Take-Home Challenge: Ultimate Technologies Inc.

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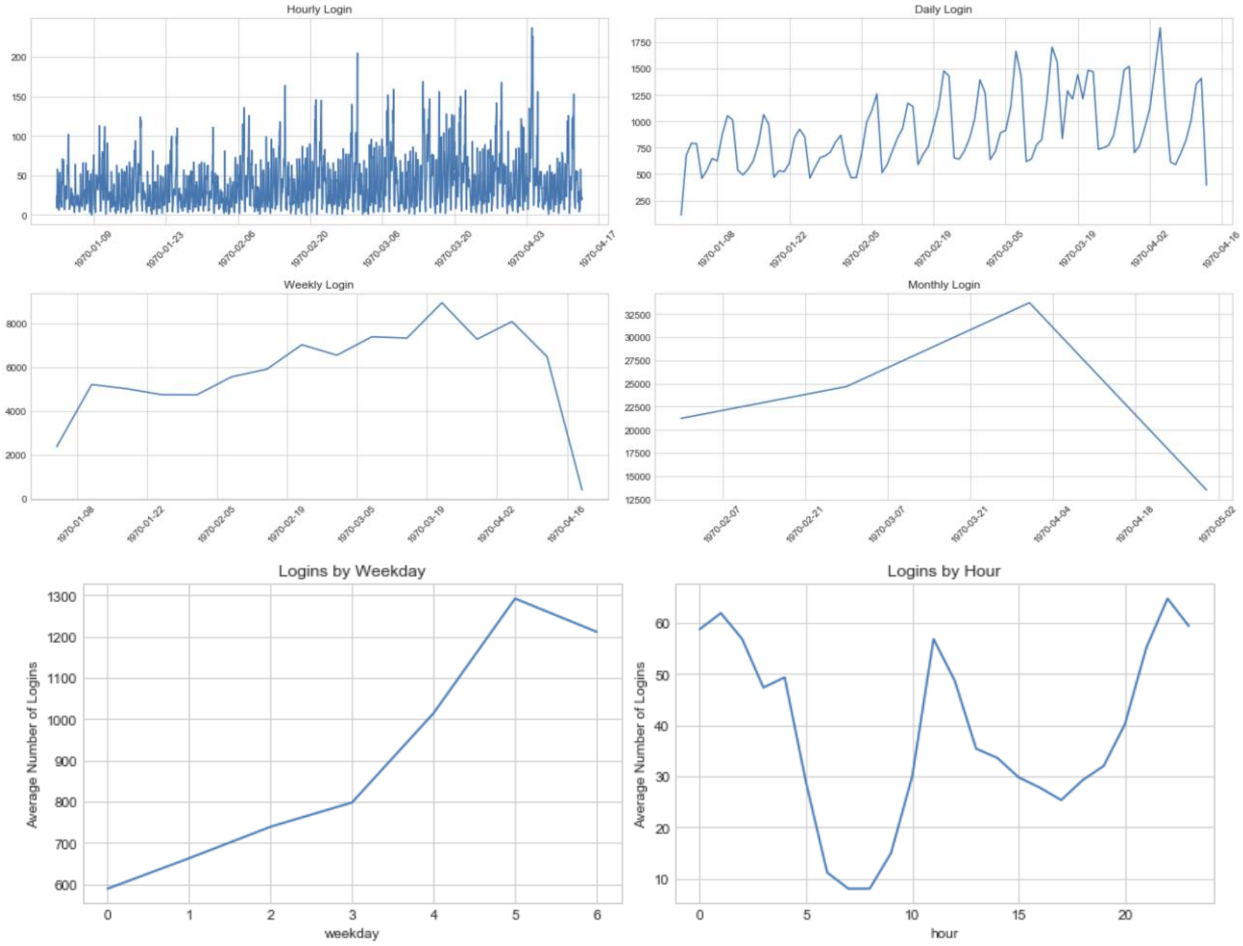
Part I: Exploratory data analysis

We learn the following facts regarding the login patterns:

- Between January and mid-April, there exists a general increasing trend in login counts.
- Daily and weekly cycles exist while monthly pattern is not detected (as the periodic patterns only exist in Hourly and Daily plots).
- Number of logins increases as we approach weekends and reaches its peak on Friday and Saturday.
- Number of logins are low during working hours and high at noon and at late night.



Part 2 - Experiment and metrics design

Q1. What would you choose as the key measure of success of this experiment in encouraging driver partners to serve both cities, and why would you choose this metric?

