STAT 210: Exam #1
Spring 2020
Points: 100

96

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Nice job!

Consider an investigation into possible racial discrimination in the hiring of coaches in college football. In a given year, 34% of the candidates for head coaching positions were African-American. Of the 18 head coaches actually hired in that particular year, only 2 were African-American.

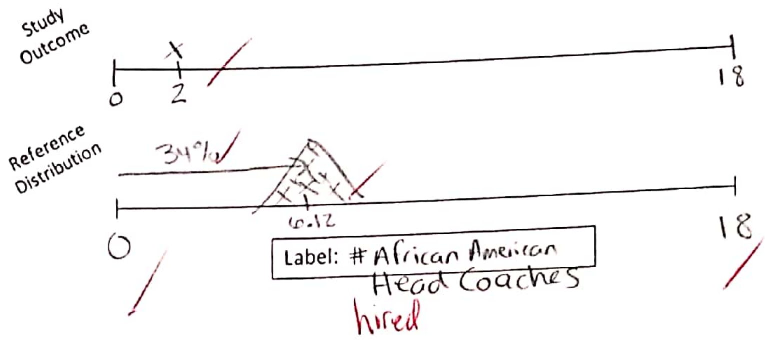
__Research Question:__ Is there evidence to suggest racial discrimination had occurred in the hiring of African-American head coaches in college football?

Note: For simplicity, you should assume all coaches are *equally* qualified for these head coaching positions.

18
.34
72
540
6.12

1. Identify the appropriate setup for this investigation. (6 pts)

- Smallest possible value
- Largest possible value
- Label for number line
- Location of pyramid
- Outcome from study



2. Specify the correct setup for StatKey that would the reference distribution. (4 pts)

Edit data

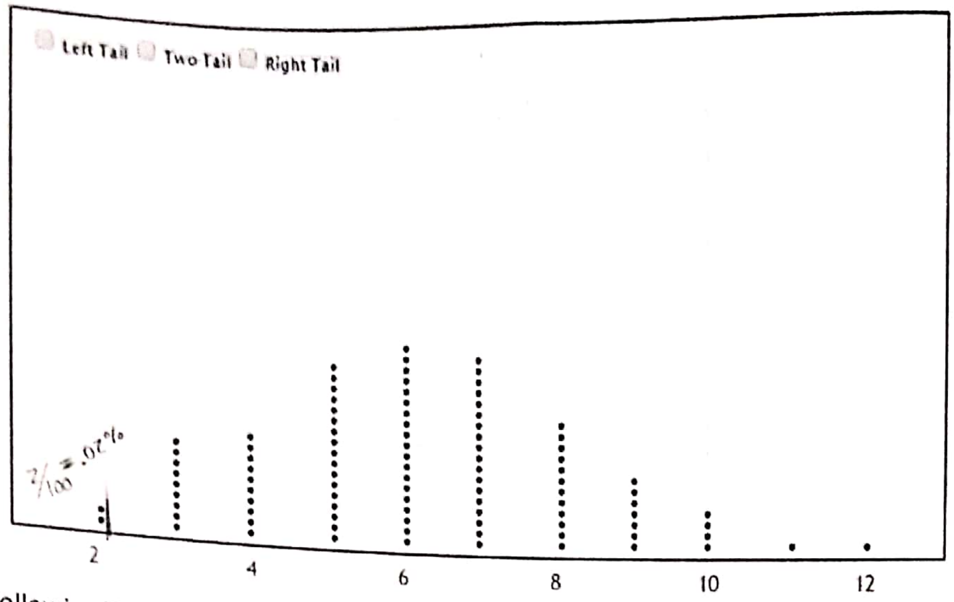
Please select values for count and sample size.

