

# **Used Car Industry Study: An Example of CarMax**

*Dinglu Pan*

*Liejiang Zhu*

*Guangdi Zhong*

*Xueying Ren*

*Yanjiang Wang*

## **1. Introduction & Objectives**

As the nation's largest used vehicle retailer headquartered at Richmond, Virginia since September 1993, CarMax provides a wide range of used vehicles and related products and services around the United States. Specifically, CarMax operates two major business segments: CarMax Sales Operations and CarMax Auto Finance. The CarMax Sales Operation segment purchases used vehicles, sells used vehicles, and provides financing options. The CarMax Auto Finance segment arranges financing options to qualifying customers who purchase used vehicles from CarMax. During the fiscal year ended February 28, 2022, CarMax "sold 924,338 used vehicles at retail, and serviced appropriately 1.1 million customer accounts in its \$15.65 billion portfolio of managed receivables" (CarMax Inc, 2022, p.5). The development of CarMax's omni-channel platform enables retailer consumers to purchase a used car in-person at stores, completely online, or a combination of both.

The outbreak of COVID-19 pandemic around the globe adversely impacted CarMax's business operations and consumer demand. On the other hand, the global shortage of car ships and declining new vehicle availability, an increasing number of consumers intend to purchase used vehicles. Even though CarMax has been the largest retailer of used vehicles in the United States, it experiences competition from franchised dealers, independent used car dealers, online sellers, and private parties, which may adversely affect CarMax's business operations and profitability.

According to our research, we find that the sales person will highly recommend customers to purchase MaxCare, which has an extended warranty, when they are buying the vehicle. CarMax has also launched their 24-Hour Test Drives and extended its 7-Day Money Back Guarantee to a 30-Day Money Back Guarantee. Based on these findings, we are interested in testing will the services (e.g. MaxCare) and guarantees (e.g. Money-Back) provided increase people's intention to buy used cars

from CarMax. We are also interested in testing if the online selling method actually increase customers' purchasing intention, and whether or not the preferences of customers on the type of cars affect their final decisions. Additionally, we want to test if there is any difference between the buying intention of male and female customers. We also want to find how customers value different aspects for different kinds of used cars and what insights we can detect for CarMax's precision marketing. Finally, by determining various factors that may influence CarMax's sales and potential customers' purchasing intention, our main objective is to provide strategic recommendations on how to boost CarMax's sales and market share and attract more customers in the post-pandemic era.

## **2. Data Description**

### **1) Data collection & data**

We designed the survey data of 147 residents from nationwide, we designed the questionnaire (Table 1) and to create a survey research method to the project study on the factors affecting CarMax sales project, the project adopted the survey and focus group methods to interview the target consumers to find the best answer. This study adopted the method of online questionnaire, which designed and distributed the questionnaire and asked respondents to determine their intention to buy used cars, their views on used cars, and their concerns about used cars. In order to determine the feasibility of the questionnaire, we launched a questionnaire on the internet and conducted research with reliable data from the Online Channel, Service, and Customer insight in three different areas. This group has a certain age range (20-64 years old), different jobs (income), accurate data collection, and can be scientifically analyzed.

To ensure the comprehensiveness of the questionnaire study, we selected participants from different sources from different organizations. At the same time, questionnaire surveys and

participation in the network environment can create a comfortable environment to ensure that everyone can participate in the discussion and fully express their ideas via USC Marshall School Slack, and Facebook target the consumers. In addition, we use short and positive questions and use the design as a survey of Likert scale. It's an agree-disagree scale, or it might be a scale that measures the frequency of a particular behavior, and it is convenient for linear regression data analysis and later processing.

Phase I (Intention of used car): It can determine the surveyors' understanding of used cars and willingness to buy used cars to determine how to obtain used car information. The respondents' potential purchase intention in CarMax was determined according to the variables.

Phase II (The intention of Online Channel in CarMax): The second step is to conduct linear regression analysis on consumers' willingness to buy used cars online. Analysis factors include saving time; Complex web design; The security of paperless contract; Charming 360-degree photos (VR car views); Cost savings; 30 days money back guarantee, increase confidence in online shopping; These variables can help CarMax determine how to use the network for marketing and fine operation of used cars through network channels.

Phase III (The Customer insight & Service): The variable is set up from the perspective of consumers: Longer warranty; Test drive; Longer money back guarantee; Dealer location; Trade in value; Multi-channel promotion; Car's Type, brand. The information exchange between consumers and CarMax is optimized. CarMax can understand customers' preferences and provide better services to help customers choose their favorite cars more effectively. Linear regression analysis can help CarMax establish a more effective interaction between the network marketing model of used cars and customers.

Phase IV (Demographic information): Basic information collects the Age, Gender, Highest

degree or level, and Job status to determine the basic information of the respondents.

### **3. Empirical Strategy & Data Analysis**

#### **1) Data Pre-processing**

We conduct our data analysis part in R programming. After collecting the survey data (147 responses) we firstly do the data pre-processing. We delete unnecessary row and columns and change the demographic related column names from the original dataset. We also update the classes of each variable into a proper type (numeric/factor).

Based on the 1<sup>st</sup> and the 5<sup>th</sup> question, we generate a new variable called “intention” to show how likely a person is willing to purchase a used car from CarMax. Since the options for the 1<sup>st</sup> and the 5<sup>th</sup> question are in interval scale (1-5), we form the formula to calculate the “intention” score for each respondent as:

$$Intention_i = \frac{Q1_i}{5} * \frac{Q5_i}{5} * 100$$

Because 3 is the median value of the 1-5 interval scale, we assume that the respondent with an “intention” score greater than 36 is a high intention potential customer for CarMax. We find that there are 94 out of 147 (63.95%) high intention potential customers in our survey data. We also generate two dummy variables called “luxury” and “economy” to represent whether the respondent prefer to buy a luxury/economy car or not. The overview of our main dataset is shown in Figure 1.

