MATH E-3 Assignment 7 **TOTAL POSSIBLE POINTS = 100**

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PLEASE BE NEAT and SHOW YOUR WORK TO RECEIVE FULL OR PARTIAL CREDIT.

Z scores

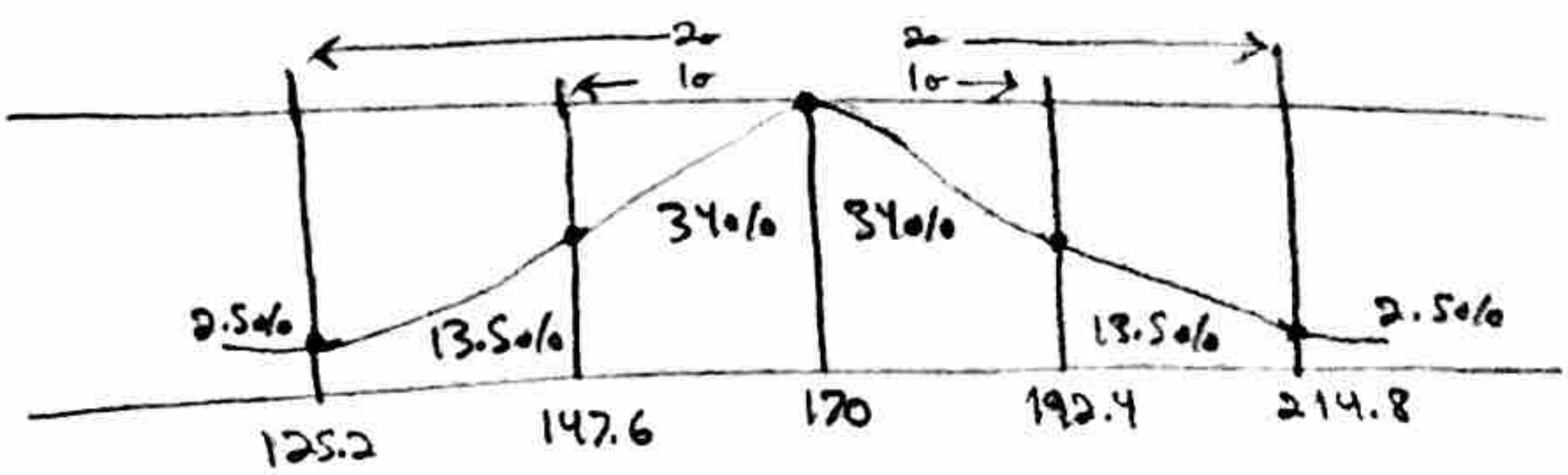
Please show your normal distribution curve. Refer to Z score tables at the end of the homework assignment to answer problems 2, 3, 6 and 11.

Round Z scores, standard deviations and percentages to 1 DP.
<u>Remember to round at the end.</u>

Problems 1-3

In a given population of males it is found that the mean weight is 170 lbs. Furthermore, the calculated standard deviation is 22.4 pounds. Assume the distribution of weights is normal.

1) Draw curve of the normal distribution of male weights. (3 points)



2) Use the Z score tables at the end of the assignment to calculate the percentage of males who have weights between 140 lbs and 170 lbs? (4 points)

$$z = \left|\frac{X - \bar{x}}{\sigma}\right| = \left|\frac{140-170}{22.4}\right| = \left|\frac{-30}{22.4}\right| = 1.33929 = 1.3$$

Graph A
.4032
↓
40.32
↓
40.3% of males have weights between 140 - 170 lbs.

3) Use the Z score tables at the end of the assignment to calculate the percentage of males who have weights between 155 lbs and 195 lbs? (5 points)

$$Z = \frac{X - \bar{X}}{\sigma} = \left|\frac{155 - 170}{22.4}\right| = \left|\frac{-15}{22.4}\right| = .669643 \rightarrow 0.7 \qquad \frac{\text{Graph A}}{.2580}$$

$$Z = \frac{X - \bar{X}}{\sigma} = \frac{195 - 170}{22.4} = \frac{25}{22.4} = 1.11607 \rightarrow 1.1 \qquad \frac{\text{Graph A}}{.3643}$$

