

# Cars Auctions

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# Introduction

The car auction market has become a significant part of the global automotive industry, with billions of dollars' worth of cars sold every year. In recent years, there has been a growing interest in using data visualization techniques to analyze and interpret large datasets related to the car auction market.

In this paper, we aim to test several hypotheses related to the car auction market using data visualization techniques.

To accomplish our goals, we will use a dataset that contains information on the prices, models, mileage, engine volume, damage type, and fuel type of cars sold in various car auctions around the world. We will use different data visualization techniques, including histograms, box plots, scatter plots, and bar charts, to compare and contrast data from different countries and analyze the relationships between variables.

We will first investigate whether damaged cars are more profitable to resell in Armenia comparing the prices of the US cars and undamaged AM cars in the dataset. Next, we will examine the repair costs of Japanese and German cars in different countries to determine if there is a significant difference in repair expenses. Then, we will explore the impact of car color, mileage, and damage type on its price using regression models and scatter plots.

Finally, we will investigate whether most cars with less engine volume have petrol as a fuel type, by analyzing the distribution of engine volume and fuel type across different car models.

Overall, our study will demonstrate the importance of data visualization in analyzing the car auction market and provide valuable insights into the industry. By using a combination of data visualization techniques, we hope to gain a comprehensive understanding of the dataset and offer new insights into the car auction market.

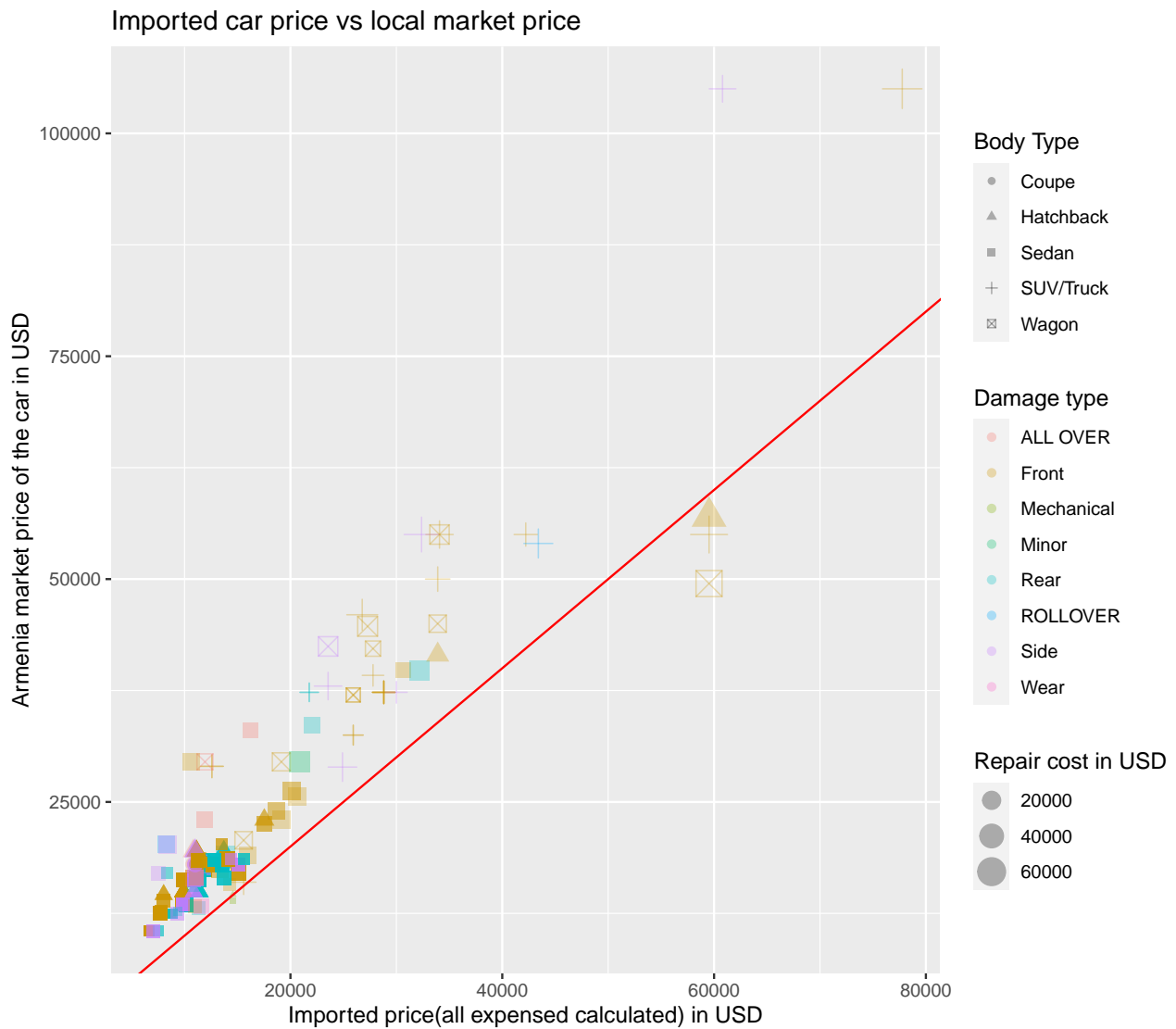
## Datasets

This study uses two datasets that were scraped from car auction websites in the United States and Armenia. The US dataset includes information on 410 cars sold in various auctions across the country, while the Armenian dataset includes data on 1406 cars offered in Armenian market.