#### **2) Factor Analysis**

There are 16 interval scaled questions (Q7--Q22) that we concern the most. To reduce the dimensions of our dataset, we conduct the factor analysis. According to the correlation plot (Figure 2

Left), and the Eigen-Value plot (Figure 2 Right), we found that there are 4 factors have Eigen-Values greater than 1. Based on that, we decide create 4 factors for our project.

After reviewing the factor loadings (Figure 3) of each question, we conclude that question No. 7, 11--13, 21, 22 are in Factor 1, question No. 15--19 are in Factor 2, question No. 8, 14, 20 are in Factor 3, and question No. 9, 10 are in Factor 4. Based on the contents of these questions (Table 1 Link), we name Factor1 as the “Online Buying Experience” to represent how people feel about the online used-car buying process, name Factor2 as “Dealer Service” to represent the services provided by dealers, name Factor3 as “Guarantee”, and name Factor4 as “Online Buying Efficiency”. Factor1 is the most important factor and all these 4 factors together can explain 46.8% of the variance (Figure 3). Finally, we store the factor scores in our main dataset (Figure 4) for later parts.

### **3) Hypothesis Tests**

We are interested in if there is any significant gender difference between intention scores. With  $H_0$ : The intention score for male and female is indifferent, and  $H_1$ : The intention score for males and females is significantly different. We create a new dataset including “intention”, “gender” (0--female, 1--male), “luxury”, “economy” and those 4 factors. We delete respondents we don’t know the gender status (5 unknown), and get 142 observations (Figure 5). Based on the new dataset generated, we firstly run a two-side t-test of “intention” by “gender” (Figure 6) and find that the  $P\text{-value} = 0.0003364 < 0.05$ , which means under 0.05 significant level, we can confidently reject  $H_0$  and conclude that the intention scores for males and females are significantly different.

To detect how the difference looks like, we run a one-side t-test of “intention” by “gender” with  $H_0$ : Female intention score  $\geq$  Male intention score, and  $H_1$ : Female intention score  $<$  Male intention score. Seeing from the results (Figure 7), we find that the  $P\text{-value} = 0.0001682 < 0.05$ . We can

confidently conclude that under the 0.05 significant level, the intention score of man is greater than that is for woman. That is, based on our survey data, males seem to be more likely to buy a used car from CarMax than females. To find exactly how gender affects intention scores, we will run a linear regression which includes factor scores and the gender dummy in the regression part.

Moreover, we run t-tests on the intention scores by luxury and economy dummy separately. The results (Figure 8) show that the P-value for the t-test run by luxury dummy is  $0.8874 > 0.05$  and for the economy dummy is  $0.67 > 0.05$ , which indicates that whether or not a person prefers to buy a luxury or an economy car will not directly significantly affect his/her intention to buy from CarMax.

We are interested in if there is any significant gender difference between the scores of those 4 factors. We run 4 t-tests (Figure 9) and find that the P-value of online experience (0.01936) and guarantee (0.01539) are less than 0.05, and we can conclude that under the 0.05 significant level, ratings of online experiences and guarantees are significantly different between male and female. For dealer service (0.06028) and online efficiency (0.124), there is no significant gender difference between ratings.

#### 4) Linear Regressions

We conduct our main linear regression based on our interests in the relationship between the intention to buy a used car from CarMax and four factors' scores:

$$\begin{aligned} \text{Intention}_i = & b_0 + b_1 * \text{OnlineExperience}_i + b_2 * \text{DealerService}_i + b_3 * \text{Guarantee}_i \\ & + b_4 * \text{OnlineEfficiency}_i + \varepsilon_i \end{aligned}$$

Seeing from the main regression results (Figure 10), we find that the P-values of online experience ( $1.17\text{e-}11$ ), dealer service (0.00252), and guarantee ( $4.31\text{e-}07$ ) are all less than 0.05, which indicates that they are significant predictors for people's intention to buy from CarMax. One possible explanation for the P-value of the online efficiency factor (0.05866), which is slightly greater than 0.05, could be

lacking of observations. From the main regression results (Figure 10), the R-squared value (0.4286) and the F-test P-value of our model ( $< 2.2e-16$ ) indicates that our main model could well explain the intention scores. For the significant coefficients' interpretation, 1 unit increase in online experience score is associated with 12.59 unit increase for intention to buy a used car from CarMax, holding everything else constant. Online tools provide customer a lot more flexibility shopping at home. Customers can use 360-degree photo to see the vehicle's internal and external at home and won't be rushed by salesperson. They may also get vehicle's appraisal which may trade into CarMax, and have more time to consider whether or not to trade in. Especially, during the COVID period, customers may not willing to go to the physical stores to take a lot more chance to get infection. For the dealer service factor, 1 unit increase in dealer service score is associated with 5.51 unit increase in intention, holding everything else constant. Customers may have confident with longer warranty for the used vehicle. CarMax offer 24-hour test drive which give customers the chance to experience for their daily life to test how this vehicle fit for them. For the guarantee factor, 1 unit increase in guarantee score is associated with 8.72 unit increase for intention, holding everything else constant. CarMax has a longer time money back guarantee policy which gives customers more confidence in buying a used car from CarMax. Just like online shopping, you don't need to worry about the return, if customers don't like the vehicle or think it doesn't fit them, they can easily return it with the money back guarantee. Seeing from the statistic t-value of each variable, online experience (7.387) is the most important indicator in explaining people's intention to buy a used car from CarMax.

