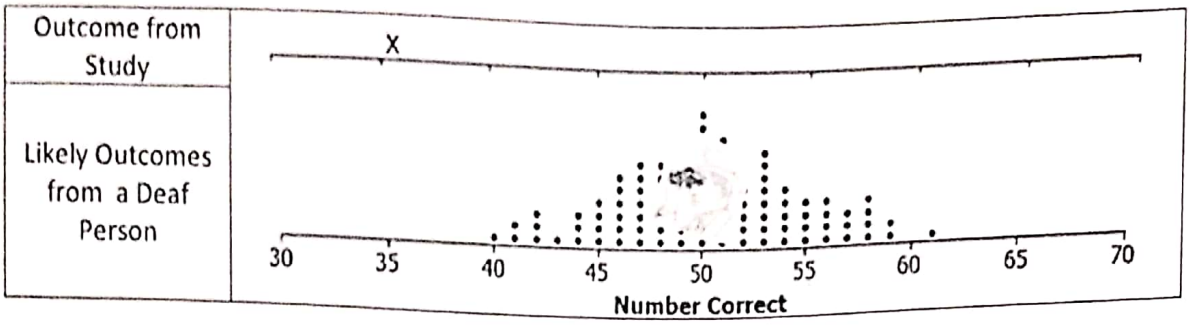
Evaluating Evidence

In the actual study, the subject was asked to complete 100 trials (instead of 20 trials as was done above). The graphic below was obtained using a computer to simulate the possible outcomes of a deaf person (i.e., a guessing subject). Each time the experiment was simulated the number of correct trials was counted and recorded. This process was repeated several times, and the results are shown below.



Questions:

7. The subject gave the correct answer in 36 of the 100 trials. What do you think about the subject's claim that he suffers from hearing loss?

He's not a terrible ~~faker~~ faker, but his outcome is lower than the expected "deaf range" so he's likely faking it

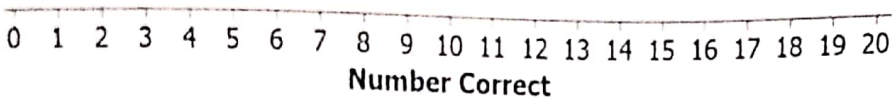
8. Complete the following fictitious medical records form for this subject. Provide a written justification to support your decision.

The evidence suggests this subject has suffered substantial from hearing loss? ___ Yes ___ No
Rationale:

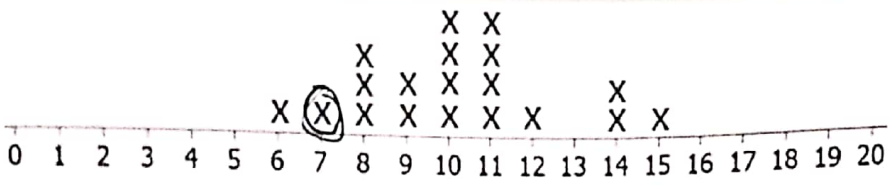
Signed _____ Date _____

9. Your friend makes the following statement. "This subject got too few correct in this hearing test. So, obviously, this person suffers from complete hearing loss!" Why is this statement incorrect? A truly random run through this test, as if done by a deaf person, would statistically get 50% of them right. While it is possible to do much worse in a random run, it is very unlikely.

Collect the simulation outcomes from everybody in the class. Place a dot for each outcome on the following number line.



Example dotplot



Questions:

4. Circle your dot on the plot above. Answer the following regarding your dot.
   a. How many correct did you get? How many could you have gotten correct?

      I got 7 out of a possible 20 correct

   b. Is your dot (i.e., outcome) similar to the others in your class? Discuss.

      Yes. I wasn't part of the most frequent result but I was by no means an outlier. I was successfully classified as deaf by the class' chosen range

5. Which of the following is true about these dots?
   (a) These dots are meant to mimic the outcomes of deaf people.
   b. These dots are meant to mimic the outcomes of people who are thought to be lying about their ability to hear.

6. Given the simulation results on the above dotplot, what would you think about a subject's claim that he suffers hearing loss if he answered
   a. 7 correctly? Likely deaf/hearing impaired
   b. 0 or 1 correctly? Very Probably faking it
   c. 3 or 4 correctly? Likely faking it

An applet has been constructed so that you can conduct your own repeated trials of this hearing experiment.

