-7
7	3.2401898e-6
8	0.00001249

3. The top portion of the JMP output is shown above. The #Blacks column starts at 0. What is the last value in this column?

Last value in # Blacks column: ___90___

4. Consider the Binomial Probability() function used in JMP. Identify each of the following values for this function.

p = _.271_   n = _90_   k = _#Blacks_

5. The probability values in JMP will continue to increase as the # Blacks increases, but eventually the probability values will start to decrease. What is the value for # Blacks that will have the highest probability? Briefly discuss.

Should be the expected value

.271(90) = $\boxed{\approx 24}$

6. Consider the Binomial Probability value of 3.24e-6 (i.e. 0.00000324) for # Blacks = 7.

# Blacks	Binomial Probability
6	7.2635252e-7
7	3.2401898e-6
8	0.00001249...
9	0.00004232

What is the correct interpretation of this value?
a. This is the probability of observing 7 blacks out of 90, under the assumption that discrimination was taking place.
b. This is the probability of observing 7 blacks out of 90, under the assumption of no discrimination.
c. This is the probability of observing 7 blacks out of 90, under no assumptions as this would bias our statistical analysis.
d. None of the above.

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7. Which of the following best describes what you would do next to find the p-value?

a. Add up the binomial probability values for 7 or more blacks selected
b. Add up the binomial probability values for 7 or less blacks selected
c. Get the binomial probability for 7 blacks selected
d. Add up the binomial probability values for 83 or more blacks selected

A recent study was conducted to explore how people's dating preferences are affected by a prospective date's tendency to reveal (vs. hide) personal information. Each subject in the study was involved in an online dating service. They viewed two questionnaires that had supposedly been completed by two prospective dates: the *revealer* vs. the *hider*.

Revealer's Questionnaire

	Never	Once	Sometimes	Frequently	Choose not to answer
Have you cheated on a tax return?				X	
Have you made a false insurance claim?				X	
Have you stolen anything worth more than $100?				X	
Have you fantasized about hurting someone?				X	
Have you hid an STD from a dating partner?				X	

Hider's Questionnaire

	Never	Once	Sometimes	Frequently	Choose not to answer
Have you cheated on a tax return?				X	
Have you made a false insurance claim?					X
Have you stolen anything worth more than $100?				X	
Have you fantasized about hurting someone?					X
Have you hid an STD from a dating partner?					

Note, for this example, the revealer answered all questions, while the hider selected "Choose not to answer" for two of the questions. The researchers hypothesized that dating prospects would be more likely to choose the revealer than the hider – even though the revealer admitted to more negative behavior (the thought being that potential dates are more afraid of those who hide information). Of the 44 subjects tested, 28 preferred to date the revealer.

8. Write the hypothesis in words, define the parameter, and rewrite the hypothesis using the parameter.

Revealer vs. Hider	
Research Question	Are potential dates more likely to choose the revealer than the hider?
Testable Hypothesis (in words) $(>, <, \neq)$	H_0: Dates are equally likely to chose the Revealer or the Hider. (50% chance of choosing the Hider) H_A: The Revealer is chosen over the Hider more than 50% of the time
Parameter	$\pi = 50\%$
Rewrite of Hypotheses (using parameter)	$H_0: \pi = 50\%$ $H_A: \pi > 50\%$

9. You have been asked to conduct a simulation study to determine what outcomes are likely to occur assuming that there is no real effect of revealing vs. hiding information. Specify the setup for a simulation in StatKey.

