Math 131 Exam Four

Name: __________________________

Please show your work. Use of a calculator is permitted.

1. A government agency requires that automobile emissions are less than 30 parts per million of carbon, and an automobile company would like to demonstrate that a new model of car meets this standard. In a sample of 200 cars of this type, the average emissions level is 29.06 ppm, and the standard deviation is 7.38 ppm.

   (a) Use this data to perform the following hypothesis test at the 5% significance level.

   \[ H_0 : \mu = 30 \quad \text{vs.} \quad H_a : \mu < 30 \]

   (b) Find the \( p \)-value for this test.

   (c) Has the auto manufacturer provided strong evidence that their cars meet the emissions standard?
2. It is often assumed that coins are fair, meaning that a flipped coin has a 50% chance of landing heads up and a 50% chance of landing tails up. To test this assumption, a student flips a quarter 1000 times, and it lands heads up 522 times.

(a) Use this data to perform the following hypothesis test at the 1% significance level.

\[ H_0 : p = 0.5 \text{ vs. } H_a : p \neq 0.5 \]

(b) Find the \( p \)-value for this test.

(c) Has the student provided strong evidence that the coin is fair?
3. Scores on the math portion of the SAT are normally distributed with mean 508 and standard deviation 111. A random sample of 20 students were tutored in math before taking the SAT, and their scores on the math portion had a mean of 553 and a standard deviation of 105.

(a) Use this data to perform the following hypothesis test at the 5% significance level.

\[ H_0 : \mu = 508 \text{ vs. } H_a : \mu > 508 \]

(b) Does this data provide strong evidence that the tutoring service improves performance on the math portion of the SAT?
4. A state senator has decided to run for governor if her approval rating is at least 40%. In a sample of 2000 voters, 841 approved of the senator’s job performance.

(a) Use this data to perform the following hypothesis test at the 5% significance level.

\[ H_0 : p = 0.4 \text{ vs. } H_a : p > 0.4 \]

(b) Does this data provide strong evidence that the senator’s approval rating is over 40%?
5. In a sample of size 750, the sample mean was 354, and the sample standard deviation was 58. Based on this data, perform the following hypothesis test at the 5% significance level.

\[ H_0 : \mu = 350 \text{ vs. } H_a : \mu \neq 350 \]

6. A sample of size 15 was taken from a normally distributed population, the sample mean was 6.12, and the sample standard deviation was 3.87. Based on this data, perform the following hypothesis test at the 5% significance level.

\[ H_0 : \mu = 8 \text{ vs. } H_a : \mu \neq 8 \]