**STAT 110: Homework 1 Solutions (20 pts)**
Fall 2017

1. A woman was involved in an accident and was seeking compensation for significant psychological and memory difficulties that she claimed were present afterwards. Right after the accident, a skull radiograph was reported as normal, a neurological examination showed no abnormality, and she was discharged home the same day. A doctor questioned her claims of memory difficulties and opted to perform what is known as "the coin-in-the-hand test" on this subject. This test requires the subject to remember in which of two hands the examiner has held a coin. After seeing the coin for about two seconds in either the examiner's left or right hand, subjects are required to close their eyes and count backwards from 10. They are then asked to open their eyes and to indicate in which of the two clenched hands the coin is held. The examiner opens the hand touched by the subject and also gives verbal feedback as to the correctness of the subject's response. Suppose 25 such trials are carried out, with the coin being held in the right and left hands for an equal number of trials, these being randomly distributed.

   Suppose you have been asked to decide whether this woman is getting fewer correct answers than we would expect by chance (which may indicate she is intentionally giving wrong answers to feign her memory loss). You will set up a simulation study to investigate this.
   .

   a. To what should you set the **Repeat** value on the spinner for your simulation? (1 pt)

      25

   b. Sketch the spinner that you will use for your simulation below. Be sure to show both the outcomes that are possible on each trial and their associated probabilities. (2 pts)
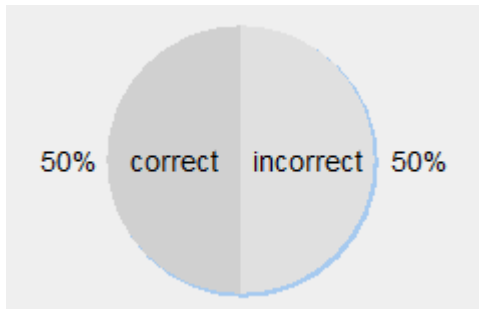

   c. What is the *expected* number of correct answers a subject would give if guessing on each of the 25 trials? (2 pts)

      50% of 25 = 12.5 (it's okay to say 12 or 13)

d. Using the examples from class to guide you, carry out a simulation study to determine what outcomes are likely (or unlikely) to occur if the subject is really guessing. In the end, you should have a graph showing the results of **1,000** runs of the simulation. Your final dotplot should show the number of **correct** answers obtained (out of 25 trials) in each of the 1,000 runs of the simulation. **You must either print a copy and attach it to your solutions or include a detailed sketch by hand to earn these points**. (2 pts)

Your results should be similar to the following:
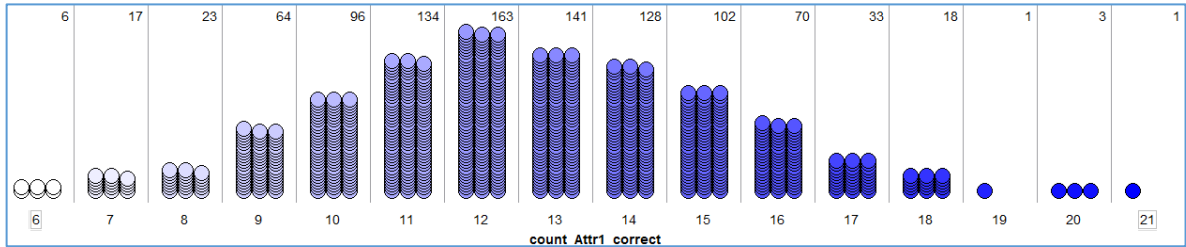
e. Suppose that in the actual investigation, the woman was correct on 6 of the 25 trials. Based on this observed result, would you believe she was intentionally giving wrong answers to feign memory loss? Explain your reasoning, and be sure to use the results of the simulation study in your explanation. (2 pts)

Yes. As shown by the results of the simulation study, an outcome such as only 6 (or fewer) correct rarely occurs if the subject really has memory loss (this happened only 6/1000 = 0.6% of the time in the simulation study). So, this result does provide statistical evidence that she does not have memory loss and is intentionally giving wrong answers.

f. Now, suppose that in the actual investigation, the woman was correct on 10 of the 25 trials. Based on this observed result, would you believe she was intentionally giving wrong answers to feign memory loss? Explain your reasoning, and be sure to use the results of the simulation study in your explanation. (2 pts)

No. As shown by the results of the simulation study, an outcome such as 10 (or even fewer) correct occurs quite often even if the subject really has memory loss. So, an outcome such as 10 correct answers is not unlikely to have happened purely by chance, and statistically there is not enough evidence to say that she has memory loss and is intentionally giving wrong answers.

