Pre-owned Vehicle Price Analysis

Under the Impact of COVID-19

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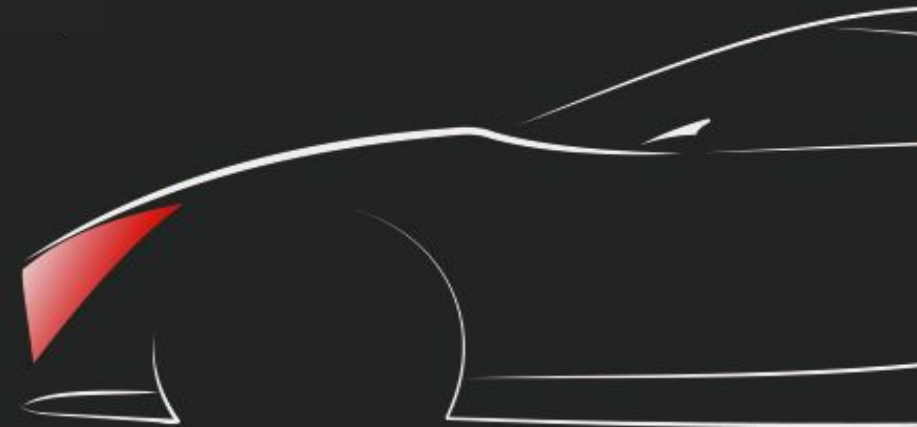Xin Xie (A59010731)
Ajit Deshpande (A59003350)
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John Malgeri (A15656397)
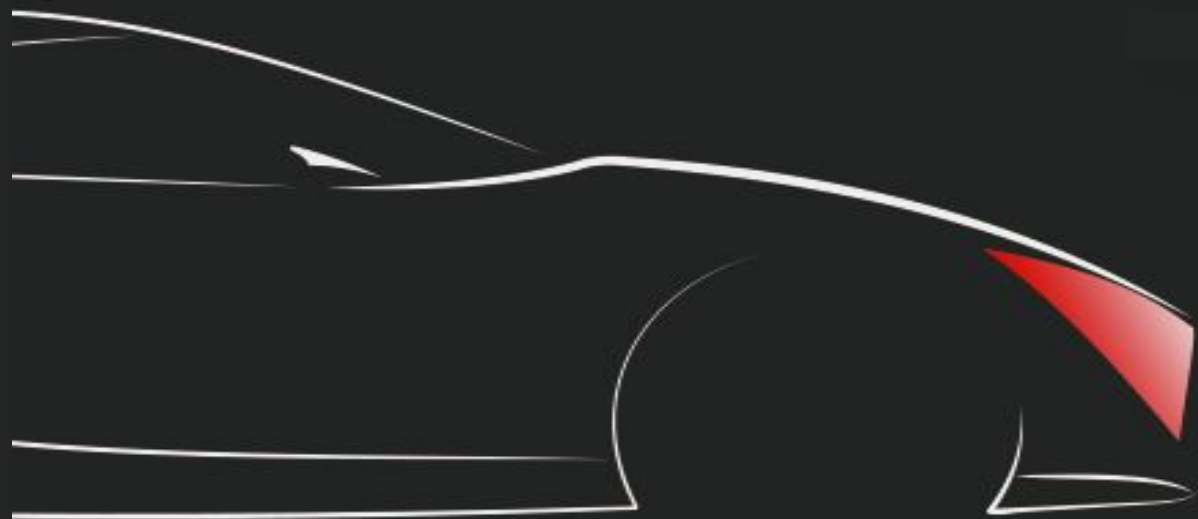LinXiao Zhang (A59013665)

CONTENT

NO.1

Background and Objective

Background

- Used cars amount to around 41M* (around 75%) of the cars in the US
- Contributed around 1%* to the inflation in 2020
- Dealer price battle during transformation to online platforms
- Federal Reserve Stimulus/monetary policy pushed up market prices
- Chip Shortage/supply delay/manufacture cost increase

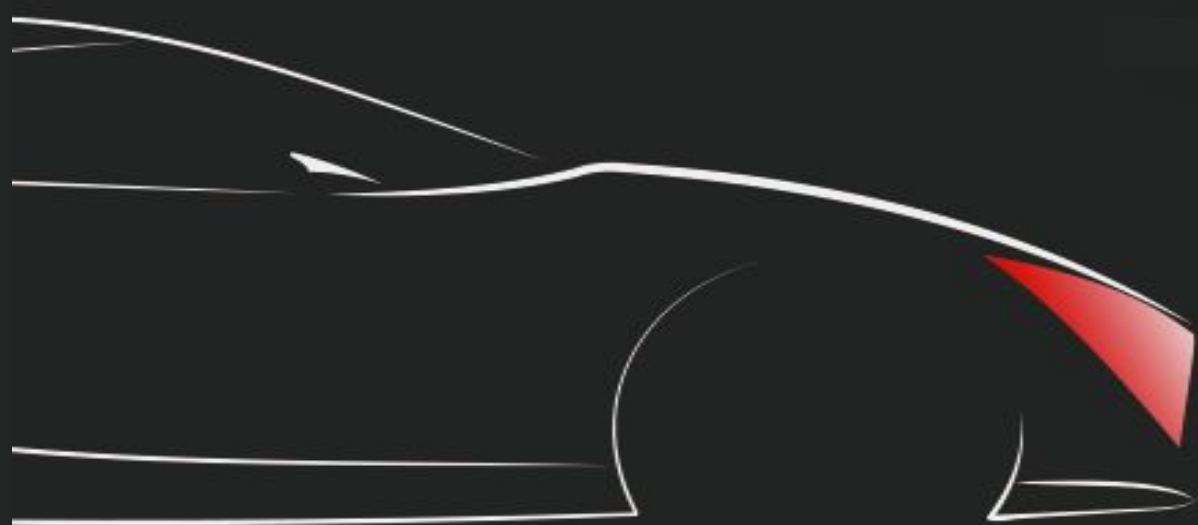
This is brilliant.

But I like this.
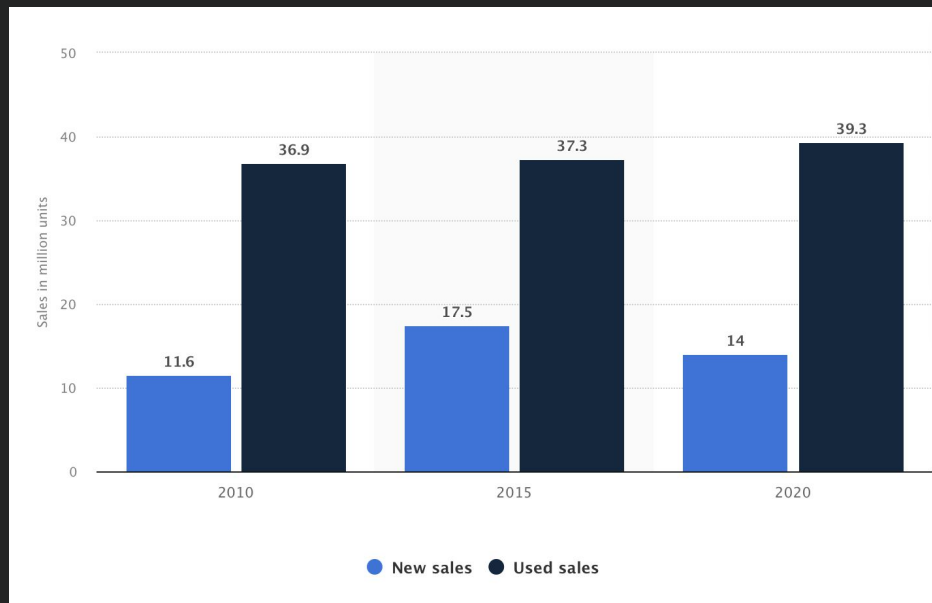
Objectives

- Price log before and after the COVID-19 pandemic

- Find leading factors in price change
  - Regional distribution
  - Vehicle characteristics
  - Market oriented factors
  - COVID-19 cases in different regions

NO.2

Dataset Processing and Data Overview

SHOW ME THE DATA!

◇ Dataset

- US pre-owned vehicle dataset from CarGurus
- Time period: before Sept 2020 (till the end of 2nd COVID-19 wave)
- Has 3M used car data points from 2013 onwards

◇ Data Cleaning

- Remove columns with more than 50% of missing data points
- Remove columns with unused factors for our analysis
- Add columns, including the month of listing, dealer rating category