count: —

sample size: 18

Null hypothesis: $p =$ .34

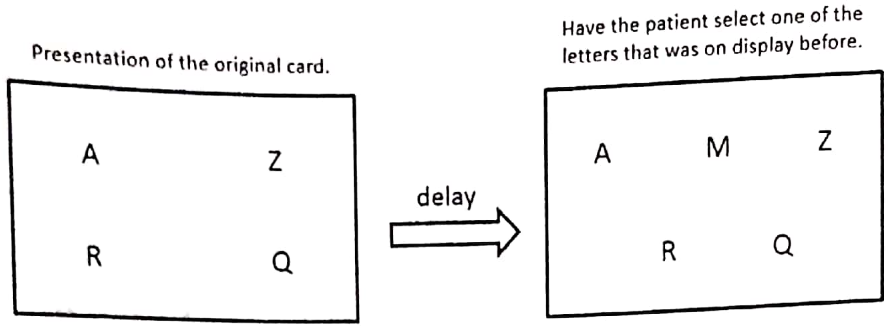
Consider the following StatKey graph of 100 runs of the simulation.



3. Answer the following True/False questions. (2 pts each)

a.	This reference distribution was obtained under the assumption that bias was occurring in the hiring of head coaches in college football.	TRUE	FALSE
b.	The above plot shows that 10 African-American coaches were hired out of 18 in 4 of the 100 runs of this simulation.	TRUE	FALSE
c.	Using the 5% rule and the observed result from the study (2 of the 18 coaches hired were African-American), there is enough statistical evidence to say there is racial discrimination against African-Americans in the hiring of head coaches in college football.	TRUE	FALSE
d.	We would have statistical evidence for discrimination against African-American head coaches if either 5, 6, or 7 coaches were hired because these results occurred most often in our simulation study.	TRUE	FALSE
e.	The following decision rule/conclusion is acceptable for making a statistical decision: We do not have evidence enough statistical evidence to say there is racial discrimination against African-American in the hiring of head coaches in college football because 2/18 = 11% is not below 5%.	TRUE	FALSE

Consider a forced-choice procedure known as the "1 in 5 Test" which can be used to evaluate a patient claiming memory loss from a head injury. For five seconds, a researcher presents the patient with a card displaying four letters, and the patient is instructed to remember the letters. After a specified delay in time, the subject is shown a second card which shows the same four letters plus one distractor letter that was not on the original card. The patient is then asked to recall any one of the letters that was on the original card.



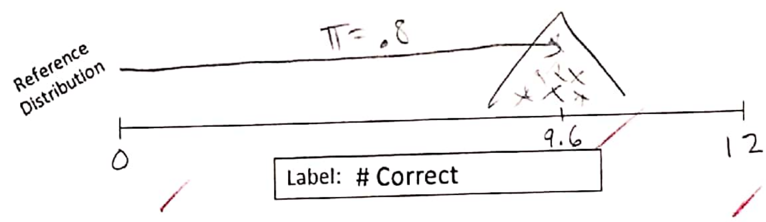
This test is typically conducted a total of 12 times and it is noted whether or not the subject answers correctly each time. A simulation setup will be used to determine what outcomes we'd expect to see when a patient truly suffers from memory loss and therefore must simply guess when presented with the second card.

4. Identify the appropriate setup for the appropriate reference distribution. (4 pts)

- Smallest possible value
- Largest possible value
- Location of pyramid

$4/5 = .8$

$12 \times .8 = 9.6$



5. Specify the correct setup for a reference distribution for StatKey. (3 pts)

Edit data

Please select values for count and sample size.

count: —

sample size: 12

Why flip to 0.2?