Identify the following

- Sample size
- Null Hypothesis

Edit data ✕

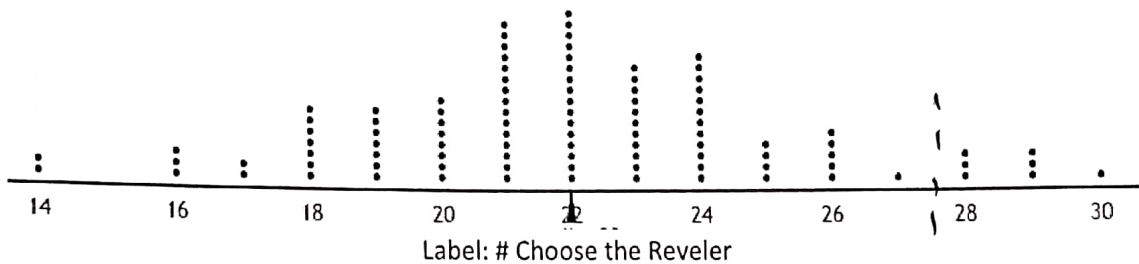Please select values for count and sample size.

count: —

sample size: 44

Null hypothesis: $p = .50$

The results of 100 repeated outcomes are obtained using StatKey.

☐ Left Tail ☐ Two-Tail ☑ Right Tail

Label: # Choose the Reveler

14   16   18   20   22   24   26   28   30

10. A right-tailed analysis is appropriate for this problem. Why is this test right-tailed? Discuss.

The $H_A : \pi > 50\%$ means we care about the right side "more likely to choose The Revealer over the Hider"

11. The study had 28 subjects chose to date the revealer. Use the plot above to estimate the p-value.

P-value: 28, $\frac{3+3+1}{100}$ (.7)

12. Which of the following is the most correct statement regarding our research question?

~~a.~~ In the study, 28/44 = 64% of the subjects chose the revealer; thus, we have statistical evidence that potential dates are more likely to choose the revealer because more than half of the subjects in our study did so.

~~b.~~ An outcome as extreme or more extreme than 28 happened less than 5% of the time in our ~~wrong~~ simulation study; thus, there is statistical evidence that potential dates prefer the revealer.

c. An outcome as extreme or more extreme than 28 happened more than 5% of the time in our ~~right~~ simulation study; thus, there is statistical evidence that potential dates prefer the revealer.

(d) None of the above.

Suppose three years from now you are visiting one of your old college roommates who has since married and has had a child. Your old roommate brags, a bit too much, about how smart their child is throughout your visit. In fact, your old roommate claims their 9 month old child knows his colors. After obtaining permission from your old college roommate, you decide to test whether or not their child really does know his colors at 9 months old. You set up a small study with four colors (green, red, yellow, and blue). You ask the child to pick up a certain color block and record whether or not the child's selection was correct. Initially, you set the study up for 30 trials, but the child threw a tantrum and you were only able to record 28 trials. This child correctly identified the color on 14 of the trials.

Green	Red
Yellow	Blue
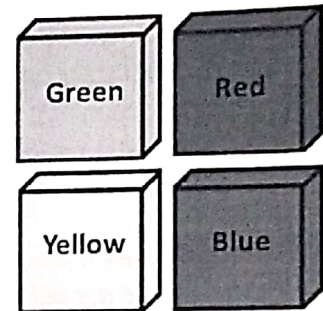
Question of Interest: Does this child really know his colors at 9 months old?

Consider the following questions regarding the above situation.

13. What is the most appropriate statistical way of dealing with the last two trials that you were not able to be completed?
    a. Wait a couple months and rerun the entire experiment as not having the last two trials will bias the outcomes from our study.
    b. Rerun the experiment using a different child, and make sure the child completes all 30 trials.
    (c) Continue with your investigation using 28 trials instead of 30 as this will not detrimentally affect or analysis or conclusions.

14. Suppose after completing your investigation, you determine that 14 does not provide enough evidence to be statistically significant (i.e., the p-value is fairly large), which of the following is the best conclusion to draw?
    a. You do not have enough evidence to conclude that all 9-month old children know their colors.
    (b) You do not have enough evidence to conclude that this 9-month old child knows his colors.
    c. You have found very strong evidence that this child does better than guessing on his colors.
    d. You have found very strong evidence that this child does no better than guessing on his colors.

15. If the result <u>does</u> turn out to be statistically significant, which of the following is a valid conclusion?
    a. It would be very surprising to obtain an observed outcome of 14 if this child did not know his colors.
    b. It would <u>not</u> be surprising (i.e. it would be likely) to obtain an observed outcome of 14 if this child did not know his colors.
    c. It would be very surprising to obtain the observed outcome of 14 if this child knew his colors.