An excerpt of the data information is shown below

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 521393 entries, 2 to 999996
Data columns (total 39 columns):
 #   Column               Non-Null Count    Dtype    #   Column                Non-Null Count    Dtype
---  ------               --------------    -----  ---   ------                --------------    -----
 0   Unnamed: 0           521393 non-null   int64    1   vin                   521393 non-null   object
 2   back legroom         502415 non-null   object   3   body type             520824 non-null   object
 4   city                 521393 non-null   object   5   city fuel economy     441595 non-null   float64
 6   daysonmarket         521393 non-null   int64    7   dealer zip            521393 non-null   object
 8   engine_type          510370 non-null   object   9   franchise_dealer      521393 non-null   bool
 10  franchise make       325422 non-null   object   11  front legroom         502415 non-null   object
 12  fuel_tank_volume     502415 non-null   object   13  fuel_type             511794 non-null   object
 14  has accidents        520774 non-null   object   15  height                502415 non-null   object
 16  highway_fuel_economy 441595 non-null   float64  17  horsepower            503178 non-null   float64
 18  is new               521393 non-null   bool     19  latitude              521393 non-null   float64
 20  length               502415 non-null   object   21  listed_date           521393 non-null   object
 22  longitude            521393 non-null   float64  23  make name             521393 non-null   object
 24  maximum seating      502415 non-null   object   25  mileage               515950 non-null   float64
 26  model name           521393 non-null   object   27  owner count           504694 non-null   float64
 28  power                473130 non-null   object   29  price                 521393 non-null   float64
 30  salvage              520774 non-null   object   31  savings amount        521393 non-null   int64
 32  seller rating        514343 non-null   float64  33  theft title           520774 non-null   object
 34  transmission         514455 non-null   object   35  transmission_display  514455 non-null   object
