Comparing Name Brand Lucky Charms And Generic brand Lucky Charms Marshmallow Content

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Introduction:

The purpose of this project was to see if the proportion of marshmallows in the name brand Lucky Charms cereal is greater than that found in the generic Kellogg's imitation brand of Lucky Charms. To complete this assignment, we took a completely random sample of grocery stores in our surrounding area. All grocery stores were chosen at random by using the Random.org website to maximize the randomness and to eliminate as much bias as possible. Once getting the numbers chosen from random.org, we collected the boxes of cereal accordingly, thus giving us our data. We also mention that we did take the first box of cereal off the shelf, however we can justify this because we can assume it has already been mixed by those who stocked the shelves as they were being taken out of boxes.

Definitions and Assumptions:

Our population is defined as the cereal boxes in Tuolumne and Stanislaus county.

Technically, our sample only applies to the cereal that was delivered between November 1 through November 7. However, our population of interest is at all times of the year. Our assumption is that our sample generalizes to all times of the year.

Sampling Design and Methodology:

To reduce bias in our study, we collected our sample by assigning the grocery stores in the locations of Oakdale, Riverbank, and Modesto a number and used Random.org to choose the stores randomly. Then we put the days of the week into Random.org to decide what day of the week we had to go to each grocery store. Once we had all the boxes, we hand-separated the marshmallows from the cereal with a few other classmates, and weighed the mass of marshmallow and non marshmallow content difference for each box. From there we recorded to the data with a electronic triple beam balance and baking scale. For each box we calculated the mass fraction as a percentage of marshmallows to total mass, that is,

$$\text{mass fraction} = \frac{\textit{mass of marshmallows}}{\textit{total mass of cereal}} \times 100.$$

The data we collected may be found in the appendix.

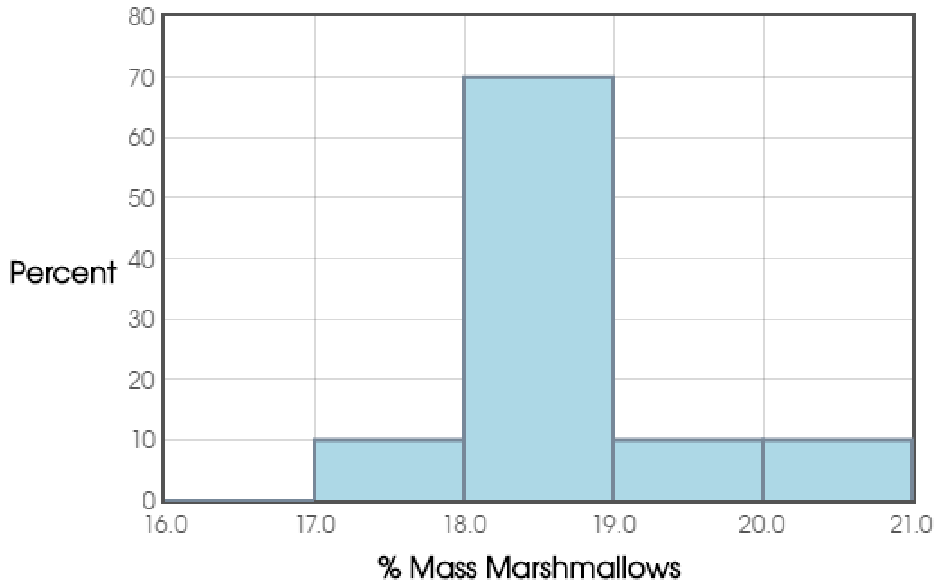
Problems We Encountered:

During this process we encountered a few problems. One of the main problems was when we went to go get the cereal not all of the places had the same off brand of lucky charms, we overcame this by generating another grocery store until we were able to fill all ten of the generic boxes of cereal. We must also mention that we purchased a different brand of cereal, and we did not realize until we were collecting our data. Our second problem that we encountered was that our scale was too crude, meaning that it was not precise enough. Luckily our teacher, Mr. Holt, was able to track down a more sensitive electronic to use so we could have more precise data.

