Math 247: Test 2 (Take Home) **Name:** KEY
(20 points)

*In-Class Test*_____*/80* *Take-Home Test*_____*/20*

- *This exam is due at the beginning of class on Thursday, 10/5/2017 You may work with other people in the class but not with tutors, other instructors, etc. Be sure that all answers are written in your own words; i.e., do not write verbatim the same answer as another student.*
- *Your work can be typed or NEATLY handwritten.*
- *Your work should incorporate all of the Minitab work mentioned below; i.e., copy and paste the Minitab results into your write-up.*

Scoring will be based on organization of your work, accuracy, and thoughtful, well-written answers.

Answer all of the following questions on another piece of paper and attach to this cover sheet. Use complete sentences in your answers!

Do certain car colors get more speeding tickets than others?

1. What is your initial impression? Are there certain colors of cars that you think would be more likely to get a speeding ticket? Briefly explain your answer (no math, here, folks, just your opinion and why you have it!).

Suppose the percentages of car colors for all cars registered in California are Red 14%; White/Silver 35%; Grey/Black 23%; Other 28%.

Next , the data shows the car color and number of speeding tickets for a random sample of 120 tickets.

Color	Red	White/Silver	Grey/Black	Other
Number of Tickets	16	33	39	32

2. Do these data show that there is a difference between the overall proportions of car colors and the proportion of tickets different colors receive? Perform a Chi-Square Goodness of Fit Test by hand to answer this question. Use .05 as the level of significance.

3. Next, use Minitab to confirm your results. Paste the Minitab display of the test results and also the graphs into a document, print it out, and include it with this packet.

4. Answer the follow-up questions:

   Which car color got more tickets than "expected?

   Which color got fewer tickets than "expected?

   Did the data show that, for the cars in the sample, some colors were more likely to be ticketed? Explain.

   Did this data provide enough evidence to show that, for all cars, not just this sample, some colors of cars are more likely to be ticketed? Explain your answer in terms of the results of the hypothesis test.

Take Home Test 2 Key

1. Answers will vary. (Personally, I would have thought brightly colored cars would be more likely to get tickets since they're more visible and often are the color of more sporty vehicles.)

2. ***The Goodness of Fit Test (By Hand)***

Hypotheses:

H_0: The proportions of colors for ticketed cars are the same as the overall proportions of colors for all cars. Specifically: $p_{red} = .14$; $p_{white/silver} = .35$; $p_{grey/black} = .23$; $p_{other} = .28$

H_a: At least one proportion is different; some colors of cars are more likely to be ticketed.

Car Color	Observed Counts (O)	Hypothesized Proportions	Expected Counts (E)	Note: n = 120 tickets E = np = 120p
Red	16	.14	16.8	
White/Silver	33	.35	42.0	
Grey/Black	39	.23	27.6	
Other	32	.28	33.6	

Level of Significance: I'll use the standard .05 level of significance.

Check Conditions for Test to be valid:

Random sample? Yes, we were told it was.
Independent Measurements? One car getting a ticket doesn't affect another so yes, independent.
Large Sample? Yes, all expected counts are greater than 5.

Find the Test Statistic: $\chi^2 = \frac{(16-16.8)^2}{16.8} + \frac{(33-42.0)^2}{42.0} + \frac{(39-27.6)^2}{27.6} + \frac{(32-33.6)^2}{33.6} = 6.752$

Df = number of categories – 1 = 4 – 1 = 3

Find the P-value: Online Chi-Square Calculator results: P-value = .0802

Conclusion:

P-value = .0802 > .05 = Level of Significance

Do not reject H_0.

There is not statistically significant evidence to conclude that some colors of cars are more likely to be ticketed. Another way to say this would be that there is not a statistically significant difference between the overall car color proportions and the ticketed car color proportions.

3. ***Minitab:*** The Minitab work shown below confirms the By-Hand work done previously.

Chi-Square Goodness-of-Fit Test for Observed Counts in Variable: Observed Counts

Category	Observed	Test Proportion	Expected	Contribution to Chi-Sq
Red	16	0.14	16.8	0.03810
White/Silver	33	0.35	42.0	1.92857
Grey/Black	39	0.23	27.6	4.70870
Other	32	0.28	33.6	0.07619

N	DF	Chi-Sq	P-Value
120	3	6.75155	0.080

4. Answer the follow-up questions:

***Which car color got more tickets than "expected*?**

The Grey/Black cars got more tickets than expected.

We can see that in the table and also we can see that in Chart of Observed and Expected Values.

