Test-plan
Value-based recommendation

1 Formulation

Problem Statement:
Now, the problem statement is:
Given that a user is reading an article A_i, what article must be recommended next so that we

1. maximize the content relevance to the user
2. maximize the ad-monetary value.

Mathematically, given A_i, we seek A_j such that:

$$j = \arg\max_J \phi(A_i, A_J),$$

where ϕ is the utility function. This above formulation is mainly for our *Read Next* pages, but it could be easily extended to *Infinite scroll*.

2 Testing

What questions do we intend to answer via the test

1. How much monetary lift do we observe?
2. How is the AQ degrading?

Some notation:

- *val* is the test-side and *bau* is the control side
- Let $\{A_1, A_2, \cdots A_N\}$ be the N articles that were served as a part of showing 3 recommendation for each of the 500 test head-articles.
- Let R_i^{val} and R_i^{bau} be the total revenue obtained on the A_i^{th} article throughout the testing period.
- Let I_i^{val} and I_i^{bau} be the total impressions obtained on the A_i^{th} article throughout the testing period.

- Let V_i^{val} and V_i^{bau} be the total page-views observed on the A_i^{th} article throughout the testing period.
- Let S_i^{val} and S_i^{bau} be the total sessions on the A_i^{th} article throughout the testing period.

2.1 Lift in the monetary value

So the metrics that we are interested in this regard:

1. Percentage lift in the 'value ' or the revenue per impression:

   (a) Lift in the 'value' evaluated over all the N articles:

   $$\frac{\left(\frac{\sum_i R_i^{val}}{\sum_i I_i^{val}} - \frac{\sum_i R_i^{bau}}{\sum_i I_i^{bau}}\right)}{\left(\frac{\sum_i R_i^{bau}}{\sum_i I_i^{bau}}\right)} \times 100$$

   (b) Mean of the lifts observed across each of the N articles:

   $$\frac{1}{N}\sum_i \frac{\left(\frac{R_i^{val}}{I_i^{val}} - \frac{R_i^{bau}}{I_i^{bau}}\right)}{\left(\frac{R_i^{bau}}{I_i^{bau}}\right)}$$

   This is more sensitive if we are dealing with high-rev pages but with few impressions

2. Percentage lift in the revenue

   $$\frac{\left(\sum_i R_i^{val} - \sum_i R_i^{bau}\right)}{\sum_i R_i^{bau}} \times 100$$

   Although, this wouldn't make much sense if the no. of impressions is widely different in bau and val.

2.2 Degradation in the audience quality

Currently the AQ metrics that the business has in mind are off-limits for us, as they are only measured through an aggregate of full month of a specific program. So we need to look at some other pseudo-metrics that measure AQ.

So we intend to look at user engagement via PVPS.

1. Reduction in the PVPS:

   $$-\frac{\left(\frac{\sum_i V_i^{val}}{\sum_i S_i^{val}} - \frac{\sum_i V_i^{bau}}{\sum_i S_i^{bau}}\right)}{\left(\frac{\sum_i V_i^{bau}}{\sum_i S_i^{bau}}\right)} \times 100$$

2. We could do similar comparisions using other metrics too such as

   - ASD
   - bounce-rate
   - IAB ad CTR

3 Conclusion

Finally we want to test our hypothesis that serving high-value pages (obtained by optimizing our utility function ϕ over all the available articles) is not detrimental to the AQ or the user-engagement.