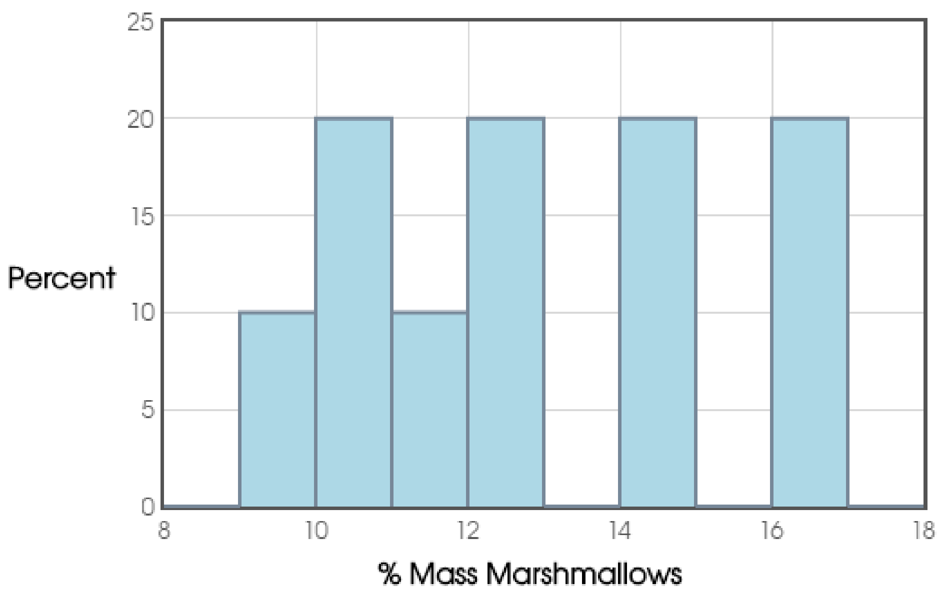
Analysis:

We computed a weight/mass fraction of marshmallows to total mass (see appendix for data). For each box we divided the weight of the marshmallows by the total weight. Below are the histograms comparing the mass fractions of both Lucky Charms brand cereal and the Kellogg's imitation brand.