We also conduct a linear regression on the relationship between intention and scores of 4 factors additionally add the interaction indicators with the luxury dummy:



$$\begin{aligned}
\text{Intention}_i = & b_0 + b_1 * \text{OnExp}_i + b_2 * \text{DS}_i + b_3 * G_i + b_4 * \text{OnEff}_i + b_5 * \text{OnExp}_i * \text{Lux1} \\
& + b_6 * \text{DS}_i * \text{Lux1} + b_7 * G_i * \text{Lux1} + b_8 * \text{OnEff}_i * \text{Lux1} + \varepsilon_i
\end{aligned}$$

From the regression results (Figure 11), the interaction term of dealer service and luxury dummy is significant (P-value = 0.00258 < 0.05) among other interaction terms. The coefficient (-14.436) of this interaction term indicates that the effect of dealer service on the intention score is expected to be 14.436 less for people interesting in luxury vehicles, holding everything else constant. This means customers who looking for luxury vehicle may not consider too much about the dealer service provided.

Based on the hypothesis test results of intention by gender, we run a linear regression on the relationship between intention and scores of four factors additionally add the gender dummy:

$$\begin{aligned}
\text{Intention}_i = & b_0 + b_1 * \text{OnlineExperience}_i + b_2 * \text{DealerService}_i + b_3 * \text{Guarantee}_i \\
& + b_4 * \text{OnlineEfficiency}_i + b_5 * \text{Gender} + \varepsilon_i
\end{aligned}$$

From the regression results (Figure 12), we find that gender dummy (P-value = 0.01630 < 0.05) is a significant predictor and the intention to buy a used car from CarMax for males is expected to be 8.00 unit greater than that for females, holding everything else constant. This indicates that under the same conditions, males are more willing to purchase a used vehicle through CarMax than that for females.

## 5) Preference Tables

For survey questions No. 3 and 6, they are asking about the resources of how people get the information about used cars and CarMax. From the information gain resources, we can get some insights for CarMax on where to acquire potential customers and where and how to advertise their company and services. From the table (Figure 13) and bar charts (Figure 14), we find that most customers know CarMax from their friends. This may be related to the concept of Word-of-Mouth (WOM) Marketing strategy. People who previously bought their cars from CarMax would recommend

it to their friends who are considering buying a used vehicle. In the main regression, we detected a positively relationship between intention scores and four factors, which indicates that for people who value more or rate higher on these factors, they are more likely to be potential customers for CarMax. To increase the customer base, CarMax can improve its quality on these 4 factors to not only acquire more potential buyers, but also provide better services for its current and past customers, and in return WOM will help CarMax attract more customers in the future.

For survey questions No. 23-26, they are asking about customers' preferences on the used car. We are interested in finding what people focus on and prefer to buy. To achieve this objective, we make 4 tables (Figure 15) and 4 bar charts (Figure 16) regarding the responses of these 4 questions. Seeing from the results (Figure 16-1), we find that the Price and Mileage are the primary concerns for a used car. The reason for this could be that people always want to get a lower mileage with lower price if possible. Low mileage would have less issues and the vehicle may still run well after purchasing. Most customers are willing to purchase the Japanese and European vehicles. Japanese vehicle has much more reliability compared to that from other countries, and this can also relate to the result that most customers prefer to buy an economy vehicle. European countries produce most of the luxury vehicles which have many loyal customers. SUVs and Sedans are the most two popular choices for our respondents. One possible reason could be sedans can provide the most daily usage and SUVs may provide the whole family a pleasant long way field trip.

#### **4. Conclusion & Recommendation**

From the linear regression of intention for used cars and respondent's scores for four factors (Online Experience, Dealer Service, Guarantee, Online Efficiency) we know that online tools effectively improve the willingness of customers to buy used cars from CarMax. Service related policies such as

the 24-hour test drive and a long-time money-back guarantee will increase the confidence to buy a used car for customers.

From the linear regression that add the interaction indicators with the luxury dummy and add the gender dummy, we can see that under the same conditions, customers looking for the luxury vehicle may not consider too much about dealer services provided, and males are more willing to purchase a used vehicle from CarMax than females.

From the survey result statistical summaries, we know that people get the information and get to know about CarMax mainly from their friends and from the online channel. From the different dimensions of choosing a used car, people prefer the type of economy and be more concerned about price and mileage. People also like to choose the brand region on Japanese and European and prefer SUVs and Sedans.

For the overall recommendation, we suggest that CarMax can continue using the online tools to improve customers' confidence and purchasing intention. CarMax can pay more attention to improve and diversify the one-on-one service quality for both online and physical buying portals, and also improve the online buying efficiency to increase the WOM effect, and adjust the dealer service strategies to better fit the person who wants to buy luxury vehicles and the group of males. We also suggest that CarMax can increase its used-car inventory for economic cars, and cars made from Japan and Europe, as well as cars with the pattern of SUV and Sedan. Additionally, CarMax should have more strict quality control for mileage, and offer customers more reasonable prices based on the quality and many other aspects of the used car, and also try to keep a balance of optimum price and high sales.