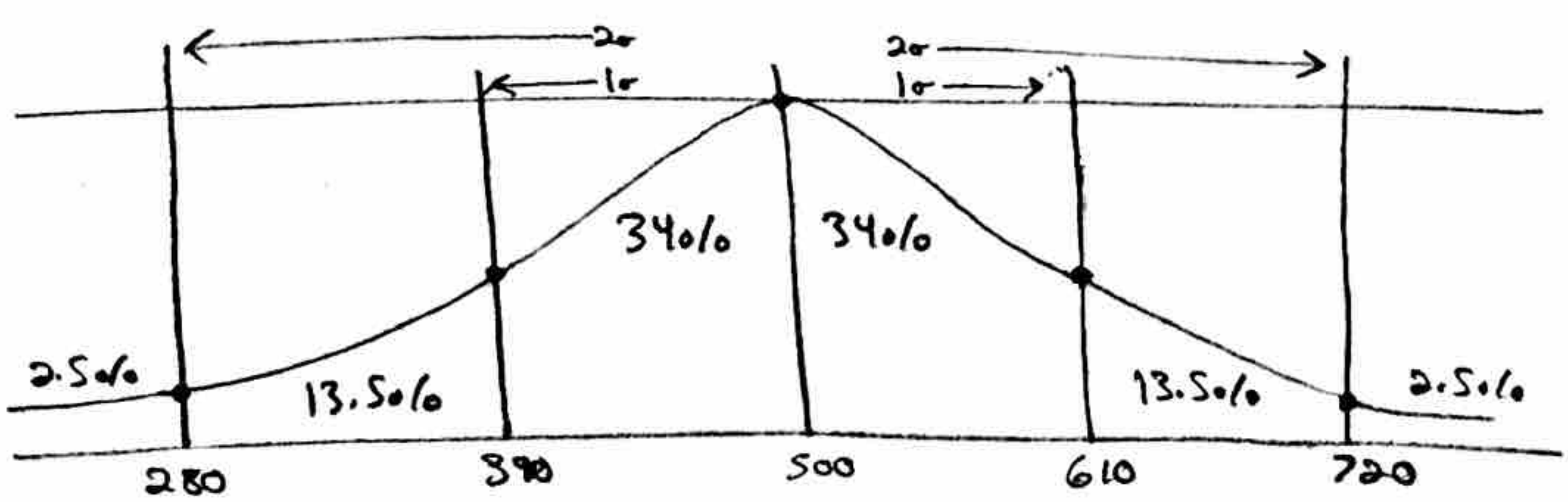
$$.2580 + .3643 = .6223 \approx 62.23 = 62.2\%$$

62.2% of males have weights between 155 - 195 lbs.

Problems 4-6

Suppose the scores on the Graduate Record Exam (GRE) are normally distributed with a mean of 500 and a standard deviation of 110.[1]

4) Draw curve of the distribution of GRE scores. (3 points)



[1] Problem adapted from *Using and Understanding Mathematics*. Jeffrey Bennett, William Briggs. Addison, Wesley, Longman, 1998.

5) If the graduate school you are interested in attending requires a GRE score of 630 for admission, how many standard deviations above the mean do you need to score? (2 points)

$$Z = \frac{X - \bar{x}}{\sigma} = \frac{630 - 500}{110} = \frac{130}{110} = 1.18182 \approx 1.2$$

1.2 standard deviations will get me a score of 630.

6) If the admission's officer chooses and applicant at random, what is the probability of finding a student who scores a grade over 700 on the GRE? Use the Z score table at the end of the assignment to help you answer this. (4 points)

$$Z = \frac{X - \bar{x}}{\sigma} = \frac{700 - 500}{110} = \frac{200}{110} = 1.81818 = 1.8$$

Graph B
.0359
↓
03.59
↓
3.6%

The probability of finding a student who scores a grade over 700 on the GRE is 3.6%.

Hypothesis Testing

For problems 7 through 12, assume all samples were randomly chosen even if not stated in the problem.

Make sure you follow the steps as outlined in class and the reading; be sure to include a diagram for each question, and remember to clearly state both the Null Hypothesis and the conclusion in each case.