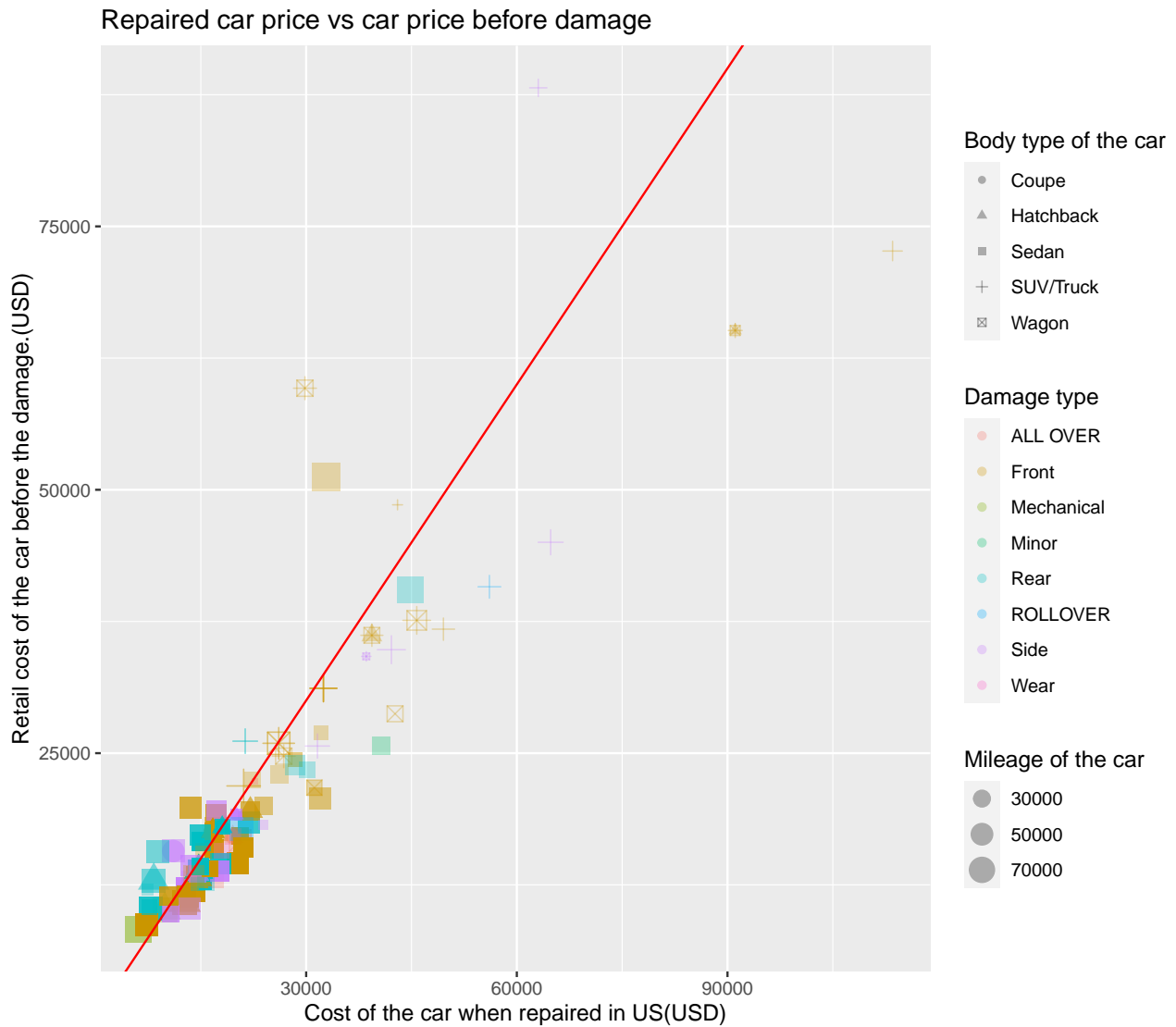
Both datasets contain information on the car's make and model, year of manufacture, mileage, engine volume, damage type, and fuel type, as well as the sale prices. The data was cleaned and preprocessed to remove any inconsistencies or errors and to estimate the importing price of each car, which takes into account taxes, customs duties, and other expenses related to importing a car into a particular country.

# Hypotheses

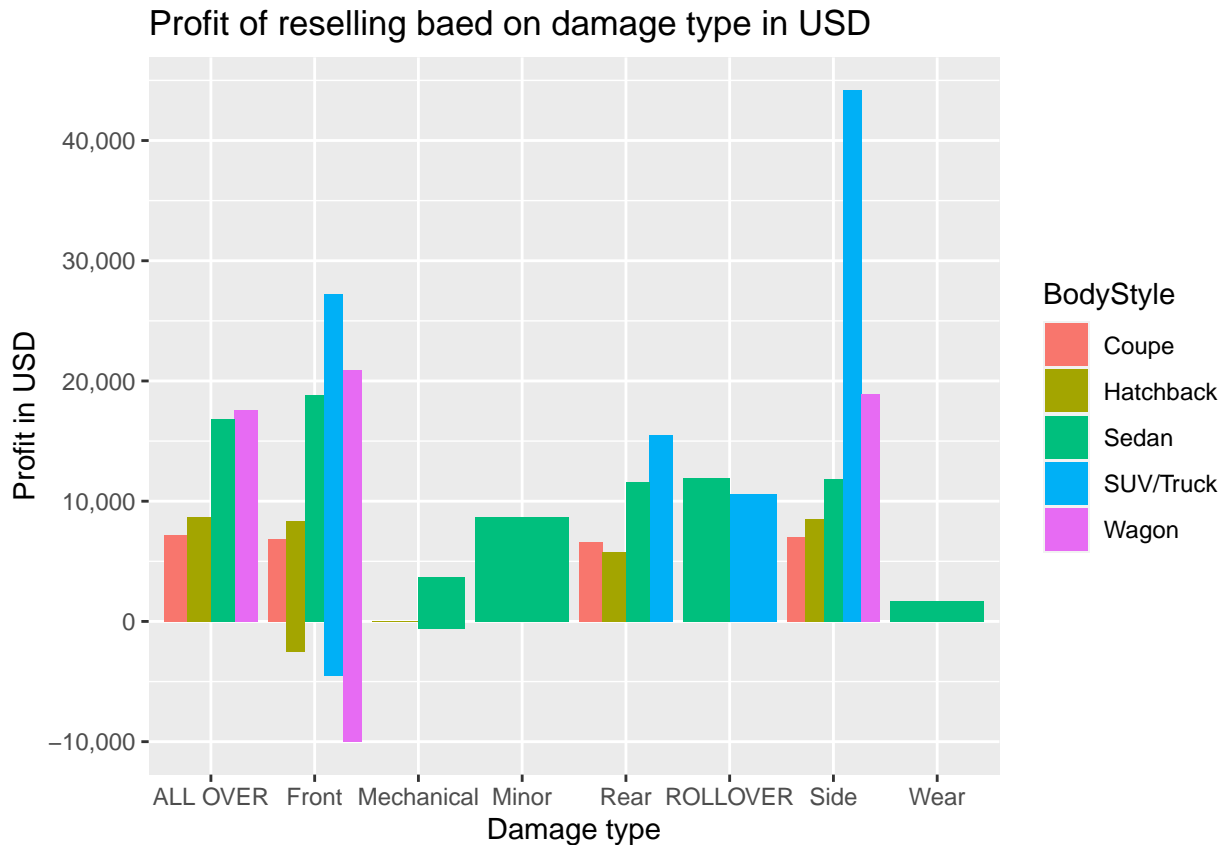
Heavily damaged cars are more profitable to resell in Armenia.



As we can see most of the cars regardless of damage type are profitable to bring and resell in Armenia, but we have a few cars, where the damage is from front and their market price is lower than the price of the same car, when imported from US. We can see that in general if the repair cost is high, the profit can be higher, which leads to an idea that the repair cost in US is higher than in Armenia, as almost all of the cars imported to Armenia are damaged are repaired in Armenia for later usage or profitable sale.

