



## “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 25 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

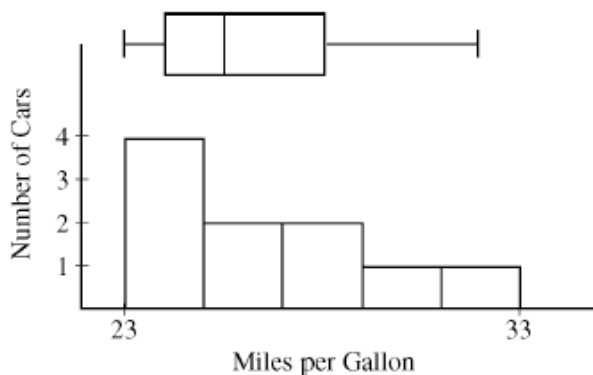
A consumer organization was concerned that an automobile manufacturer was misleading customers by overstating the average fuel efficiency (measured in miles per gallon, or mpg) of a particular car model. The model was advertised to get 27 mpg. To investigate, researchers selected a random sample of 10 cars of that model. Each car was then randomly assigned a different driver. Each car was driven for 5,000 miles, and the total fuel consumption was used to compute mpg for that car.

### Scoring:

- (a) Define the parameter of interest and state the null and alternative hypotheses the consumer organization is interested in testing.

**E P I**

One condition for conducting a one-sample  $t$ -test in this situation is that the mpg measurements for the population of cars of this model should be normally distributed. However, the boxplot and histogram shown below indicate that the distribution of the 10 sample values is skewed to the right.

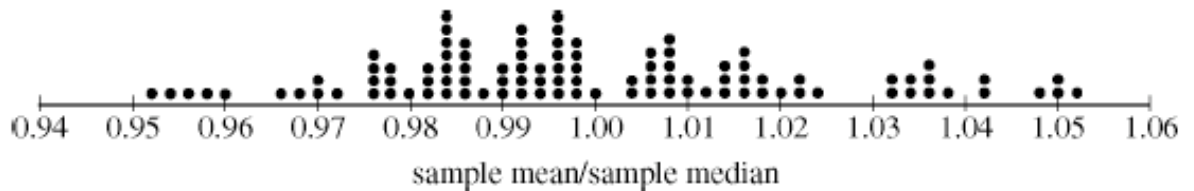


- (b) One possible statistic that measures skewness is the ratio  $\frac{\text{sample mean}}{\text{sample median}}$ .

What values of that statistic (small, large, close to one) might indicate that the population distribution of mpg values is skewed to the right? Explain.

**E P I**

- (c) Even though the mpg values in the sample were skewed to the right, it is still possible that the population distribution of mpg values is normally distributed and the that skewness was due to sampling variability. To investigate, 100 samples, each of size 10, were taken from a normal distribution with the same mean and standard deviation as the original sample. For each of those 100 samples, the statistic  $\frac{\text{sample mean}}{\text{sample median}}$  was calculated. A dotplot of the 100 simulated statistics is shown below.



In the original sample, the value of the statistic  $\frac{\text{sample mean}}{\text{sample median}}$  was 1.03. Based on the value of 1.03 and the dotplot above, is it plausible that the original sample of 10 cars came from a normal population, or do the simulated results suggest the original population is really skewed to the right? Explain.

**E P I**

- (d) The table below shows summary statistics for mpg measurements for the original sample of 10 cars.

Minimum	Q1	Median	Q3	Maximum
23	24	25.5	28	32

Choosing only from the summary statistics in the table, define a formula for a different statistic that measures skewness.

What values of that statistic might indicate that the distribution is skewed to the right? Explain.

**E P I**

**Total: \_\_/4**