Round standard deviations and percentages to 1 DP. <u>Remember to round at the end.</u>

Follow this format for full credit for problems 7, 8, 9, 10, and 12:

Step 1) State your Null Hypothesis – use words not just a percentage.
Step 2) Calculate the Standard Deviation.
Step 3) Draw your diagram with the mean and 1 and 2 standard deviations identified.
Step 4) Calculate (if necessary), state, and compare the observed percentage.
Step 5) Construct the proper sentence either rejecting or not rejecting the Null Hypothesis. Use the proper statistical language.
Step 6) Give an informal conclusion.

Problem 11 does not require a new hypothesis test.

Problem 7

(15 points)

The Beautiful Body Cosmetics Company claims that its new wart cream dissolves 54% of all warts with one application. A scientist from a competing company is given the job of disproving this claim. She purchases a few jars of the product and does her own tests. If this scientist tries the cream on several randomly selected people (and randomly selected warts!) and finds that after applying the cream to 300 warts, 158 of the unattractive warts disappeared with one application. Perform a hypothesis test and determine what the scientist would conclude about Beautiful Body's product.

H_0: New wart cream dissolves 54% of all warts with one application. $P = .54$, $n = 300$

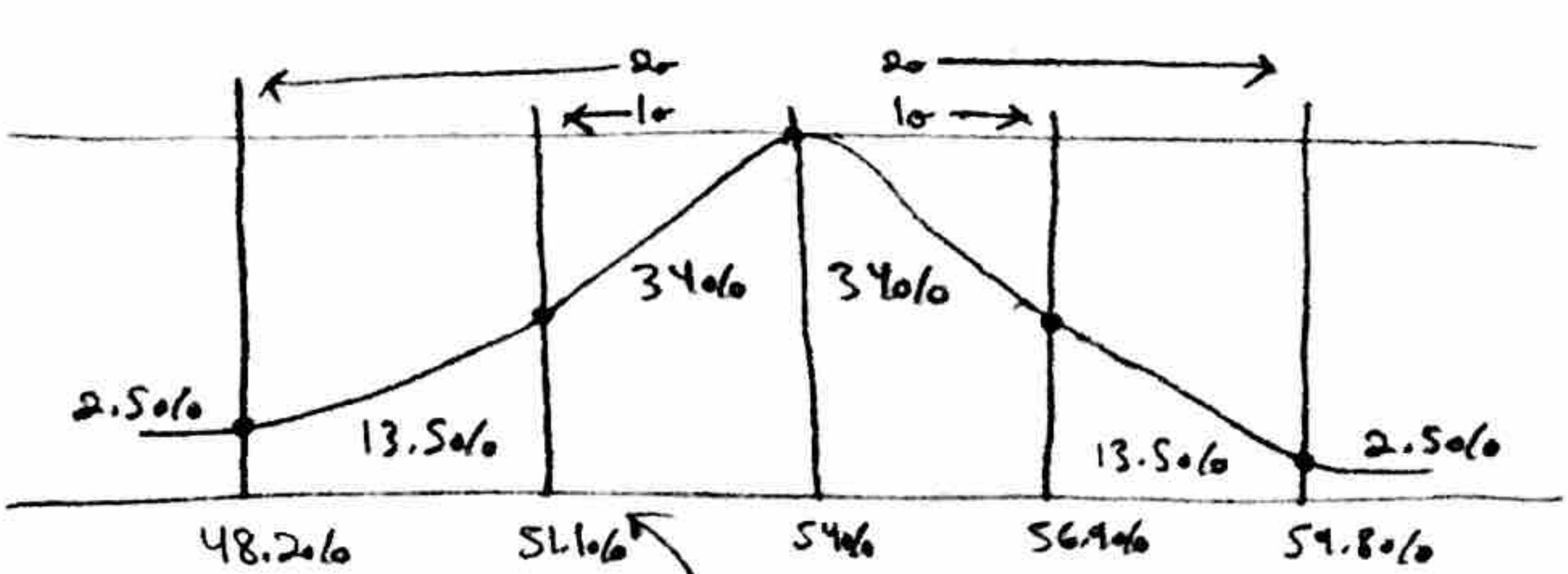
$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.54(1-.54)}{300}} = \sqrt{\frac{.54(.46)}{300}} = \sqrt{\frac{.2484}{300}} = \sqrt{.000828} = .028775$$

$\downarrow$

02.8775

$\downarrow$

$\sigma = 2.9\%$



$\frac{158}{300} = .526667$

$\downarrow$

52.6667

$\downarrow$

52.7%

The scientist would conclude that she/he cannot reject the claim of the new cream dissolving 54% of all warts with one application because 52.7% falls inside the 95% interval at a 5% level of significance.