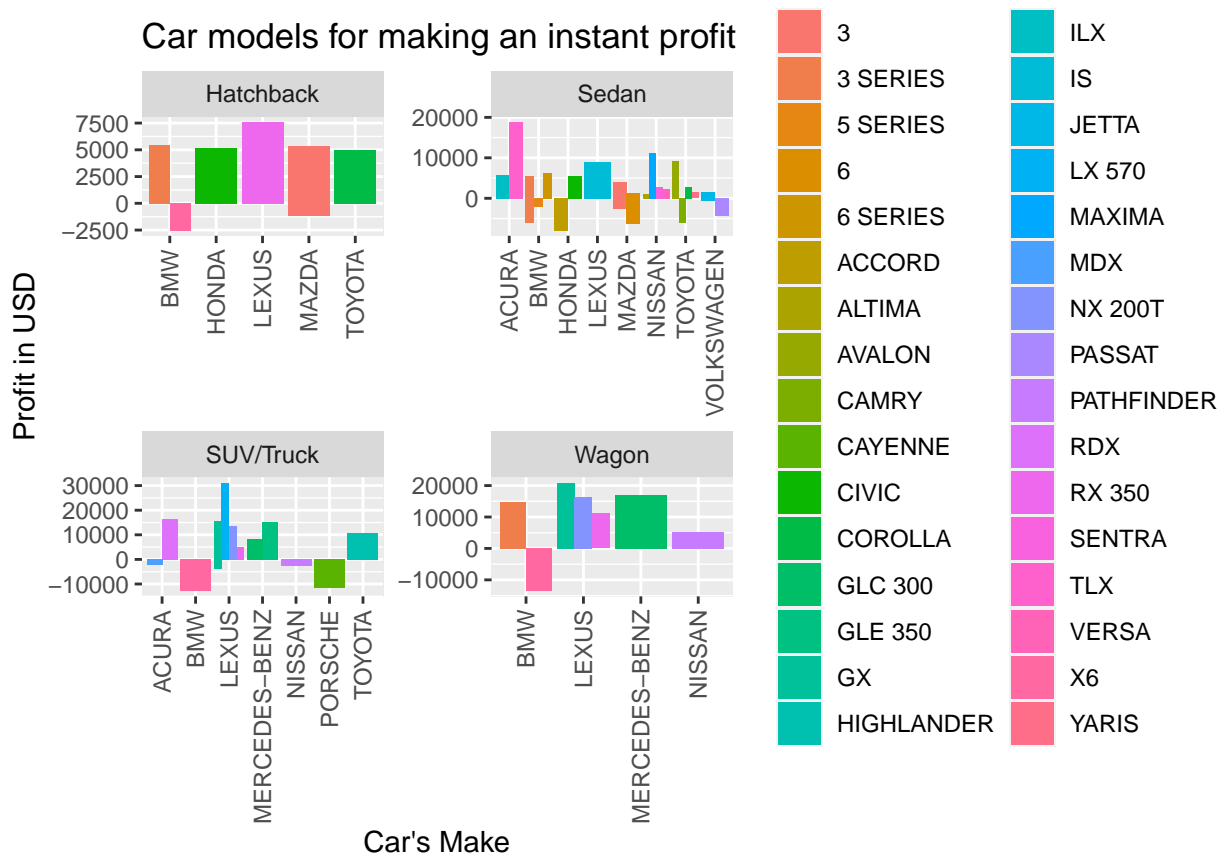


As we can see the the observations are equally distributed along the  $y = x$  line, meaning that depending on the type of the damage, the repair may be or may not profitable. We can see that the repair is mostly profitable for cars with higher mileage, as most probably the parts can be bought from the OEM used market and the material cost will be cheap. We can see that most of the cars that are worth repairing in US are damaged from the Front side. As the material cost is going to be the same in Armenia and US, and actually in US the material cost may be even lower, as the market is more advanced there.

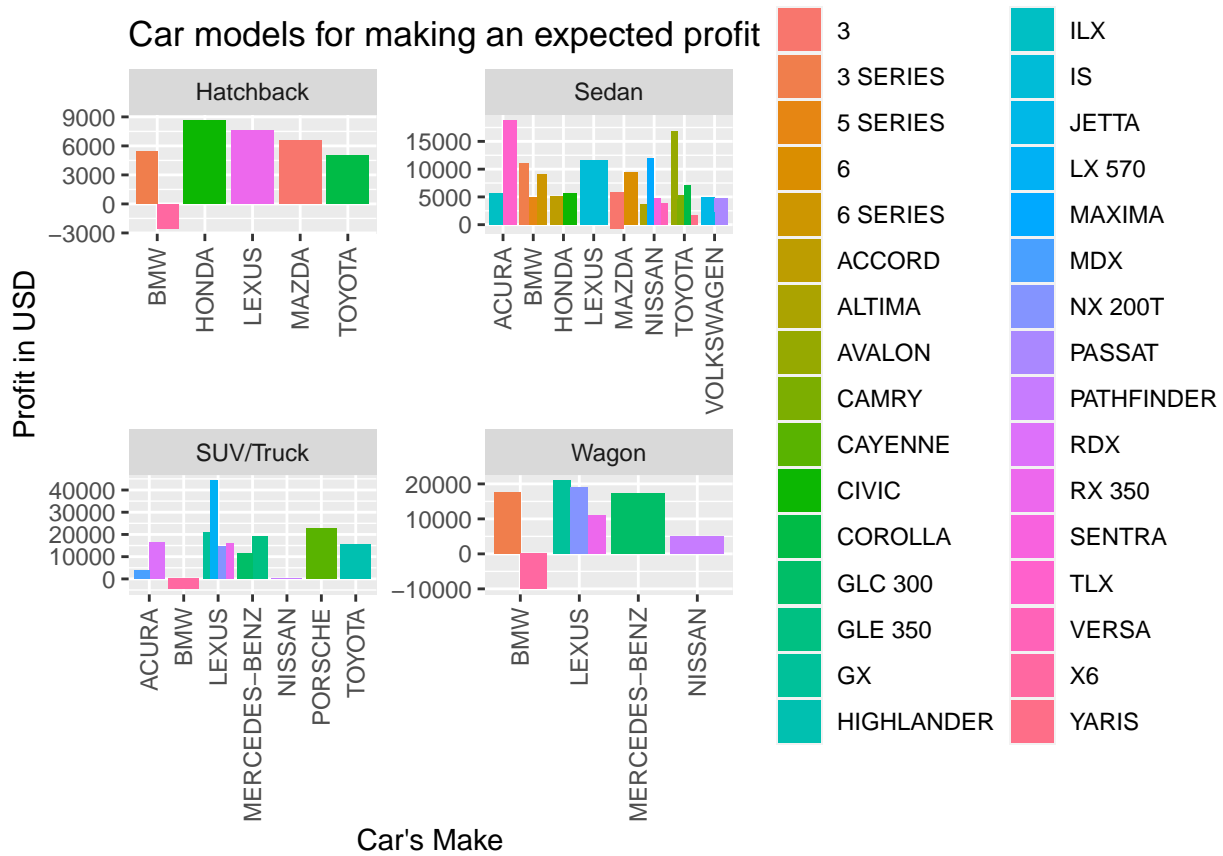


As we can see the cars that are damaged from the front side are most profitable to resell in Armenia, whereas the cars with minor damages are not that profitable, as probably the repair cost is almost identical in United States. Also the cars that are hit from the front side, can have some technical problems with the engine, transmission or other technical components of the car, whereas the rear, side or minor damages are less likely to cause technical problems. However, front damage cars can also be non profitable in cases if labor work such as fixing a bumper, drying or similar jobs are not necessary to do and the repair can be limited to just changing the front headlight or something like that, which includes only material cost.