Null hypothesis: p = .2

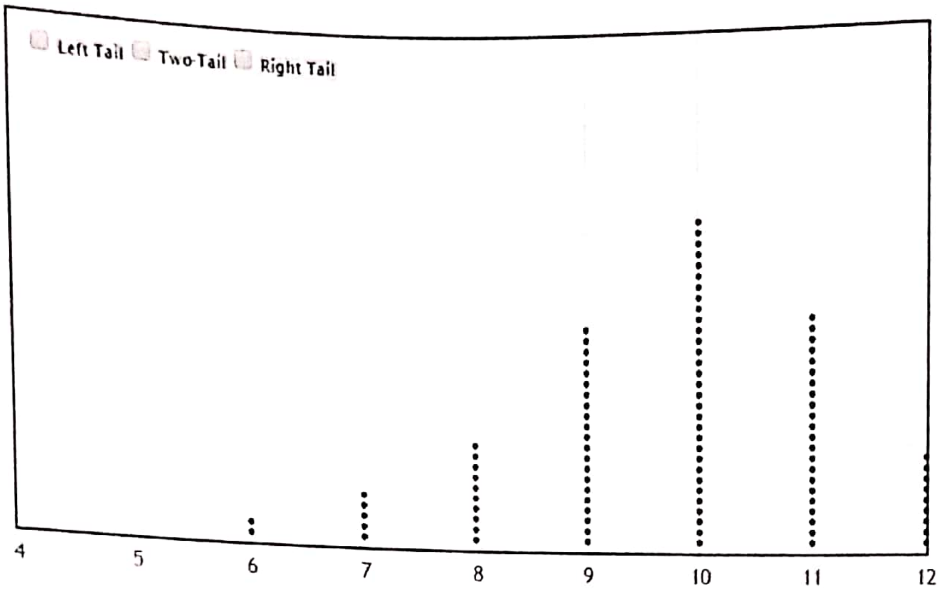
0.80 −2

6. How many of the 12 trials do we expect a patient to answer correctly if they truly suffer from memory loss? (2 pts) About 10 times. Random guessing would be right 4 out of 5 times, $4/5 = .8$ $\boxed{.8(12) = 9.6}$ Round that up to "About 10 times"

−2

Scanned with CamScanner

The following graph shows 100 simulated outcomes that were obtained when the patient suffered from memory loss and hence needed to guess on the "1 in 5 Test."



The researchers are considering the following rule for determining whether or not there is enough statistical evidence to suggest someone is faking their memory loss.

Rule: "5 correct out of the 12 trials should be used as the cutoff because this simulation did not produce an outcome at 5 or anything less than 5."

a. Statisticians would not use a rule like this one stated above. Why? (3 pts)

More trials would tend to increase this range. 5 or even 0 is not impossible just unlikely, and with enough simulations each outcome would likely have a dot on it. We need this cutoff to be proportional to the data to avoid this problem.

b. What is an appropriate statistical cutoff for when we believe someone might be faking their memory loss? Briefly explain how you obtained this value. (4 pts)

Cutoff: 6 (p-value = .02)

Rationale: "Faking Memory Loss" implies intentional failing to me. So $\pi < .8$, thus making this a Left Tailed test.

if 6 is the cutoff, $\frac{2}{100} = .02$ | if 7 is the cutoff, $\frac{7}{100} = .07$

Using our 5% rule I'd say that 6 makes a better cutoff value because $.02 < .05$ and because $.07$ is not.

Suppose the prevalence of left-handedness in the general population is 10%. Researchers have obtained a sample of 86 patients diagnosed with hemifacial microsomia (HFM), a condition that affects the development of the lower half of the face, and 14 of the 86 patients were left-handed (14/86 = 16%).

Research Question: Is the prevalence of left-handedness higher for those diagnosed with HFM than for the general population?

