You are allowed to operate a calculator and refer to one page (front and back of standard 8.5 by 11 inch sheet) of notes while taking this examination. Your solutions should be clear, complete, and sufficiently detailed in order to demonstrate your understanding and communicate your reasoning and method of solving the problem. Each problem will be evaluated on a 5-point standard rubric.

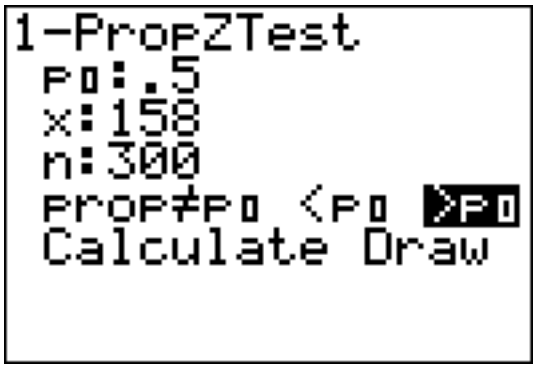
Student's Name

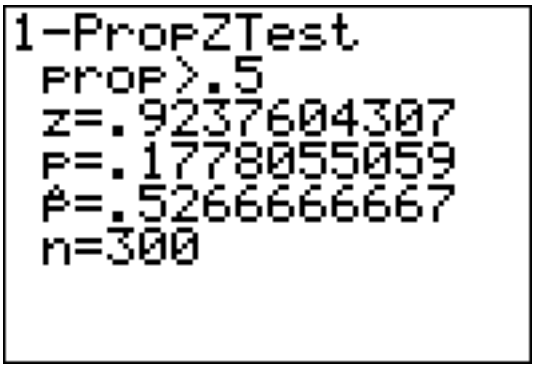
Problem 1

The investment firm Brown & Johnson reported that 52.7% of 300 randomly selected American households owned stocks. Does this result provide sufficient sample evidence to indicate that a majority of households in America own stocks? Use $\alpha = 0.05$.

$$H_0 : p \le 50\%$$
$$H_1 : p > 50\%$$

Use $\alpha = 0.05$ $\qquad$ $x = n \cdot \hat{p} = 300 \cdot 0.527 = 158.1 \approx 158$





p-value ≈ 0.178

Since the p-value of 0.178 is not 0.05 or less, the decision is to not reject H_0.

Therefore, this result does not provide sufficient sample evidence to indicate that a majority of households in America own stocks.

Problem 2

The results of a nationwide Gallup poll concerning a person's race and their opinion on the death penalty are summarized in the table below.

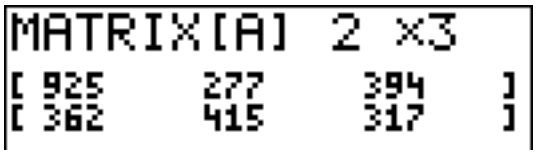
		Person's Race		
		White	Black	Hispanic
Person's Opinion on the Death Penalty	In Favor	925	277	394
	Opposed	362	415	317

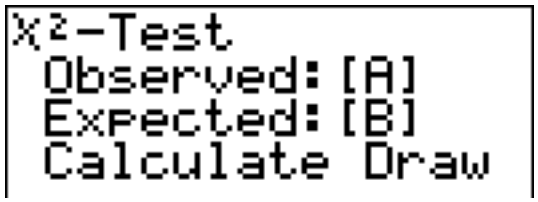
(a) Is a person's opinion on the death penalty independent of their race at the 1% level of significance?

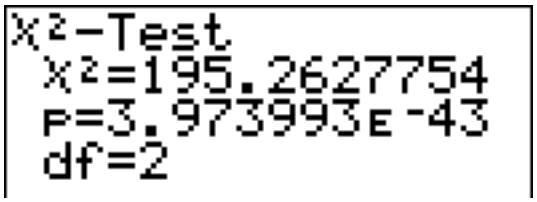
H_0 : The events are independent.

H_1 : The events are not independent.

Use $\alpha = 1\%$







$\text{p-value} \approx 4.0E-43 \approx 0.000$

Since the p-value of 0.000 is 0.01 or less, the decision is to reject H_0.

Therefore, a person's opinion on the death penalty is not independent of their race at the 1% level of significance.

(b) Based on these results, what can one conclude about the relationship between a person's race and their opinion on the death penalty?

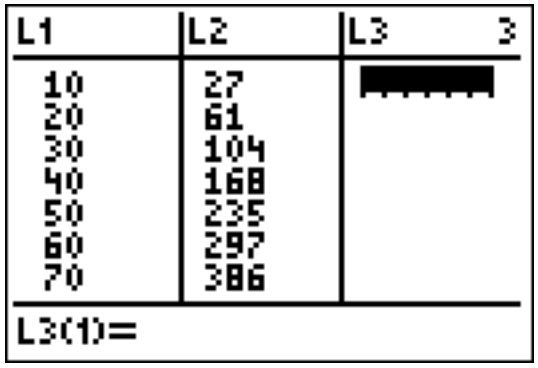
Based on these results, one can conclude that a person's opinion on the death penalty is related to their race. The data indicate that both whites and Hispanics are more likely to be in favor of the death penalty, whereas blacks are less likely to be in favor of the death penalty.