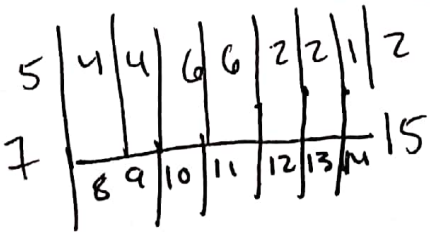
Applet Link: http://course1.winona.edu/cmalone/afc_hearing/

Recall that the goal is to mimic the outcomes of a deaf person. Therefore, when conducting this experiment, you should mute the speakers on your computer.

Task: Conduct 20 repeated trials of the hearing experiment. Record the number of correct results below.

Trial	Choice	Correct?	Trial	Choice	Correct?
1	Red / Blue	☐	11	Red / Blue	☑
2	Red / Blue	☑	12	Red / Blue	☐
3	Red / Blue	☑	13	Red / Blue	☐
4	Red / Blue	☑	14	Red / Blue	☐
5	Red / Blue	☐	15	Red / Blue	☐
6	Red / Blue	☐	16	Red / Blue	☐
7	Red / Blue	☐	17	Red / Blue	☐
8	Red / Blue	☐	18	Red / Blue	☑
9	Red / Blue	☑	19	Red / Blue	☐
10	Red / Blue	☑	20	Red / Blue	☐

Total Number of Correct Results: 7



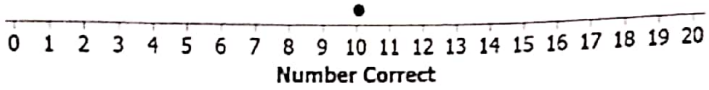
Definition

The **expected** outcome is the outcome which is identified as the *most* likely outcome.

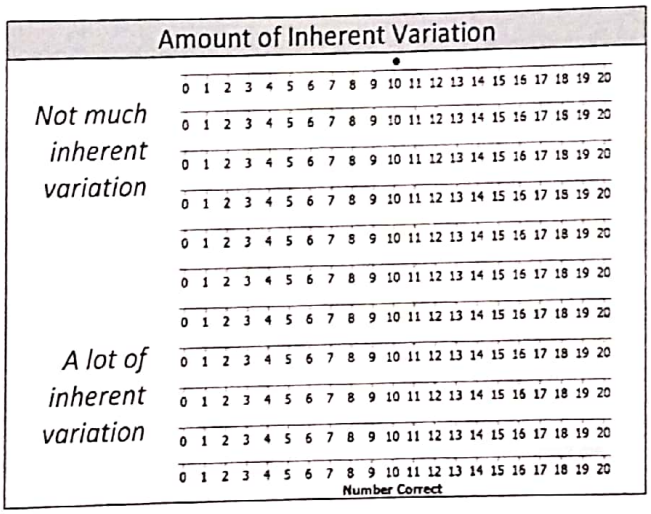
The expected outcome for the number of correct responses for 20 trials with each trial having a $\frac{1}{2}$ chance of being correct is 10.

$$Expected = 20 * \frac{1}{2}$$
$$10$$

The expected value for a model with a $\frac{1}{2}$ chance of being correct will be in the middle; i.e., halfway across the number line representing the number correct.



The most important element that a statistical approach provides to solving a problem of this nature is an understanding of the inherent variation that exists in the outcomes from the simulation model. In particular, there is inherent variation (i.e., randomness) present in the number of correct responses over repeated trials. The amount of inherent variation depends on the model being used. In this situation, the number of trials and the likelihood of a correct response determine the amount of inherent variation.



Consider one final set of outcomes.

Situation C

Outcome	Number
Number of times an individual was able to **correctly** associate the light with the playing of the sound	0
Number **incorrect**	20
Total	20

Question:

3. What can be said about this individual in terms of their ability to hear? Discuss.
Probably "faking it" (lying)

Statistical methods can be used to help fight against insurance fraud. In this situation, it is necessary to determine whether or not the subject in this investigation is intentionally giving the wrong answers. In order to make a determination of this nature, we must first gain an understanding of *likely* versus *unlikely* outcomes. A simulation model can be used to identify likely outcomes given a particular situation.