7. Which of the following gives the best description of the scope-of-inference for this problem? (2 pts)

   a. The general population
   b. Those diagnosed with HFM
   c. The 86 patients in this study
   d. The 14 patients in this study who are left-handed

8. Suppose the researcher plans to use the binomial distribution to find a p-value for this study. What values should be used for n and π? Note: n = number of trials and π is the parameter, i.e. the percentage used to build the reference distribution. (3 pts)

   a. $n = 14$, $\pi = .50$
   b. $n = 14$, $\pi = .10$
   c. $n = 14$, $\pi = .16$
   d. $n = 86$, $\pi = .50$
   e. $n = 86$, $\pi = .10$
   f. $n = 86$, $\pi = .16$

9. The p-value for this study is found to be 0.24. Which of the following conclusions is most appropriate? (3 pts)

   a. This study provides statistical evidence that the prevalence of left-handedness is greater for those diagnosed with HFM than for the general population (p-value = 0.24).
   b. This study does not provide statistical evidence that the prevalence of left-handedness is greater for those diagnosed with HFM than for the general population (p-value = 0.24).
   c. This study provides statistical evidence that the prevalence of left-handedness of those diagnosed with HFM is indeed 10% (p-value = 0.24).
   d. The outcomes from this study cannot be trusted because the p-value is not below 0.05 (p-value = 0.24).

10. A friend claims that he can taste the difference between Coke and Coke Zero. You set up an experiment during which your friend tastes a sample of each and identifies which sample is the Coke Zero, and this process is repeated a total of eight times. Your friend makes the correct distinction between Coke and Coke in 7 of the 8 attempts. What value for the parameter would you use when setting up a simulation study to investigate whether or not your friend has the ability to tell the difference between Coke and Coke Zero? (3 pts)

a. $\pi = 1/2$ → "guessing" → could not tell the difference
b. $\pi = 1/8$
c. $\pi = 7/8$
d. It is impossible to tell.

11. Consider the previous problem. You use the binomial distribution and find that the probability he could get 7 or more correct by guessing is 0.035. Which of the following is the most correctly written conclusion? (3 pts)

a. We do not have enough statistical evidence to say that he can really tell a difference (p-value = 0.035).
b. We do have enough statistical evidence that he can tell a difference because he got more than 4 correct which is the expected number if he was guessing. (p-value = 0.035).
c. We do have enough statistical evidence to say that he can tell a difference (p-value = 0.035).
d. Both b and c.

12. Consider the previous problem. Which of the following is the most correct interpretation of the p-value, which was .035 or 3.5%? (3 pts)

a. There is a 3.5% chance that your friend is guessing.
b. There is a 3.5% chance that your friend can tell the difference between Coke and Coke Zero.
c. If your friend is just guessing, there is a 3.5% chance he would get 7 or more correct.
d. If your friend can tell the difference between Coke and Coke Zero, there is a 3.5% chance he would get 7 or more correct.

13. A student participates in a Coke versus Pepsi taste test. She correctly identifies which soda is which four times out of six tries. She claims that this proves that she can reliably tell the difference between the two soft drinks. You have studied statistics and you want to determine the probability of anyone getting at least four right out of six tries just by chance alone. Which of the following would provide an accurate estimate of that probability? (3 pts)

a. Have the student repeat this experiment many times and calculate the proportion of times she correctly distinguishes between the brands.
b. Simulate this on the computer with a 50% chance of guessing the correct soft drink on each try, and calculate the proportion of times there are four or more correct guesses out of six trials.
c. Repeat this experiment with a very large sample of people and calculate the percentage of people who make four correct guesses out of six tries.
d. All of the methods listed here would provide an accurate estimate of the probability.

An advertisement for an insurance company states that 90% of its claims are settled within 30 days. The Better Business Bureau is investing this statement and believes that the actual rate is less than 90%.

Research Question: Is there evidence to suggest that the rate in which claims are settled within 30 days for this insurance company is less than 90%?

14. Answer the following regarding the setup of null and alternative hypotheses. (5 pts)

Write out in words	H_0: 90% of claims are settled within 30 days H_A: Less than 90% of claims are settle within 30 days
Define the parameter	$\pi = .9$
Write out using parameter	$H_0: \pi = .9$ $H_A: \pi < .9$

15. Suppose a binomial test is carried out, and the p-value for this problem is 0.031. Which of the following is the most correctly written conclusion? (2 pts)

a. We have evidence that the proportion of claims settled within 30 days is less than 90% (p-value = 0.031).

b. We have evidence that the proportion of claims settled within 30 days is NOT less than 90% (p-value = 0.031).

c. Without a doubt, the proportion of claims settled within 30 days is less than 90% (p-value = 0.031).

d. The sample size is too small to draw a valid conclusion (p-value = 0.031).