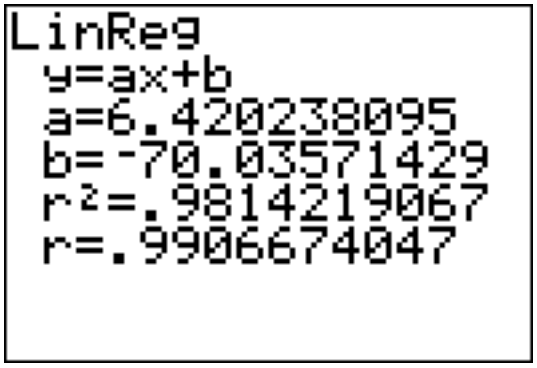
Problem 3

The total stopping distance (in feet) was measured for a midsize four-door sedan driving in dry conditions at various speeds. The resulting data are presented in the table below.

Speed (in mph)	10	20	30	40	50	60	70	80
Total Stopping Distance	27	61	104	168	235	297	386	473

(a) Determine the linear regression model that will best predict the total stopping distance for a midsize four-door sedan driving in dry conditions based on the speed of the vehicle.





The linear regression model is $\hat{y} = 6.42x - 70.04$

(b) How well does the linear regression model fit this sample data?

Since the coefficient of determination $r^2 \approx 0.981$ is very close to 1, the linear regression model fits this sample data very well.

(c) Predict the total stopping distance for a midsize four-door sedan driving at a speed of 65 mph in dry conditions.

For $x = 65$, $\hat{y} = 6.42 \cdot (65) - 70.04 \approx 347.26$

Thus, the total stopping distance for a midsize four-door sedan driving at a speed of 65 mph in dry conditions is predicted to be 347.3 feet.

Problem 4

Every day for an entire week, a cup of coffee was purchased at Starbucks, McDonalds, and Dunkin Donuts. The temperature (in °F) was determined immediately after the cup of coffee was served. The following table contains the sample results.

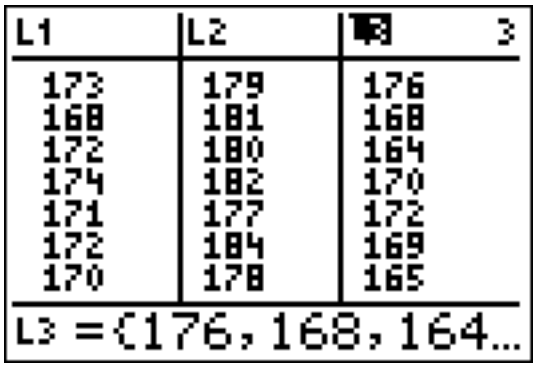
Establishment	Serving Temperature (in °F) of Cup of Coffee						
Starbucks	173	168	172	174	171	172	170
McDonalds	179	181	180	182	177	184	178
Dunkin Donuts	176	168	164	170	172	169	165

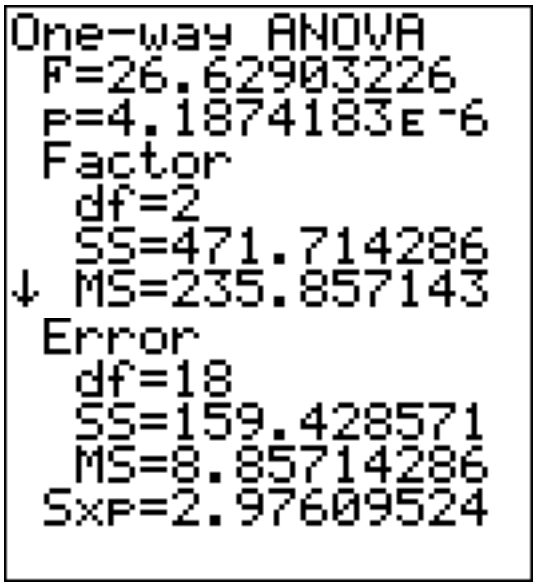
Conduct a hypothesis test using $\alpha = 0.05$ to determine whether the mean serving temperature of a cup of coffee is the same at Starbucks, McDonalds, and Dunkin Donuts.

H_0 : All of the population means are equal.

H_1 : Not all of the population means are equal.

Use $\alpha = 0.05$





p-value $\approx 4.2E-6 \approx 0.000$

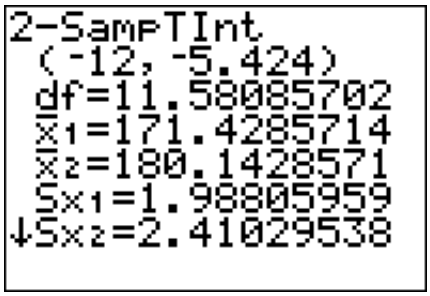
Since the p-value of 0.000 is 0.05 or less, the decision is to reject H_0.

