I. 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?

First I would have the experiment only include weekends for testing due to both cities being similarly active throughout those days. Assuming that the goal is to increase overall revenue from the services in both cities, the best metric to measure success would be to compare total revenue brought in on a normal weekend where tolls are not reimbursed with total revenue on a weekend where they are. Of course, the way that profit would be calculated would have to include deducting costs on the city for reimbursing the tolls to properly view the change in profit. We then could simply check to see if more money is coming in or not based on the reimbursed toll fees. If increasing revenue isn't the focus, then another option could be to track the proportion of time spent in either city on a weekend with the tolls not reimbursed, then comparing it with the proportion on a weekend where the tolls are reimbursed. Since activity is similar on the weekends in both cities this would allow us to better understand how much more opportunity there is to make money or have more active drivers in both cities by reimbursing tolls for drivers.

II. 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:

Moving forward with this part of the challenge, I'm going to assume that the primary goal of the experiment is to find out if reimbursing tolls for drivers will significantly increase the amount of time drivers spend in opposite cities on the weekends (rather than to increase revenue).

A. How will you implement the experiment? What statistical test(s) will you conduct to verify the significance of the observation?

1. Get a random sample of 200 drivers from each city (200 each).
2. Select a weekend with no holidays to track the percentage of time each driver spends in either city. Keep measurements for drivers in once city separate from drivers in the other.
3. Select another weekend with no holidays (preferably the one after) to track the percentage of time each driver (same ones) spends in either city once again, but this time notify all drivers of the reimbursed tolls for the weekend. Of course, we would not let the drivers know about the experiment.
4. Since we do not know the population standard deviation, a z-test would not be as appropriate as a t-test. For this reason we would perform a t-test on the proportions of time spent in each city to see if the means are significantly different (95% CI, alpha=0.05).

a. It's worth noting that we would perform two separate t-tests:
    (1) Compare the proportions of time spent in Metropolis on each weekend for drivers in Gotham.
    (2) Compare the proportions of time spent in Gotham on each weekend for drivers in Metropolis.
b. Breaking it down this way would also allow us to see if one city is using the toll more than the other.
c. If we reject the null hypothesis that there exists no difference in mean proportions of time spent in the opposite city of the drivers than we can accept the alternative hypothesis and say that reimbursing the tolls made a significant difference in amount of time drivers spent in the opposite city.

B. How would you interpret the results and provide recommendations to the city operations team along with any caveats?

1. We would interpret the results by concluding that for weekends only, the percentage of drivers using the reimbursed tolls to make trips to the opposite city is or is not significantly higher than when the tolls are not reimbursed. We could then go even further and compare the mean proportions of both cities under the toll reimbursement using another t-test to see if one city is using the reimbursed tolls to spend significantly more time in the opposite city than the other city.