Customers - Opaque and Unexpected Decisions

How surprising customer trends can lead to improved search recommendations

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March 31, 2022

Introduction

Expedia, a popular travel website, has gathered information on searches on their platform between June 1^{st}, 2021, and July 31^{st}, 2021.

This data includes information about recommendations the site offered to its customers, as well how they responded to these recommendations.

The data has been used to examine:

- The feasibility of offering recommendations based on information about the composition of the group the consumer is travelling with.
- Whether offering a discounted price actually makes people more interested in a location.
- How much use the recommendations actually get.

Objectives

- Determine whether there is an association between the number of adults, children and infants in a group, and the price of the bookings they are interested in.
- Determine whether the likelihood of a user clicking on a recommendation is the same between price-reduced and non-price-reduced recommendations.
- Determine a range of plausible values for the likelihood of a user clicking on a recommendation.

- Each row was split into three new rows, one for each recommendation shown. Each row included observations on:
  - The number of clicks (**num_clicks**)
  - The number of infants, children, and adults (**infant_count**, **child_count**, **adult_count**)
  - Whether the recommended listing was price-reduced (**is_drr**)
  - The price bucket of the recommendation (**price_bucket**).

- A new variable called **is_click** was added to indicate whether a user clicked a recommendation. This variable was assigned a value of:
  - *TRUE* when **num_clicks** was greater than 0
  - *FALSE* otherwise.

- All missing values (*NA*) were removed.

Table 1: Number Of Clicks On Recommendations

Searches	Resulted in Click
1000	133

- *Table 1* suggests the number of recommendations clicked on and used by customers may not be that high—indicating that questioning the number of recommendations that are clicked may be an interesting idea.

Table 2: Number Of Recommendations Clicked On

	Recommendations	Clicks
Price-Reduced	1814	75
Non-Price-Reduced	1053	76

- *Table 2* shows that the number of non-price-reduced locations getting clicks is proportionately higher than the number of discounted ones getting clicks.
- This encourages statistical analysis of how the two groups perform relative to each other.

Statistical Methods

Can Price Be Predicted From Group Composition?

- To see if the composition of a group, and the price of the recommendations they were interested in, were related, a *classification tree* was made.
- It made predictions on the *price bucket* groups clicked on were based on the number people of different ages in the groups.

Classification Tree

A system that makes predictions on the category inputs will fall in by looking at what categories previously entered inputs with similar characteristics fell in.

Price Bucket

How expensive is the booking:

1. Cheapest 20% of bookings
2. Bottom 20%-40% of bookings
3. Middle 40%-60% of bookings
4. Upper 60%-80% of bookings
5. Most expensive 80%-100% of bookings

- Recommendations that were not clicked on were ignored
- 75% of clicked on recommendations were used to teach the tree what different priced bookings looked like relative to the composition of the group clicking on them.
- The remaining 25% tested the tree to see how accurate it was. (See *table 3*)
- If the tree is making accurate predictions, there may be a relationship between group composition and price, if not then it appears there may not be a strong relationship.

Table 3: Testing/Training Split Example

Training | Testing

Row	Price Bucket	# of Adults	# of Children	# of Infants
1	5	2	0	0
2	4	2	2	1
3	4	2	2	0
4	2	1	2	0

Do Price-Reduced Clicks Differ From Standard Clicks?

- 10 000 simulated scenarios assuming clients clicked on price-reduced recommendations and non-price-reduced recommendations at same rate were examined.
- Reality was examined and compared to these simulated scenarios to determine whether price-reduced and non-price-reduced recommendations are clicked on at the same rate in real life.
- If reality doesn't resemble many of the simulated scenarios, it's likely price-reduced and non-price-reduced recommendations are clicked on at different rates.

Simulated Scenario

- Scenarios were simulated by taking existing data, and switching which recommendations were price-reduced.
- Each simulation had similar characteristics to reality, and had the same number of price-reduced and non-price-reduced rows as reality.

Roughly How Frequently Are Recommendations Clicked On At Least Once?

- This was examined by taking random groups out of the recommendations we have, and looking at how frequently recommendations are clicked in those random *subgroups*.
- There is a relationship between the range of frequencies in the subgroups, and the range where the frequency of clicking recommendations is in real life.
- The range where 95% of subgroups fell within was examined, and used to find a range the real frequency of clicking recommendations is likely inside.

Subgroup

- Each *subgroup* has the same amount of items as the real group, but some items are repeated more than once.