 36  wheel system display 505997 non-null   object   37  width                 502415 non-null   object
 38  year                 521393 non-null   int64
dtypes: bool(2), float64(9), int64(4), object(24)
memory usage: 152.2+ MB
```
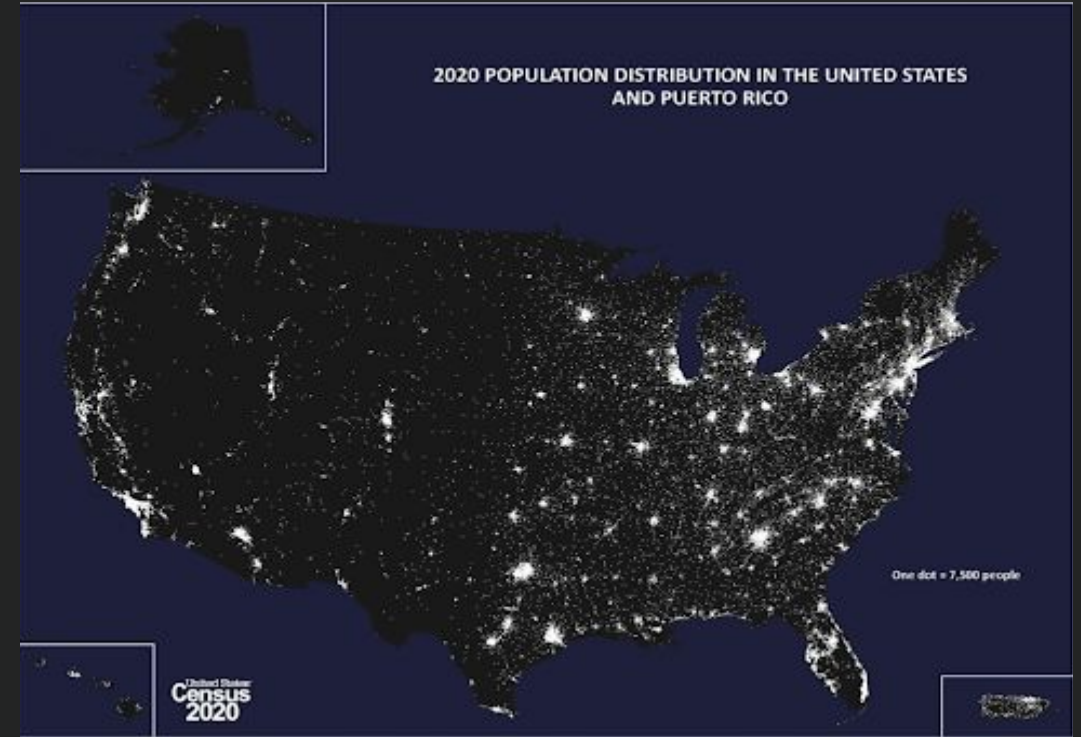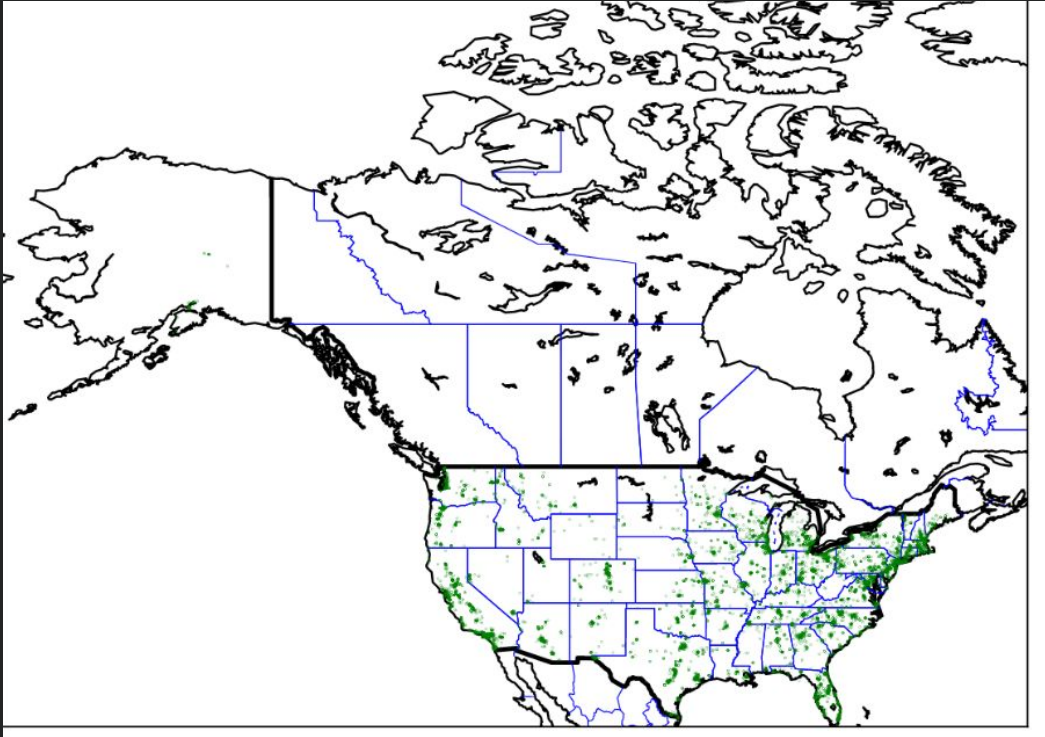
Distribution of data according to car body type

Car Body Types
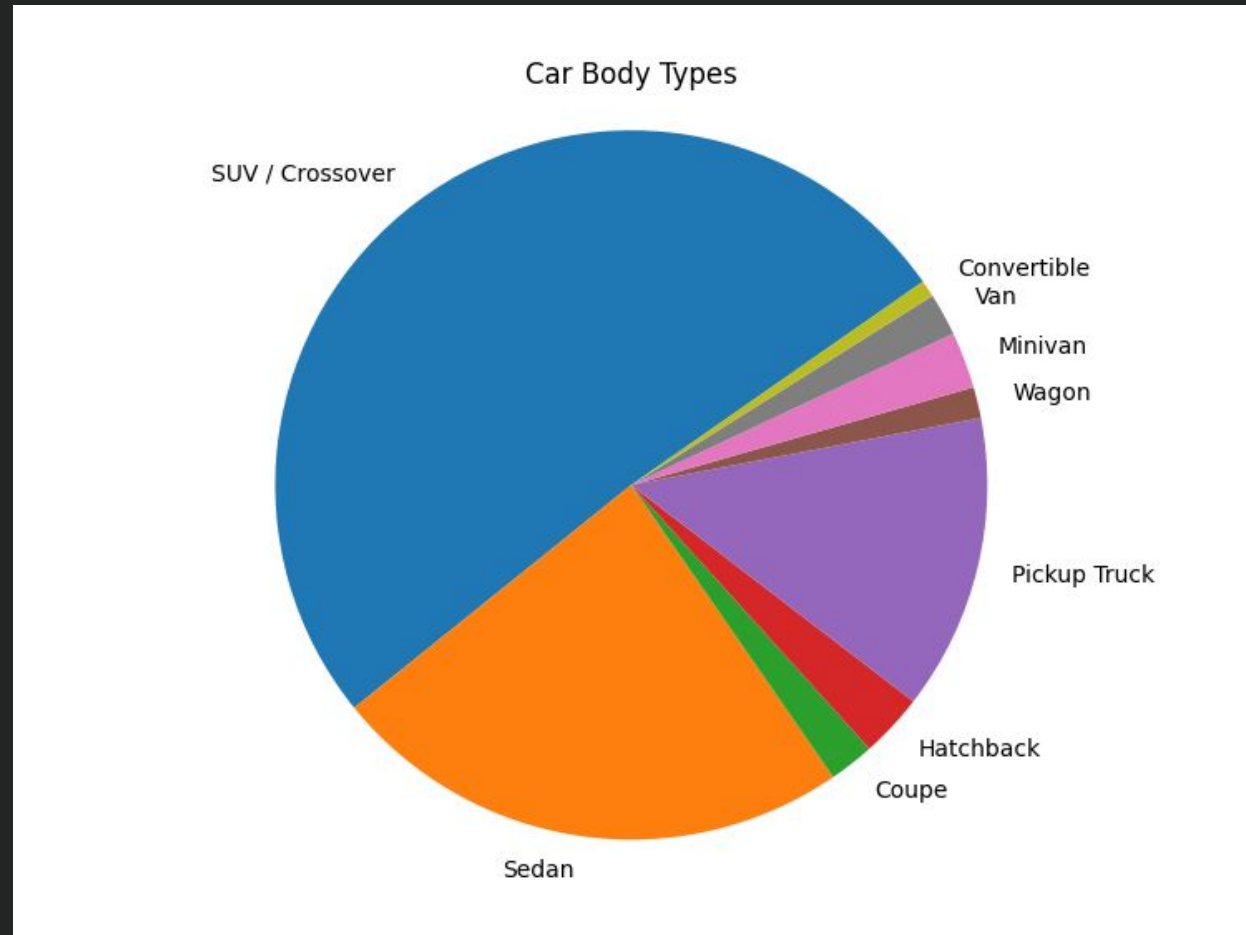
Body type	% presence
SUV / Crossover:	51.09%
Sedan:	23.79%
Pickup Truck:	13.48%
Hatchback: 2.90%	
Minivan:	2.57%
Coupe:	2.06%
Van:	1.94%
Wagon:	1.42%
Convertible:	0.77%

Vehicle Regional Distribution

2020 POPULATION DISTRIBUTION IN THE UNITED STATES AND PUERTO RICO

One dot = 7,500 people

Census 2020

Green dots: each vehicle listing data point

Population distribution in the US

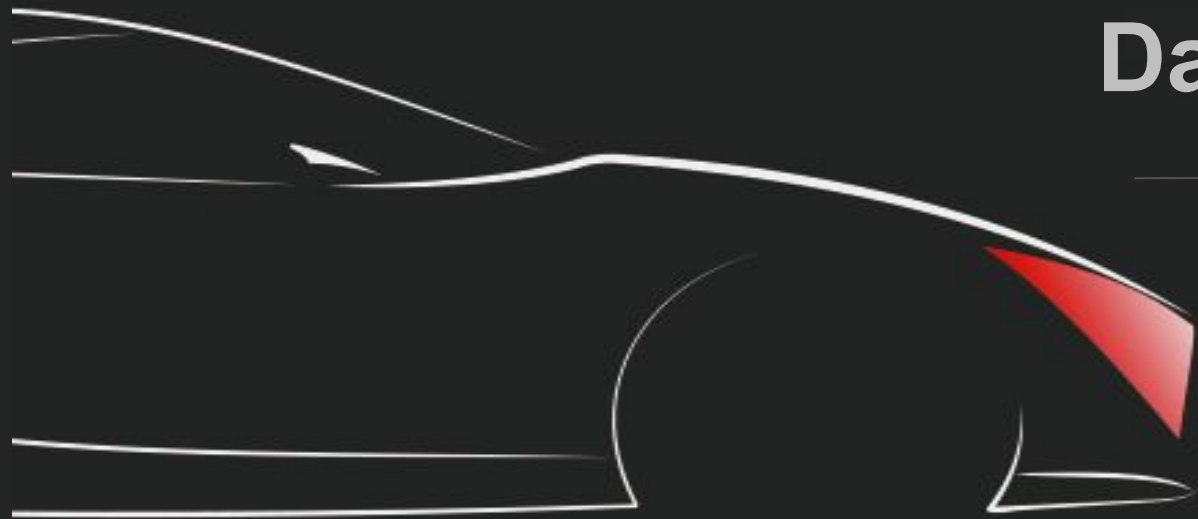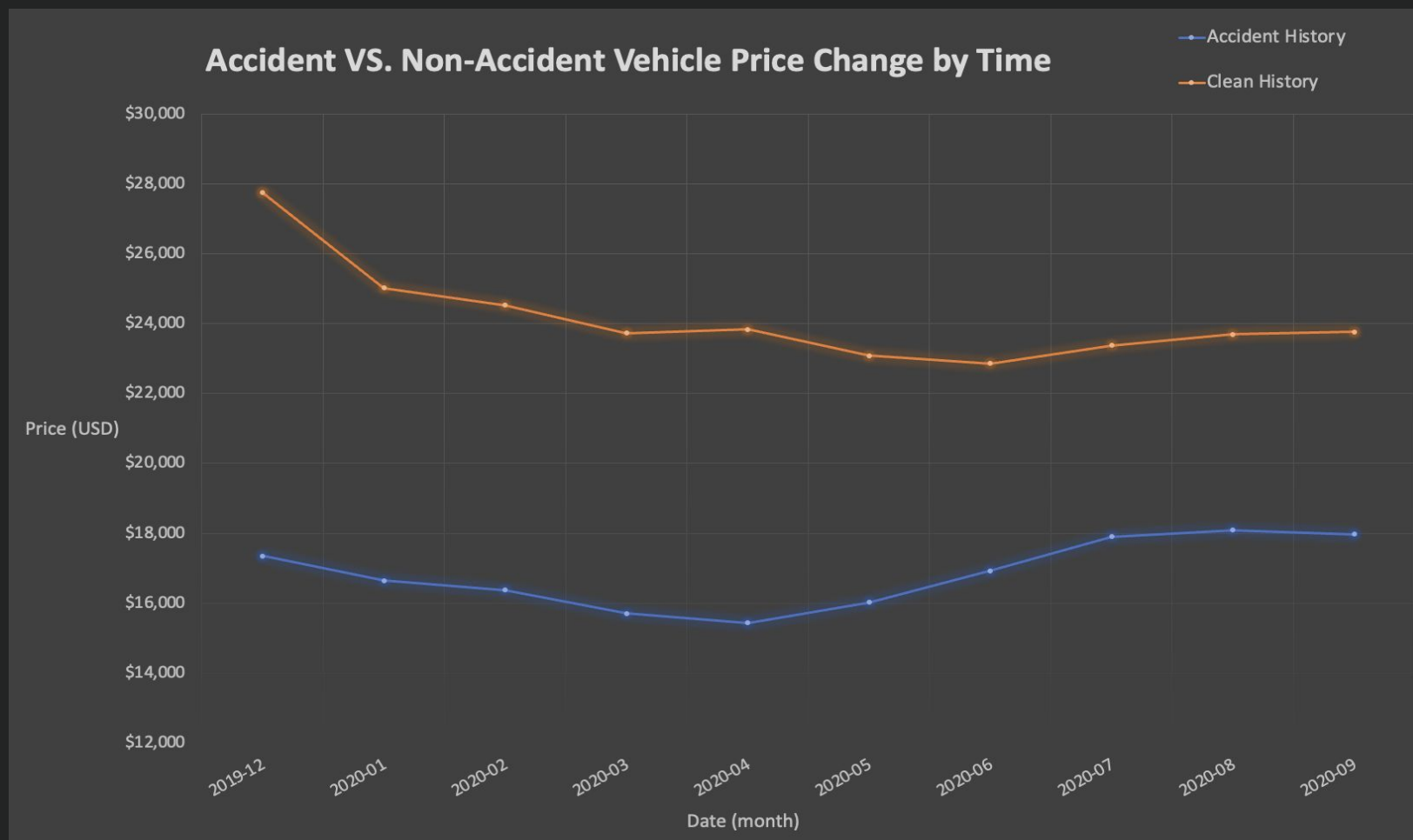Blue line: state boundaries

Odometer Distribution
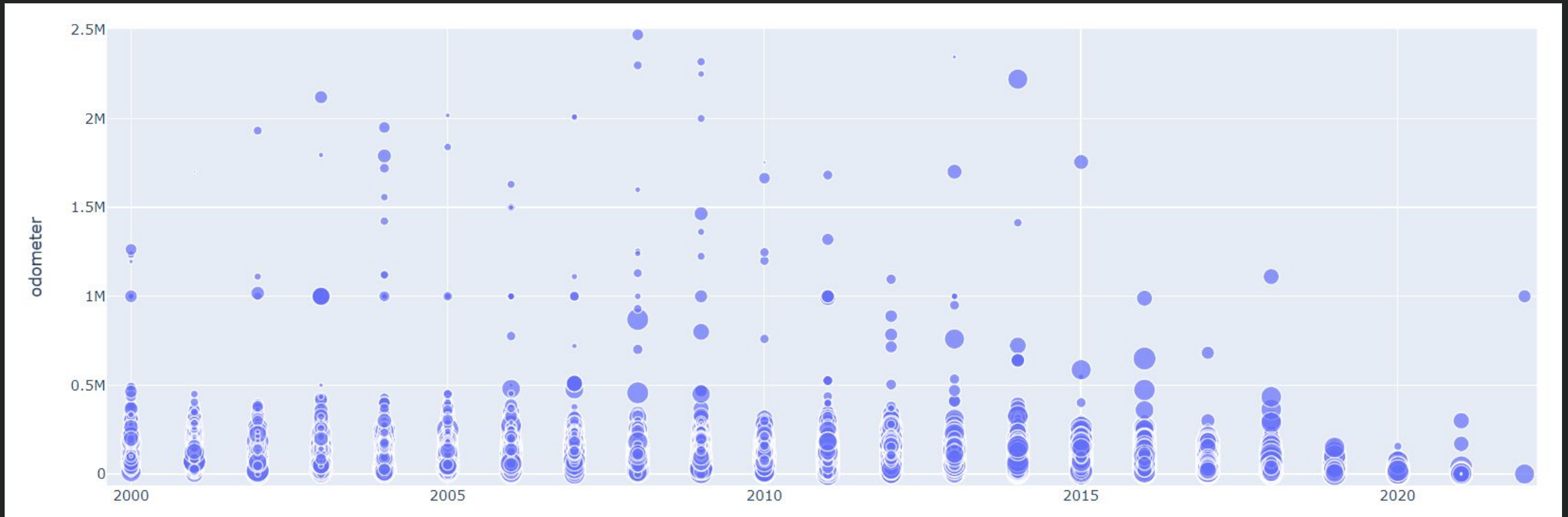
- The size of the circle is price which shows an interesting fact that cheaper cars have larger odometer

- Most cars don't get more than 0.5 million miles before they get replaced