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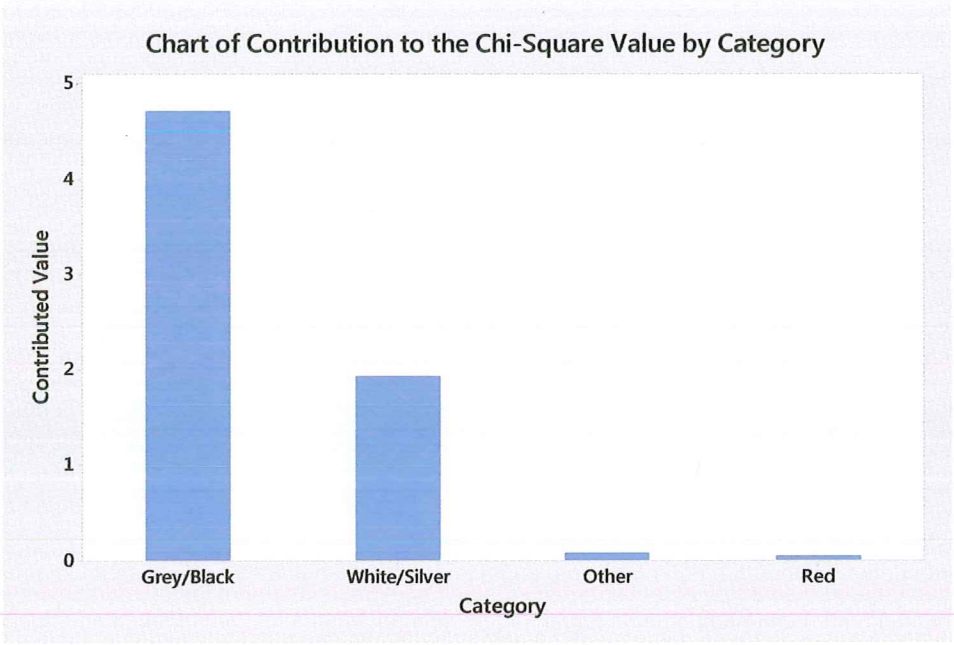
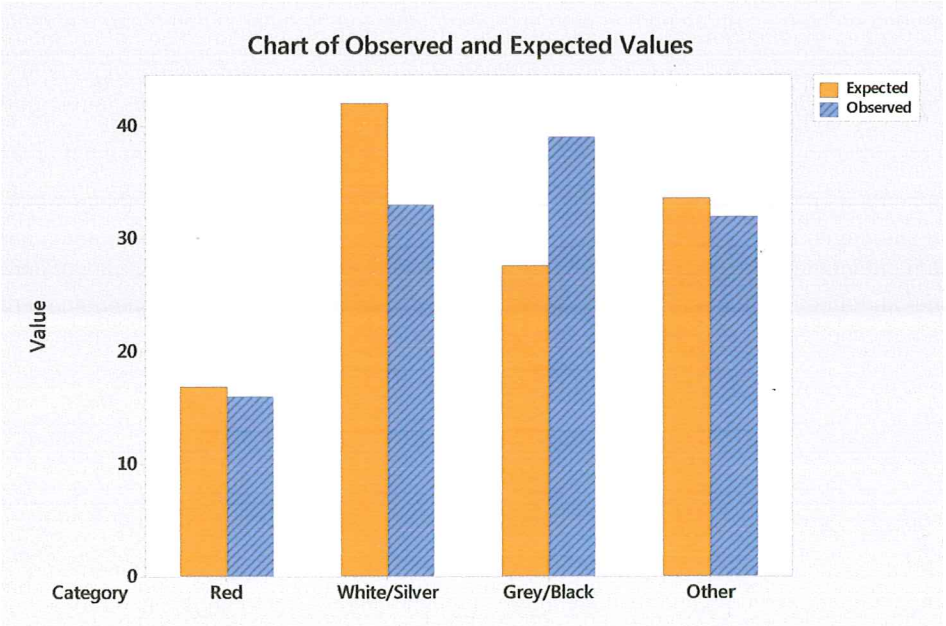


Which color got fewer tickets than "expected?

The Red, White/Silver, and Other car colors all got fewer tickets than expected.

We can see that in the table and in the Chart of Observed and Expected Values.



Did the data show that, <u>for the cars in the sample</u>, some colors were more likely to be ticketed? Explain.

Yes, in the sample, the Grey/Black cars were ticketed at a much higher rate than expected. Based on the overall proportions, we expected only 27.6 of these cars to get ticketed but in the sample, 39 out of the 120 cars got ticketed.

Did this data provide enough evidence to show that, <u>for all cars</u>, not just this sample, some colors of cars are more likely to be ticketed? Explain your answer in terms of the results of the hypothesis test.

No, this data does not provide evidence that some cars are more likely to be ticketed.

Even though the numbers in the sample showed some cars (Grey/Black) as more likely to be ticketed, this could be due just to sampling variability. So the question is, is the difference between the Observed Results and Expected Results large enough to tell us that, overall, the proportion of ticketed cars truly IS different from the overall proportion of car colors?

Since our P-value from the hypothesis test is .08, this tells us that there is an 8% probability that we would see these differences in the sample data from what we expected to see, even if the ticket proportions truly are the same as the overall car color proportions. This is a small probability, but it isn't small enough to rule out sampling variability as the reason we saw those differences, so this is why we fail to reject the null hypothesis and thus fail to conclude that some colors of cars IN THE ENTIRE POPULATION OF TICKETED CARS get more than their share of tickets.