Power analysis - Part 2

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The main objective is to decide the lower bound for the number of people to be kept in ML group, Random group and to see what to expect from the existing lifetime members for the Referral group and UMAA group.

ML group and Random Group

From the pilot, the take up on the offer from the ranked group is 0.4% and for mittens offer it is 0.01%

We can consider the proportion of 0.004 as the lower bound for ML group. Anything high will work in our favor as the power will increase for the same sample size.

We consider 0.0001 as the lower bound for the random group as 2:1 offer seems to be better than mittens offer.

Lets consider five scenarios: (All effects are in same direction ML > Random)

1. Status quo - ML group - 0.004, Random group - 0.0001

```
power.prop.test(p1 = 0.004, p2 = 0.0001, sig.level = 0.05, power = .80, alternative ='one.sided')
Two-sample comparison of proportions power calculation

              n = 1662.104
             p1 = 0.004
             p2 = 1e-04
      sig.level = 0.05
          power = 0.8
    alternative = one.sided

NOTE: n is number in *each* group
```

2. Better ML group (50% better performance) - ML group - 0.006, Random group - 0.0001

```
power.prop.test(p1 = 0.006, p2 = 0.0001, sig.level = 0.05, power = .80, alternative ='one.sided')
Two-sample comparison of proportions power calculation

              n = 1079.062
             p1 = 0.006
             p2 = 1e-04
      sig.level = 0.05
          power = 0.8
    alternative = one.sided

NOTE: n is number in *each* group
```

3. Better Random group (100% better performance) - ML group - 0.004, Random group - 0.0002

```
power.prop.test(p1 = 0.004, p2 = 0.0002, sig.level = 0.05, power = .80, alternative ='one.sided')
Two-sample comparison of proportions power calculation

              n = 1793.428
             p1 = 0.004
             p2 = 2e-04
      sig.level = 0.05
          power = 0.8
    alternative = one.sided

NOTE: n is number in *each* group
```

4. Optimistic scenario (50% better ML, 100% better Random) - ML group - 0.006, Random group - 0.0002

```
power.prop.test(p1 = 0.006, p2 = 0.0002, sig.level = 0.05, power = .80, alternative ='one.sided')
Two-sample comparison of proportions power calculation

              n = 1134.893
             p1 = 0.006
             p2 = 2e-04
      sig.level = 0.05
          power = 0.8
    alternative = one.sided

NOTE: n is number in *each* group
```

5. Worst case scenario (500% better Random) - ML group - 0.004, Random group - 0.0005

```
power.prop.test(p1 = 0.004, p2 = 0.0005, sig.level = 0.05, power = .80, alternative ='one.sided')
Two-sample comparison of proportions power calculation

              n = 2264.987
             p1 = 0.004
             p2 = 5e-04
      sig.level = 0.05
          power = 0.8
    alternative = one.sided

NOTE: n is number in *each* group
```

💡 Considering the worst case scenario, sample size of around 2500 people per group seems to be the best for ML, random groups

Referral group and Random group

There are 12,183 Lifetime members. If we follow the same power calculation between ML and random group, we would need atleast 2500 members to be referred. That brings the conversion rate in Lifetime members to 20%. This seems pretty high. If we need 2500 members per each of referral and UMAA groups (split), then the conversion rate need to be 40%.

💡 Lifetime members conversion rate needs to be 40% in order to detect the same effect of that of worst case ML and random groups.

Referral group (or UMAA group) and ML group (Two sided)

Best case scenario (200% better Referral group) - ML group - 0.004, Referral group - 0.008 or vice versa

```
power.prop.test(p1 = 0.004, p2 = 0.008, sig.level = 0.05, power = .80, alternative ='two.sided')
Two-sample comparison of proportions power calculation

              n = 5850.161
             p1 = 0.004
             p2 = 0.008
      sig.level = 0.05
          power = 0.8
    alternative = two.sided

NOTE: n is number in *each* group
```

Worst case scenario (0.1% better Referral group) - ML group - 0.004, Referral group - 0.008 or vice versa

```
power.prop.test(p1 = 0.004, p2 = 0.005, sig.level = 0.05, power = .80, alternative ='two.sided')
Two-sample comparison of proportions power calculation

              n = 70320.86
```

```
             p1 = 0.004
             p2 = 0.005
      sig.level = 0.05
          power = 0.8
    alternative = two.sided

NOTE: n is number in *each* group
```

💡 Worst case scenario here is practically unattainable

Fixing one sample size to determine the other

As there is a constraint on Lifetime members availability, lets see the n required from other group in we fix n from the lifetime group

```
pwr.2p2n.test(h = ES.h(0.004,0.008), n1=2500, sig.level = 0.05, power=0.8, alternative ='less')Two-sample comparison of proportions
difference of proportion power calculation for binomial distribution (arcsine transformation)

              h = -0.05254923
             n1 = 2500
             n2 = 21437.54
      sig.level = 0.05
          power = 0.8
    alternative = less

NOTE: different sample sizes
```

💡 If we fix the lifetime members referrals at 2500, then we would need atleast 21000 people in ML group to detect the effect.

```
pwr.2p2n.test(h = ES.h(0.004,0.008), n1=2300, sig.level = 0.05, power=0.8, alternative ='less')Two-sample comparison of proportions
difference of proportion power calculation for binomial distribution (arcsine transformation)

              h = -0.05254923
             n1 = 2300
             n2 = 84284.88
      sig.level = 0.05
          power = 0.8
    alternative = less
```

💡 For the same effect, If we fix the lifetime members referrals at 2300, then we would need atleast 85000 people in ML group to detect the effect.