Assumptions:

I. All visitors were showed the same banner from July 1 to 8, 2018; promotion was from the 4th to the 8th.
II. If a visitor clicked the banner, the product they added to the basket and purchased would be relative to the banner.

Problem-solving Process:

1. Identified issues:

The data is the test results from the "July 4, 2018" marketing campaign. To boost consumption and stimulate customer engagement, Wayfair wants to better leverage its sale banners by gaining insights from the data.

2. Exploratory Data Analysis and data cleaning:

Only 37.7% of the dataset is completely clean. A large number of values were missing in "State", "Gender", and "Income Range", and most of them came from new visitors. Therefore, we decided to divide the dataset into two groups: New Visitors and Prior Visitors. Then, we dropped the missing data in Prior Visitors Group to do further analysis.

Through exploratory data analysis, we discovered the following problems with the banner:

- Low clickthrough rate in Sales Banner
- Compared with Taobao, BestBuy, and Amazon, Wayfair's banner rotated too slowly
- Banner is not personalized nor targeted to visitors

3. Feature engineering and data analysis:

We generated a new feature: **"Banner effective"** to evaluate the banner's effect on customers' behavior. If a customer clicked the banner and added an item to the basket or purchased, we count it as banner effective. Otherwise, the banner was not effective for this customer.

For the prior visitors, we used Python deployed **K-Modes[1] algorithm** to separate them into two clusters. We found out these two clusters have different traits in their income range, platform used, and visit source.

For the new visitors, we created a flow chart in Tableau to trace how visitors from different sources ended up to be in different banner effective groups. 67.9% of them came from a Web Search. The average banner effective rate is 0.3%. However, the banner effective rate of Web Search group only had 0.22%. It is highly possible that the banner failed to attract these visitors.

Problems from both prior visitors and new visitors indicate banner personalization is indeed.

Actionable Insights:

1. Banner rotation time should be shortened to 3.5s - 6s.
2. Improve the banner UX design in the mobile version, because the banner click rate from the phone is much lower than the web.
3. Wayfair should push different banners to prior visitors according to the visitor clusters "Target" and "Potential" as they have different preferences regarding sales, and make collaborative-based[2] recommendations.
4. Personalize the banner for different visitors, use popularity-based[3] recommendations for new visitors. Wayfair should also take new the visitors' web searched keywords (cookies) into the banner recommendation system.
5. Promotion strategies
   - Use the pre-campaign data to analyze the products that people viewed and added to basket. Promote personalized ads on the starting day of the campaign. Advertise again on the final day of campaign.
   - Click banner and get coupons during the pre-campaign period, the coupons can only be used in the upcoming promotion period.

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[1] http://www.cs.ust.hk/~qyang/Teaching/537/Papers/huang98extensions.pdf, https://pypi.org/project/kmodes/#huang98

[2] https://en.wikipedia.org/wiki/Collaborative_filtering

[3] https://hackernoon.com/popularity-based-song-recommendation-system-without-any-library-in-python-12a4fbfd825e