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Take Home Challenge 1

<div align="center">Part 2 – Experiment and Metric Design</div>

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

For this question, I will assume that the company's goal is to maximize revenue. An easy way to see if revenue has been maximized is to see if a price equilibrium has been reached; the cost per unit distance that the company charges is the same in both Gotham and Metropolis. For example, if most of the company's drivers are in Gotham, then a trip to Gotham costs $5/mile. Because there will be fewer drivers in Metropolis, the company might be able to charge $10/mile to meet demand. To create more revenue, the company would want to move some of their drivers in Gotham to Metropolis so they can take advantage of the higher returns. Doing this will reduce the supply of drivers in Gotham, allowing the drivers who remain there to make more.

This revenue equilibrium should occur on its own. The presence of the toll distorts the market in a way that the drivers think that it is better for them to remain in one city. From an economist's point of view, the toll might cause the drivers to act contrary to the market. If demand leads to $10/mile rate to Metropolis and only $5/mile rate to Gotham, then drivers should leave Gotham until the demand evens out. If we introduce a $20 toll, then it will not be financially viable for drivers from Gotham to go to Metropolis in the short term. If this cost is removed, the company should allow drivers to think about meeting the demand. The burden for drivers of calculating whether crossing over to earn the price/mile. The company should do research on whether their drivers are earning enough money to offset the toll cost. We are assuming here that the company has done this research already and wants their drivers to cross over when a demand imbalance exists.

I think that the best metric to measure success would the percentage of drivers who cross the bridge when a demand imbalance exists. To conduct this experiment correctly, we would need to know with an extremely high confidence what percentage of drivers cross the bridge when the company does not pay the toll versus the increase that occurs when the company does pay the toll. We would expect this increase to be as large as possible.

In order to have a more accurate answer to this problem, the metric we would want to maximize would be the percentage of drivers who cross the bridge such that the company thinks the extra revenue gained per trip by crossing more than offsets the cost of crossing. Another possible metric would be to minimize the imbalances that occur with demand.

2. *Describe a practical experiment you would design to compare the effectiveness of the proposed change in relation to the key measures of success. Please provide details on:*
a) *How will you implement the experiment?*

If the company has an application that keeps track of the percentage of drivers that already cross the bridge and pay the toll, as well as keeps track of the driver's location and the current demand for them in each city, then we would want to keep track of what number changes when the company pays the toll fees, which should be simple to accomplish.

b) *What statistical test(s) will you conduct to verify the significance of the observation?*

A hypothesis test would be used to compare the proportion of drivers who cross from the city with less demand to the city with greater demand in a specific time frame. The null hypothesis would be that the proportion of drivers who cross would be the same regardless of what is changed.

c) *How would you interpret the results and provide recommendations to the city operations team along with any caveats?*

If the proportion of drivers who cross the bridge into the city with greater demand to the city with lesser demand in each period was large, then we would know that paying the driver's toll fees was a good idea when meeting demand. If that percentage was small, then paying the toll fees would not be effective and the company would need to provide further incentive to cross over.

My recommendation to the operations team would depend a lot on the answers to this question: Does demand remain strong enough in the city to which drivers are going to and do the drivers do enough trips in the 'new' city to justify the cost of paying the toll? There should be some analysis done to answer this question before any change is implemented. Some of the questions asked can only be answered by real-time data, so from my point of view, I would need to know if the net effect to revenue from paying the tolls before any recommendation could be made.

An important caveat here not mentioned would be competition. In this case, the company might want to pay the toll to remain competitive in the market. This would need to be incorporated into any analysis, but it would not change any recommendations to keep the change.