Modeling Deaf Outcomes

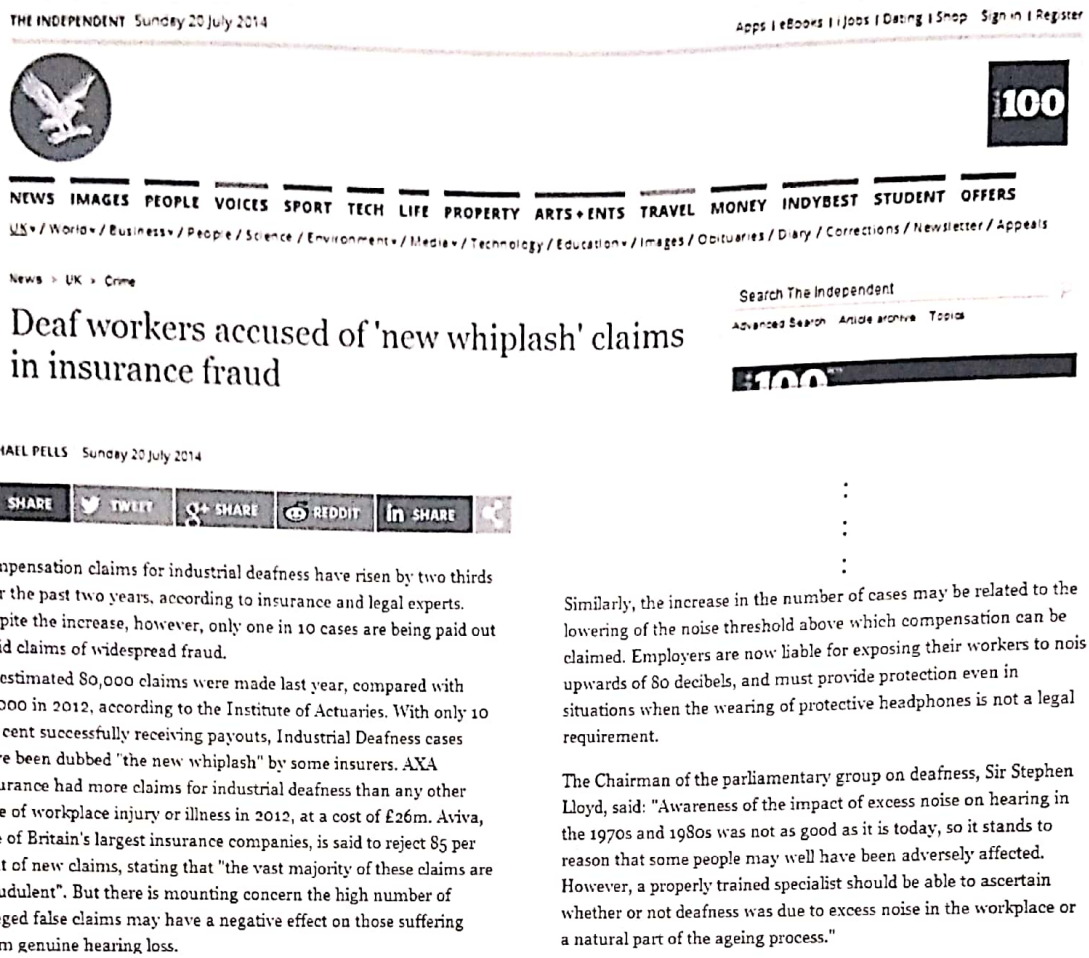
A simulation model will be constructed to mimic the outcomes of a deaf person. This model requires the identification of two pieces of information.

- Number of completed trials
- The likelihood or chance of obtaining a correct response

For our example, the number of completed trials is 20, and the chance of obtaining a correct response for a deaf person is 1 out of 2, or 50%.

Necessary information for building a model	Deaf Example
• Number of completed trials	20
• The likelihood or chance of obtaining a correct response	1 out of 2; i.e., $\frac{1}{2}$

Example 1.1: Insurance Fraud - Deafness



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Deaf workers accused of 'new whiplash' claims in insurance fraud

RACHAEL PELLS Sunday 20 July 2014

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Compensation claims for industrial deafness have risen by two thirds over the past two years, according to insurance and legal experts. Despite the increase, however, only one in 10 cases are being paid out amid claims of widespread fraud.

