The Chicago HS for the Arts
AP Statistics
Unit 3: Anticipating Patterns

Name: ____________________

Date: __________

STATION 1: CRAPS

Roll a pair of six-sided dice. If the sum is 7 or 11, you win. If the sum is 2, 3, or 12, you lose. If the sum is any other number, you roll again. In fact, you continue throwing the dice until you either roll that number again (WIN!) or roll a 7 (LOSE!).

(a) Play 20 games of craps with your partner. Each of you should throw the dice for 10 games. Record your results in the tables below. *Note: You can simulate rolling two dice and obtaining their sum using your TI-83/84/89 by typing* `RandInt(1,6)+RandInt(1,6)` *and pressing ENTER.*

Game	1st roll	Result	Subsequent result
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Game	1st roll	Result	Subsequent result
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

1. In what proportion of the games did you win on your first roll?

2. In what proportion of the games did you win?

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(b) Probability Questions

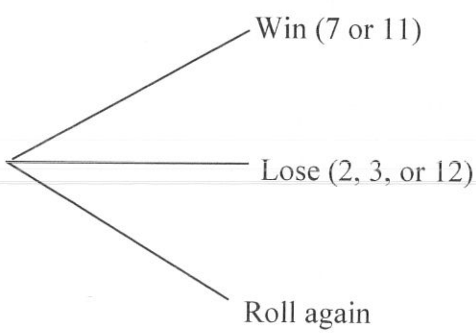
1. What is the probability that you obtain a sum of 7 or a sum of 11 on the first roll? How does this compare with your estimate from part (a)?

2. What is the probability that you obtain a sum of 2, 3, or 12 on the first roll?

3. What is the probability that you roll again after the first roll?

4. Suppose you roll a sum of 8 on the first roll. Find the probability that you subsequently win the game, given that you rolled an 8 to start with.

(c) Tree diagram: Complete the tree diagram shown below for the *first roll* in the game of craps.



(d) Find the probability that you win at craps.

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STATION 2: ROULETTE

A roulette wheel has 38 numbered slots, 1 to 36, 0, and 00. There are many possible bets, including a "dozen bet" where players bet that the ball will end up in the first dozen (1-12), second dozen (13-24) or third dozen (25-36).

(a) SIMULATION: You can easily simulate the roulette game on your TI-83/84/89 by entering `RandInt(1,38)` and letting 37 = 0 and 38 = 00. Have one partner operate the calculator, and let the other person guess 1st dozen, 2nd dozen, or 3rd dozen prior to each spin. Play 20 rounds, then switch jobs. Record your results in the table below.

Name	Number of Wins	Number of Losses

(b) Suppose you bet \$1 to play a game. If you guess the correct dozen, you win \$2 and get your original dollar back. If you're wrong, you lose the \$1 bet. Let X = the amount gained on a single play. Complete the probability distribution for X.

x_i	-1	2
p_i		

(c) Find the expected amount gained per play.

(d) Calculate the standard deviation of the amount gained per play.

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(e) Suppose you play two games. Find the total expected amount gained after two plays and the standard deviation of the total amount gained after two plays.

(f) Suppose you were to play 10,000 times. Find the expected amount gained after 10,000 plays and the standard deviation of the amount gained after 10,000 plays?

(g) Is a gambler more likely to make a profit after 2 plays or after 10,000 plays? Explain using your results from parts (e) and (f).

STATION 3: BLACKJACK

The game of blackjack begins by dealing 2 cards to a player, the first face-down and the second face-up on top of the first. At this station, you'll play a modified version of the game in which a player only gets these two cards. We'll say the player has "twenty-one" if he has an ace and a 10, Jack, Queen, or King. If a player has a "twenty-one" with an ace and a black jack as his two cards, we'll say that the player has a "blackjack."

1. Deal 10 blackjack hands, one at a time, shuffling between each hand. That is, deal 2 cards, then check the result, then shuffle, then deal two more cards, etc. Record the number of "blackjacks" and "twenty-ones" you obtain:

"Blackjacks": __________ "Twenty-ones": __________

2. Given that the face-up card is an ace, find the probability that you have
a. a "blackjack" b. "twenty-one"

3. Given that the face-up card is a black Jack, find the probability that you have
a. a "blackjack" b. "twenty-one"

4. Find the probability of getting a "blackjack". *Hint:* Consider the sample space of (top card, bottom card).

5. Are the events A = face-up card is a black Jack and B = you get "blackjack"
a. independent? b. disjoint? (mutually exclusive)

Justify your answers!

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STATION 4: MONTE'S DILEMMA

This game is based on the old television show *Let's Make a Deal*, hosted by Monte Hall. At the end of each show, the contestant who had won the most money was invited to choose from among three doors: door #1, door #2, or door #3. Behind one of the three doors was a very nice prize. But behind the other two were rather undesirable prizes—say goats. The contestant selected a door. Then Monte revealed what was behind one of the two doors that the contestant DIDN'T pick—goats. He then gave the contestant the option of sticking with the door she had originally selected or switching.

1. Simulate this game as follows. Pull an ace and two 2s from the deck of cards. These represent the 3 doors with prizes (ace is good!). Have your partner arrange the cards and act as game show host. You pick a door. He or she will then show you one of the doors you didn't pick (always with a 2). You must then decide to stick with your original choice or to switch doors. Perform this ten times and record the results. *Modern version:* Visit the Web site www.stat.sc.edu/~west/javahtml/LetsMakeaDeal.html

Trial	Door chosen	Stick/switch	Win/lose
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

2. What's the probability that you picked the door with the nice prize behind it in the first place?

3. Intuition tells us that it shouldn't make any difference whether you stick or switch. There's still a 1/3 chance that you're right. Agree or disagree?

4. A related question: A woman and a man (who are unrelated) each have two children. At least one of the woman's children is a boy, and the man's older child is a boy. Which is more likely: that the man has 2 boys or that the woman has 2 boys?

AP Statistics Formula Sheet

(I) Descriptive Statistics

$$\bar{x} = \frac{\sum x_i}{n}$$

$$s_x = \sqrt{\frac{1}{n-1}\sum(x_i - \bar{x})^2}$$

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)}}$$

$$\hat{y} = b_o + b_1 x$$

$$b_1 = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$$

$$b_o = \bar{y} - b_1\bar{x}$$

$$r = \frac{1}{n-1}\sum\left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y_i - \bar{y}}{s_y}\right)$$

$$b_1 = r\frac{s_y}{s_x}$$

$$s_{b_1} = \frac{\sqrt{\frac{\sum(y_i - \hat{y}_i)^2}{n-2}}}{\sqrt{\sum(x_i - \bar{x})^2}}$$

(II) Probability

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$$E(X) = \mu_x = \sum x_i p_i$$

$$Var(X) = \sigma_x^2 = \sum(x_i - \mu_x)^2 p_i$$

If X has a binomial distribution with Parameters n and p, then:

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

$$\mu_x = np$$

$$\sigma_x = \sqrt{np(1-p)}$$

$$\mu_{\hat{p}} = p$$

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

If $\bar{x}$ is the mean of a random sample of size n from an infinite population with mean μ and standard deviation σ, then:

$$\mu_{\bar{x}} = \mu$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$