I conclude that Beautiful Body Cosmetics Company is accurate in their statements, however this may not be true.

Problem 8 (This was an issue a few years ago, when Trent Lott was in the Senate) (15 points)

Senator Lott claims that 50% of Americans want federal funding for PBS cut. You, a devout fan of "Barney" and "Lamb Chop" (sadly, Shari Lewis passed away in 1998), are deeply suspicious of this claim. So, you decide to take your own *unbiased* poll. You sample 250 people and find that 46% want to see the cuts in funding. Perform a hypothesis test, and give your conclusions.

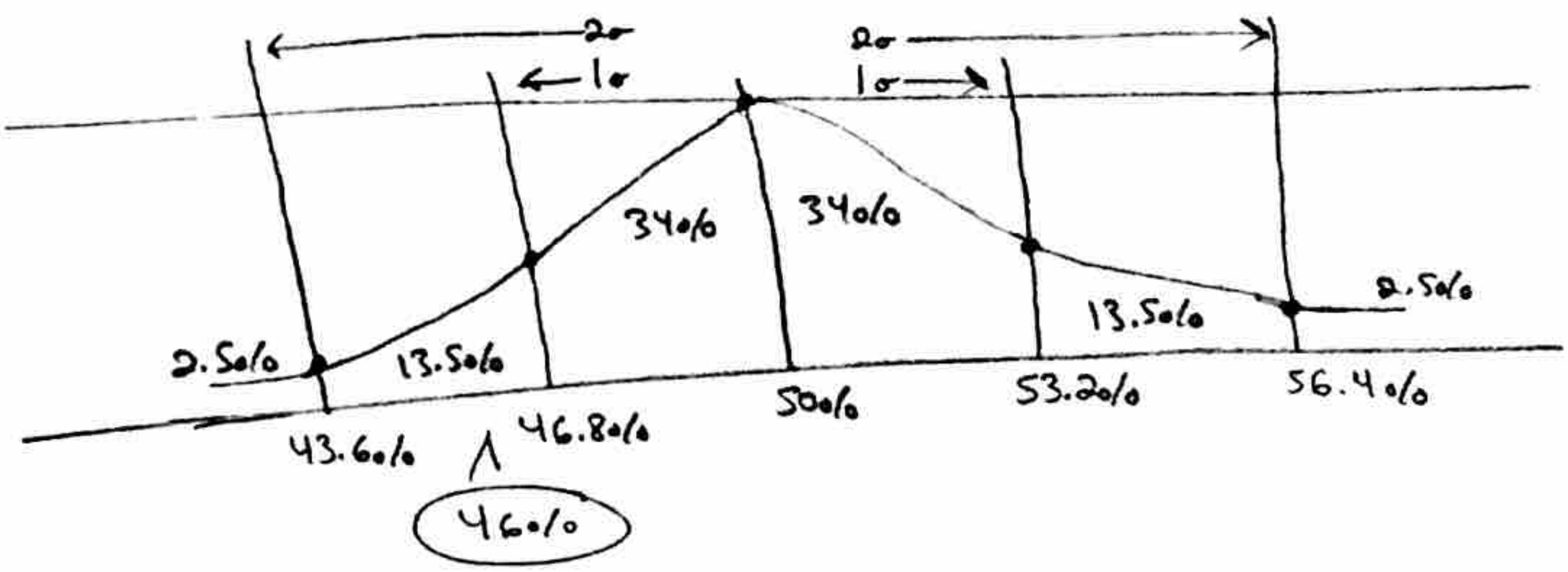
H_0: Senator Lott claims that 50% of Americans want federal funding for PBS cut.

$p = .5$, $n = 250$

$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.5(1-.5)}{250}} = \sqrt{\frac{.5(.5)}{250}} = \sqrt{\frac{.25}{250}} = \sqrt{.001} = .031623$$

03.1623

$\sigma = 3.2\%$



I cannot reject the claim that 50% of Americans want federal funding for PBS cut because 46% falls inside the 95% interval at 5% level of significance.