Therefore, the mean serving temperature of a cup of coffee is not all the same at Starbucks, McDonalds, and Dunkin Donuts.

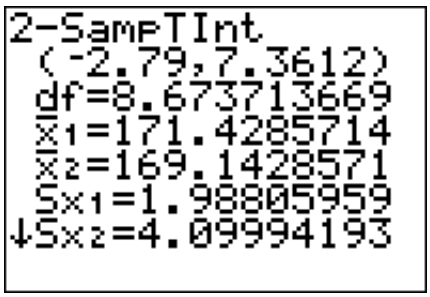
Problem 5

Use the sample data collected in Problem 4 to construct all pairwise comparison confidence intervals to estimate the difference in the mean serving temperature of a cup of coffee at Starbucks, McDonalds, and Dunkin Donuts with a simultaneous confidence level of 95%. Interpret the results.

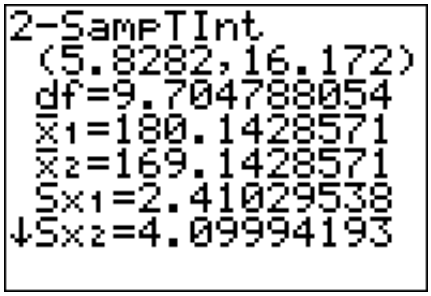
For the 3 pairwise comparison confidence intervals, use an individual confidence level of $1 - \alpha = \sqrt[3]{0.95} \approx 0.983$



$$-12 < \mu_1 - \mu_2 < -5.4$$



$$-2.8 < \mu_1 - \mu_3 < 7.4$$



$$5.8 < \mu_2 - \mu_3 < 16.2$$

Thus, the mean serving temperature of a cup of coffee at McDonalds is anywhere from 5.4°F to 12°F higher than that at Starbucks and anywhere from 5.8°F to 16.2°F higher than that at Dunkin Donuts.

Furthermore, there is no significant difference in the mean serving temperature of a cup of coffee at Starbucks and Dunkin Donuts.

Problem 6

The Fish and Game Department stocked Lake Loomis with fish according to the following percentages: 10% catfish, 30% bass, 40% bluegill, and 20% pike. Five years later they sampled the lake to see if the distribution of fish had changed. Of the 500 fish in their sample, 62 were catfish, 108 were bass, 204 were bluegill, and 126 were pike.

Use a Chi-Squared test to determine whether the distribution of fish in Lake Loomis had changed significantly over this five-year period. Based on this result, what conclusion should the Fish and Game Department reach?

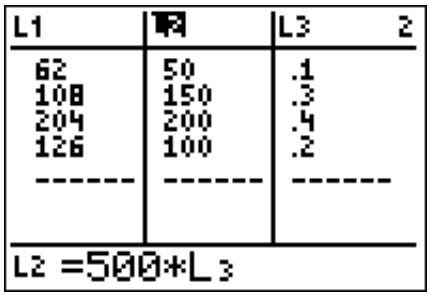
H_0 : All of the expected frequencies fit the observed frequencies.

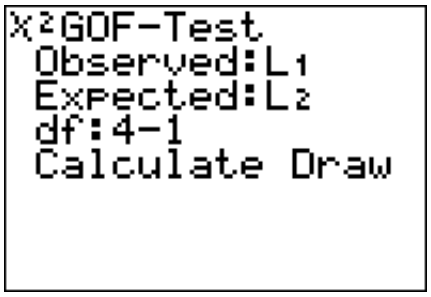
H_1 : Not all of the expected frequencies fit the observed frequencies.

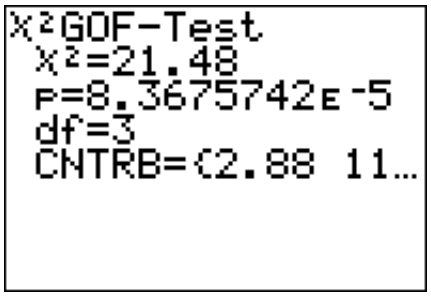
Use $\alpha = 0.05$

$n = 62 + 108 + 204 + 126 = 500$

$E_i = n \cdot p_i$ $\qquad$ $df = c - 1 = 4 - 1 = 3$







p-value $\approx 8.4E-5 \approx 0.000$

Since the p-value of 0.000 is 0.05 or less, the decision is to reject H_0.

Therefore, not all of the expected frequencies fit the observed frequencies. So, based on this result, the Fish and Game Department should reach the conclusion that the distribution of fish in Lake Loomis had changed significantly over this five-year period. The data indicate that the proportion of Bass has decreased while the proportion of Pike has increased.