Let's identify which cars can make instant profit, for that we will summarize the Armenian cars dataset by taking the minimum of the price, supposing that the car can be sold instantly, if it is close to the minimal price offered in the market.



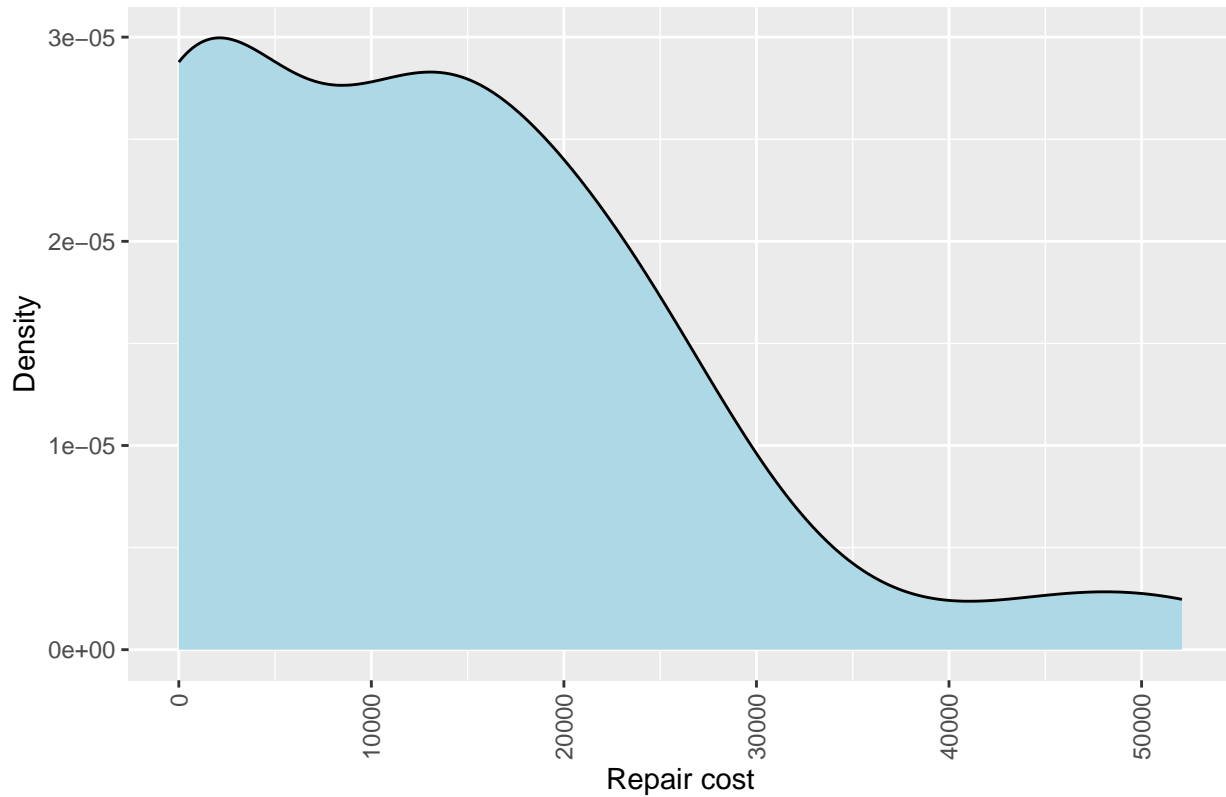
We can see that hatchbacks and wagons are most suitable for making a profit fast, as the market does not have many wagon or hatchback cars, and those are assumed to be bought for a lower price than other type of cars. We can see that sedans do not make an instant profit as the variation is higher, so the price varies from low to high as well, and for the same model of the car the difference between the cheapest car and an average price car can be huge. We can see that Lexus in each category are profitable to bring from US and are expected to give a profit, even when sold for a price close to the market's minimal price. The popular cars such as Mazda 6, Toyota Camry, Honda Accord are not expected to bring an instant profit very fast, as the market is filled with lots of various cars from these models. We can also see that only sedan variations of nation-loved BMW are profitable, if the seller wants to sell the car fast. Volkswagen and Porsche are from the same family and are not valued in Armenia in terms of making a profit when selling the cars close to minimal price.



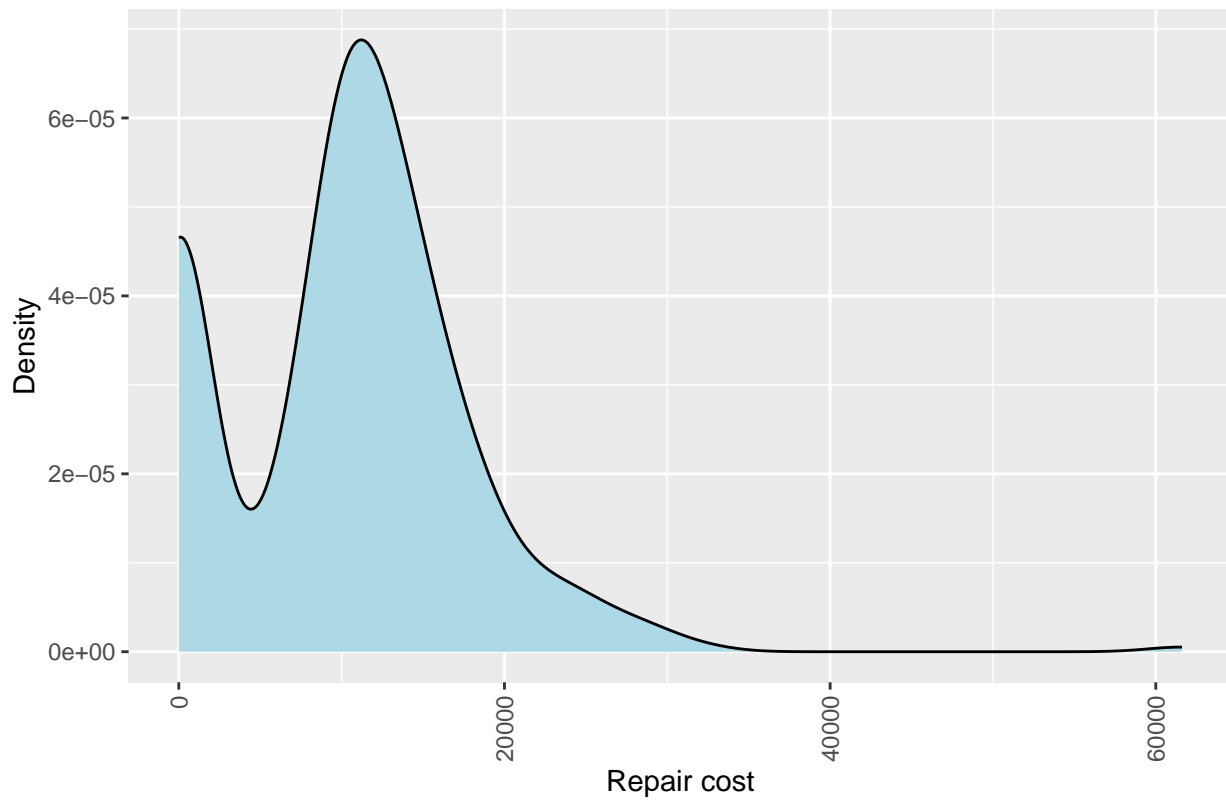
We can see that sedans are pretty common to make profit on, Acura and Toyota are most profitable options, if the seller is willing to sell the car close to the average price in the market. We can again see that Lexus is profitable in its every variation, whereas BMWs are again profitable in sedan variation only.