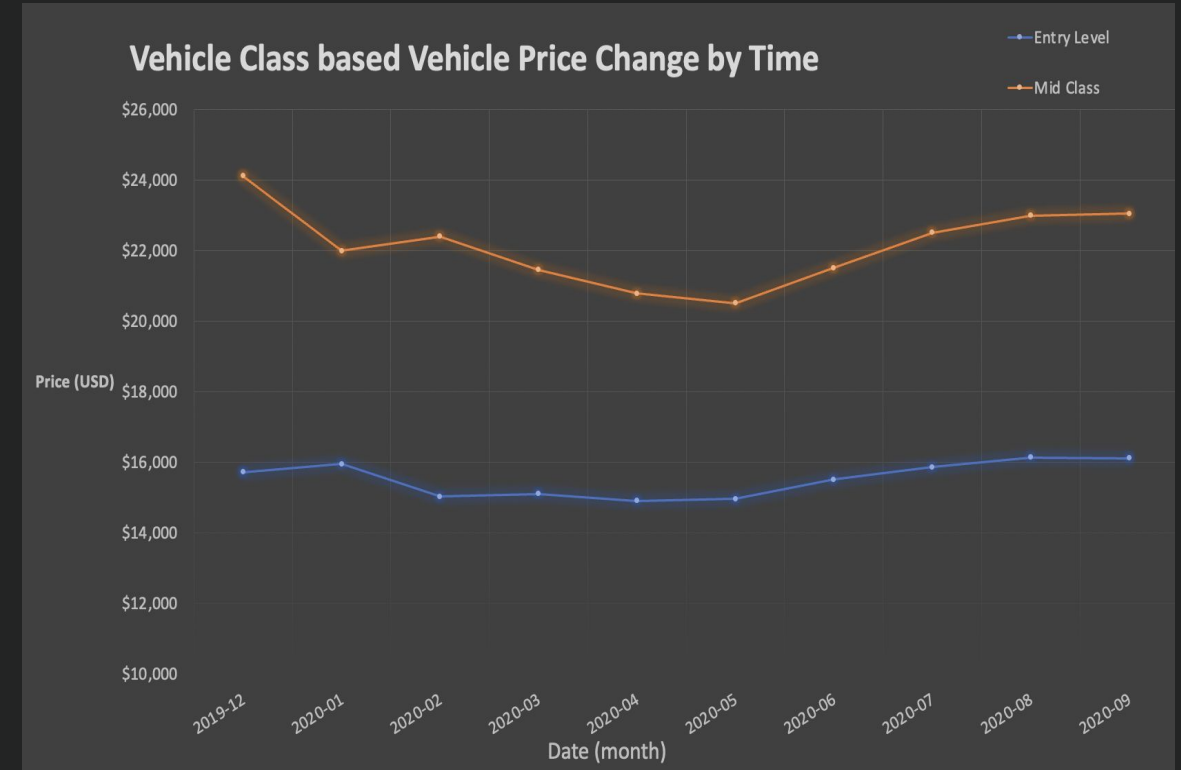
NO.3
Data Analysis and Visualization

# Price Analysis by Accident History

- Clean history vehicles have a higher base price

- More affordable vehicles are preferred during economic recovery

Price Analysis by Vehicle Class

Vehicle Class based Vehicle Price Change by Time — Higher End

Vehicle Class based Vehicle Price Change by Time — Entry Level, Mid Class

- Greater price hit during COVID & less recovery on the price

- Family-friendly/utility vehicles showed stronger price recovery

- Indication: stronger demand for affordable vehicles during economy recovery

Price Analysis by Vehicle Desirability
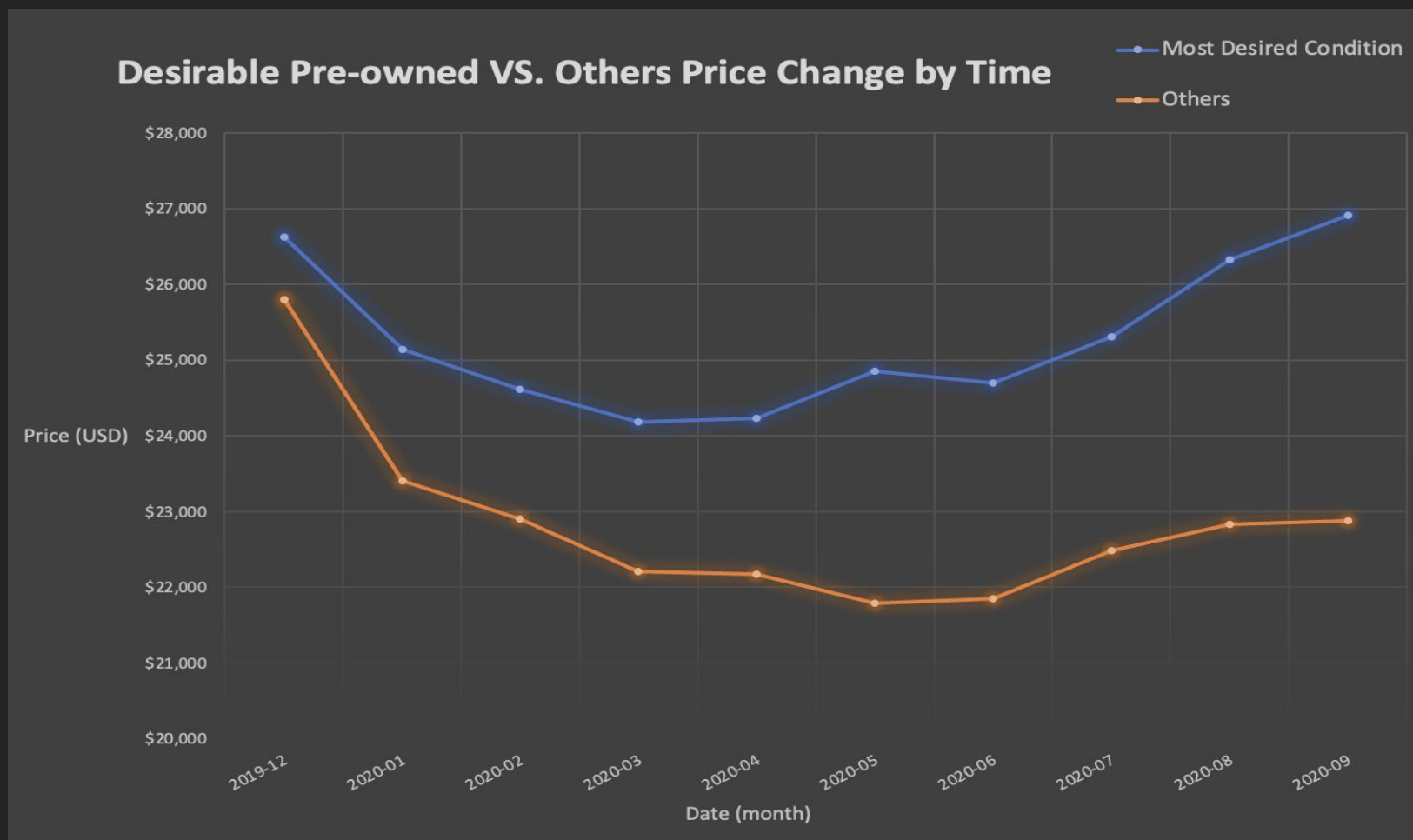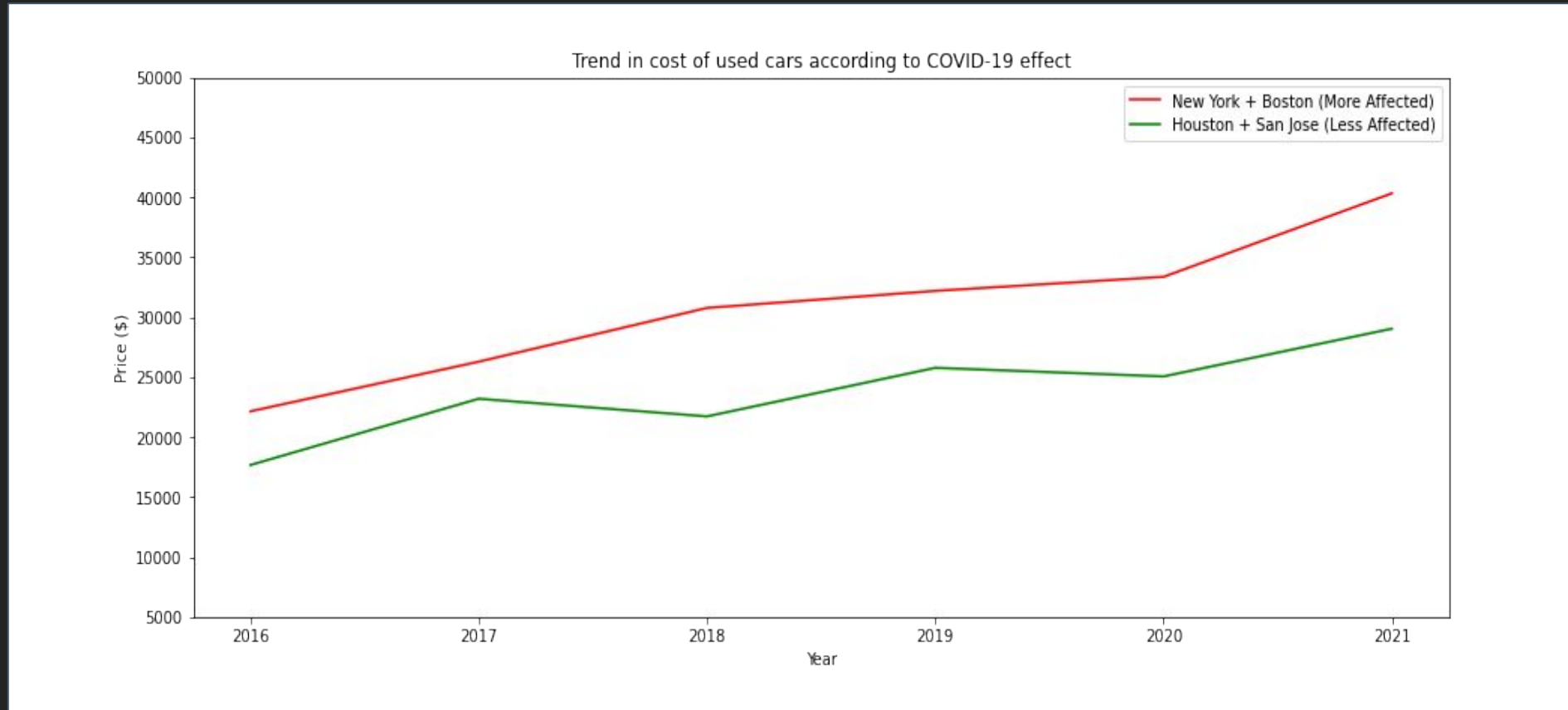

Desirable condition:
- < 35,000 miles
- model year > 2016
- owner count <= 3
- not branded title (salvage/theft)

- Those factors are most commonly considered when picking pre-owned vehicles

- Data shows stronger price recovery on vehicles with those desirable factors

Effect on used car prices based on COVID-19 impact

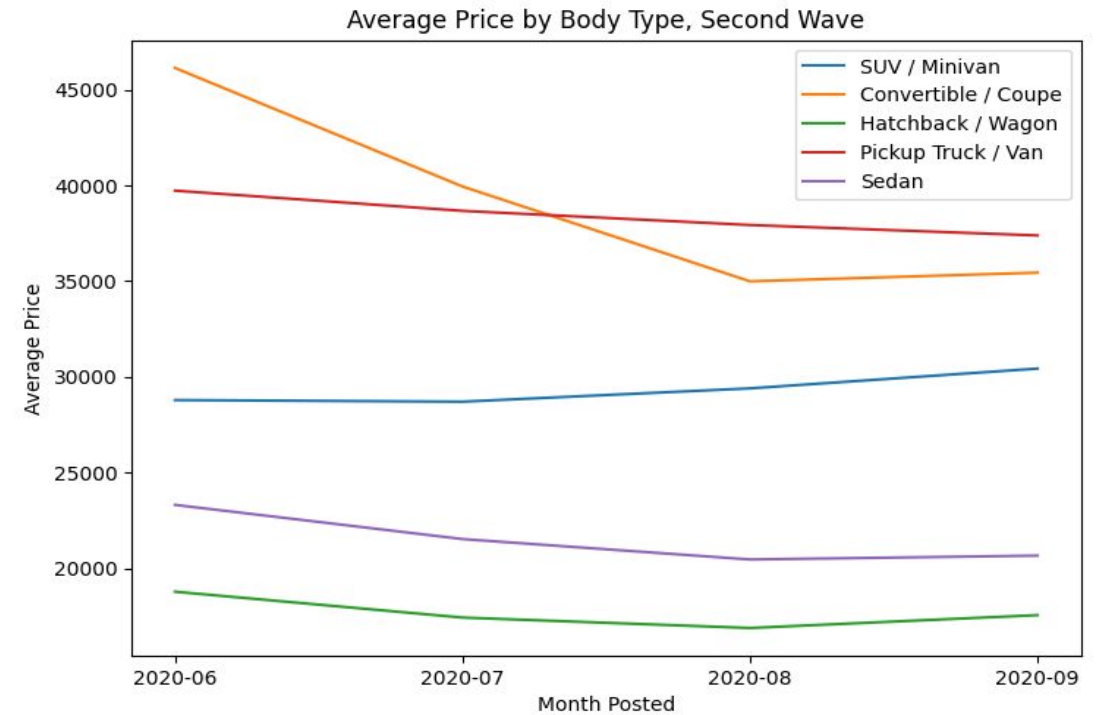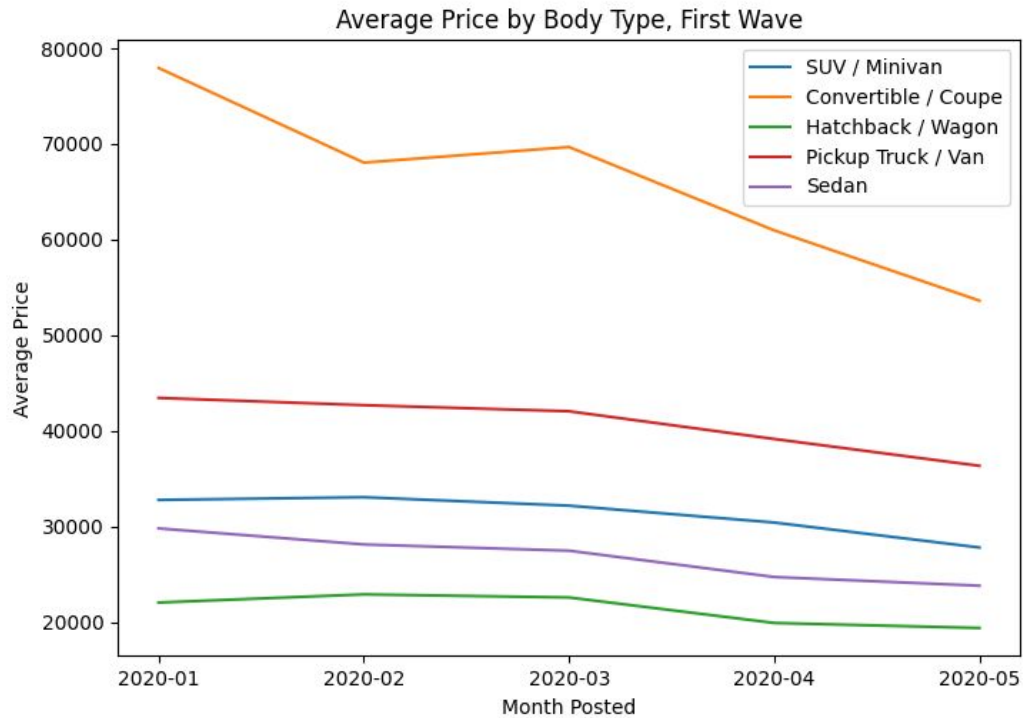Trend in cost of used cars according to COVID-19 effect