I can conclude that Senator Lott is accurate in his statement about the cuts.

Problem 9 (15 points)

You decide to take another sample of people to find out for sure about the public's opinion on cuts to PBS, this time of 1500 people. From this sample, 700 folks favor the cuts. Perform another hypothesis test. What is your conclusion this time? If your conclusion is different than in problem 8 above, explain *why* there is a difference. Ho: 50% of Americans want funding for PBS cut.

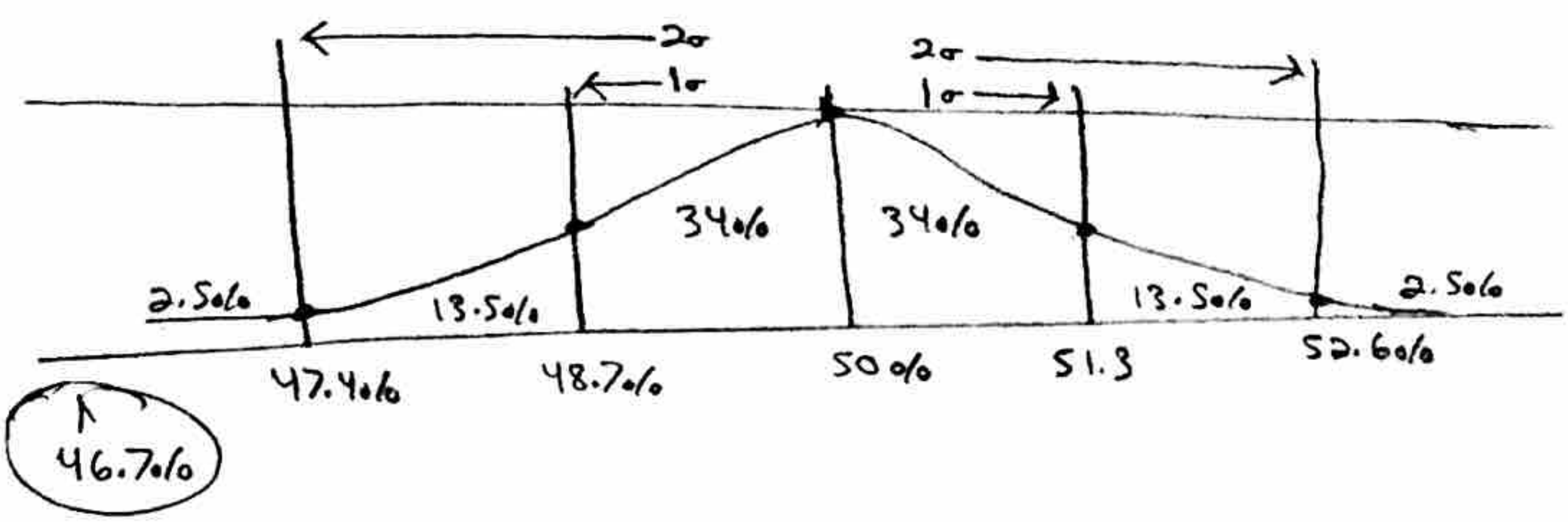
$p = .5$

$n = 1500$

$\frac{700}{1500} = .466667 = 46.6667 \rightarrow 46.7\%$

$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.5(1-.5)}{1500}} = \sqrt{\frac{.5(.5)}{1500}} = \sqrt{\frac{.25}{1500}} = \sqrt{.000167} = .012923 \rightarrow 01.2923$$

$\sigma = 1.3\%$



We can reject the claim that 50% of Americans want federal funding for PBS cut since 46.7% fall outside the 95% interval at 5% level of significance.

I conclude that Senator Lott is not accurate in his statement, however this is not certain.

A larger sample of 1500 compare to 250 people results in a smaller standard deviation of 1.3%.