Japanese cars are cheaper to repair compared to German cars in Armenia.

Distribution of repair costs for German cars



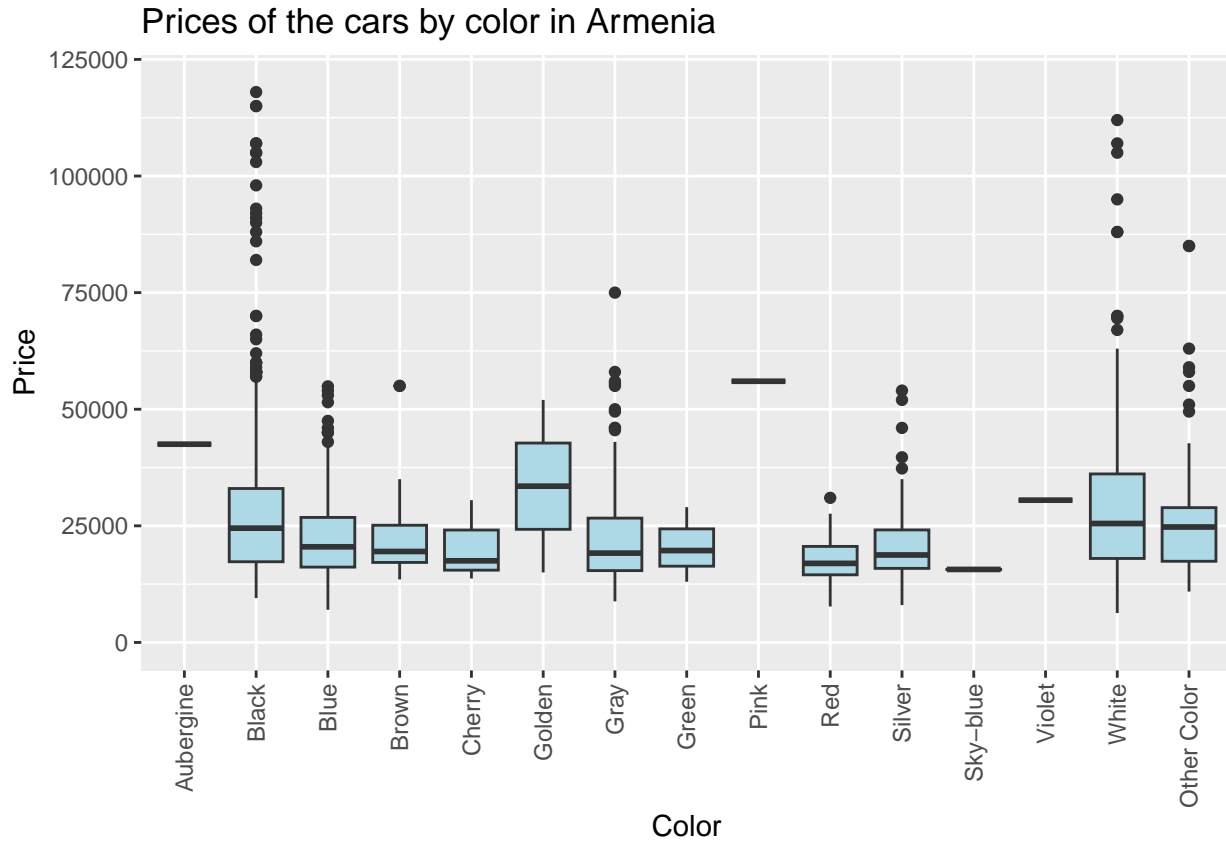
Distribution of repair costs for Japanese cars

