AP Statistics Lesson 11.1

Comparing Counts NAME________________________________

1. What day of the week were you born? ______________ Collect tallies from the rest of the class. Is there evidence from our class's sample that the distribution of birthday days is uniform? Conduct a statistical procedure to support your claim.

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Observed Data							

_________ = ______________________ = ______________

What does a simulation show (use Statkey)? Under what assumption are we operating (null hypothesis)? Is this a valid hypothesis for this problem?

2. Mendel's Peas: 9/16, 3/16, 3/16, 1/16

	Round Yellow	Wrinkled Yellow	Round Green	Wrinkled Green
Observed	315	101	108	32
Expected				
χ^2				

3. Is the distribution of colors of M&M's in Mr. Ferris's big bag the same as the Mars Company claims? Let's get a SRS of 50 M&M's and find out! Serial number of bag: ___________________________

M&M'S MILK AND DARK CHOCOLATE HKP:
25% Blue, 25% Orange, 12.5% Green, 12.5% Yellow, 12.5% Red, 12.5% Brown
M&M'S MILK AND DARK CHOCOLATE CLV:
20.7% Blue, 20.5% Orange, 19.8% Green, 13.5% Yellow, 13.1% Red, 12.4% Brown

M&M's	Blue	Orange	Green	Yellow	Red	Brown
Observed						
Expected						

4. Now obtain your own cluster sample using a cup (either in pairs or groups). Conduct a X^2 Goodness of Fit test on the distributions of colors.

M&M's	Blue	Orange	Green	Yellow	Red	Brown
Observed						
Expected						

5. Biologists wish to cross pairs of tobacco plants having genetic makeup Gg, indicating that each plant has one dominant gene (G) and one recessive gene (g) for color. Each offspring plant will receive one gene for color from each parent. A Punnett square will predict that the offspring will be in a 1:2:1 ratio of GG (green) to Gg (yellow-green) to gg (albino). Do the data below differ significantly from what the biologists have predicted? Carry out an appropriate test at the alpha = 0.05 level.

Offspring Color	**Observed**		
Green	23		
Yellow-green	50		
Albino	11		
Totals:			

Hi Scott--
Sorry for my earlier short reply--I was trying to write it on my phone in a hurry.
Here are more details:

1) I have a big bag of M&M's and we ask: "Is the distribution of color in this large bag the same as what the company claims?" (Learning about the two different factories is a new twist. I'm not sure if I will try to take advantage of that fact in some way or just make sure I buy the bag in advance to know where it came from).

2) We take 1 SRS of size n = 50 M&M's for the entire class. We write the observed counts on the board and then I ask them to create a test statistic that measures how different the observed counts are from the expected percents. (This is obviously before I have taught them about the chi-sq statistic). Kids work in teams and I roam giving suggestions as necessary. Kids come up with lots of different approaches, but the most common is to sum the absolute values of the differences in percents.

3) We then talk about the different approaches and why one might be better: Compare percents or counts? (counts are better because they preserve info about sample size). Square the differences or use absolute values? (I ask them to trust me that squaring is better--more on this soon). Do anything else before summing? (almost no one does this, but I convince them that a "difference of 10" isn't really meaningful with out something to compare it to. A difference of 10 is a big deal if I was expecting 5, but not if I was expecting 1000000). This leads to the chi-square statistic.

4) We calculate the chi-sq statistic for the class data and I just keep staring at it on the board. Usually someone asks "Umm...so what does that number mean?" Occasionally someone says exactly what I want to hear: "Is that a big value or could it have happened just by chance?"

5) I turn to Fathom and we simulate samples from the claimed distribution to see what values of the chi-sq stat could happen by chance alone. This leads to a discussion of how a chi-sq distribution is a good fit for this sampling distribution--assuming conditions are met, and assuming we square the differences instead of using absolute values. (Fathom file attached, but it uses the old percentages).

I like this activity because it forces kids to think creatively about how we measure things--and because we can have a nice snack!

I hope this helps,
Josh Tabor (joshtabor@hotmail.com)

Let's also remember that since we are interested in the distribution of individual colors, mixing bags of M&Ms, besides violating some conditions, would be mixing cluster samples (since each bag is a cluster).

Nevertheless, since this is a Goodness-of-FIT test, we should not ignore a very large P value, and perhaps say something like the fit is very good if P > 0.95, while keeping in mind that a small P-value (say the usual P < alpha = 0.05) may really be a Type I error!

-- David Bee

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http://www.sbs.com.au/food/article/2017/03/16/statistician-got-curious-about-mm-colours-and-went-endearingly-geeky-quest?cx_cid=edm:food:1703016