I'd measure the number of completed rides. Given the context, on weekdays, during the day most rides will take place in Metropolis and at night in Gotham. On weekends, we expect similar number of rides in both cities. The goal of the proposed toll-reimbursement plan is to re-free the market, encouraging the driver partners to go where they are most needed. The expectation is that more rider requests will be met, total number of completed rides will go up and on a city-time level, this number should be highly correlated with the active level of the city. Thus, if we are only choosing one, the number of completed rides should be the key metric to measure the success of this experiment.

Q2. Describe a practical experiment you would design to compare the effectiveness of the proposed change in relation to the key measure of success. Please provide details on: a. how you will implement the experiment; b. what statistical test(s) you will conduct to verify the significance of the observation; c. how you would interpret the results and provide recommendations to the city operations team along with any caveats.

Randomly select half of the driver partners to the treatment group, with the rest being the control group. Make sure the selection is truly random in terms of the drivers' home city, active hours, service provided, vehicle types, etc. For a period of two weeks, the treatment group would receive the toll reimbursement (be sure notify the drivers at the very start of the experiment through a number of venues) while everything about the control group remains untouched. Choose an experiment period where no special event takes place in both cities. Run A-A test to make sure there is no difference in the two groups' key metrics.

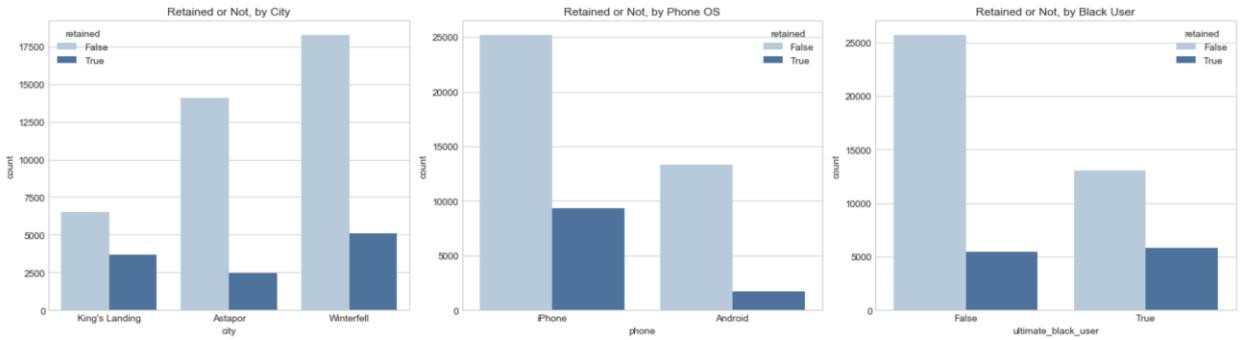
Next, start the experiment and run it for two weeks. Gather the key metric (number of completed rides) data of both groups. Use two-sample t-test to test the null hypothesis that there is no difference in the two groups' key metric. If we reject the null hypothesis and the treatment group's number of completed rides is greater than that of the control group, we proceed to additional analysis.

- Compare the revenue generated by both groups, less the toll reimbursement expenses (for treatment group's calculation only). Did an increase in completed rides lead to increase in revenue?
- Compare the one-week retention rate before and after the experiment. In this comparison, the 'before' period should be one that is after the implementation of the toll and is comparable to the experiment period. Did the experiment increase the ease of getting a ride and thus increase the rider retention rate?

If the answers to the above questions are also 'yes', the city operations team could consider provide 'toll reimbursement' for all drivers on Ultimate's platform. The team should also try to negotiate discounted toll charge with the two cities, as the increase in completed Ultimate rides (which is a form of carpool) can decrease private car usage, go hand in hand with public transportation and lead to more tax revenue.