- People in cities highly affected by COVID-19 prefer buying used cars over public transport

- Increase in price in less affected cities is less drastic
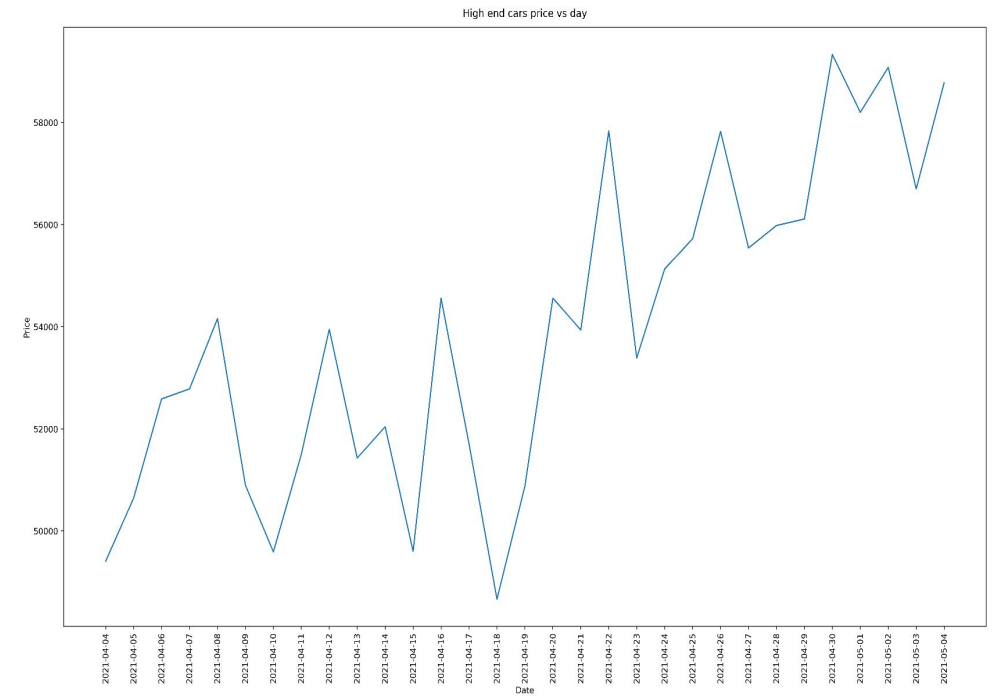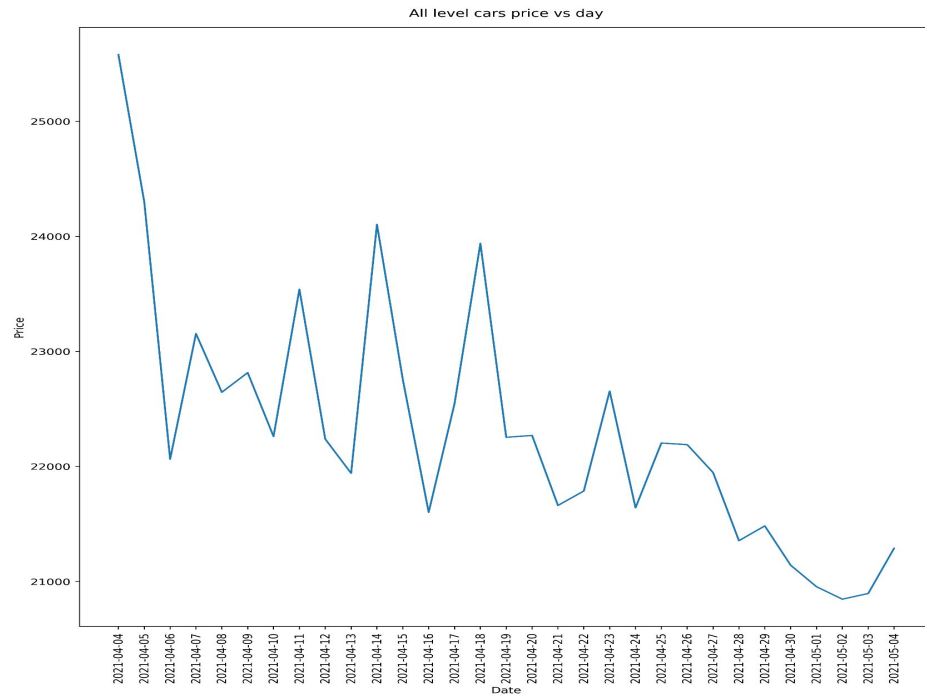
Price vs Days on Market by Body Type
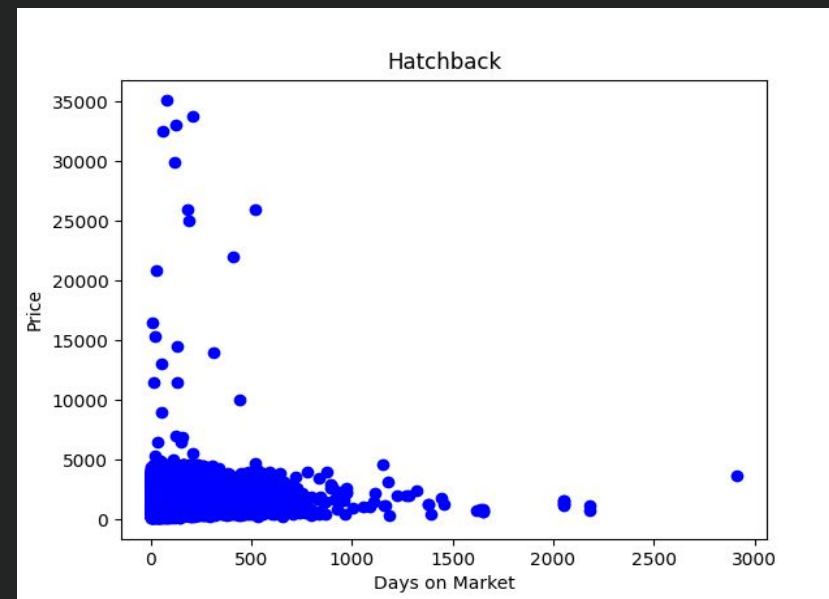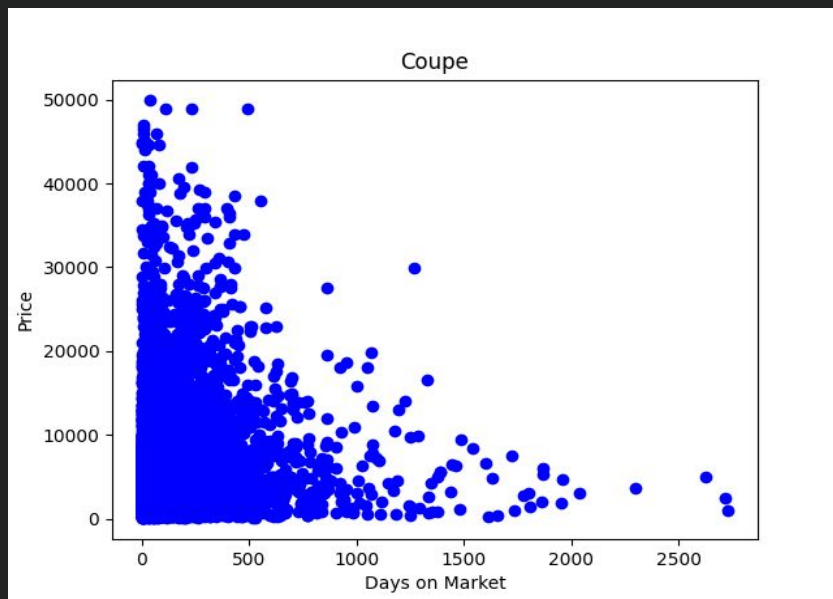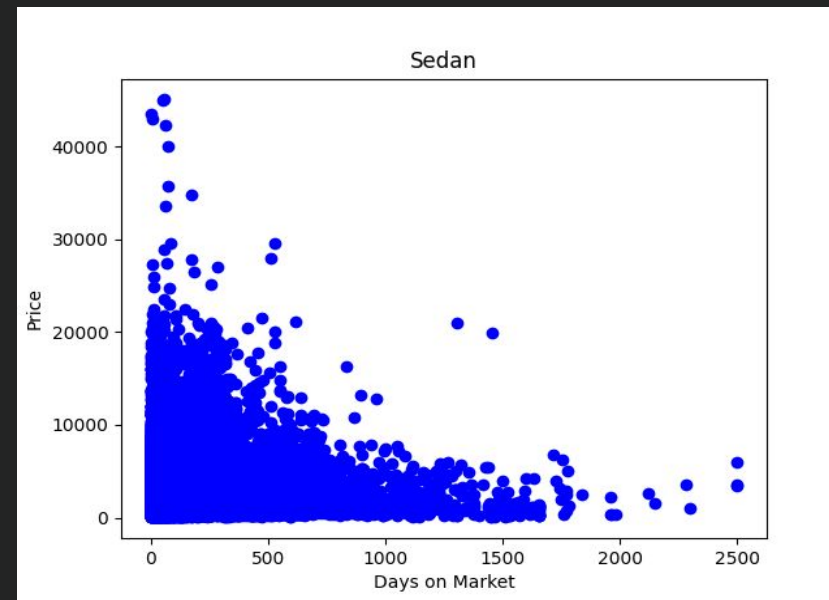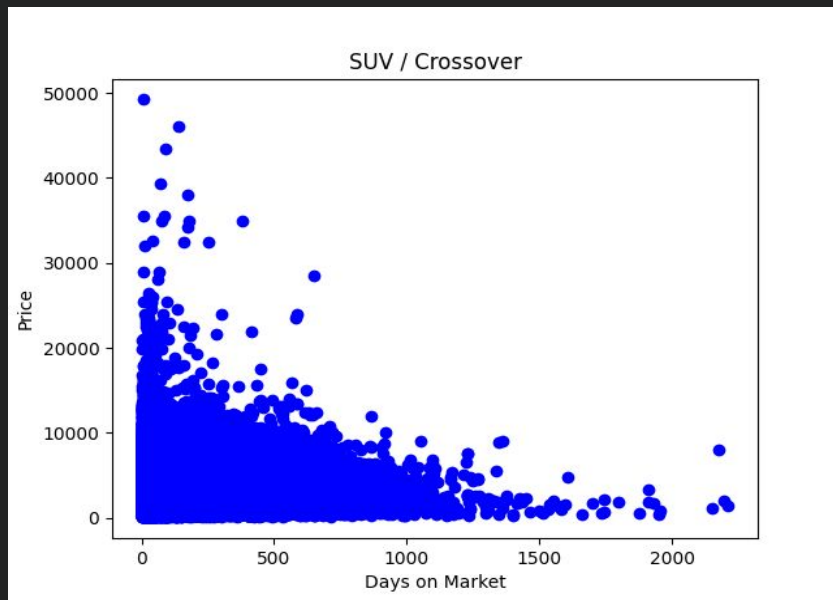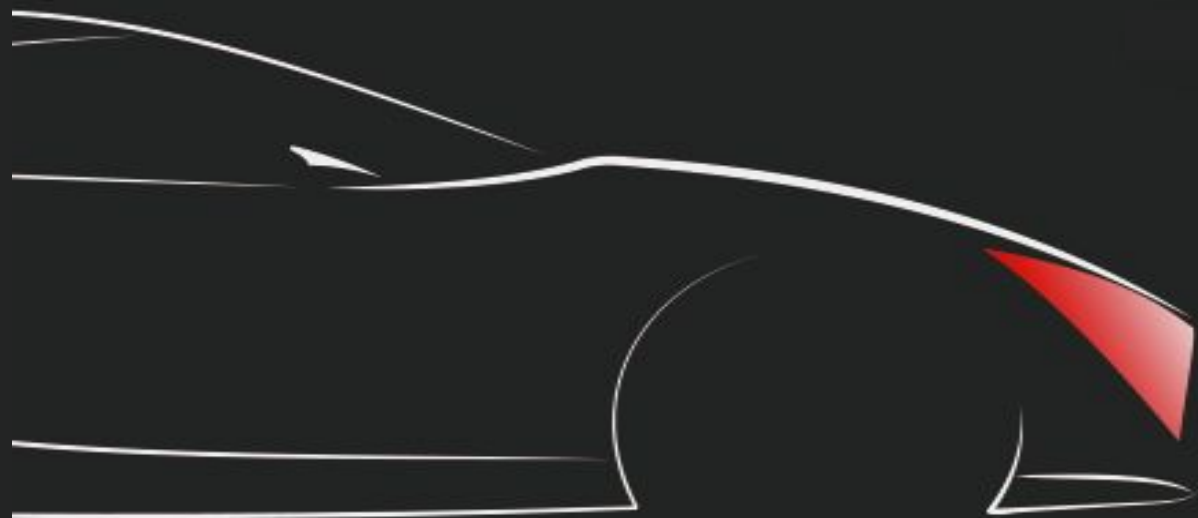
Price vs Month by Body Type

- Trend in prices of different car types during the 1st and 2nd wave of COVID-19

- Luxury car types have a reduction in price due to less demand during COVID times
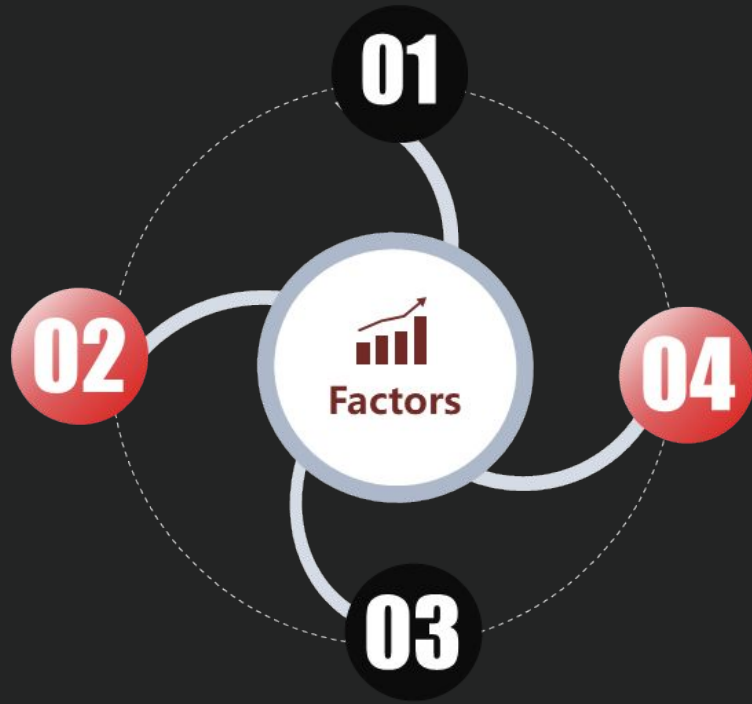
Car Price vs Time

- In 2021, the trend continues to follow the expected trend

- Cars of higher brand value have increase in prices

NO.4

Conclusions

Conclusions

01 The rise of COVID-19 has been a catalyst to the used cars market (eg. New York and Boston)

02 Covid-19 —> people avoid public transportation —> increase in used car sales

03 People are sensitive to vehicle costs —> Sales for affordable cars increases