2. Consider a forced-choice procedure known as the "1 in 5 Test" which can be used to evaluate a patient claiming memory loss. 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 delay of a few minutes, 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.

Presentation of the original card.

A   Z

R   Q

delay

Have the patient select one of the letters that was on display before.

A   M   Z

R   Q

This process is repeated a total of 12 times, and it is noted whether or not the subject answers correctly each time. To determine what outcomes we expect to see when a patient truly suffers from memory loss and is therefore guessing when presented with the second card, we will carry out a simulation in Tinkerplots. Answer the following questions regarding the set-up of the simulation study.

a. Setup a simulation in Tinkerplots that would allow us obtain a total of 1,000 simulated outcomes to investigate the research question stated above. (3 pts)

Identify (1) the labels, (2) appropriate percentages, and (3) the Repeat value for the Tinkerplots spinner.

Repeat
12

Attr1

20%
incorrect

Draw
1

correct

80%

Identify the appropriate value for the Collect box (note that the results from your first simulated run will already be shown in this table).

History of Result...   Collect
                       999
count_...   <ne

b. What is the *expected* number of correct answers a subject would give if guessing on each of the 12 trials? (1 pt)

4/5 (or 80%) of 12 = 9.6.

3

c. The following graph shows 1,000 simulated outcomes that were obtained when the subject was truly guessing on the "1 in 5 Test."

0	0	0	0	0	0	10	65	144	235	269	208	69
0	1	2	3	4	5	6	7	8	9	10	11	12

count Attr1 correct
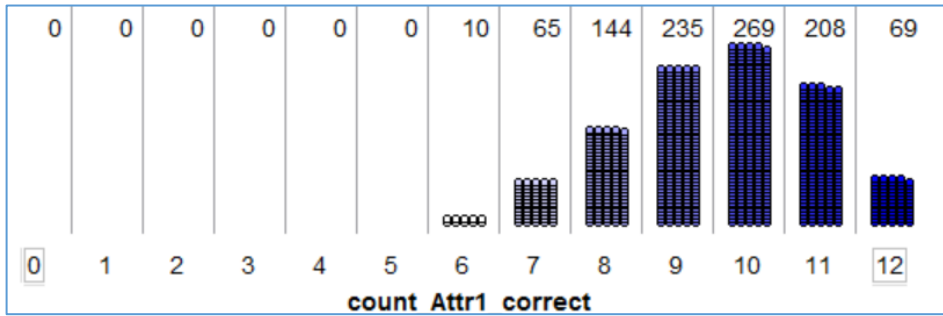
Which of the following statements is correct? Circle your answer. (1 pt)

    i.   Each dot on the above plot represents a correct answer.
    ii.   In 6 of the 1,000 simulated runs of this experiment, the subject was correct on 10 of the 12 trials.
   (iii) In 10 of the 1,000 simulated runs of this experiment, the subject was correct on 6 of the 12 trials.
    iv. None of the above is a correct statement.

d. Use the results of the above simulation study to estimate the probability that the subject would get 8 <u>or fewer</u> correct answers (out of 12 trials) if they were really just guessing. (2 pts)

219/1000 = .219, or 21.9%

e. Suppose that in the actual study, the subject got 8 out of 12 trials correct. Based on the results of the simulation study, do you believe this outcome provides statistical evidence that the subject is answering wrong on purpose? Explain your reasoning, and use the results of the simulation study in your explanation. (2 pts)

As calculated in the previous problem, the probability of observing an outcome of 8 or fewer correct if the subject is really guessing is almost 22%. In other words, an outcome such as the observed study result occurs quite often even if the subject is guessing, so this study does <u>NOT</u> provide statistical evidence that the subject is intentionally giving wrong answers.