Problem 10 (15 points)

The Mars Company, maker of M&M's, recently claimed that M&M's were so much fun because they were a perfect rainbow, that is, each bag they made contained equal numbers of each of the five colors. An enterprising student decided to test this and bought one small bag, chosen at random. The number of M&M's found for each color was:

Brown:	19/48 = .395833 = 39.5833 = 39.6%
Blue:	5/48 = .104167 = 10.4167 = 10.4%
Green:	5/48 = .104167 = 10.4167 = 10.4%
Orange:	9/48 = .1875 = 18.8 = 18.8%
Yellow:	10/48 = .208333 = 20.8333 = 20.8%
	48

Perform a hypothesis test and state your conclusions about Mars' claim.

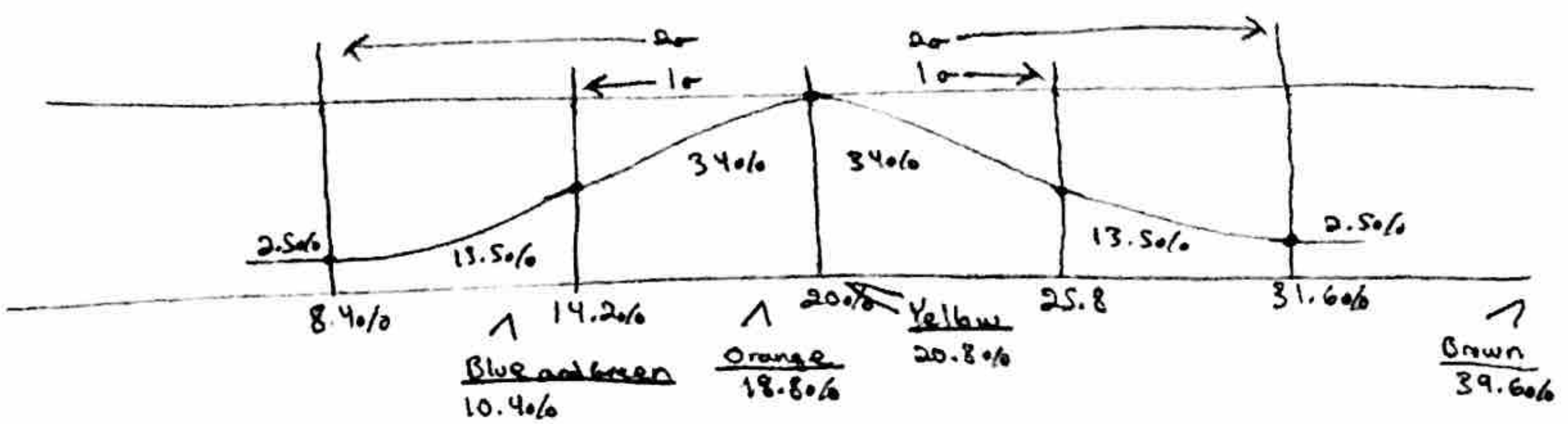
$P = P(\text{Every M and M bag contained equal numbers of each of the five colors}) = 1/5 = .2 \rightarrow 20\%$

H_0: Each bag contain equal numbers of each of the five colors.

$P = .2$

$n = 48$

$$\sigma = \sqrt{\frac{P(1-P)}{n}} = \sqrt{\frac{.2(1-.2)}{48}} = \sqrt{\frac{.2(.8)}{48}} = \sqrt{\frac{.16}{48}} = \sqrt{.003333} = .057732 \rightarrow 05.7732 \rightarrow 5.8\%$$



We can reject the claim that each bag contain equal numbers of each of the five colors because the color brown falls outside of the 95% interval at 39.6% with a 5% level of significance.

I can conclude that Mars is not accurate in the claim.

Problem 11 (4 points)

Refer to problem 10 above. If the colors were in equal numbers, what would be the <u>probability</u> that a random sample of 48 M&M's will have the above proportion of brown ones? (Hint: Go back to the Normal Distribution Curve and look at the probabilities under the curve.) No need to perform another hypothesis test here.

