

Car Matching Algorithm CARMA

Project Proposal

CSE6242 Fall 2019 | Team 8

Introduction

In 2018, 40.2 million used vehicles were sold in the U.S. In 2019, Edmunds analysts predict used vehicle sales could approach 41 million (Edmunds, 2019). Buying a second-hand car can be a harrowing experience for the inexperienced. Majority of automobile sales websites (Autolist, 2019) rank car listings based on expert ratings (Kelley Blue Book Co., Inc., 2019) and sellers' advertising fee (Autotrader, 2018). These neglect reliability, safety ratings and model-specific design issues. We present CARMA, a one-stop used car recommendation platform that streamlines inexperienced buyers' shopping experience by aggregating used car listings and car safety and recall information on third party websites.

Approach (Heilmeier Questions)

Data sources and implementation

CARMA incorporates various data sources, including used cars listings on popular platforms (Kelly Blue Book and Autotrader), quantitative reliability scores (J.D. Power, 2019) and recall information by car model (National Highway Traffic Safety Administration, 2019).

Taking users' input, CARMA will rate and rank all available car models based on users' price range, car feature preferences, Zip Code as well as car model reliability data in the database. The recommendations will be visualized in an interactive graph as clusters by hierarchy of car types, colored by price and sized by ranking.

Target audience

Two in three buyers in the used-car market are uninformed and have very little knowledge of cars (Autotrader, 2018). These buyers are highly reliant on branding and marketing of the car for their purchase decision. CARMA makes complex information accessible and understandable to these buyers and helps them make more informed decisions.

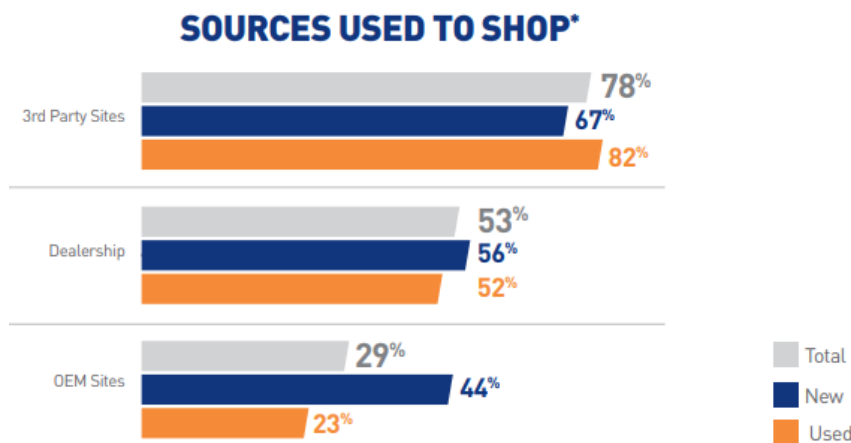


Figure 1: Sources used to shop for cars (Autotrader, 2018)

Limitations of Current Practice

Buyers currently look for fragments of information across sites, which is inefficient and difficult. Figure 1 (above) shows that most used cars buyers mostly rely on third-party sites (Autotrader, 2018). Most expert reviews also neglect performance deterioration over time. Therefore, uninformed buyers are unable to knowledgeably filter by brand, mileage and model (Autolist, 2019) and end up making suboptimal purchases.

Innovation

With our approach, we plan to overcome the aforementioned limitations, by aggregating used cars listings, incorporating additional dimensions such as reliability scores, past car recalls and maintenance schedule, and visualizing ranked recommendations in an interactive network map instead of a list. This user experience is designed to simulate how uninformed buyers screen through listings and understand technical data. Similar to the role of human agents in used car dealerships, CARMA will act as an agent for all used cars in the market, offering expertise and personalized recommendations to uninformed users. This should help uninformed buyers be more informed about the market and make better purchase decisions more confidently.

Impact

The success of this platform can be validated through various metrics.

To measure	Metrics
Platform's success in helping users find reliable used cars	<ol style="list-style-type: none"> 1. Post-purchase satisfaction survey 2. Number of listings browsed by users before making a purchase vs. industry benchmark 3. Money spent on car maintenance post-purchase
Platform's success in engaging users	<ol style="list-style-type: none"> 1. Bounce rate of the platform

Cost

The only project cost is platform hosting fees (\$15 per annum).

Potential risks and payoff

Currently, CARMA cannot account for car-specific damages and defects. The responsibility of inspecting the actual car still fall on the buyers themselves. However, CARMA reduces the risk of uninformed car buyers trying out or purchasing unreliable car models and unreasonably priced used cars, which is a substantial improvement compared to the current situation.

Related Work

Asymmetric information

The used car market has always been a sizable market in the United States. Most studies agreed that the market presents asymmetric information between buyers and sellers (Dangol, Jitpaiboon, & Walters, 2007) and is disadvantageous to buyers. Used car buyers are often subject to the "brand halo" bias (Sultan, 2010; Häubl, 2000), causing them to judge a brand's reliability by the average quality of its cars and ignore model-specific design flaws. Similarly, buyers are likely to mistaken more expensive cars to be of higher quality, when used car are priced independent of quality in reality (Lacetera, Pope, & Sydnor, 2012). Other than branding and marketing, buyers also overemphasized the car's mileage when examining how safety the used car option is (Vrkljan & Anaby, 2011).

Knowledge Bias

Experienced car buyers can overcome these biases by researching online. However, the majority of buyers are sensitive to the convenience of information (Bae & Benítez-Silva, 2011; Willmott & Warren, 1987) and were turned away by sparse information online. These information biases combined with abundant options available contributed to lower quality

of decisions made by used car buyers (Darbrowski & Acton, 2010). By taking buyers' inputs (Callahan & Koenemann, 2000) and applying preference-based pre-filtering (Vila, 2011), CARMA only displays a fraction of car listings to buyers. Using an interactive clustering map in lieu of a list of recommendations, users are more likely to be converted into buyers (Rohm, 2004; Rohm, 2004).

Success metric

So given a world with perfect transparent information, what are buyers looking for in a used car? Surveys showed that buyers value safety and reliability over design and performance (Prieto, Caemmerer, & Baltas, 2015). A successful used car purchase can be defined as: positive customer response post-purchase, no repair requirements pre-sale and little to no repair expenditures post-purchase (Shende, 2014). Different research indicates that reliability of second-hand cars may have little to do with their mileage (Betts & Taran, 2004), age (Consumer Reports, 2009). Instead, factors like engine power, reliability scores by rating agencies (Rijnsoever, Farla, & Dijst, 2009) and whether or not the model has an outstanding recall (Kim, 1985) indicate a reliable used car.

These studies suggested variables that buyers should and should not consider when making a used car purchase, however it is unclear how buyers should juggle all these factors. CARMA aggregates all factors into a single quality metric, allowing users to research information, evaluate alternatives and schedule a test drive in one platform (Ginter, Young, & Dickson, 1987).

Plan of activities and Milestones

The 8-week project can be divided into four phases:

Phase	Milestone	Deadline	Note
I	Finalized project scope	10/6	
II	Scrape necessary data. Minimum Viable Product is able to aggregate listings from different sources with required metadata	10/20	
II	Platform is able to filter car listings by user requirements	11/3	Midterm check for success
IV	Devise ranking algorithm	11/24	
V	Test the weighting function and create an intuitive visualization	12/1	Final check for success

All team members have contributed a similar amount of effort.

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