Results

No Strong Relationship Between Group Composition And Booking Price

- The *classification tree* only correctly identified price buckets 21.05% of the time.

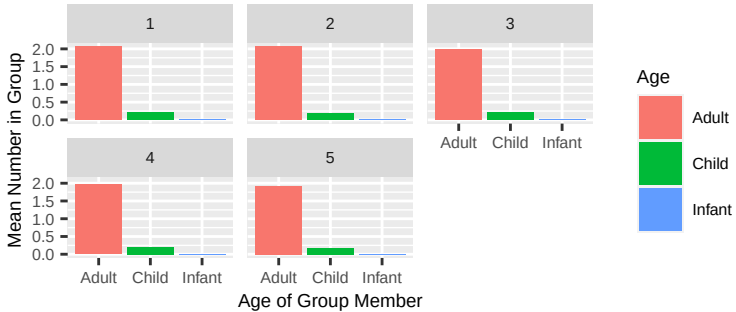

Figure 1: Average Number of Each Age in Groups Clicking on Different Price Buckets

- They all look pretty similar (*fig. 1*). There appears to be no relationship between group composition and price bucket.

Price-Reduced And Non-Price-Reduced Listings Are Treated Differently

- Of the 10 000 simulated scenarios, only 0.01% or 1 item were similar to the real life scenario.
- This provides moderate evidence that the price-reduced and non-price-reduced listings are clicked on at different rates by customers.

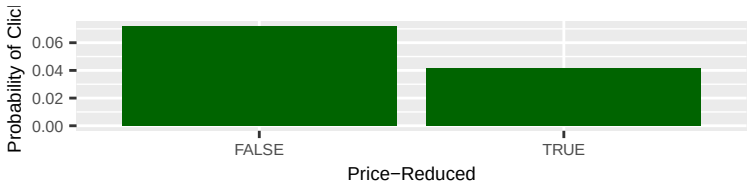

Figure 2: Probability of Clicking Different Recommendations In Real Data

- In *figure 2*, non-reduced listings were clicked almost 50% more than reduced ones. There is a clear difference in how often they are clicked.

Clicks Aren't Likely

- If the calculations to find the range of values the probability of a click were repeated many times, 95% of the time the probability of a click would fall within the range.

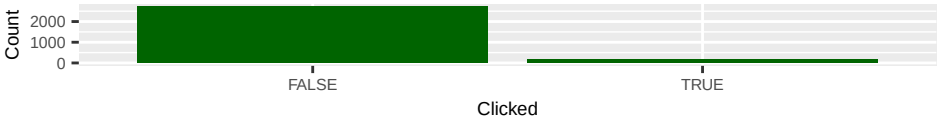

Figure 3: Number of Recommendations Clicked

Found Interval

- 95% interval: **[0.044646, 0.0610394]**.
- In the real data, 5.27% of the first three recommendations were clicked.
- This is within the found interval.

Conclusions

Can't Try To Cater Prices To Group Composition

- As *figure 1* showed, group compositions are similar regardless of the price of the location being booked.
- This is surprising, one might expect older families that potentially have dual-incomes and had time to establish themselves to have more money to spend on vacation.
- It is possible that solo travellers and childless couples are also able to spend money on large accommodations, while the financial drain of children makes some families less able to spend, thus, evening the playing field.

Main Takeaway

- Trying to adjust recommendations to show more expensive venues to customers without kids for instance, may not be effective, and I recommend against it.

Discounted And Standard Price Locations Are Different

- While they are different, *figure 2* shows it may not be in the expected way.
- Evidence that the probabilities for clicking discounted and non-discounted recommendations are not the same was found.
- In the data, non-discounted recommendations are clicked almost 50% more often.
- One reason for this surprising result, could be that people perceive discounted locations as 'cheap' and 'second rate'. They may be worried about the quality of locations that need to resort to discounts to attract customers.

Main Takeaway

- I would recommend Expedia present fewer discounted recommendations.

Recommendations Are Not Fully Utilized

- Only a small fraction of the first three recommendations are clicked on (1 in 16 at the high end, 1 in 25 on the low end).
- Recommendations may not be very valuable to Expedia, if they are so rarely used.
- It is clear that at the moment, recommendations do very little to help Expedia.

Main Takeaway

- If Expedia wishes to continue providing recommendations, I recommend Expedia invest immediately in further investigation into which factors make a 'good' (i.e. clickable, results in transaction) recommendation.

References and Acknowledgements

The author would like to thank Amin Banihashemi for his helpful comments and suggestions that immensely improved the visualizations in this presentation.

References


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