P(Random Sample of 48 M and M's will have the same probability of brown ones)

P(BrownColors) = 39.6%, $\bar{x} = 20\%$, $\sigma = 5.8\%$

$$Z = \frac{X - \bar{x}}{\sigma} = \frac{39.6 - 20}{5.8} = \frac{19.6}{5.8} = 3.37931$$

$$\downarrow$$

$$z = 3.4$$

<u>Graph B</u>

00.03 % = P(Random Sample of 48 M and M's will have the same probability of brown ones)

Problem 12 (15 points)

A psychologist wants to test whether very young children are especially attracted to bright 'crayon box' colors. Thus, she places her young subjects in a playroom with three balls to choose from:

> one is striped with <u>black and white</u>
> one is made up of two assorted <u>pastels shades</u>
> the last is striped with two <u>bright primary colors.</u>

The balls are identical in all other respects and their position is shuffled between trials so that it will not influence the results. From her observations she found that of the 80 toddlers she tested, 42 went for the brightly colored ball.

Formulate an appropriate null hypothesis as if you were the researcher, and perform a hypothesis test. (Remember that in hypothesis testing, you must have a proportion (percent) to work with. Think carefully about this percentage.) At the end, state your conclusion explicitly, i.e. do children tend to show a preference for bright colors?

12. $P = P(\text{Children will pick the } \underbrace{\text{bright stripped ball}}_{1} \text{ out of } \underbrace{\text{all balls}}_{3}) = 1/3 = .\overline{3}$

H_0: There is a 33.3% chance that children will choose the brightly striped ball.

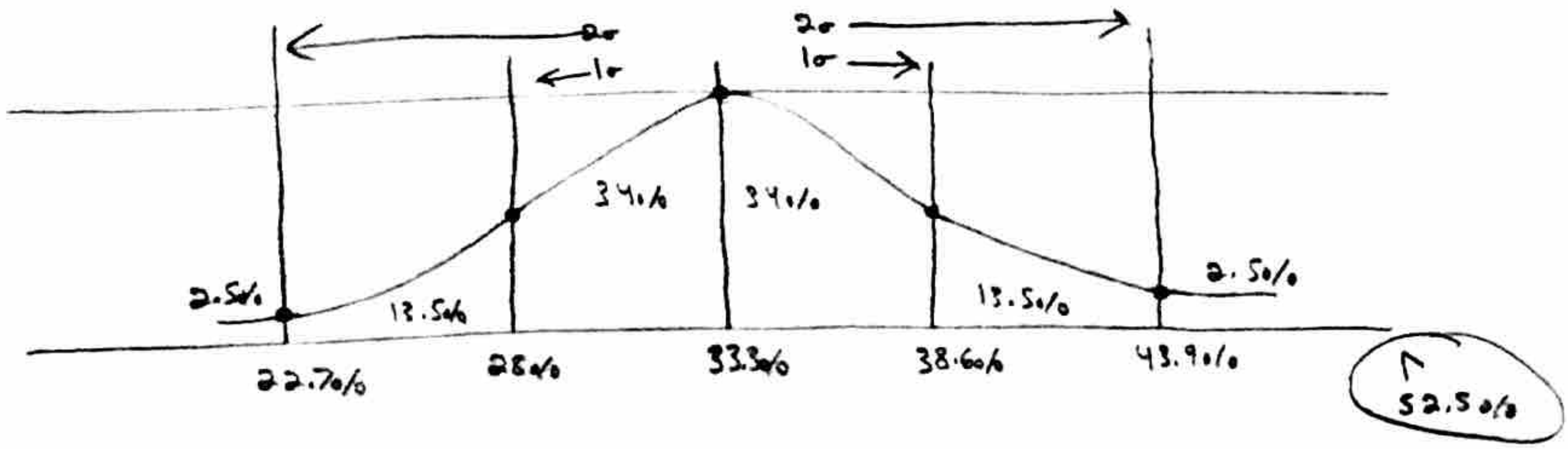
$p = .333$ observed % → $\frac{42}{80} = .525 = 52.5\%$

$n = 80$

$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.333(1-.333)}{80}} = \sqrt{\frac{.333(.667)}{80}} = \sqrt{\frac{.222111}{80}} = \sqrt{.002776} = .052688$$

05.2688

$\sigma = 5.3\%$



I can reject my claim that there is a 33.3% chance of children choosing the brightly striped ball because 52.5% out of the 80 children sampled fall outside of the 95% interval with a level of significance of 5%.

I can conclude that children attracted to bright 'crayon box' colors are attracted to bright 'striped' balls, however this might not be true. Overall, there seem to be a trend that more children are attracted to bright colors from the sample.