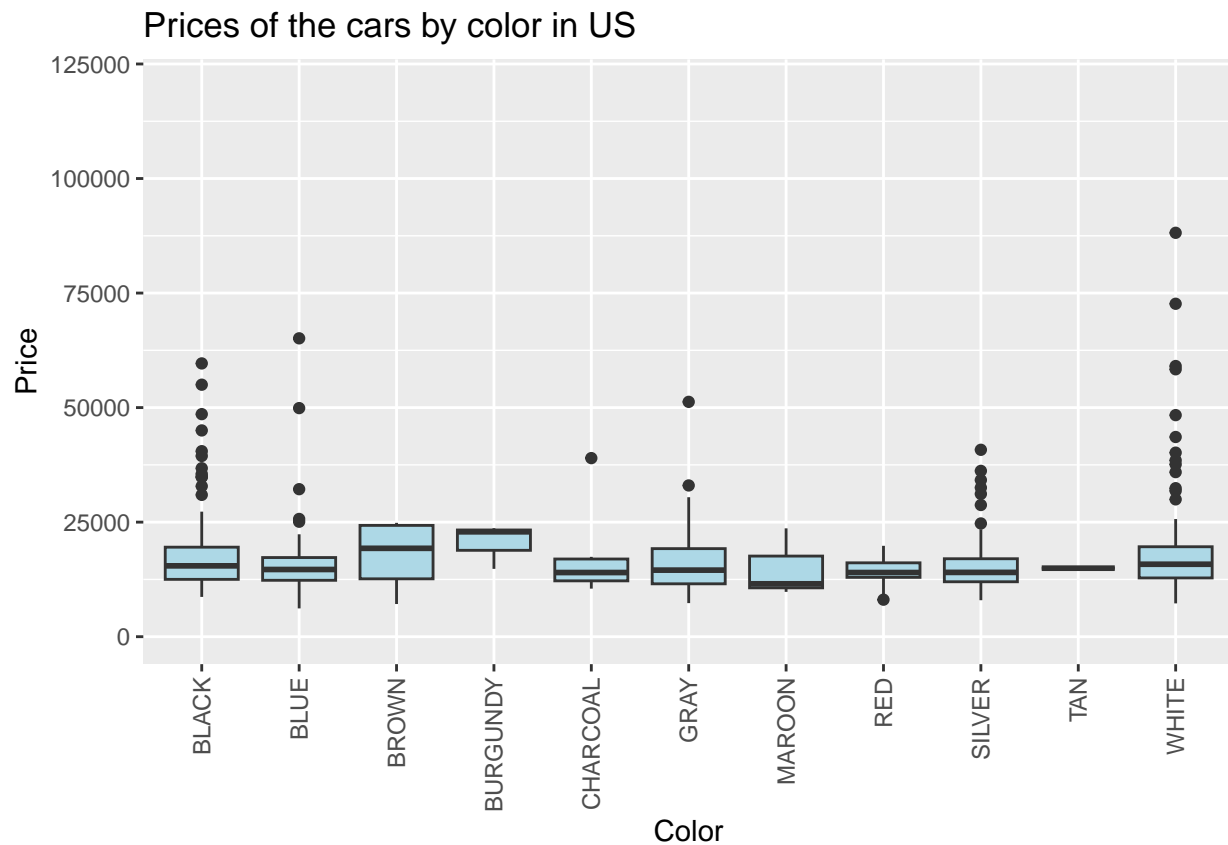




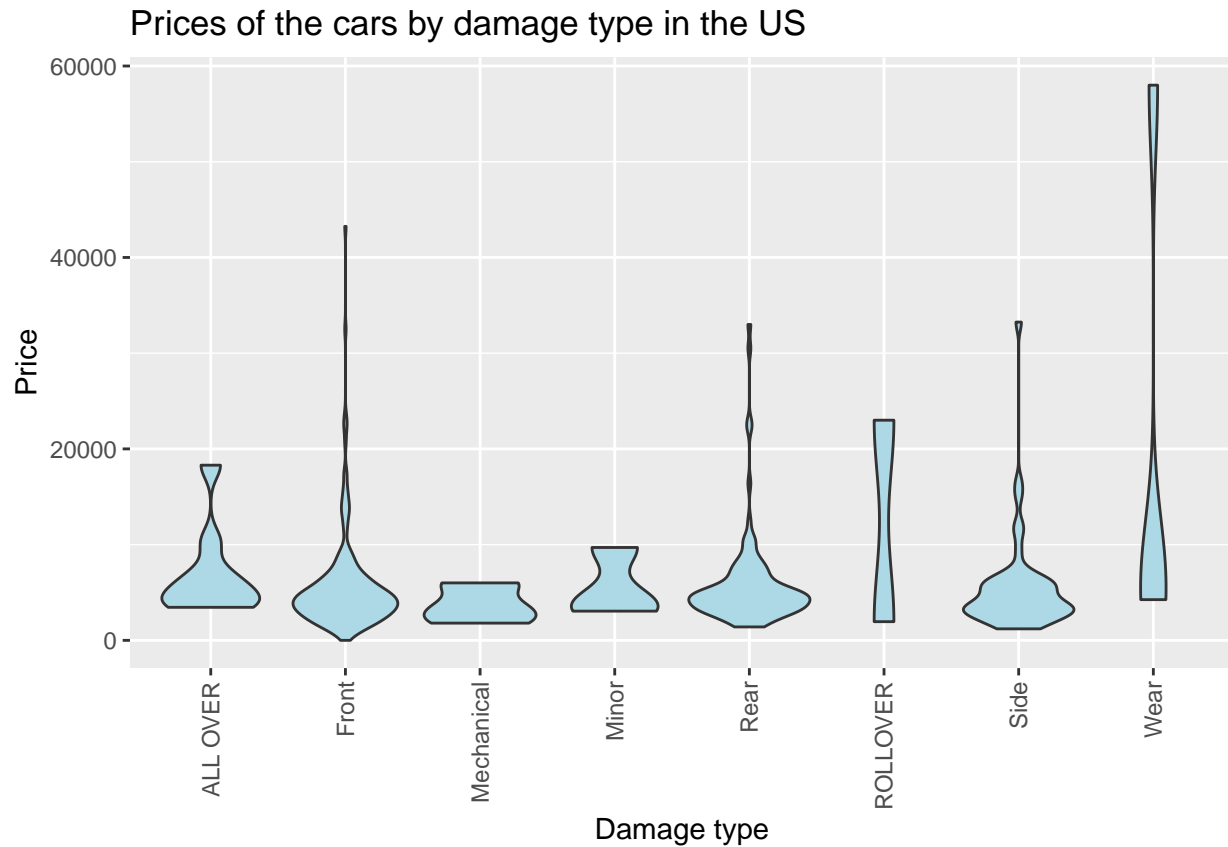
We can see the distribution plots of the repair costs both for Japanese and German cars. For the Japanese cars we can see that most of the observations are within the region of  $[0, 20000]$  dollars. Nevertheless, for the German cars the range is much wider reaching up to 35000-40000 dollars for most of the observations. This supports the claim that in general Japanese cars are cheaper to repair compared to German cars in Armenia.

Color, Mileage and damage type have a lot of impact on the cars price.



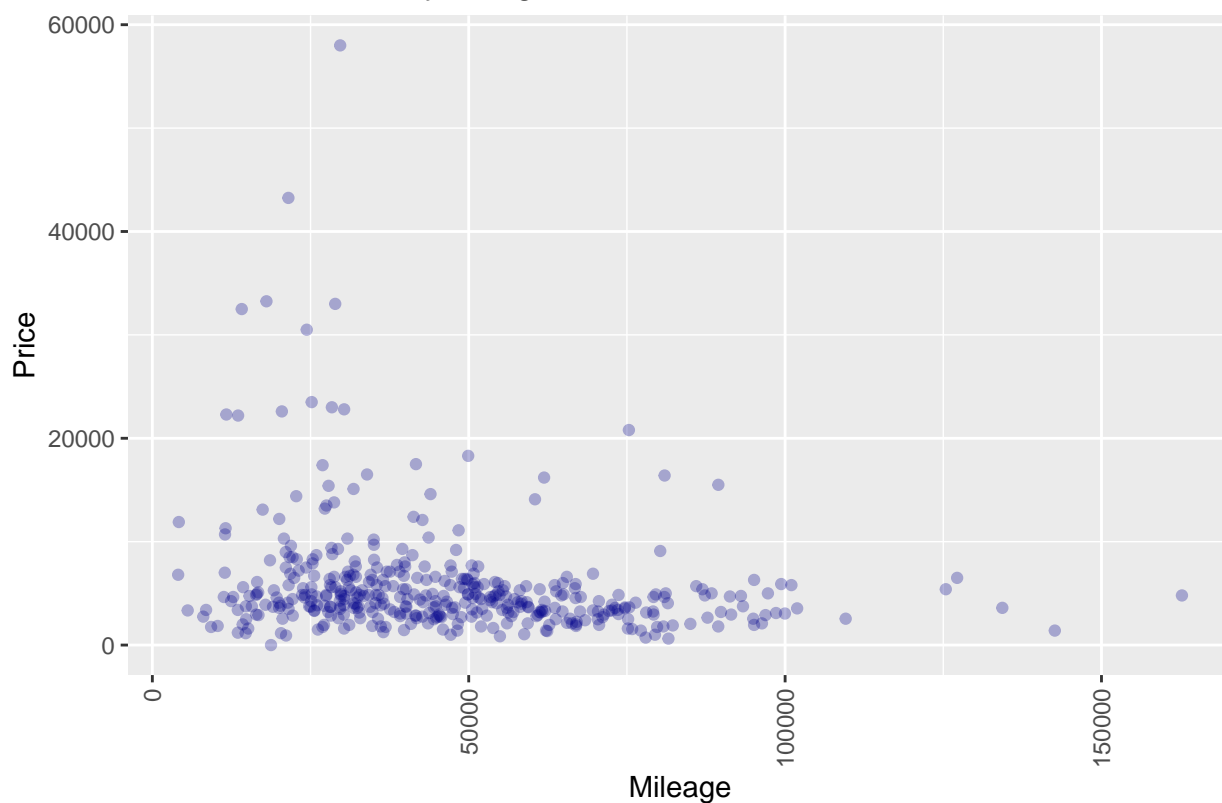


We can see the boxplots of the prices for each color both plotted using Armenian and US cars datasets. We can see that the overall picture is quite similar for both countries. However, for Armenia we can notice that Golden color has the highest median compared to US where Burgundy has the highest median. In Armenia, however the price difference between colors and their corresponding price ranges is way more noticeable as such colors as Black and White also have comparably higher prices. Note that we don't take into account the colors which have very few observations.

