CarMax Analytics Showcase

BEC CONSULTING

Aaron Huynh, Ajeet Subramanian, Simon Wang, Rohan Krishnan

Meet The Team

Aaron Huynh
Freshman

Computer Science & Data Science
Fairfax, VA

Ajeet Subramanian
Senior

Applied Mathematics
Mechanicsburg, PA

Simon Wang
Junior

Economics & Psychology
Wyomissing, PA

Rohan Krishnan
Senior

Economics & BIS
Mechanicsburg, PA

Agenda

01

**Introduction
& Data
Overview**

02

**Exploratory
Analysis &
Modeling**

03

Results

Basic Data Exploration

132717 Observations
31 Variables

| Appraised Vehicles	Appraisal Offer, Make, Model, Trim, Year, Mileage, Engine, Cylinders, MPG (City), MPG (Highway), Horsepower, Fuel Capacity, Vehicle Type, Color
Purchased Vehicles	Purchasing Price, Make, Model, Trim, Year, Mileage, Engine, Cylinders, MPG (City), MPG (Highway), Horsepower, Fuel Capacity, Vehicle Type, Color
Other	State Where Sale Occured, Online vs In-Person Appraisal, Days Between Offer and Sale

Data Cleaning

1. Using **R and Python** programming languages
2. Many missing values coded as "null" → **removed from data**
3. "model" and "model_appraisal" had **too many** categories to effectively contribute to modelling
4. Conducted **exploratory & PCA analysis**

Most Popular Makes (Overall and By Region)

<u>Ford</u>	**<u>15891</u>**
Nissan	14560
Chevrolet	13438
Toyota	12589
Honda	11718
Jeep	9978
Hyundai	7690
Dodge	5296
Kia	4947
Volkswagen	2735

Region	Appraised	Purchased
Midwest	Jeep	Chevrolet
Northeast	Jeep	Jeep
South	Toyota	Ford
West	Toyota	Toyota

Where are customers buying?

Number of Observations in Each Region
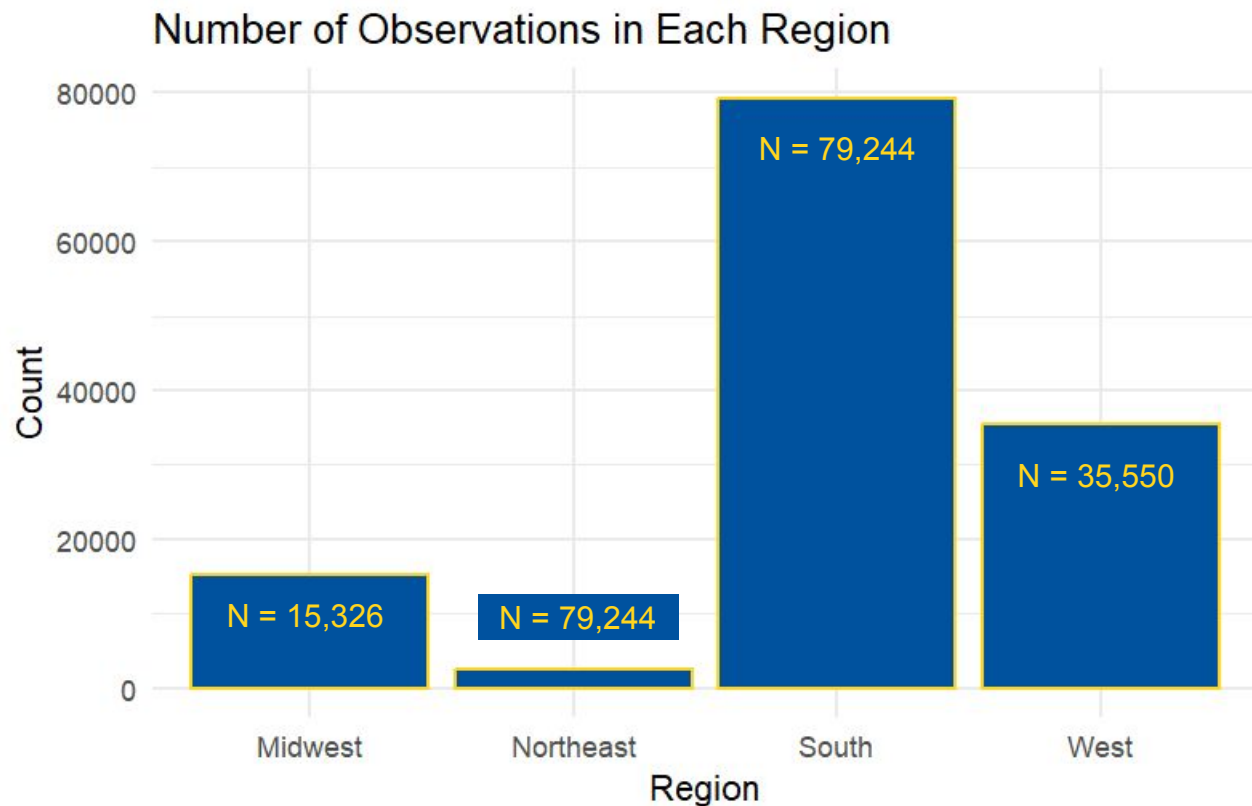
Do average vehicle prices and appraisal offers differ by region?

