

## Chi Square Modeling Using M & M's Candies

### Introduction:

The Chi Square test ( $\chi^2$ ) is often used in science to test if data you observe from an experiment is the same as the data that you would predict from the experiment. This investigation will help you to use the Chi Square test by allowing you to practice it with a population of familiar objects, M & M candies.

**Objectives:** Before you start this investigation you should be able to:

- write a null hypothesis that pertains to the investigation;
- determine the degrees of freedom (df) for an investigation;
- calculate the  $\chi^2$  value for a given set of data;
- use the critical values table to determine if the calculated value is equal to or less than the critical value;
- determine if the Chi Square value exceeds the critical value and if the null hypothesis is accepted or rejected.

After completing the investigation you should be able to:

- write and test a null hypothesis;
- determine the degrees of freedom (df) for an investigation;
- calculate the  $\chi^2$  value from observed data;
- use the critical value table to determine if the null hypothesis is rejected or accepted.

Materials:

- several 1lb. Bags of candies of M & M or other colored candies
- cups or other containers to hold candies
- calculator (one for every 2 students)
- critical value table (provided in the AP Lab Manual in Lab 7)

Procedure

1. Place the contents of a 1 lb. Bag of candies in a large dish or finger bowl. Record the different *Colors (classes)* in **Table 1** and in **Table 2**.
2. Without counting, estimate the number (percentage out of 100%) of the different colors of each color of the candies. Record the estimates in Table 1 under "Percentage Expected."

**Table 1**

Color of Candy	Number Observed (o)	Percentage Expected	Number Expected (e) (Total number of all pieces of candy X Percentage Expected)
	<b>Total # candies =</b>		

- In the space below, write a null hypothesis, which predicts the percentage of the different colors of candies.
- Count the number of each color of candy and record the number in **Table 1** under “Number Observed.”
- Calculate the number of each color expected in Table 1 and record under “Number Expected.”  
HINT: You must count all the colors and add the total number of M & M’s before you can calculate the number expected of each color.
- Record the numbers expected, and the numbers observed in **Table 2**.
- Complete the calculations and determine the Chi Square value.

**Table 2**

Classes (Colors)	Expected (e)	Observed (o)	$o-e$	$(o-e)^2$	$\frac{(o-e)^2}{e}$

Degrees of freedom = \_\_\_\_\_  $\Sigma =$  \_\_\_\_\_  
(number of classes – 1)

Analysis Questions:

- What is the  $\chi^2$  value for your data? \_\_\_\_\_
- What is the critical value ( $p = 0.05$ ) for your data? \_\_\_\_\_
- Is your null hypothesis accepted or rejected? Explain why or why not.
- If the null hypothesis is rejected, propose an alternate and recalculate the  $\chi^2$  value.