# Appendix

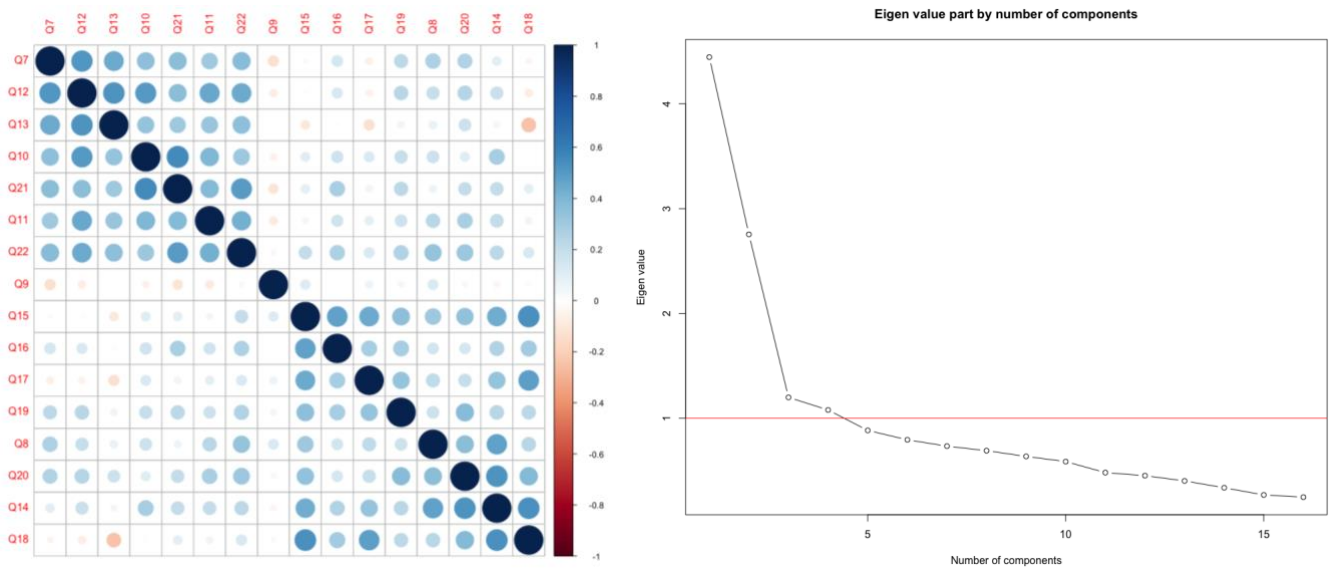
**Table 1.** Questionnaire Link and Overview

Variable	Description of Variable(specific)
Survey Link	<a href="https://usc.qualtrics.com/jfe/form/SV_7aOaxcLAKeGcuDY">https://usc.qualtrics.com/jfe/form/SV_7aOaxcLAKeGcuDY</a>
Intention of second-hand car	How well know about used cars; How respondents get the used car information; The willingness to buy used cars.
The intention of Online Channel in CarMax	The willingness of buying a used car online; save time; webpage designed complicated; The secure of paperless contract; The attractive 360-degree photo (VR view of the car); Save cost; 30-Day Money Back Guarantee increase confidence buying online.
The Customer insight & Service	longer warranty; Test drive; Longer money back guarantee; dealer location; trade in value; multi-channel promotion; Car's type, brand.
Demographic information	Age; Gender; Highest degree or level; Job.

**Figure 1.** Overview of The Main Dataset

Q26 Q27 Q28 age gender edu job intention luxury economy																																					
1	1	1	1	5	1	4	1	2	5	4	4	2	2	5	5	5	5	5	5	5	5	5	5	1	2	4	1,7,8,9,11	1	5	2	0	3	3	16	0	1	
2	2	4	2	4	2	4	1	1	4	2	3	4	4	2	4	3	4	4	4	4	5	4	4	1	1	1	1,2,3,4,8	3	5	2	0	4	3	64	1	0	
3	3	4	1	3	1	4	4	4	4	2	4	4	4	1	4	5	5	5	5	5	5	5	5	3	2	2	1,5,6,7,8	2	4	3	1	4	3	64	0	1	
4	4	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	4	2	2	3	3	1	2,4,6	3	3	3	0	3	2	16	0	0
5	5	3	4	4	1	4	1	2	4	2	4	1	4	1	3	1	2	4	3	1	3	1	2	4	3	4	1,4	2	3	2	1	3	1	48	0	0	
6	6	4	4	4	3	4	4	4	5	2	3	4	4	4	5	4	5	4	4	3	4	4	3	4	1	1	4	1,4,7,11,14	5	5	2	1	5	3	64	1	0

**Figure 2.** Correlation Plot and Eigen-Value Plot of Q7-Q22



**Figure 3.** Factor Loadings

```
Call:
factanal(x = car_df[, c(8:23)], factors = all_fa_num, scores = "regression", rotation = "varimax")

Uniquenesses:
  Q7  Q8  Q9  Q10  Q11  Q12  Q13  Q14  Q15  Q16  Q17  Q18  Q19  Q20  Q21  Q22
0.550 0.688 0.972 0.304 0.656 0.411 0.524 0.005 0.428 0.676 0.598 0.441 0.696 0.502 0.527 0.539

Loadings:
      Factor1 Factor2 Factor3 Factor4
Q7   0.666   0.000   0.073   0.034
Q8   0.238   0.218   0.455  -0.016
Q9  -0.035   0.077  -0.019  -0.145
Q10  0.495   0.189  -0.008   0.644
Q11  0.538   0.114   0.111   0.172
Q12  0.729  -0.032   0.122   0.204
Q13  0.644  -0.217   0.072   0.093
Q14  0.032   0.319   0.884   0.334
Q15  0.016   0.702   0.268  -0.084
Q16  0.170   0.537   0.072   0.037
Q17 -0.072   0.610   0.154   0.030
Q18 -0.139   0.607   0.410  -0.051
Q19  0.294   0.445   0.123  -0.068
Q20  0.325   0.263   0.549  -0.148
Q21  0.518   0.251  -0.018   0.375
Q22  0.614   0.254   0.140   0.012

      Factor1 Factor2 Factor3 Factor4
SS loadings    2.875    2.168    1.631    0.808
Proportion Var  0.180    0.136    0.102    0.051
Cumulative Var  0.180    0.315    0.417    0.468

Test of the hypothesis that 4 factors are sufficient.
The chi square statistic is 85.7 on 62 degrees of freedom.
The p-value is 0.0248
```