Average Price and Appraisal Offer by Region
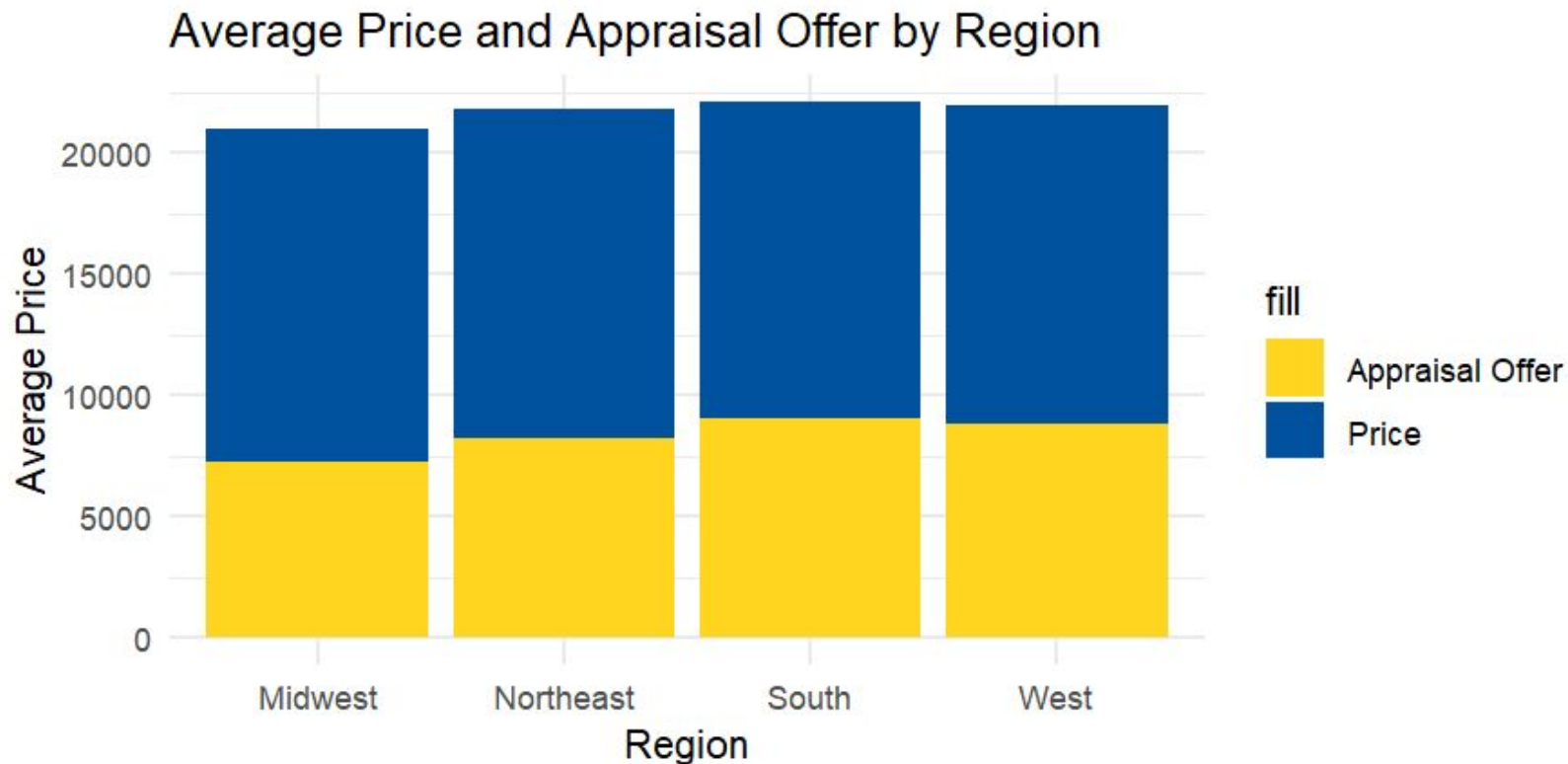
Do Online Appraisals Differ From In-Store Ones?

