Classroom Activity 10               Math 113          Name : _____
10 pts                        Intro to Applied Stats

## Materials Needed:
12 dice per group.

## Instructions:
Dice are often made by drilling holes out of the plastic and using paint to fill the holes. The paint is of less mass than the material the of the die and the paint doesn't completely fill the hole, so the dice should be slightly off center and the 5 and 6 sides should be lighter (therefore appearing more). We can roll one die 120 times or 12 dice ten times. We've opted for rolling 12 dice ten times.

1.  Roll the twelve dice and record the frequency of each side. Repeat the process nine more times so that there are 120 rolls total.

2.  Since we're rolling 120 dice, how many times should we expect each side to appear if the dice are fair?

3.  Total each row (should be 12) and each column as well as the grand total.

4.  Are the assumptions of a $\chi^2$ Goodness of Fit test met (write yes or no for each one)?

    a.  The data represent a random sample.
    b.  The sample data consists of frequency counts.
    c.  The expected frequency of each category is at least 5.

| Roll # | Frequency of Each Side | | | | | | Tot. |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| Obs | | | | | | | |

5.  The claim is that the dice are not fair because of the way the dots are created. Write the null and alternative hypotheses.

    $H_0$:

    $H_1$:

6.  At the $\alpha=0.10$ level of significance, what is the critical value?

7.  Copy the observed frequencies from the table on the first page and complete the table to calculate the test statistic.  Give at least three decimal places.

| Side | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| *Obs* | | | | | | | |
| *Exp* | | | | | | | |
| $(Obs - Exp)$ | | | | | | | |
| $(Obs - Exp)^2$ | | | | | | | |
| $\dfrac{(Obs - Exp)^2}{Exp}$ | | | | | | | |

8.  What is the value of the test statistic?

9.  Use Minitab to find the p-value.

10. The test statistic ( does / does not ) fall in the critical region.

11. The p-value is ( less / greater ) than the significance level.

12. The decision is to ( reject / retain ) the null hypothesis.

13. There ( is / is not ) enough evidence to ( reject / support ) the claim that the dice are not balanced.

14. There ( is / is not ) enough evidence to ( reject / support ) the claim that the dice are fair.

15. Now, collect the total observed frequencies from all of the groups in the class and total them to get the combined results for the class.

| Group | Number of Dots | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| | | | | | | | |
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| | | | | | | | |
| **Total Observed** | | | | | | | |

16. At the $\alpha=0.10$ level of significance, what is the critical value?

17. Draw a $\chi^2$ curve with the proper degrees of freedom and place the critical value on the curve. Shade and label the critical region. Label the non-critical region. Label the area in the critical and non-critical regions using the proper symbolism involving $\alpha$.

18. Copy the total observed frequencies from the table on the previous page and complete the table to calculate the test statistic. Give at least three decimal places.

| Side | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| *Obs* | | | | | | | |
| *Exp* | | | | | | | |
| $(Obs - Exp)$ | | | | | | | |
| $(Obs - Exp)^2$ | | | | | | | //// |
| $\dfrac{(Obs - Exp)^2}{Exp}$ | | | | | | | |

19. What is the value of the test statistic?

20. Use Minitab to find the p-value.

21. The test statistic ( does / does not ) fall in the critical region.

22. The p-value is ( less / greater ) than the significance level.

23. The decision is to ( reject / retain ) the null hypothesis.

24. There ( is / is not ) enough evidence to ( reject / support ) the claim that the dice are not balanced.

25. There ( is / is not ) enough evidence to ( reject / support ) the claim that the dice are fair.