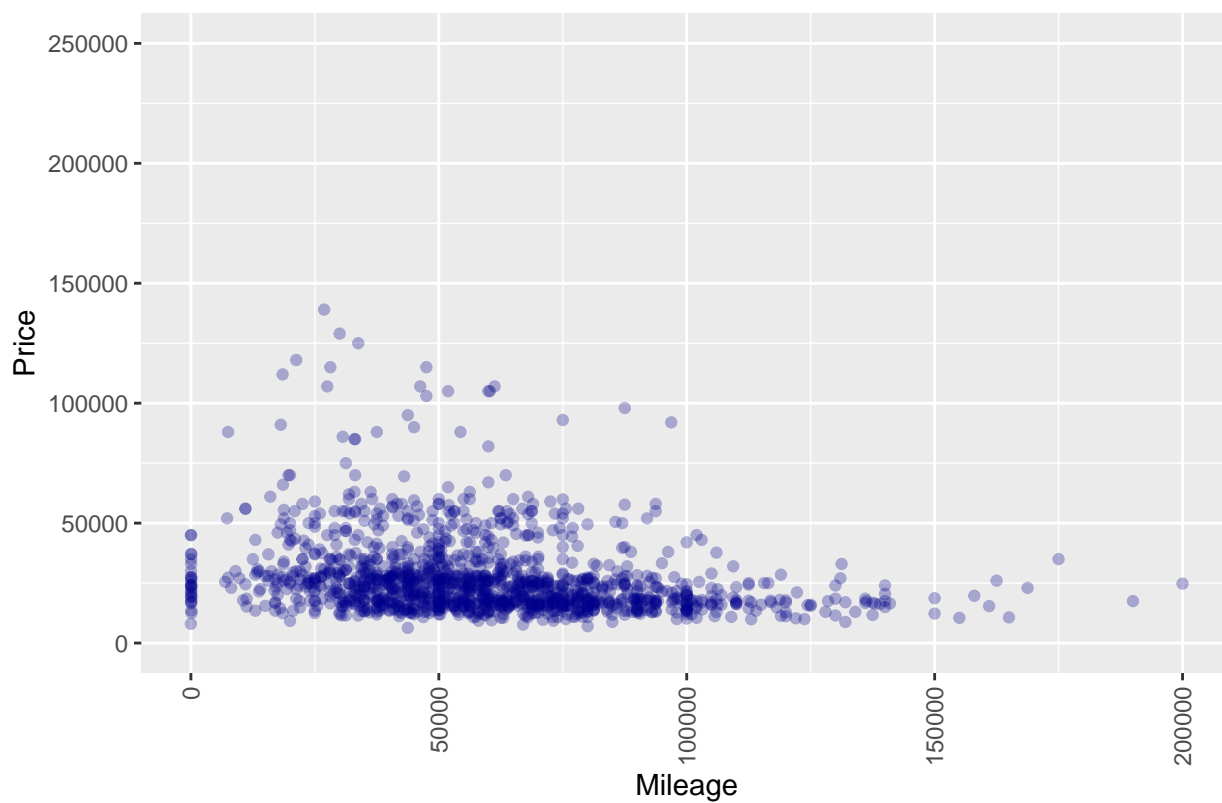


The violin plots above show the distributions of the price of the car by the damage types. As we can see for such damages as All Over, Mechanical and Minor the Price doesn't go higher than 20000 dollars. Yet, for all the other damage types the prices may go up to 58000 dollars. Therefore, we may claim that the damage type has an impact on the price.

