

NOTE: We present a model solution with some trepidation. This is not a scoring key, just an example. Many other approaches could fully satisfy the requirements outlined in the scoring rubric. That (not this) is the standard by which student responses should be evaluated.

Chapter 5 – Investigative Task A – Model Solution – Auto Safety

To: Boss

From: Employee

Re: Automobile insurance injury losses and rates.

The Highway Data Institute has collected data on automobile insurance injury losses for 2000-2001. These losses are reported in relative terms, with a rating of 100 being average for all cars. For instance, the Buick LeSabre, with a rating of 39, was $100 - 39 = 61\%$ better than average. The Toyota Corolla, with a rating of 147, was $147 - 100 = 47\%$ worse than average. These ratings, when viewed with the size of the car in mind, will have a great impact on the rates we charge to insure cars.

The summary statistics for the insurance injury losses are organized in the table below. I have chosen to use 5-number summaries and interquartile range as a measure of variability, since one of the distributions of ratings for the small cars contained outliers. The presence of outliers makes means and standard deviations unreliable statistics. Since the ratings are measuring relative safety, parallel boxplots will be useful for comparing the ratings of the three different sizes of cars.

Group	Count	Min	Q1	Med	Q3	Max	IQR
small	26	63	104	133.5	147	247	43
mid-size	28	58	79	102	125	169	46
large	16	39	57.5	68	77	92	19.5

The median of the distribution of large car ratings is 68, meaning the typical larger car has a rating that is 32% better than average.

The median of the distributions of mid-size car ratings is 102, which means that a typical mid-size cars has a rating that is about average for all cars. The median of the distribution of ratings of small cars is 133.5, which means that a typical small car is expected to be 33.5% worse than average with regards to injury losses. When comparing the cars by median rating, large cars are safest, followed by mid-size cars. Small cars are the least safe.

In addition to being safer in general than mid-size and small cars, large cars are also *consistently* safe. The interquartile range, which measures the spread of the middle 50% of ratings, is only 19.5. Small and mid-size cars have much more variability in their ratings, with IQRs of 43 and 46, respectively. It should also be noted that several small cars, the Kia Sephia, the Mitsubishi Mirage, and the Suzuki Esteem, had extremely high injury losses, the highest of which was 147% worse than average. Using the parallel boxplots to compare the quartiles, we can see that every large car is safer than the median mid-size car, and every large car is safer than more than 75% the small cars. Also, the safest 50% of mid-size cars are rated safer than about 75% of small cars.

Our company can expect to pay more in claims for cars with higher insurance injury losses. Owners of small cars should pay the highest insurance premiums, with premiums for mid-size car owners slightly lower. Large car owners should have the lowest premiums, since their cars generally have much lower insurance injury losses. Additionally some attention should be paid to individual models, since some models are very safe, while others are quite unsafe.