16. Suppose the p-value from your investigation turns out to be 0.002. Which of the following is a *possible* explanation for the study's significant result?
    a. There is a very small probability (0.002) that the observed result was obtained by chance if this child did not know his colors.
    b. This child knows his colors.
    c. Either (a) or (b) are *possible* explanations for this significant result.

17. Reconsider the previous question. Now think about not *possible* explanations, but *likely* explanations. Which is the more likely explanation for this significant result?

    a. There is a very small probability (0.002) that the observed result was obtained by chance if this child did not know his colors.
    b. This child knows his colors.
    c. These are equally likely explanations.

A study was conducted regarding potential differences and preference for wild-caught vs. cultured yellow perch. 51 judges performed what is known as a triangle test. A **triangle test** is a type of discrimination test that is commonly used in sensory analysis (e.g. taste test) to determine whether or not there is a detectable difference among two or more items.

In a triangle test, a judge is presented with 3 plates. 2 of the plates have the same type of perch, and the third plate has the other type:

Plate 1   Plate 2   Plate 3

The types are randomly assigned to 1 of the three plates. The judge's task is to pick which plates "match" (have the same type of perch). Suppose that out of the 51 judges, 25 of them (49%) correctly identified the 2 plates with the same type.

18. Suppose there is truly no difference between the types of perch. How many judges would you expect to correctly pair the 2 plates with the same type? Show your math.

$$51(^1/3) = \sim 17 \text{ judges}$$

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19. Write the null and alternative hypotheses using defined parameter.

| Research Question	Wild vs. Cultured Yellow Perch Can judges distinguish between these two types of yellow perch?
Parameter	π = probability that a judge can correctly pair the 2 plates that match when there is no difference in taste between the two types of yellow perch
Rewrite of Hypotheses (using parameter)	$H_0: \pi = .3\overline{3}$ $H_A: \pi \neq .3\overline{3}$ $\pi > .3\overline{3}$

20. The p-value computed from StatKey is 0.002. Based on these results, which statement is most correct?

a.) It is very unusual to get a sample with 25/51 judges selecting the correct 2 plates, if there truly is no difference in the flavor. Therefore, there is evidence that the 2 perches differ in flavor.

~~b.~~ It is very unusual to get a sample with 25/51 judges selecting the correct 2 plates, if there truly is a difference in the flavor. Therefore, there is evidence that the 2 perches do not differ in flavor.

c. It is not very unusual to get a sample with 25/51 judges selecting the correct 2 plates, if there truly is no difference in the flavor. Therefore, there is not enough evidence that the 2 perches do differ in flavor.

d. It is not very unusual to get a sample with 25/51 judges selecting the correct 2 plates, if there truly is no difference in the flavor. Therefore, there is not evidence that the 2 perches do differ in flavor.

Of interest here is whether or not minority coaches were given a fair chance to coach 3rd base in major league baseball. It was determined that 45% of the coaches in the major leagues were minority and thus if everything is fair about 45% of 3rd base coaches should be minority. The NY Times reported that only 7 of the 30 3rd base coaches are minorities and thus a potential race bias may be occurring.

Research Question: Do the data presented by the NY Times provide statistical evidence to suggest that minority coaches are not given a fair opportunity to coach 3rd base?

Consider the following outcomes from a simulation of 100 trials.

Label: # Minority Coaches

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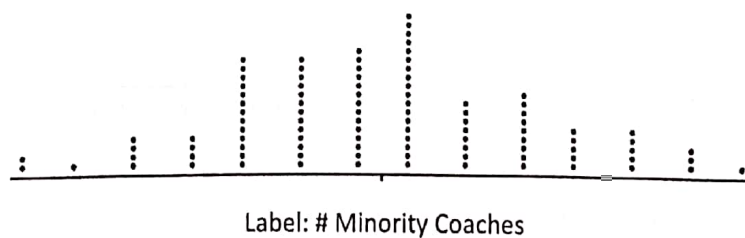
21. Which of the following is most correct regarding the above reference distribution?