04 Customer preference/vehicle desirability/national economy are major causes
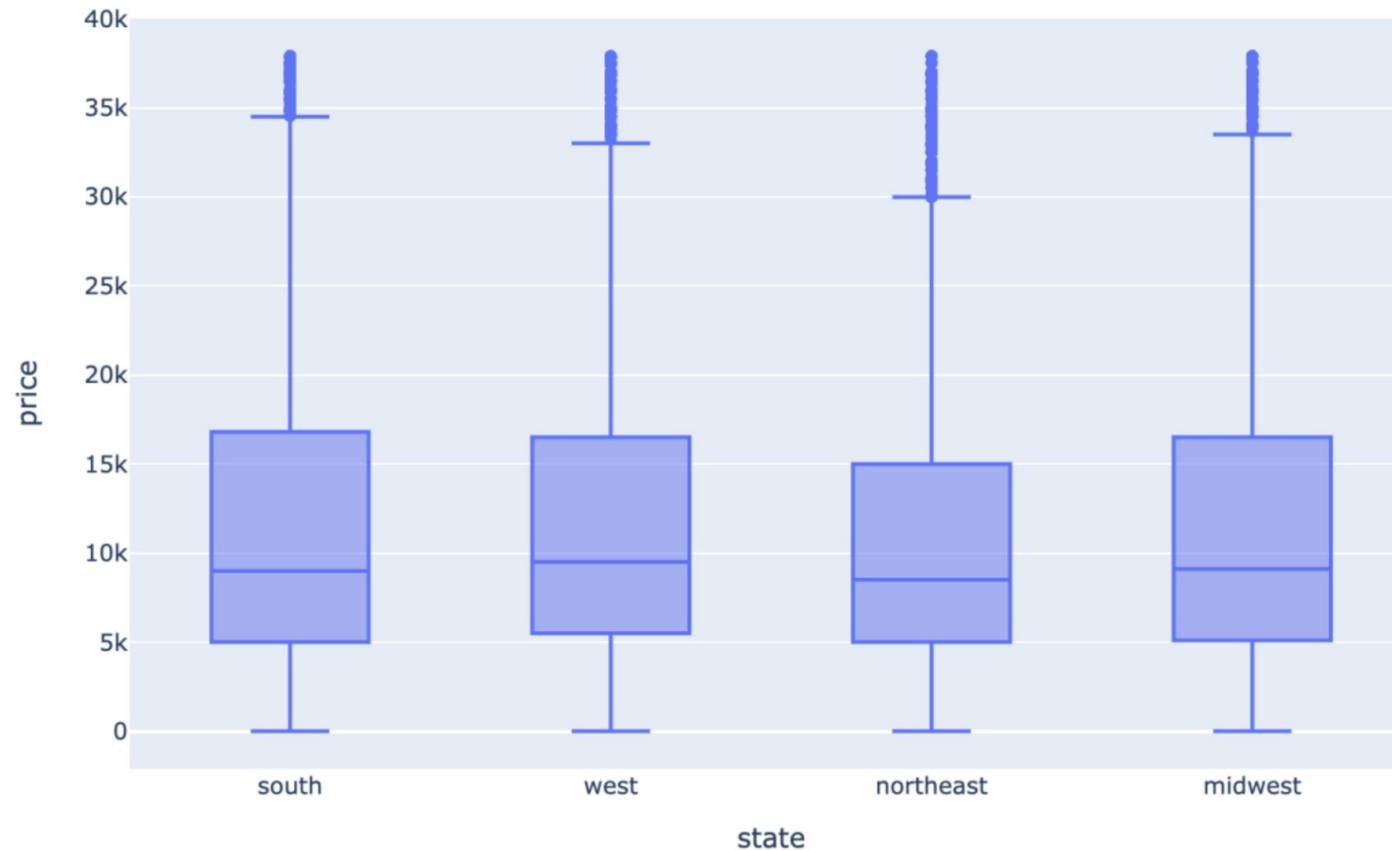
Questions?

Thanks for watching!

References

- https://www.statista.com/statistics/183713/value-of-us-passenger-cas-sales-and-leases-since-1990/

- https://www.census.gov/library/visualizations/2021/geo/population-distribution-2020.html

- https://www.bls.gov/cex/anthology/csxanth8.pdf

- https://www.bls.gov/cpi/factsheets/new-vehicles.htm

- https://www.cnbc.com/2022/01/13/why-used-car-prices-are-pushing-inflation-higher.html

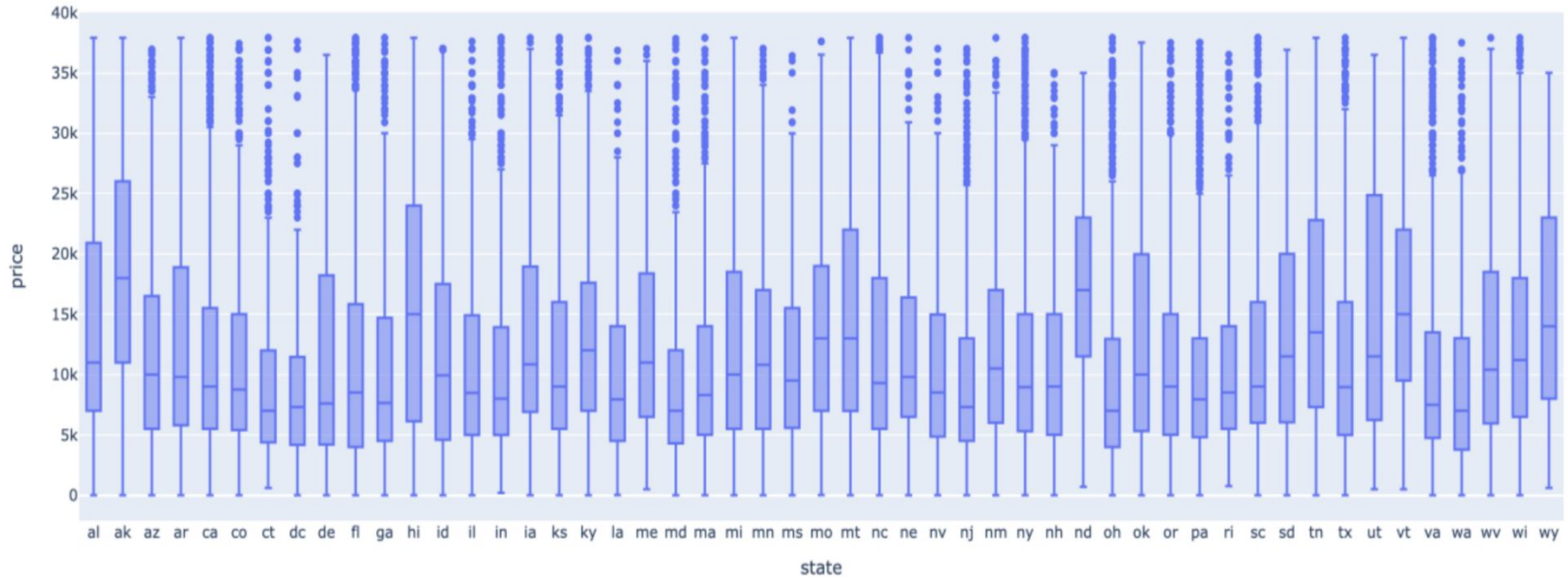- https://www.cnbc.com/2020/10/15/used-car-boom-is-one-of-hottest-coronavirus-markets-for-consumers.html

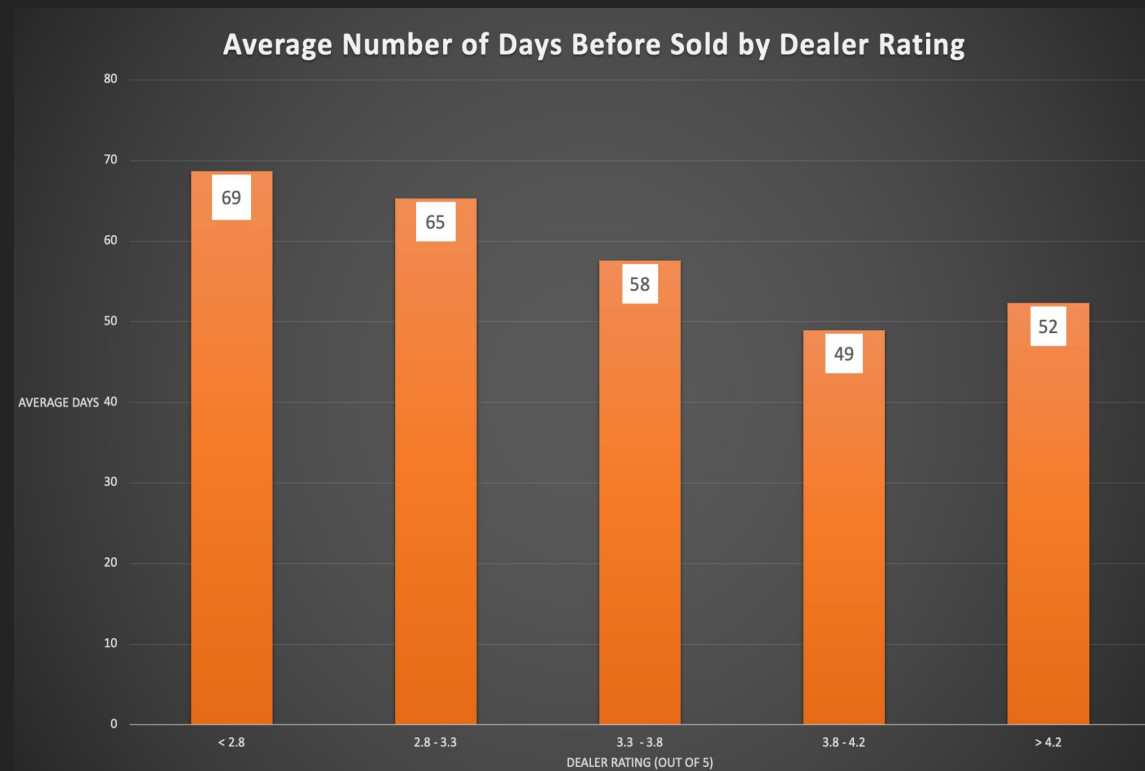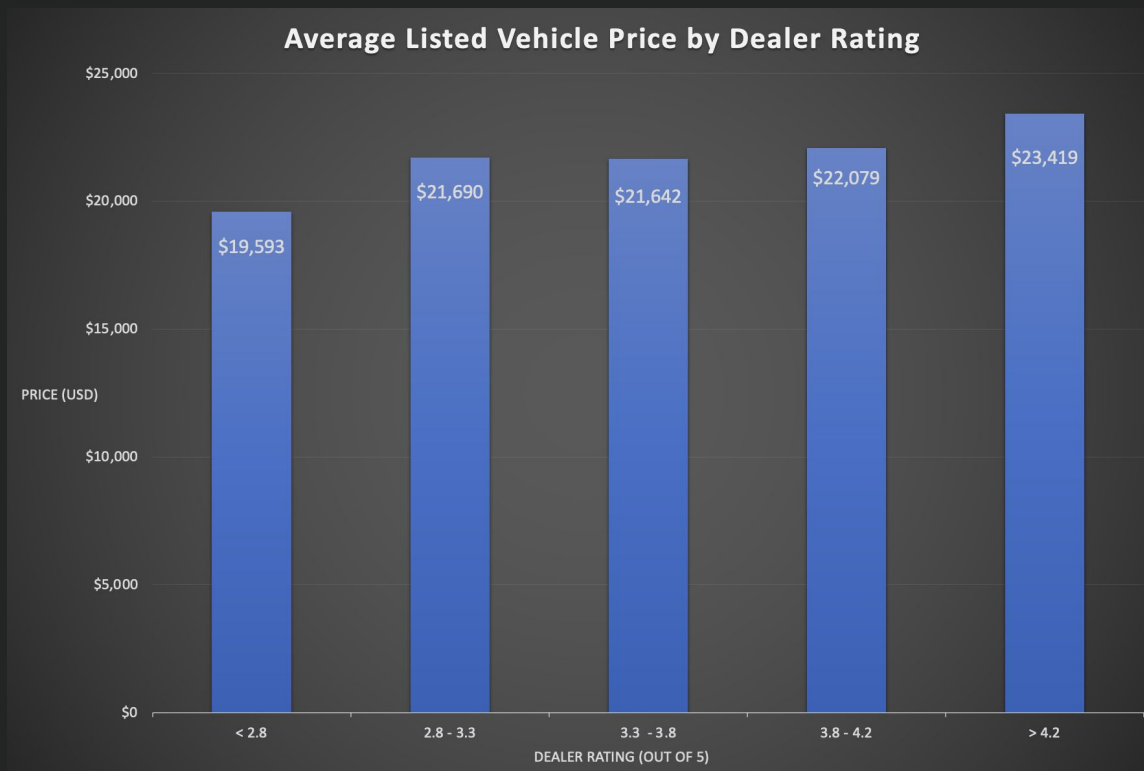# Regional Availability (South, West, Northeast, Midwest)

South - TX, OK, AR, LA, KY, TN, MS, AL, DE,MD, DC, WV, VA, NC, SC, GA, FL
West - CA, OR, WA, HI, AK, NV, ID, MT, WY, UT, CO, AZ, NM
Northeast - PA, NY, VT, ME, NH, MA, CT, RI, NJ
Midwest - ND, SD, NE, KS, MN, IA, MO, WI, IL, MI, IN, OH

Price distribution on states