16. Suppose a governor is concerned about their "negatives" (i.e., the percentage of state residents who express disapproval with their job performance). Their campaign pays for a series of television ads, hoping that they can keep the negatives below 30%. They use follow-up polling to assess the ads' effectiveness. The negatives come in at 28%, and the p-value obtained is 0.18. Which of the following is the most correctly written statement? (3 pts)

a. This p-value gives strong evidence that the negatives are below 30% because the p-value is small.

b. This p-value gives strong evidence that the negatives are below 30% because the p-value is large.

c. This p-value does not provide enough evidence that the negatives are below 30% because the p-value is small.

d. This p-value does not provide enough evidence that the negatives are below 30% because the p-value is large.

17. Consider the previous problem (the p-value was 0.18). Which of the following is the most correct interpretation of this p-value? (3 pts)

a. There is an 18% chance that the ads were effective.
b. There is an 82% chance that the ads were effective.
c. There is an 18% chance that the poll was conducted correctly.
d. There is an 18% chance that poll results as extreme as these could occur even if the ads weren't really effective.

18. One of my consulting clients is designing a research study. She is hoping to show that the results of an experiment are statistically significant. What type of p-value would she want to obtain? (2 pts)

a. A small p-value.
b. A large p-value.
c. The magnitude of a p-value has no impact on statistical significance.

Consider the following formula for the margin-of-error.

$$MOE = \pm 1.96 * \sqrt{\frac{\hat{\pi} * (1 - \hat{\pi})}{n}}$$

19. Which of the following statements is most correct regarding the margin-of-error calculations? (2 pts)

a. Holding all else constant, an increase in the sample size leads to an increase in the margin of error.
b. Holding all else constant, an increase in the sample size leads to a decrease in the margin of error.
c. The sample size has no effect on the margin of error.

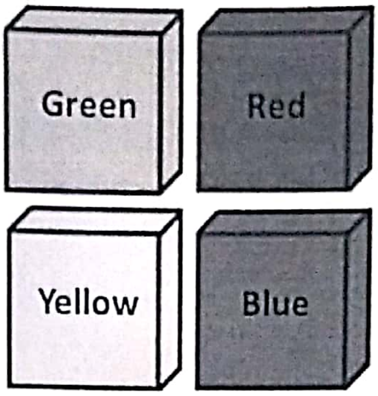
20. Suppose a recent poll was conducted to estimate the proportion of Winona residents who want to ban frac sand mining. The margin of error calculated from this poll of 800 randomly selected Winona residents was about ± 3.5%. Now, suppose that you want to estimate the proportion of *Minnesotans* who want to ban frac sand mining and that you want to achieve the same margin of error (± 3.5%) for this poll, as well. Consider the margin-of-error formula provided above, how many Minnesotans would you need to randomly sample to achieve this margin of error? (3 pts)

a. Much fewer than 800
b. About 800
-2 c. Much more than 800

-2

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.

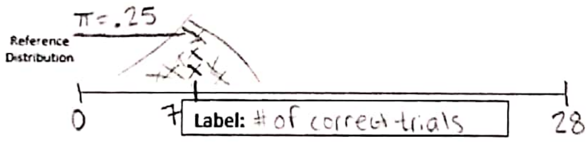
After obtaining permission from your old college roommate, you decide to test whether or not their child really does know his colors at 9 months old. You set up a small study with four colors (green, red, yellow, and blue). You ask the child to pick up a certain color block and record whether or not 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.



<u>Question of Interest</u>: Does this child really know his colors at 9 months old?

