Playing Cards Activity 2

You and your partner have been given a deck of cards. Within your pair designate one person as the dealer (Subject A) and one as the player (Subject B).

Scenario: (Note: Same as Activity 1)

To the Player (Subject B): You are taking a stroll in the park when you encounter a dealer (Subject A) playing card tricks for an audience. You are skeptical that the dealer is using a standard fair deck of cards. The dealer refuses to let you hold and look at the cards (mostly because he/she is also not a trusting person ☺) but does agree to play a little game to help you determine whether the deck is a standard fair deck. (Before you play the game the dealer does prove to you that there are 52 cards in the deck.) [A standard fair deck of cards consists 52 cards: 13 red hearts, 13 red diamonds, 13 black clubs, and 13 black spades]

Game:

Step 1: For your game you set up your null and alternative hypothesis for the proportion of black playing cards in the deck.

$$\boldsymbol{H_0: p =}\_\_\_\_\_$$

$$\boldsymbol{H_A: p \neq}\_\_\_\_\_$$

Step 2: Gather sample information

1. Subject A fan out the deck and Subject B chooses a card at random from the deck
2. Subject B makes note of the color of the card (in the table below)
3. Subject B returns the card to the deck
4. Subject A shuffle the deck 2 or 3 times
5. Repeat this process for a total of 15 cards drawn.

For each card designate the color of the card selected.

	Color		**Color**
Draw 1		Draw 9	
Draw 2		Draw 10	
Draw 3		Draw 11	
Draw 4		Draw 12	
Draw 5		Draw 13	
Draw 6		Draw 14	
Draw 7		Draw 15	
Draw 8			

Note: The selection of the cards satisfies the conditions for inference because the cards selected are drawn at random, and since we are sampling with replacement the sample size is large enough for the sampling distribution to be approximately normal and trials are independent.

Step 3: Calculate the test statistic.

- Find the sample proportion of black $\hat{p} =$ _____
- Calculate the test statistic and p-value for your test.

$$z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} =$$

$$p - value = \_\_\_\_\_$$

Step 4: What is the decision based on the p-value calculated above – use a 0.05 significance level? (Circle One)

Reject Null

Fail to Reject Null

Step 5: Based on your answer above do you have evidence to believe the dealer is NOT playing with a standard fair deck of cards? Explain.

Follow up question: Do you have evidence that the dealer IS playing with a standard fair deck of cards? Explain.

Combine Class Results

- Write your sample proportion on the post-it note provided and turn in. Wait until results are in for all groups before proceeding with next questions.

- How many total games were played in the class? _____

- Student A determine what the true proportion of black cards in your deck is. *(Note: Typically for a hypothesis test you do not know the population parameter – in this case we do)*

$$\boldsymbol{p} = \_\_\_\_\_$$

- Which of the following four situations resulted from your game? (Check the appropriate cell)

	Null Hypothesis is Actually True	Null Hypothesis is Actually False
Sample resulted in Rejecting Null		
Sample resulted in Failing to Reject the Null		

- What type of error is occurring if the decision was to <u>fail to reject</u> the null hypothesis? _____

- How many of the total games played in the class resulted in the decision to <u>fail to reject</u> the null hypothesis? _____ What proportion? _____

- For this game, give an example of a conclusion which "fails to reject the null hypothesis" and one which "accepts the null hypothesis". Which one of your examples is the correct conclusion for this hypothesis test?

(Class Discussion)

- Do your results actually determine whether or not the dealer is playing with a fair deck?

- Does this mean your game is flawed?

- Are there improvements you would make to this game to better be able to detect that the population proportion of black cards is different from 0.50?

- Increase Sample Size? Let's look at a simulation of what would happen to the distribution of decisions if the same size is increased.

- **Even with High Power STILL Write in Terms of ALTERNATIVE Hypothesis:**

  Let's say we decide to draw 5000 cards instead of 15 cards therefore the power of the test is no longer a concern. Let's also suppose that our hypotheses had been:

  $$H_0: p = 0.50$$
  $$H_A: p < 0.50$$

  We can see from our simulation that with almost 100% certainty that a hypothesis test would result in a decision to "fail to reject the null hypothesis". Which with the above hypotheses IS a correct decision. However, a student that then writes a conclusion saying "I fail to reject the null hypothesis therefore there is evidence that the population proportion of black cards is 0.50" is INCORRECT.

  Remember hypothesis tests are designed to test the alternative NOT the null hypothesis!!!

Random Assignment and Random Sampling in Inference

Activity 1: Glass of Water

We are going to try to determine if a selected individual in our class can determine the difference in tap water and bottled water.

What is the ***Population of Interest*** for our study?

What is the ***sample*** in our study?

Hypotheses:

H_0 :

H_A :

Define parameter:

What is a ***trial*** in this study?

What assumptions/requirements are needed for this study? How can we be sure they are met?

Random Assignment and Random Sampling in Inference

Activity 2: "The Tasting Room"

We are going to try to determine if our class can determine the difference in tap water and bottled water.

What is the ***Population of Interest*** for our study?

What is the ***sample*** in our study?

Hypotheses:

H_0 :

H_A :

Define parameter:

What is a ***trial*** in this study?

What assumptions/requirements are needed for this study? How do we check if they are met?

Which do you think is the bottled water? (Circle one) A B

Sample Proportion:

$\hat{p}$ =

Test Statistic:

Random Assignment and Random Sampling in Inference

Activity 3: "I'd Like to Give the World a…….Glass of Water"

Now we would like to design an experiment to test how good our school is at determining the difference in brand and generic products.

What is the ***Population of Interest*** for our study?

Design an Experiment to test whether the entire school can determine the difference in tap water and bottled water