(a.) This reference distribution was constructed under the assumption that minority coaches are given a fair opportunity to coach 3rd base.

b. This reference distribution makes no assumption about the fairness in which minority coaches are given to coach 3rd base. Making an assumption like that would be unfair and bias the analysis.

c. This reference distribution was constructed under the assumption that minority coaches are not given a fair opportunity to coach 3rd base.

22. Answer the following True/False Questions

Definition
P-Value: the probability of observing an outcome as extreme or more extreme than the observed outcome

The context of "as extreme or more extreme" in this problem implies values of 7 or less.	**TRUE**	FALSE
7, the observed number of minority 3rd base coaches, is the expected or anticipated value in our simulation	TRUE	**FALSE**
The p-value for this problem is just the percentage computed from the data, i.e. $7/30 = 0.233$ so about 23%.	TRUE	**FALSE**
A very small p-value, i.e. much less than 0.05, suggests the data supports the research question.	**TRUE**	FALSE

Consider the following poll found on the Minneapolis Star Tribune website. This poll was centered around Matt Birk, a former Minnesota Vikings player, decision to not visit the White House with his teammates. He refused to visit with President Obama because of Obama's stance on abortion. For the following questions, you can assume: (i) that a sufficient number of people took this online poll, and (ii) That the people that took this poll were representative of people who are online readers of the Star Tribune newspaper.

Matt Birk, Former Baltimore Raven, Skips White House Visit Over Obama's Abortion Stance
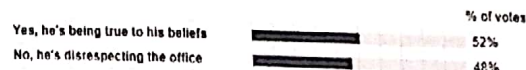
StarTribune | polls

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Question
Poll: Do you agree with Matt Birk's decision to boycott his team's White House visit

Results

|	% of votes
Yes, he's being true to his beliefs	52%
No, he's disrespecting the office	48%

23. Answer the following True/False questions regarding this poll.

		TRUE	FALSE
a.	For the people who took this online poll, a majority agree with Matt Birk's decision to not visit the White House.	~~TRUE~~ (circled)	FALSE
b.	For all the online readers of the Star Tribune, we can say that a majority agree with Matt Birk's decision to not visit the White House.	TRUE (X'd out)	FALSE (circled)
c.	A small number of people from California read the online version of the Minneapolis Star Tribune. These people are not in the scope-of-inference for this poll because they do not live in MN.	TRUE	FALSE (circled)
d.	The outcomes from this poll cannot be trusted because abortion is a sensitive issue.	TRUE	FALSE (circled)

24. Consider an investigation into possible discrimination against women in the selection of managers for a supermarket chain. Of the pool of employees eligible for management, 60% are female; however, out of the last 10 employees chosen, no females were selected.

To investigate possible bias, a researcher carried out a simulation study. He took 100 samples (each of size 10) through a process which assumed that no bias was present in the selection of managers. The number of women in each sample was counted, and the results were summarized in a dotplot.

Recall that in the observed data, zero females were selected. The researcher used both this observed data and the results of her simulation study to conclude he had evidence that the observed data and the resultsof her simulation study to conclude he had evidence that the selection process was biased. The following dotplots show possible outcomes from her simulation. Identify the Graph that provides the most amount of evidence that the process was biased. Explain your reasoning.

