

# Experiment and Metrics Design

1. Let  $M1$  be the number of toll reimbursements that the manager of Gotham City hands out over some interval of time  $T$ , and  $M2$  be the number of toll reimbursements that the manager of Metropolis hands out over the same interval of time  $T$ . If a driver managed by Gotham's management currently resides in Gotham, and is available for a job in Metropolis, and performs a job in Metropolis then  $M1$  will increase. Also if a driver managed by Gotham's management currently resides in Metropolis, and is available for a job in Gotham, and performs a job in Gotham, then  $M1$  will increase as well. Likewise the inverse for  $M2$  and drivers managed by Metropolis's management. Essentially  $M1$  and  $M2$  increase whenever a driver is available for a job in a city opposite to where the driver currently resides in, and he performs that job. The metric we will use to evaluate whether the driving partners are being encouraged to serve both cities, will be:  $M = M1 + M2$ . Since  $M1$  increases whenever drivers managed by Gotham's management are more available for jobs in a cities opposite to where they currently reside, and  $M2$  increases whenever drivers managed by Metropolis' management are available for jobs in cities opposite to where they currently resides,  $M$  should increase whenever drivers in general are more available for jobs in both cities.

2. An experiment we can perform to determine whether reimbursing drivers for tolls will increase the amount of drivers willing to serve both cities would be a simple AB test of our proposed metric. We will implement the experiment by telling all drivers to report whenever they receive a toll charge, and small group a drivers (the experimental group) that we will reimburse their reported toll charges. We will then measure  $M$  for the control group (the group of all drivers minus those in the experimental group) and the experimental group. Our null hypothesis is that the reimbursement program will have no effect, we will take this to imply that on average our metric  $M$  will show no change across both the control and experimental groups. The test statistic we will use is the difference between the sample averages of the experimental group and control group. Because of the central limit theorem we know that this sample statistic conforms to a Gaussian distribution and thus we can extract a p-value to either debunk or confirm the null hypothesis. If the null hypothesis is confirmed then we can interpret our experiment as concluding that the reimbursement program does not have any change. On the other hand if we conclude the null hypothesis is debunked, then this does not imply that the reimbursement program has a positive effect of increasing driver's willingness to work in both cities. All we can conclude is that the reimbursement program has an effect.