Analysis according to Dealer Rating

Average Listed Vehicle Price by Dealer Rating

Dealer Rating	Price
< 2.8	$19,593
2.8 - 3.3	$21,690
3.3 - 3.8	$21,642
3.8 - 4.2	$22,079
> 4.2	$23,419

PRICE (USD) — DEALER RATING (OUT OF 5)

Average Number of Days Before Sold by Dealer Rating

Dealer Rating	Average Days
< 2.8	69
2.8 - 3.3	65
3.3 - 3.8	58
3.8 - 4.2	49
> 4.2	52

AVERAGE DAYS — DEALER RATING (OUT OF 5)

- Higher dealer rating leads to higher average price and less days before sold

- Better rating implies better vehicle quality, service guarantee, and experience
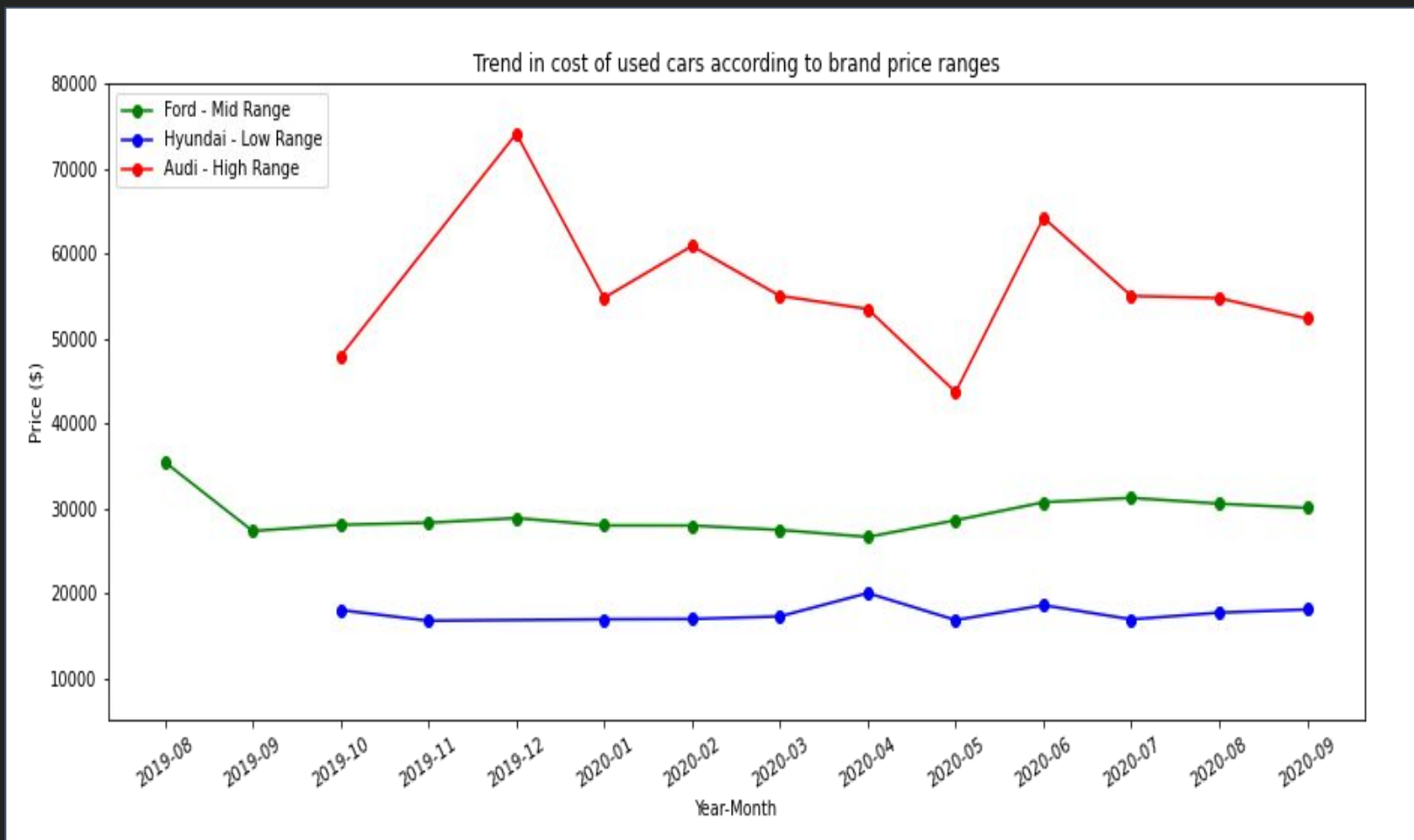

FOR SALE RUNS WELL
SEEMS LEGIT.

Price Analysis by Seasons
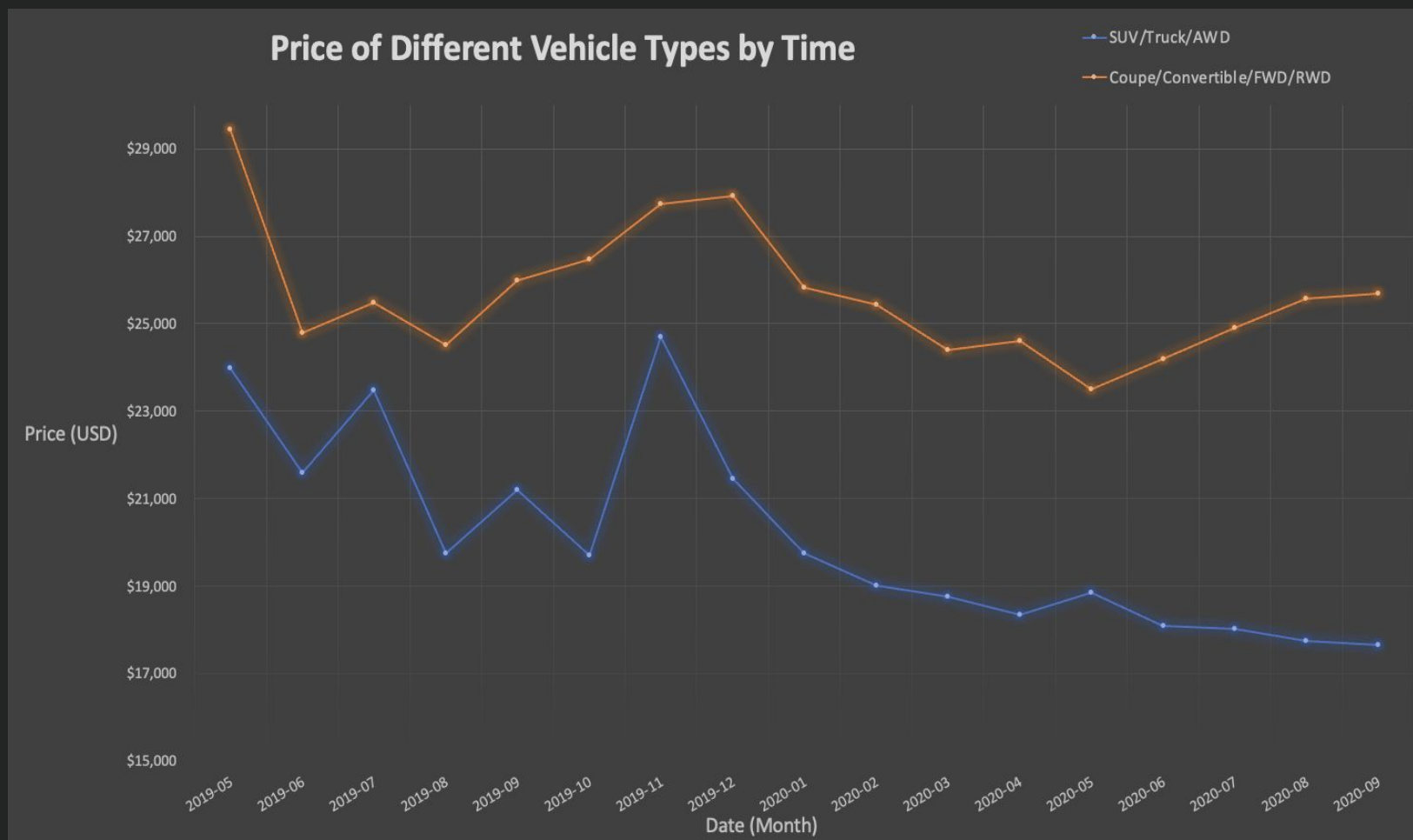
- Coupe/convertibles has higher average price
- Price is generally higher in holiday season (November to December)
- Price of winter preferred Vehicles dropped more due to season change and COVID hit

Price Analysis on Some Brands

Trend in cost of used cars according to brand price ranges

- Preference towards low range and mid range brands during COVID-19

- Prices for high range cars reduce in the initial wave of COVID-19