Toll Bridge Reimbursement Experiment Design

1. Key Measure of Success
   The key measure of success for an experiment aimed at encouraging driver partners to be available in both Ultimate Gotham and Ultimate Metropolis would be the number of rides driver partners give throughout the course of the entire day. Because these neighboring cities have complementary circadian rhythms, prior to the experiment, the majority of the drivers' rides would occur either during the day or the night, but not both. If this experiment is successful, the drivers would be completing rides during both nighttime and daytime. Another possible metric could be the location each ride was carried out. This, however, requires prior knowledge of where the driver typically completed rides prior to the experiment which may not be available. Another possible metric would be measuring reimbursement costs. This, however, does not accurately reflect whether rides were given in both cities, just that driver partners were travelling between cities looking for potential rides.

2. Practical Experiment Design
   a. Implementation
      i. Randomly sample the current driver partners.
      ii. Divide sampled drivers into two groups for each city(Control and Variable).
      iii. Aggregate ride completion times for all samples within all four groups and plot distribution. Should expect normal distribution for each group (centered around daytime and nighttime based on city).
      iv. For the variable groups, reimburse all toll costs.
      v. After a set amount of time(a business quarter), aggregate ride completion times for all samples within all four groups.
      vi. Aggregate ride completion times for all samples within both groups. If the experiment was successful, the Variable groups from both cities should have a bimodal distribution.

   b. Statistical Tests
      In order to validate the results, the distributions between the control and variable groups for each city can be compared using a Kolmogorov-Smirnov(KS) test. This test validates whether two distributions belong to each other by measuring the distance between their empirical cumulative distribution functions.

      Additionally, one can use bootstrapping to determine means between cities. This will reveal whether there is a significant difference in means between the variable and control groups of each city.

c. Interpretations/Recommendations

Should the experiment fail, it does not automatically exclude the possibility that there is demand for additional drivers in both cities. One possible cause could be the drivers' active times. They might not be able to take full advantage of the increased availability due to sleep.

Should the experiment prove successful and that reimbursing the toll does encourage driver partners to be available in both cities, a study needs to be done on the amount of demand in both cities. The following questions need to be answered:

1. Does either city require more drivers during their active times?
2. Of the drivers who provide services in both cities, what is the revenue generated? Does the amount of revenue generated equal or surpass the cost of toll?
3. How will the driver partners of each city react if they lose money to other drivers coming from the other city?