Graph A

Graph B — Number of females

Graph C — Number of females
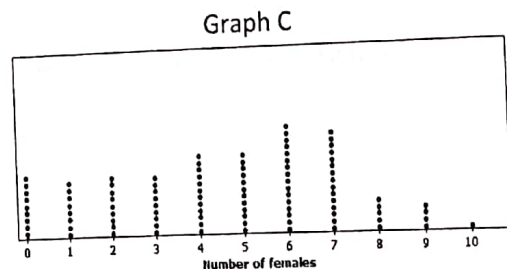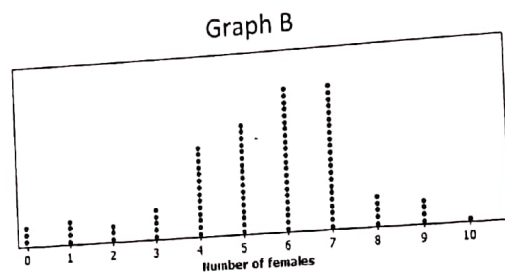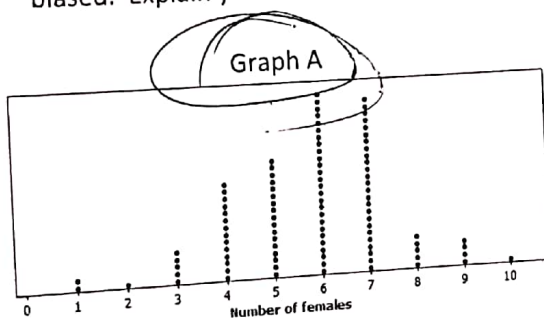
Fewest dots near zero
↳ smallest p-value

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Consider the following plot provided by HuffingtonPost.com regarding the those that Favor/Oppose Obama Health Care Law. The dotted lines provided are centered around 50% to assist in indicating a clear majority.

POLL CHART
Obama Health Care Law: Favor/Oppose

Currently tracking 569 polls from 57 pollsters   Updated about 1 month ago   FAQ
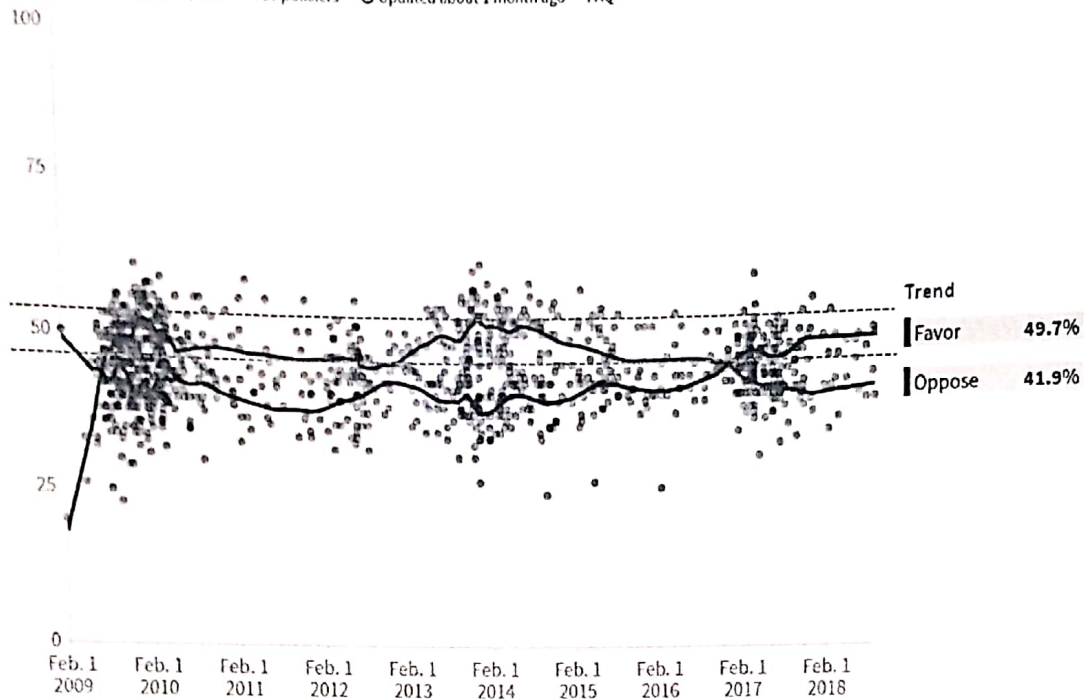
25. From a statistical perspective, why might including a margin-of-error band centered around 50% be a reasonable thing to include on this graph? Discuss briefly.

26. The trend lines provided here never appear to reach above the upper margin-of-error band. What implication does this have? That is, what does it mean if neither trend line never reaches above the upper margin-of-error limit? Discuss briefly.

We cannot be 95% certain