Math 10 Statistics Lab	Names	

Chapter 3 Lab: The M&M Experiment

Student Learning Outcome:

- The student will calculate theoretical and experimental probabilities.
- The student will appraise the differences between sampling with and without replacement.
- The student will demonstrate an understanding of long-term relative frequencies.

Directions:

1. Using the M&Ms provided by your instructor, record the number of each color below.

Color	Quantity
Yellow Y	
Green G	
Blue BL	
Brown BR	
Orange O	
Red R	
N = TOTAL	

2. Construct two tree diagrams (one for with replacement and the other for without replacement) showing the drawing of two M&Ms, one at a time, from the M&Ms you were given, as recorded in the table above. Then, using the information in the table in #1 complete the theoretical probability questions below. Show the appropriate arithmetic (such as 2/3 * 4/5 = 8/15) **Leave your answers in unreduced fractional form.** Attach the tree diagrams to your lab when you turn the lab in.

	With Replacement	Without Replacement
P(BL_1 and BL_2):		
P(BL_1 and BR2 or BR1 and BL_2):		
P(BL_1 and O_2):		
P($O_2 \mid BL_1$):		
P(no yellows on either draw):		
P(doubles):		
P(no doubles):		

Note: O_2 = orange on second pick; BL_1 = blue on first pick; BL_2 = blue on second pick; doubles = both picks are the same color. BR1= brown on first pick; BR2 = brown on second pick.

3. Put the M&M's in a cup and conduct the experiment of picking 2 M&M's, one at a time, **with replacement**. Do NOT look at them as you pick them. Repeat this experiment 23 more times. Remember, each experiment starts with N M&M's in the cup. Record the result of each experiment below.

With Replacement
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)
(.) (.)

4. Use the table in #3 above to answer the following probability questions. Remember you now have a sample space so you need only count the number of the experiments that fulfill what's being asked. **Leave your answers in unreduced fractional form. All answers MUST include both the numerator and the denominator.**

Experimental Probabilities

With Replacement

P(BL_1 and BL_2): _____

P(BL_1 and BR2 or BR1 and BL_2): _____

P(BL_1 and O_2): _____

P($O_2 \mid BL_1$): _____

P(no yellows on either draw): _____

P(doubles): _____

P(no doubles): _____

5. Repeat the experiment described in #3, only this time **without replacement**. Do NOT look at them as you pick them. Repeat this experiment 23 more times. Remember, each experiments starts with 40 M&M's in the cup. Record the result of each experiment below.

Without Replacement
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)
(,) (,)

6. Use the table in #5 to answer the following probability questions. Remember you now have a sample space so you need only count the number of the experiments that fulfill what's being asked. **Leave your answers in unreduced fractional form. All answers MUST include both the numerator and the denominator.**

Experimental Probabilities

Without Replacement

$P(BL_1$ and $BL_2)$: _____

$P(BL_1$ and BR2 or BR1 and $BL_2)$: _____

$P(BL_1$ and $O_2)$: _____

$P(O_2 \mid BL_1)$: _____

P(no yellows on either draw): _____

P(doubles): _____

P(no doubles): _____

Questions (answer in complete sentences):

1. Why are the "With Replacement" and "Without Replacement" probabilities different?

2. Convert **P(no yellows on either draw)** to decimal format for both Theoretical "With Replacement" and for Experimental "With Replacement". Round to 4 decimal places.

    a. Theoretical "With Replacement": **P(no yellows) =** _____

    b. Experimental "With Replacement": **P(no yellows) =** _____

    c. Are the decimal values "close"? _____ (yes or no)

    d. Did you expect them to be closer together or farther apart? _____ Why?

3. If you were to repeat this experiment another 24 times, why would experimental probability values change?

4. Would increasing the number of times the experiment is conducted cause the empirical probabilities and theoretical probabilities to be closer together or farther apart? How do you know?

5. Explain the differences in what $P(BL_1 \text{ and } O_2)$ and $P(O_2 \mid BL_1)$ represent. Hint: Think about the sample space for each probability.