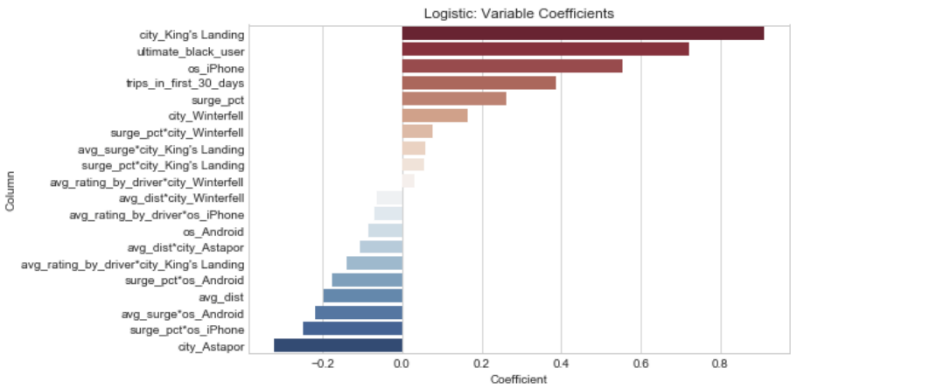
Part 3 - Predictive modeling

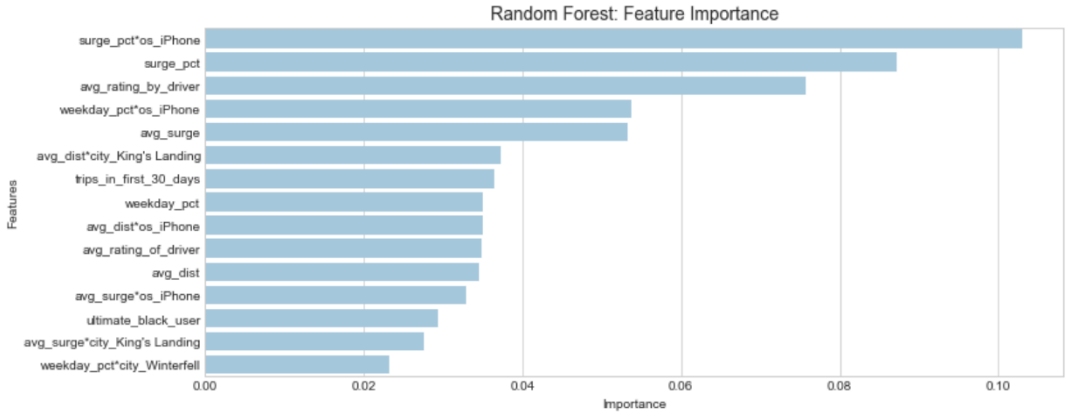
We consider a rider 'retained' if they take trips in their 6th month on the system. In our dataset, out of 50000 users, 22% of them were retained. Based on our exploratory analysis (see below for selected figures), the common characteristics of the retained users include living in King's Landing, using iPhone, giving more diverse ratings (not all 5-star) and taking rides both on weekends and during weekdays.



Next, we built a model predicting user retention using Random Forest method, given its flexibility (free of assumption between response and predictive variables) and high accuracy. The model had an AUC of 80.1% and an overall precision of 81% (91% in unretained class and 43% in retained class). For the purpose of interpretation, we also built a logistic model. Its performance was worse than Random Forest in almost all aspects.

We then dive deeper to understand the relation between response and predictive variables. Based on Random Forest's feature importance and Logistic regression's variable coefficients, we learn the following facts:





- City: King's Landing are more likely to be retained than those in Winterfell and Astapor.
- Phone: iPhone users are more likely to be retained than Android's.
- Trips in the first 30 days: The more trips the rider took in their first month, the more likely they would be retained.
- Ultimate Black: Ultimate Black users are more likely to be retained.
- Surge: The more surged trips the rider took, the more likely they would be retained.
- Average distance: Retained riders tend to make shorter trips.
- Average rating by driver: Retained riders have lower average ratings.

Takeaways:

Based on our findings, the team can consider the following approaches to increase customer retention:

- Why were users in King's Landing more likely to stay? What aspects of services in Winterfell and Astapor could be improved? Find out answers to these questions and fix them!
- Why were iPhone users more likely to stay? Was that due to better app experiences, better marketing strategy on iOS or their socioeconomic condition? Find out the answer and improve user experience for Android users.
- Encourage users to make more trips in their first 30 days! More marketing and sales plans targeting the new users (i.e., a 30-day pass).
- Encourage people to try Ultimate Black.
- Retained riders tend to make shorter trips. See if these trips took place in a certain area (i.e., around residents' home, daily commute route). It's possible to introduce 'regional pass' to this type of users.

However, before taking any action, it is important to first understand the direction of retention and key features' interactions (in econometric term: endogeneity). Is X causing Y or is it the other way around? For example, in our model, average rating by driver is negatively correlated with the retention dummy. While lower average rating leads to more retained customers sound counter-intuitive, a more reasonable explanation may be: a retained/frequent rider of Ultimate is more likely to take the rating seriously and gives their honest opinions. The same logic applies to the 'surge' features. Thus, before coming up with any marketing/sales plans based on the findings, it is essential to take one step further and check for the endogeneity issue first.