**Figure 4.** Overview of The Main Dataset with Factor Scores

> head(car_df)																																	
	id	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	age	gender	edu	job
1	1	1	1	1	5	1	4	1	2	5	4	4	2	2	5	5	5	5	5	5	5	5	5	1	2	4	1,7,8,9,11	1	5	2	0	3	3
2	2	4	2	4	2	4	1	1	4	2	3	4	4	2	4	3	4	4	4	4	5	4	4	1	1	1	1,2,3,4,8	3	5	2	0	4	3
3	3	4	1	3	1	4	4	4	4	2	4	4	1	4	5	5	5	5	5	5	5	5	3	2	2	1,5,6,7,8	2	4	3	1	4	3	
4	4	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	3	4	2	2	3	3	1	2,4,6	3	3	3	0	3	2
5	5	3	4	4	1	4	1	2	4	2	4	1	4	1	3	1	2	4	3	1	3	1	2	4	3	4	1,4	2	3	2	1	3	1
6	6	4	4	4	3	4	4	4	5	2	3	4	4	5	4	5	4	4	3	4	4	3	4	1	1	4	1,4,7,11,14	5	5	2	1	5	3
	intention	luxury	economy							online_experience					dealer_service					guarantee			online_efficiency										
1	16		0						1						-0.01924582				1.1372727							0.9210784						0.1995883	
2	64		1						0						-0.10701052				-0.3128905							0.2634650						-0.1421261	
3	64		0						1						0.12443885				1.2148943							0.8474910						0.2979229	
4	16		0						0						-0.37430524				-1.6266664							-0.5467756						-0.2178149	
5	48		0						0						-1.25712148				-2.1039753							-0.8035940						1.0207118	
6	64		1						0						0.74268817				-0.3600479							0.4012184						-0.5603381	

**Figure 5.** Overview of The New Dataset for Hypotheses Tests

	intention	gender	luxury	economy	online_experience	dealer_service	guarantee	online_efficiency
1	16	0	0	1	-0.01924582	1.1372727	0.9210784	0.1995883
2	64	0	1	0	-0.10701052	-0.3128905	0.2634650	-0.1421261
3	64	1	0	1	0.12443885	1.2148943	0.8474910	0.2979229
4	16	0	0	0	-0.37430524	-1.6266664	-0.5467756	-0.2178149
5	48	1	0	0	-1.25712148	-2.1039753	-0.8035940	1.0207118
6	64	1	1	0	0.74268817	-0.3600479	0.4012184	-0.5603381

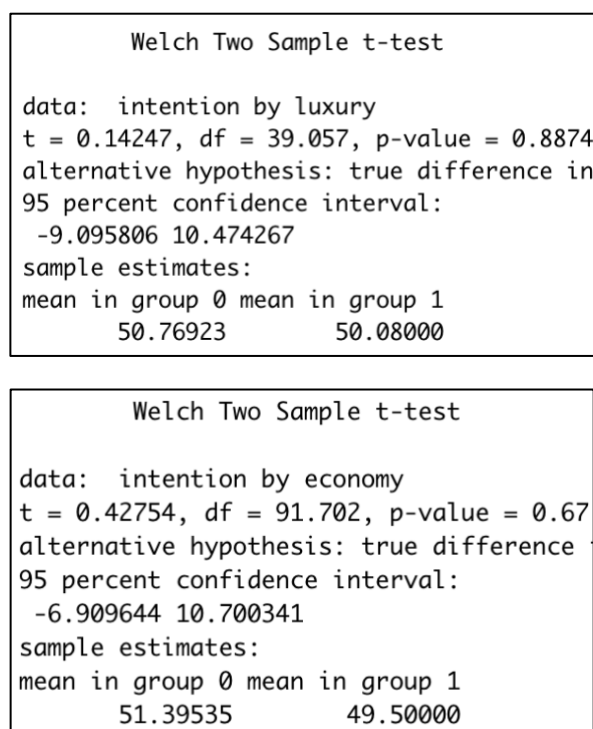
**Figure 6.** Two-side T-test of Intention by Gender

Welch Two Sample t-test
data: intention by gender
t = -3.6773, df = 138.55, p-value = 0.0003364
alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0
95 percent confidence interval:
-21.885765 -6.579945
sample estimates:
mean in group 0 mean in group 1
43.03030 57.26316