Answer the following questions regarding the setup of a reference distribution that would allow us to investigate this situation.

21. Identify the most appropriate label that will be used for tracking the outcomes from the simulation. (2 pts)



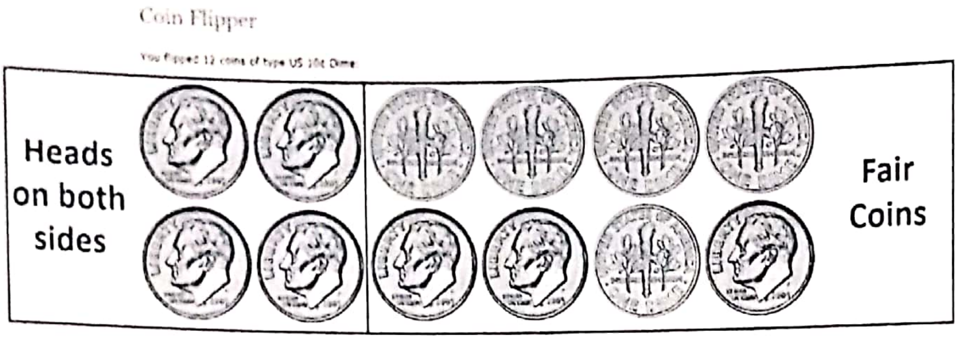
a. Child Knows His Colors, Child Does not Know his Colors
b. Correct Guess, Incorrect Guess
c. Child Only Knows These Four Colors, Child Knows All His Colors

22. The appropriate parameter choices are (2 pts)
a. 0.50 / 0.50
b. 0.25 / 0.75
c. 0.125 / 0.875
d. None of the above

23. The sample size value would be (2 pts)
a. 28
b. 30
c. 12

Consider the following 12 coins flips provided by Random.org.

Suppose a computer hacker has changed the algorithm on this site so that the two left-most coins in the first and second row are *always* heads, the other coins remain fair coins.



24. Answer the following regarding the hacker's version of flipping 12 coins? (3 pts)
    a. The smallest number of heads possible is 4
    b. The largest number of heads possible is 12
    c. The expected number of heads is 8

25. Which of the following would be the best way to setup a simulation study to mimic the hacker's version of flipping these 12 coins? (3 pts)
    a. Setup a simulation with Sample Size = 12, Null hypothesis: p = 0.50 which represents chance of head for each individual toss, then count the number of Heads and add 4 because we know 4 coins will always be Heads.
    b. Setup a simulation with Sample Size = 12, Null hypothesis: p = 0.33 (4/12) which represents chance of heads overall, then count the number of Heads and add 4 because we know 4 coins will always be Heads.
    c. Setup a simulation with Sample Size = 8, Null hypothesis: p = 0.50 which represents chance of head for each individual toss then, count the number of Heads and add 4 because we know 4 coins will always be Heads.
    d. Setup a simulation with Sample Size = 8 Null hypothesis: p = 0.33 (4/12) which represents chance of heads overall, then count the number of Heads and add 4 because we know 4 coins will always be Heads.

26. Last one --- more True or False... (2 pts each)

a.	The point for which we start to believe the outcome is an outlier is always found near the upper or lower end of the reference distribution. $p < .05$ 7.5 each side or $p > .95$	TRUE	FALSE
b.	When using a standard 5% error for a one-tailed problem, the cutoff value for when we start to believe we have an outlier always includes either the top 5% or the bottom 5% of the dots from the simulation.	TRUE 0	FALSE
c.	A parameter, denoted by π, is required to build a reference distribution.	TRUE	FALSE
d.	The p-value is computed by determining the proportion of dots that are as extreme as or more extreme than the outcome from the study.	TRUE	FALSE
e.	You need to know the outcome from the study before a reference distribution can be created.	TRUE	FALSE
f.	The binominal probability distribution has no assumptions or conditions for its use and can be used in any statistical analysis.	TRUE	FALSE