An estimated 80,000 claims were made last year, compared with 55,000 in 2012, according to the Institute of Actuaries. With only 10 per cent successfully receiving payouts, Industrial Deafness cases have been dubbed "the new whiplash" by some insurers. AXA insurance had more claims for industrial deafness than any other type of workplace injury or illness in 2012, at a cost of £26m. Aviva, one of Britain's largest insurance companies, is said to reject 85 per cent of new claims, stating that "the vast majority of these claims are fraudulent". But there is mounting concern the high number of alleged false claims may have a negative effect on those suffering from genuine hearing loss.

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Similarly, the increase in the number of cases may be related to the lowering of the noise threshold above which compensation can be claimed. Employers are now liable for exposing their workers to nois upwards of 80 decibels, and must provide protection even in situations when the wearing of protective headphones is not a legal requirement.

The Chairman of the parliamentary group on deafness, Sir Stephen Lloyd, said: "Awareness of the impact of excess noise on hearing in the 1970s and 1980s was not as good as it is today, so it stands to reason that some people may well have been adversely affected. However, a properly trained specialist should be able to ascertain whether or not deafness was due to excess noise in the workplace or a natural part of the ageing process."

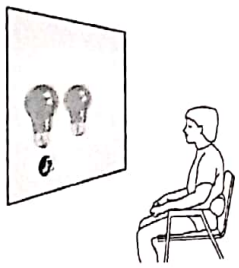
Source: http://www.independent.co.uk

Consider the following case study centered on potential insurance fraud regarding deafness. This case study was presented in an article by Pankratz, Fausti, and Peed titled "A Forced-Choice Technique to Evaluate Deafness in the Hysterical or Malingering Patient." *Source: Journal of Consulting and Clinical Psychology, 1975, Vol. 43, pg. 421-422.* The following is an excerpt from the article:

> *The patient was a 27-year-old male with a history of multiple hospitalizations for idiopathic convulsive disorder, functional disabilities, accidents, and personality problems. His hospital records indicated that he was manipulative, exaggerated his symptoms to his advantage, and that he was a generally disruptive patient. He made repeated attempts to obtain compensation for his disabilities. During his present hospitalization he complained of bilateral hearing loss, left-sided weakness, left-sided numbness, intermittent speech difficulty, and memory deficit. There were few consistent or objective findings for these complaints. All of his symptoms disappeared quickly with the exception of the alleged hearing loss.*

STAT 210: Statistics
Handout #1: Evaluating a Claim of Hearing Loss

To assess his alleged hearing loss, testing was conducted through earphones with the subject seated in a sound-treated audiology testing chamber. Visual stimuli utilized during the investigation were produced by a red and a blue light bulb, which were mounted behind a one-way mirror so that the subject could see the bulbs only when they were illuminated by the examiner. The subject was presented several trials on each of which the red and then the blue light were turned on consecutively for 2 seconds each. On each trial, a 1,000-Hz tone was randomly paired with the illumination of either the blue or red light bulb, and the subject was instructed to indicate with which light bulb the tone was paired. Because the researchers were implementing a "forced-choice" technique, the subject was forced to answer each time with either "red" or "blue."



Understanding Outcomes

Suppose an individual was asked to participate in the hearing evaluation experiment presented above. A total of 20 trials of the experiment were conducted.

Situation A

Outcome	Number
Number of times an individual was able to **correctly** associate the light with the playing of the sound	20
Number **incorrect**	0
Total	20

Situation B

Outcome	Number
Number of times an individual was able to **correctly** associate the light with the playing of the sound	10
Number **incorrect**	10
Total	20

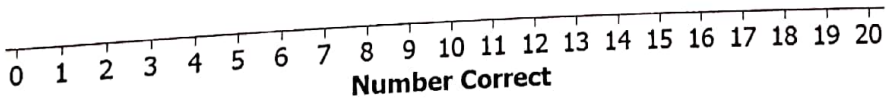
Questions:

1. What can be said about an individual whose outcomes are similar to Situation A? Discuss.

   They can hear just fine

2. What can be said about an individual whose outcomes are similar to Situation B? Discuss.

   Maybe they don't hear, maybe they're pretending to not hear



Deaf person would be expected to get half of them right (10)

$20 \leftarrow n$
$\times .5 \leftarrow \pi$