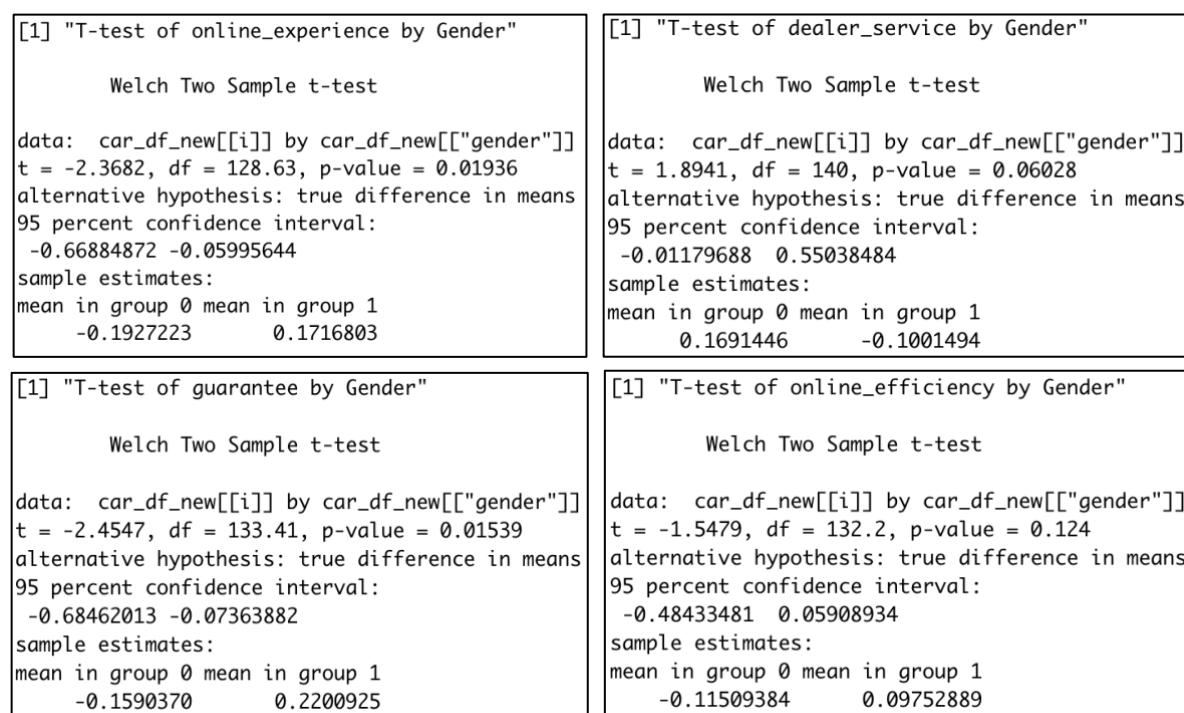
**Figure 7.** One-side T-test of Intention by Gender (Less)

Welch Two Sample t-test
data: intention by gender
t = -3.6773, df = 138.55, p-value = 0.0001682
alternative hypothesis: true difference in means between group 0 and group 1 is less than 0
95 percent confidence interval:
-Inf -7.823573
sample estimates:
mean in group 0 mean in group 1
43.03030 57.26316

**Figure 8.** Two-side T-test of Intention Scores by Luxury and Economy



**Figure 9.** Two-side T-test of Factor Scores by Gender



**Figure 10.** Main Regression Results

```
Call:
lm(formula = intention ~ online_experience + dealer_service +
    guarantee + online_efficiency, data = car_df)

Residuals:
    Min       1Q   Median       3Q      Max
-48.613 -12.154   0.549  11.705  41.465

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    49.823     1.537   32.408 < 2e-16 ***
online_experience  12.594     1.705    7.387 1.17e-11 ***
dealer_service    5.511     1.792    3.075 0.00252 **
guarantee         8.721     1.645    5.301 4.31e-07 ***
online_efficiency  3.669     1.925    1.906 0.05866 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 18.64 on 142 degrees of freedom
Multiple R-squared:  0.4286,    Adjusted R-squared:  0.4125
F-statistic: 26.63 on 4 and 142 DF,  p-value: < 2.2e-16
```

**Figure 11.** Regression Results (Adding Luxury Interaction)

```
Call:
lm(formula = intention ~ online_experience + dealer_service +
    guarantee + online_efficiency + online_experience:luxury +
    dealer_service:luxury + guarantee:luxury + online_efficiency:luxury,
    data = car_df)

Residuals:
    Min       1Q   Median       3Q      Max
-51.807 -12.866  -0.643  11.334  39.702

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    49.798     1.521   32.733 < 2e-16 ***
online_experience  12.012     1.838    6.537 1.13e-09 ***
dealer_service    7.946     1.943    4.089 7.33e-05 ***
guarantee         9.024     1.774    5.088 1.16e-06 ***
online_efficiency  4.463     2.121    2.104 0.03722 *
online_experience:luxury -2.642     4.916   -0.538 0.59178
dealer_service:luxury -14.436     4.703   -3.069 0.00258 **
guarantee:luxury    -2.525     4.218   -0.599 0.55036
online_efficiency:luxury -5.541     4.859   -1.140 0.25606
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 18.21 on 138 degrees of freedom
Multiple R-squared:  0.4703,    Adjusted R-squared:  0.4396
F-statistic: 15.32 on 8 and 138 DF,  p-value: 5.921e-16
```



**Figure 12.** Regression Results (Adding Gender Dummy)

```
Call:
lm(formula = intention ~ online_experience + dealer_service +
    guarantee + online_efficiency + gender, data = car_df_new)

Residuals:
    Min       1Q   Median       3Q      Max
-44.158 -11.970   0.636  13.225  41.617

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)      45.852      2.334  19.644 < 2e-16 ***
online_experience  11.496      1.736   6.621 7.60e-10 ***
dealer_service     5.941      1.836   3.236 0.00152 **
guarantee          7.711      1.739   4.435 1.88e-05 ***
online_efficiency  3.346      1.944   1.721 0.08754 .
gender1           8.009      3.293   2.432 0.01630 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 18.33 on 136 degrees of freedom
Multiple R-squared:  0.4403,    Adjusted R-squared:  0.4197
F-statistic: 21.4 on 5 and 136 DF,  p-value: 9.461e-16
```