Prices of the cars by milage in the US

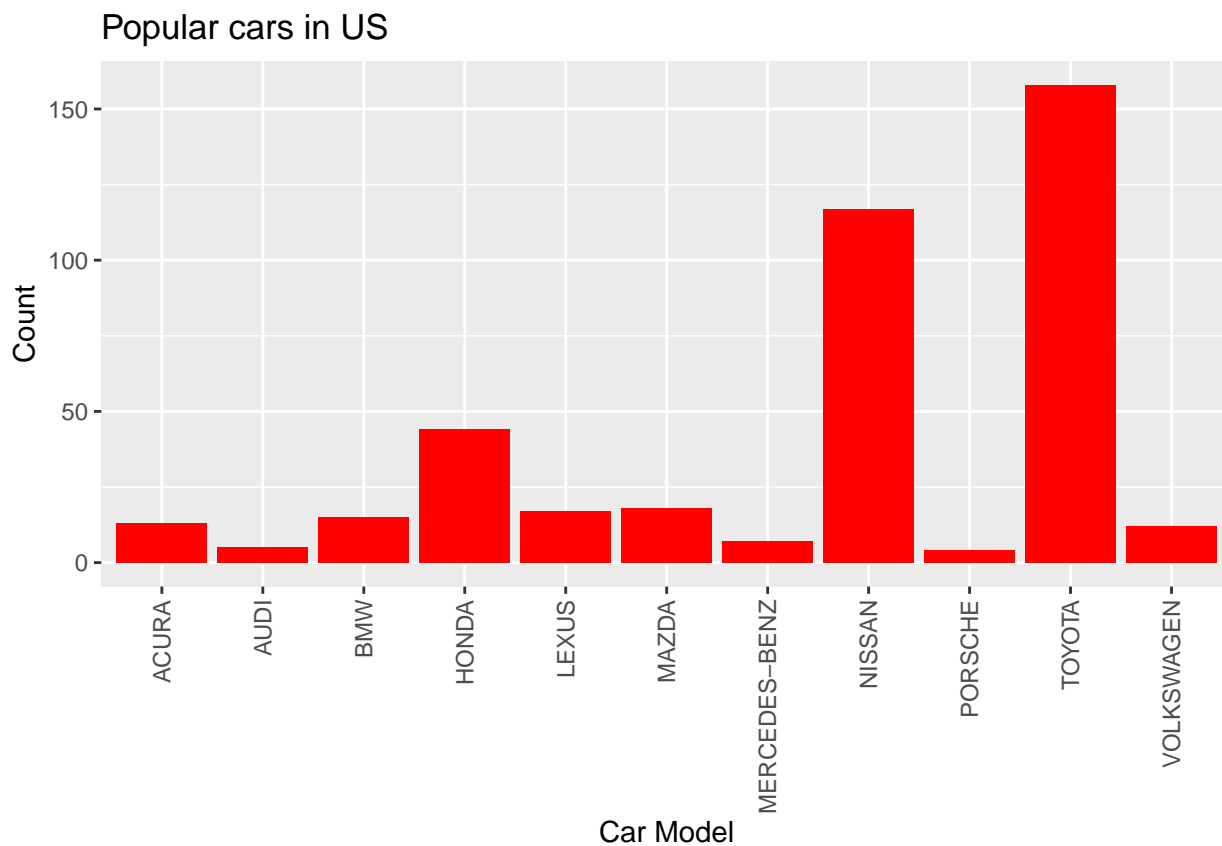


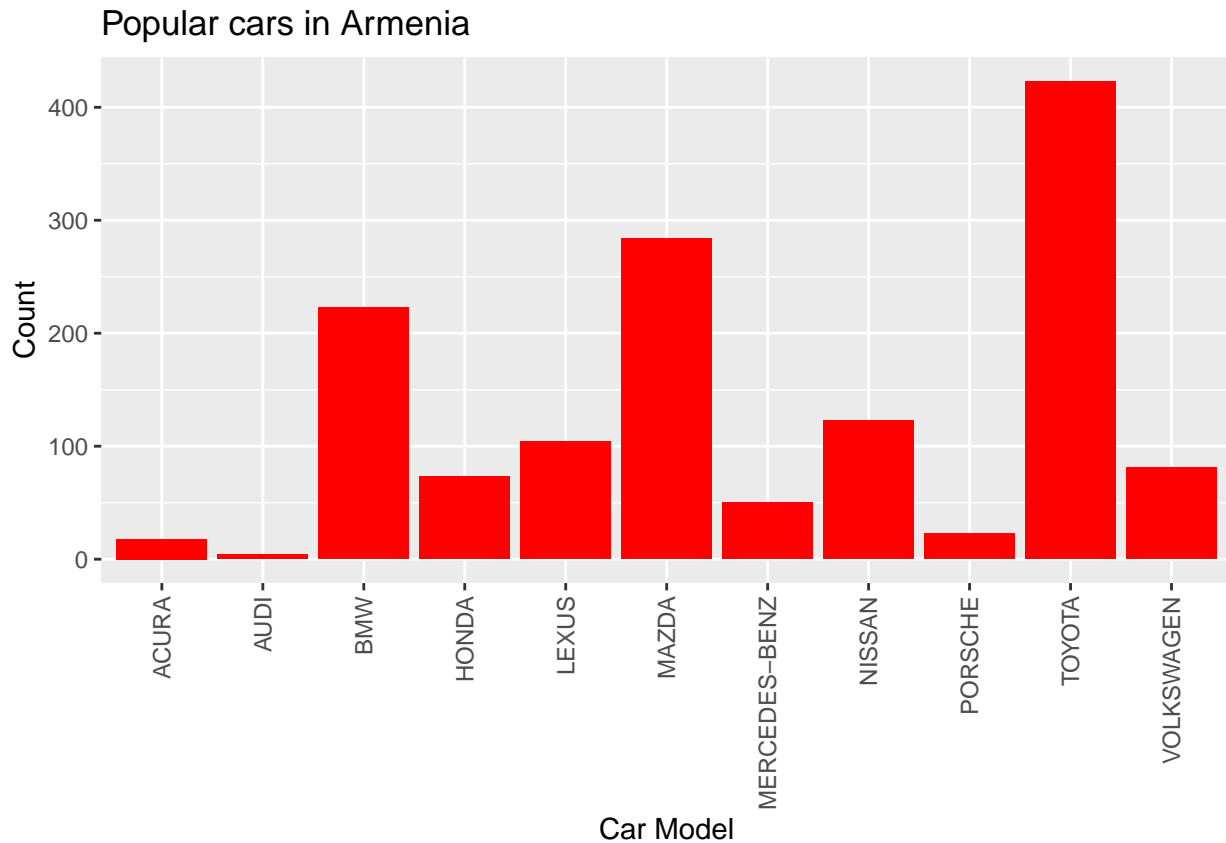
Prices of the cars by mileage in Armenia



The scatterplots above show the relationship of the Mileage and the price of the cars in Armenia and US. Though we have much less observations for US cars, the overall picture is very much similar. We may notice that we have cars with higher price when the milage is low and as the Milage increases we have less and less cars with higher prices. Therefore, we may state that Mileage does have an impact on the price.

**The popular cars in US and Armenia are quite different**





The bar plots above displays the counts of the cars by car models for Armenia and US. For most of the cars which don't have high counts the results are very much alike (Acura, Audi, Mercedes-Benz, Volkswagen). For Toyota, it's nearly the same, since this is the car which appears the most in the auctions both for Armenia and US. Yet, for such car models as BMW, Lexus, Mazda the picture is different for Armenia compared to US, since the numbers are higher for the former. In US, Toyota is followed by Nissan and Honda.

# Conclusion

## Findings

We can see that cars that have minor damages are not profitable to import taking into account the expenses needed for bringing the car to Armenia from the auctions, such cars are desirable in US as well as with low investment in Repair they can get a car that is cheaper than its retail. In general the profitable cars are the ones that are heavily hit from the front side or from all sides. Sedans are most popular options for importing and in a long turn are the most profitable cars. Wagons Hatchbacks or SUV s are profitable for short term, as the market does not have many options and the reseller is expected to sell those cars with a price that is close to the minimum offered in the market, but still make a profit. SUV cars are in general pretty expensive, so as an option of a fast and reliable investment hatchback is better. The popular cars in the market are not expected to bring huge profit, when the saler wants to sell the car close to minimum price, as the market contains multiple variations and the buyer has wider set of options to choose from. Lexus is the most profitable Make for importing in almost every category. Lexus is joined by its family member Toyota, Honda and Acura.

As the profitable cars are of Japanese origin we continued investigation on repair prices by comparing the country of origin of the cars. Our datasets intersected on German and Japanese cars and the visualizations showed that the Japanese cars are much cheaper to repair compared to German cars. German cars are well known for adopting the latest technologies in their newest generation of cars, but after time Japanese cars seem to be more practical mean of transportation as having less fancy options they are not prone to have technical difficulties. This finding is visible in the last hypothesis as well, where we see that the Japanese cars are pretty popular in US, where driving takes around 5 percent of their life, so they value practicality over the comfort and luxury features more than in Armenia where we can see that people are willing to buy luxury cars such as BMW, Mercedes Benz or Porsche more frequently than people in United States.

As a logical combination of the preference practicality, we have seen that mileage has more effect on the price of the car in Armenia, rather than in US, as the cars in Armenia tend to have problems in a shorter manner than in US, because of the road conditions and comfort vs practicality preference. As US people prefer practical cars, those cars do not lose their value over time as the mileage does not affect their working condition, whereas luxury cars are equipped with dosens of electronical fancy features, which may break over high mileage and affect the price of the car.