#### **Option #1: Critical Thinking: Cars**

An expert who works for a car magazine obtained random data (rounded to the nearest thousand) among two categories of used or new cars: Domestic and Foreign

The expert would like to understand sales based on list price (rounded to the nearest thousand dollars), sale price (rounded to the nearest thousand dollars), and number of days it takes to sell each car. The complete data set is in the file named Cars.

**Managerial Report**

Prepare a report (see below) that summarizes your assessment of the nature of the car market. Be sure to include the following *items* in your report.

1. Calculate descriptive statistics (mean, median, range, standard deviation, and coefficient of variation) to summarize each of the three variables for the all Domestic cars. If there is an outlier, please list them and state for which category they are an outlier. X
   * Use z-scores to determine if there any outliers in the data set for any of the three variables. If there are any outliers in any category, please list them and state for which category they are an outlier.
   * If a result is an outlier, state whether it is below or above the mean.
   * How can one use the above descriptive statistics to understand the Domestic car market better?
   * Could there be any other descriptive statistics that can help one understand the Domestic car market better?
2. Descriptive statistics (mean, median, range, standard deviation, and coefficient of variation) to summarize each of the three variables for the all Foreign cars. X
   * Use z-scores to determine if there any outliers in the data set for any of the three variables.
     1. If there are any outliers in any category, please list them and state for which category they are an outlier.
     2. If a result is an outlier, state whether it is below or above the mean.
     3. How can one use the above descriptive statistics to understand the Foreign car market better?
     4. Could there be any other descriptive statistic that can help one understand the Foreign car market better?
     5. ONE OUTLIER: DAYS TO SELL.
3. Compare your summary results from #1 and #2. Discuss any specific statistical results that would help the car expert understand the two-car markets. X
   * Answer: X
4. **X** Develop a 98% confidence interval estimate of the **population mean sales price** and population mean **number of days to sell** for Domestic cars. What is the margin of error?
   * Interpret what each confidence interval means. How can both confidence intervals provide useful car sales information?
   * **See below for answer**
5. **X** Develop a 98% confidence interval estimate of the **population mean sales price** and population mean **number of days to sell** for Foreign cars. What is the margin of error?
   * Interpret what each confidence interval means. How can both confidence intervals provide useful car sales information?
   * **Answer:**
   * CI goal: estimate the population mean from a sample
   * The CI is driven by the chosen level of confidence and the standard deviation of the sampling distribution.
   * The standard deviation is affected by 2 things
     + 1. The standard deviation of the population
          1. Standard deviation (definition): measures how far data values are from their mean.
       2. The sample size
     1. Confidence Interval (CI) definition:
        1. An interval estimate for an unknown population parameter.
        2. This depends on:
           1. The desired confidence level
           2. The standard deviation
           3. The sample size
     2. Confidence Level
        1. The percent expression for the probability that the confidence interval contains the true population parameter
        2. If the confidence level is 98%, the interval estimate will enclose the true population parameter
6. **X** Assume the car expert **requested estimates** of the mean number of days to sell for the Domestic cars with a margin of error of seven days and the mean selling price of foreign cars with a margin of error of eight days.
   * Using 98% confidence, how large should the sample sizes be for each one?
     + 1. Foreign is 211 days
       2. Domestic is 276 days
   * How could the sample size formula be useful in understanding both types of car businesses? What are some advantages of a larger sample size?
   * **Answer:**
   * Larger sample sizes provide more accurate mean values X
   * the larger the sample size, the smaller the margin of error. X
   * Large sample sizes ensure for the reliability of the sample mean as the estimator of the population parameter. X
7. **X** Suppose a Domestic car has a list price of $30,000 and a Foreign car has a list price of $30,000. What is your **estimate** of the final selling price (based on the percent difference for the sale and list price) and number of days required to sell each of these cars?
   * How would these two estimates be useful in this application?
     1. Domestic estimate is about $2.5k lower approximately 32 days
     2. Foreign estimate is about $2.5k lower approximately 24 days

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**Cars**

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**Introduction**

A car expert collected random data on two categories of new and used cars: Domestic and Foreign. This report aims to provide the expert a clearer understanding of car sales by examining the following dataset features: list price, sale price and number of days it takes to sell each car.

**Descriptive Statistics**

Foreign cars were listed on average $16,000 higher than Domestic cars. Across a range of $75,000, the standard deviation for the Domestic cars was $18,000, about $6,000 less than Foreign cars over a range of $88,400. Both Foreign and Domestic cars sold on average about $2,000 less than list price. However, Domestic cars maintained a coefficient of variation of about 6% greater than Foreign cars. This means we can expect more dispersion around the average sale price with Domestic cars (Brown, 1998). Ultimately, Foreign cars sold over a notably longer range of 99 days as compared to Domestic cars’ 69 days. This is due to an outlier at 100 days, far above the mean. On average Domestic cars required 32 days to sell, close to Foreign cars at 35 days.

**Confidence Intervals**

Using a 98% confidence interval we can estimate the population mean sales price and mean number of days to sell for Domestic and Foreign cars. The confidence interval is described as the population mean plus or minus the confidence level, the percentage that the confidence interval contains the true population mean (Holmes et al., 2018). Domestic cars on average sell between $26,710 and $32,770 within 30 and 36 days. On the contrary, Foreign cars on average sell between $41,990 and $50,430 within 32 and 38 days. Typically, Foreign cars require about 2 days more to sell, but return almost $20,000 more revenue.

**Estimates**

The car expert requested estimates of the mean number of days to sell for the Domestic cars with a margin of error of seven days and the mean selling price of Foreign cars with a margin of error of eight days. For a 98% confidence interval, the sample sizes should be 276 and 211 days for Domestic and Foreign, respectively. A larger sample size would produce more accurate mean values as estimates for the population (Holmes et al., 2018). The larger the sample size, the smaller the margin of error. Further, we can compare the list prices of Domestic and Foreign, starting near the Domestic’s mean list price at $30,000 to examine the differences in the final selling price and number of days to sell. Starting at a list price of $30,000, a Domestic car’s final sale price will be about $2,500 lower than list price and selling close to 32 days later. Likewise, a Foreign car with the same starting list price will also sell approximately $2,500 less than list price, but around 10 days sooner. These estimates suggest that a car dealership should consider advertising more Foreign than Domestic cars to bring in faster revenue.

**Conclusion**

Foreign cars may take longer to sell on average, but it is a minimal difference. Given the same list price as a Domestic car, Foreign cars sell nearly 10 days earlier. They return around $41,990 on average, $20,000 more than a Domestic car. Lastly, Foreign cars have a smaller coefficient of variation so we can expect less volatility in the final sale price.

**References**

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