**Figure 13.** Information Resources Statistical Summaries

```
> Q3_table      > Q6_table

 1  2  3  4  5      1  2  3  4  5
2  8 55 51 31    16 21 18 74 18
```

**Figure 14.** Information Resources Bar Plots

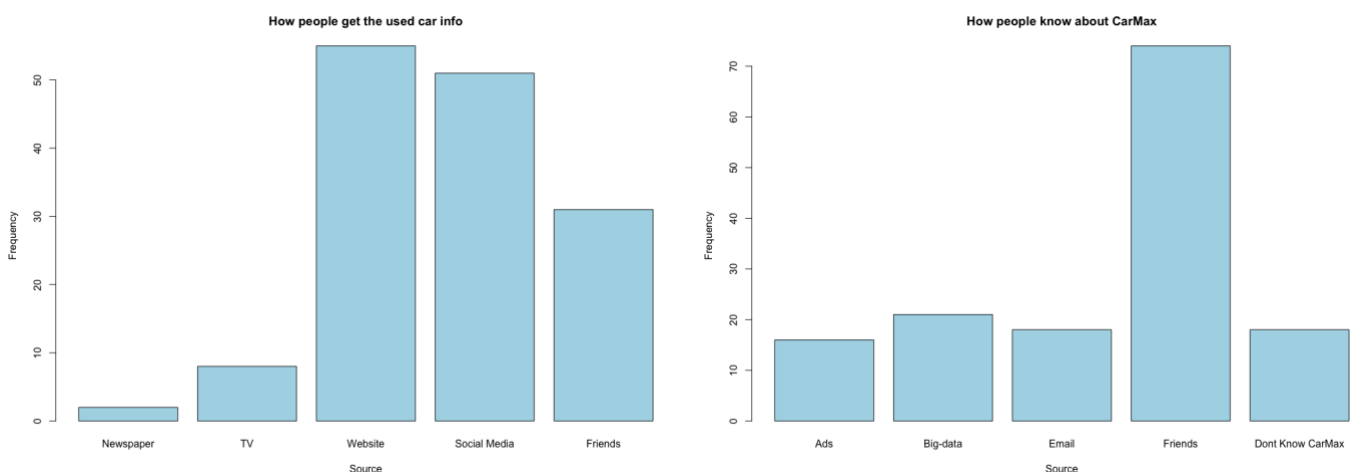


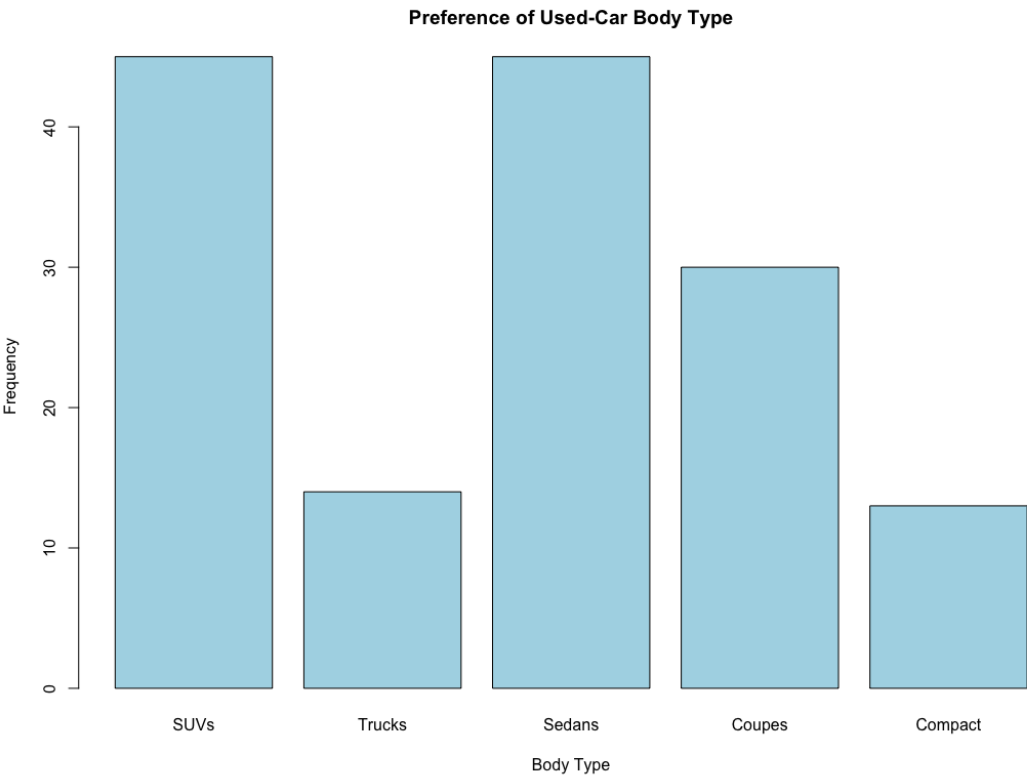
Figure 15. Customer Preferences Statistical Summaries

> body_type			> car_model			> brand_region		
	Type	Freq		Model	Freq		Region	Freq
1	SUVs	45	1	Luxury	25	1	Domestic	21
2	Trucks	14	2	Economy	57	2	Japanese	52
3	Sedans	45	3	Electric	27	3	Korean	9
4	Coupes	30	4	Hybrid	17	4	European	50
5	Compact	13	5	Sports	21	5	Others	15

