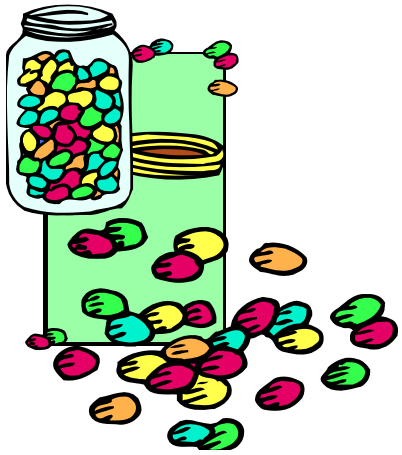
Chi Square (X^2)Modeling Using M & M's Candies

Introduction:

The Chi Square test (X^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. Calculating X^2 values allow you to determine if test results can be attributed to randomness or not. If the data differs greatly and it is not due to randomness, other factors must be influencing your results. 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:

- determine the degrees of freedom (df) for an investigation;
- calculate the X^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.

Biologists generally accept p=.05 as the cutoff for accepting or rejecting a hypothesis. If the difference between your observed data and your expected data would occur due to chance alone fewer than 1 time in 20 (p = 0.05) then the acceptability of your hypothesis may be questioned. Biologists consider a p value of .05 or less to be a "statistically significant" difference.

Materials:

- several 1lb. Bags of candies of M & M or other colored candies (Skittles)

Procedure

1. Place approximately 200 candies in a cup or bowl and **Record the different *Colors*** *(classes)* in **Table 1** and in **Table 2**. (You can also just look into your bag.)
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)
	Total # candies =		

3. In the space below, write a hypothesis, which predicts the percentage of the different colors of candies.

_____

_____

4. Count the number of each color of candy and record the number in **Table 1** under "Number Observed."
5. 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.
6. Record the numbers expected, and the numbers observed in **Table 2.**
7. 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 = _____ Σ = _____
(number of classes – 1)

Analysis Questions:

1. What is the X^2 value for your data? _____
2. What is the critical value for your data? _____
3. What is the ***p*** value for your X^2 statistic? _____
4. Given your p-value, create a statement that describes the "goodness of fit" of your data.
5. Given a critical value (p = 0.05) Is your hypothesis accepted or rejected? **Explain why or why not**.
6. If the hypothesis is rejected, propose an alternate hypothesis.
7. Suppose you were to obtain a Chi-square value of 7.82 or greater in your data analysis (with 2 degrees of freedom). What would this indicate?