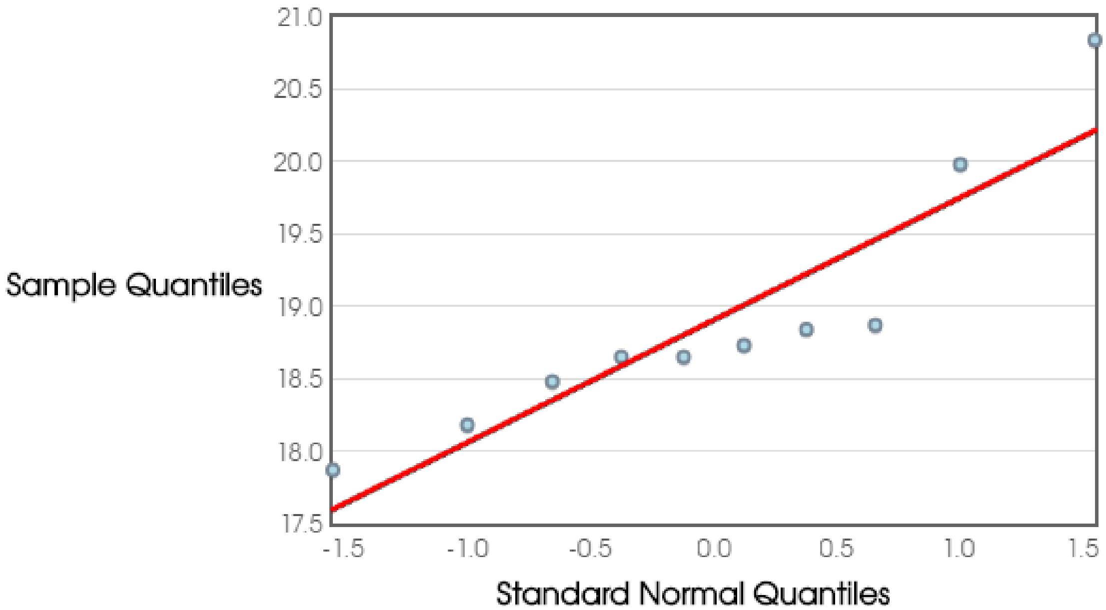
Lucky Charms



Kellogg's



Looking at the histograms, we decided to check normality using a normal probability plot on the Lucky Charms data. The following is the normal probability plot.



Number of Data Points: $n = 10$

Regression Line: $y = 0.8459x + 18.909$

Correlation: $r = 0.9122$

After this, we performed a PPCC test to see if the data was still significant. It is significant at the .05 level. Therefore we have evidence against non-normality for the Lucky Charms data. The Kellogg's data revealed no such departures from normality.

Despite evidence on non-normality in the Lucky Charms data we nonetheless compared the average of the mass fractions of the Lucky Charms, $\underline{x_L}$ and the average of the mass fractions at the generic brand $\underline{x_G}$ using the t procedures.

We then used a two-sample t hypothesis test for comparing two population means: In particular, we tested the hypotheses: Ho: muL=muG

Ha: muL>muG

The results (using holt.blue) of the Two-Sample t Hypothesis Test are given below:

Sample Sizes:	n_1 =10	n_2 =10
Sample Means:	$\overline{x}_1$ =18.909	$\overline{x}_2$ =12.959
Sample Standard Deviations:	s_1 =0.872	s_2 =2.495
Degrees of Freedom:	df =11	
Critical t Value:	t^* =2.20098	
95% Confidence Interval:	(4.11, 7.79)	
t statistic:	t =7.119	
p value:	p =0	

After we completed this test we wanted to double check our findings: as the overall sample size was low and the normality of the Lucky Charms data was slightly questionable, we therefore completed a Wilcoxon Rank Sum test. The below is output from holt.blue:

Sample Sizes:	n_1 =10	n_2 =10
Sample Medians:	M_1 =18.69	M_2 =12.59
W statistic:	W =145	
Mean of W under H_0:	μ_W =105	
Standard Deviation of W under H_0 (with tie correction):	σ_W =13.2238	
z Value for Test (with continuity correction):	z =2.987	
Critical z Value:	z^* =1.6449	
p-value:	p =0.0014	

Conclusion:

The p-value of our two-sample t-test is 0 and the p-value of the Wilcoxon Rank Sum test is .0014. Therefore, in both cases, we reject the null hypothesis. That is, there is good evidence that Lucky Charms brand name cereal has more marshmallows than generic off brand when measured as a mass fraction.

References:

______Holt, Benjamin. “Math 2.” *Mr. Holt's Homepage*, Jan. 2016, holt.blue/Math_2/homepage.html.
______Moore, David S., William Notz, and Michael A. Fligner. The Basic Practice of Statistics. New York: W.H. Freeman, 2015. Print.

Appendix:

Below is the data we collected.

Lucky Charms

Cereal & Marshmallows (g)	635.0	680.4	771.1	680.4	725.7	680.4	680.4	771.1	680.4	725.7
Marshmallows Only (g)	126.9	125.8	137.8	128.2	132.0	128.4	141.8	144.5	126.9	135.4
% Mass Marshmallows	19.98	18.48	17.87	18.84	18.18	18.87	20.84	18.73	18.65	18.65

Generic Lucky Charms

Cereal & Marshmallows (g)	283.5	255.1	255.1	283.5	255.1	255.1	311.8	226.8	311.8	311.8
Marshmallows Only (g)	31.3	32.2	43.2	35.6	41.5	37.5	34.0	32.2	34.1	29.4
% Mass Marshmallows	11.04	12.62	16.93	12.56	16.27	14.7	10.9	14.2	10.94	9.43