> aspect\_preference

	Price	Exterior	Interior	Space	FuelEconomy	EnginePerformance	Mileage	Safety	DamageReport	ServiceRecord	ProductionYear	PastUsage	DealerService	Brand
Frequency	92	48	52	53	62	50	84	57	62	34	55	35	40	34

Figure 16. Customer Preferences Bar Plots



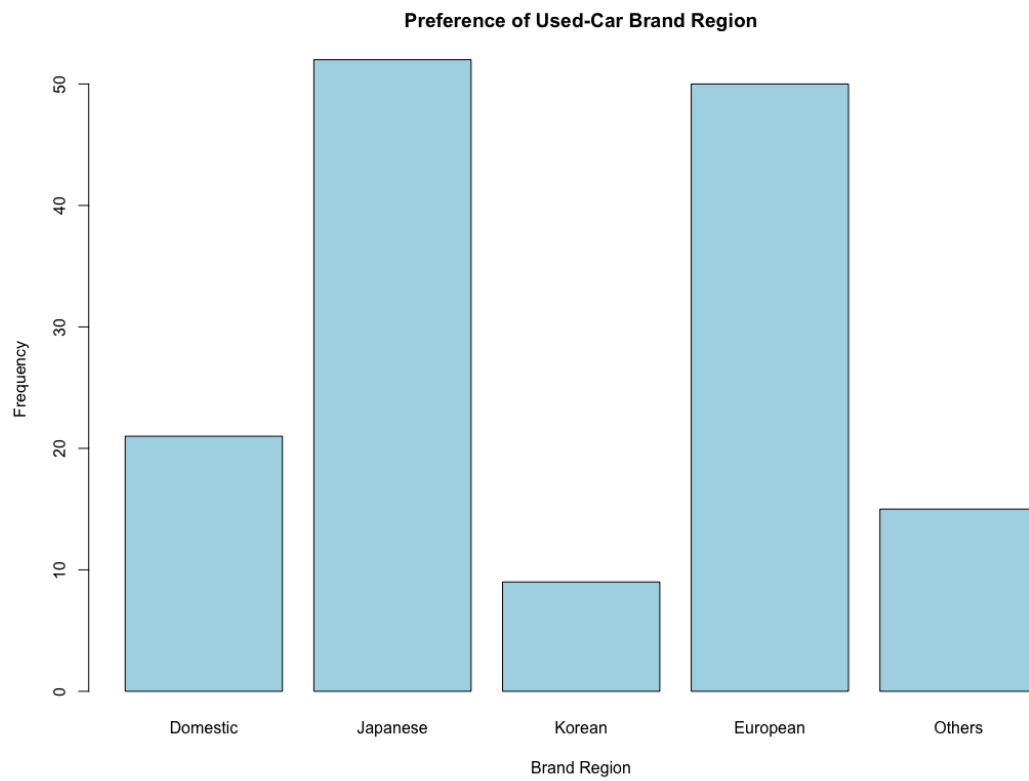
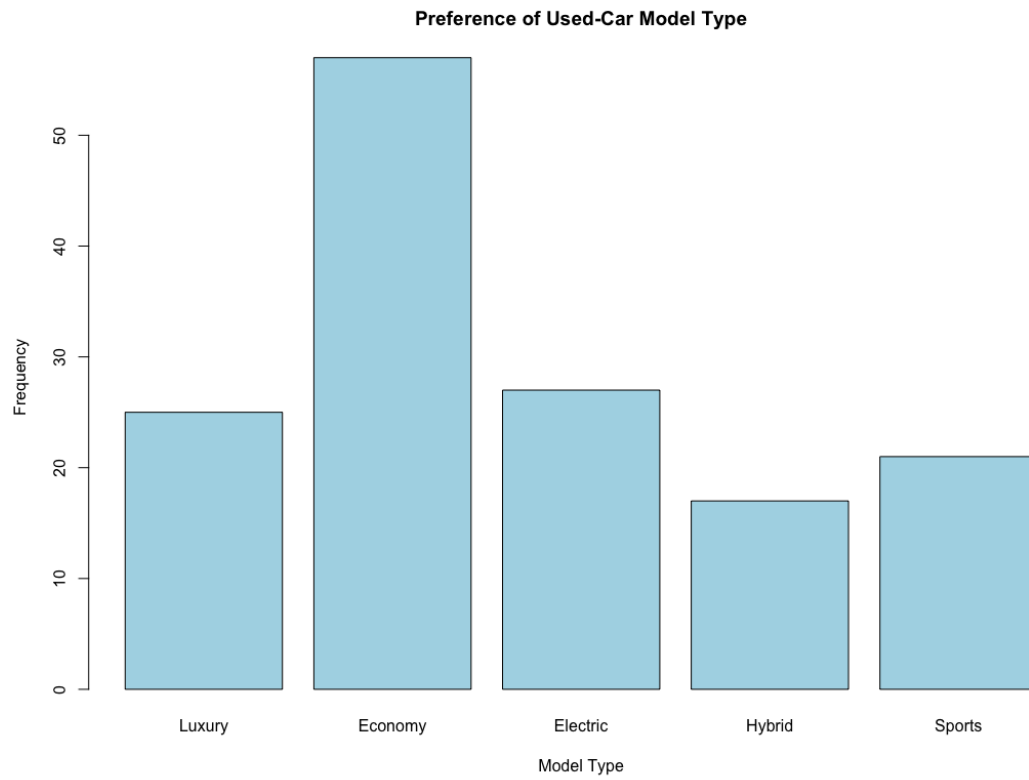


Figure 16-1. Customer Preferences on Used-car Aspects Bar Plot