Average Appraisal Offer for In-Store vs Online Trade

95 Percent Confidence Interval of Difference Between Online and In-Store

$10345.747   **$7915.642**

With a **p-value ≈ 0 and α = 0.05**, the difference between the average appraisal of a car online versus in-store is significantly different that 0.

Does mileage affect brand loyalty?

	Brand Loyal	Not Brand Loyal	Total	Proportion Brand Loyal
High Mileage	8,842	30,076	38,918	.227
Low Mileage	17,464	76,335	93,799	.186

NOTE: High Mileage → Mileage > 100k miles

Two-Sample Proportion Z Test (unpooled)

With a **p-value ≈ 0 and α = 0.05**, the proportion of drivers with a high-mileage car that are brand loyal is significantly greater than the proportion of those with a low-mileage car that are also brand loyal.

# Does mileage affect vehicle type loyalty?

	Type Loyal	Not Type Loyal	Total	Proportion Type Loyal
High Mileage	13,527	25,391	38,918	.348
Low Mileage	27,904	65,895	93,799	.297

NOTE: Vehicle type refers to the body description (small SUV, pickup, van, ect.)

Two-Sample Proportion Z Test (unpooled)

With a **p-value ≈ 0 and α = 0.05**, the proportion of drivers with a high-mileage car that are type loyal is significantly greater than the proportion of those with a low-mileage car that are also type loyal.

Principal Component Analysis (PCA)

Scree Plot
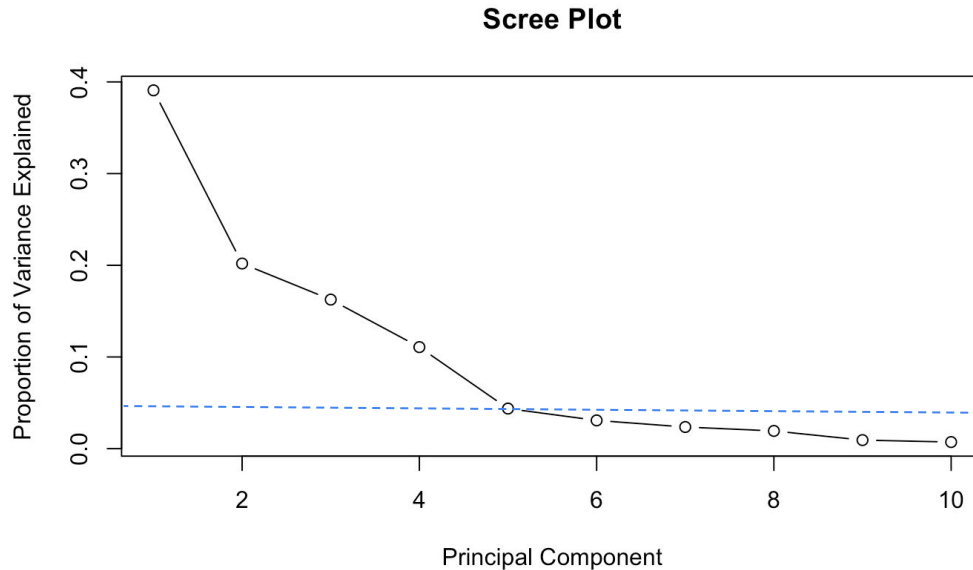
Change in proportion of variance explained for principal components becomes negligible after 5.

Based on this, we can take a look at the following variables as the main principal components (quantitative variables only) of our data set.

Principal Components (From the Data)

1. **Purchased Highway MPG**
2. **Appraisal Mileage**
3. **Appraisal Offer**
4. **Purchased Mileage**
5. **Purchasing Price**

Conclusions

Standardize in-store appraisal procedures to **reduce differences in average appraisal offer between in-store and online interactions**

Ensure **adequate stock of Ford vehicles in Southern** distribution channels and **Toyota in Western** distribution channels

Adjust **car make recommendations** based on **appraisal car mileage** (show similar brands to people who traded in high-mileage cars)

Adjust **vehicle type recommendations** based on **appraisal car mileage** (show similar vehicle types to people who traded in high-mileage cars)

Make **highway MPG, mileage, and price directly visible** on each car's profile to improve ease of shopping for customers