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W241: Experiments and Causality
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Essay 2 - Do subscriptions encourage consumption?

Do we consume more of something when we subscribe to a service that provides that thing? An audio book service is a an example. Would we listen to more audio books if we buy subscription to a service like “Audible”, compared to buying and downloading one book at a time?

The question could not be more timely. With the increase in digitization and plentiful shipping mechanisms, a lot of material acquisition is happening though the web. Buying and selling online is convenient and reduces the cost for both the buyer and the seller. A subscription plan (a method that makes that purchase for you automatically over and over) takes the convenience and cost reduction even further. A reasonable question though is if this causes a bump in consumption.

Why is this question important or interesting? and for whom? The question is interesting for almost all buyers and sellers. For a seller, an increase in usage would increase the cost of delivering the service. For a buyer, it could be a good thing in some cases and not so much in others. Let’s consider subscription to a “Pizza” service. Would such a subscription service increase usage? The seller would have to scale operations to meet the demand. The buyer would have to worry if this is going to impact their health. Not having to worry about the buying and selling process each time is convenient but the cost of service or the cost to well being may have to be worked out on a case to case basis. In all cases, it’ll be good to know if the subscription actually impacts usage.

The question naturally divides into multiple parts: Do subscriptions encourage or increase consumption of “things” considered *good* for the

user? Do subscription increase consumption of “things” considered *bad* in increasing quantities. Example questions would be: Does a subscription to a health club increase usage? Does subscription to a movie service cause unhealthy binging? A good analysis would require us to explore at least these two classes.

An significant amount of observational data is available to answer all of parts of the questions above. A lot of vendors have services that are offered in “pay as you go” or subscription form. Data comparing usage could be got from a book seller, a gym or a bike sharing service. Would we be able to trust the conclusions from such observations? Probably not. If it is not the same user, we’ll have to see if the cause and effect are inverted i.e. did a user subscribe due to her increasing usage pattern? Even if its a same user converting from one model to another, we’ll have to worry if she’s changing to subscription on anticipation of increased usage.

An experiment would help in answering the question more formally. An **ideal experiment** would happen at 2 providers. One providing a “good” service (like a gym) and one providing a “bad” service(like a cigar shop). We’ll follow these steps for the experiment:

1. Randomly select 1000 users from the customer base for an “opt in to subscription” lottery offer
2. Send offer for the conversion lottery to 1000 users. My assumption is that 10% of the customers would take that offer
3. Recruit 100 “pay per use” customers who would not mind a conversion to “subscription” through a lottery(Opt in group)
4. Monitor and record the service usage for all 100 customers for 2 weeks
5. **Conduct a lottery** and assign half of the “opt in” group to treatment (subscription model)
6. **Monitor and record service usage** for “control” and “treatment” group

The following enrollment pipeline (1000--->100-->50 in treatment) is as good as we can get on independence from confounding variables like pre-existing or changing usage patterns in this scenario. Our outcome measure will be “service usage” through the experiment. We’ll not have to collect data for any other variable to answer the question.

An **enhancement to the experiment would be to block based on existing usage** as a follow up to the first experiment. It is intuitive that heavy users in our customer base (in the 1000 we selected randomly) may increase usage by a much higher rate. We can reduce the chances of a bias in the average effect size by **randomizing among groups of varying usage**.

While ideal, above may not be a feasible experiment for the duration of the course (unless one of us owns and runs these service providers. We can try to find out if someone actually does). A class version of this could be conducted on a low cost front to a popular service. We’ll follow these steps for the experiment:

1. Find users of the commodity (like books or Music) on mechanical turk, school or equivalent
2. Conduct a survey to find out about existing usage (units are determined by the commodity)
3. Randomly select 50 from the responders of the survey
4. **Randomize further into control and treatment while blocking on 2 classes of usage (high, low)**
5. Offer the control group access to the service on a pay as you go basis.(This can be designed with a simple request access--->grant access--->revoke access pipeline for a single unit of the commodity)
6. Offer the control group access a subscription to the service. This can be designed by using a one time access token exchange
7. Monitor and record usage for 3 weeks

Note: The access to the service is free for the users in either case. We're not measuring the economic factors that lead to a decision on "pay as you go" or "subscription".
Note: We're ignoring the classes (good or bad) products in the class version of the experiment (I think we may just go with the good).

The collected data should look like this in either the real or class experiment:

User	Usage units from survey	Usage units during experiment (Control) Pay as you go	Usage units during experiment (Treatment) Subscription
A	2		
B	3		

We'll analyze the collected data in 3 ways:

1. Randomization inference to find the p value for our observed ATE in the experiment
2. T-test or regression to build a confidence interval
3. Regression to build a model for predictions

The experiment could involve significant expense (student or school resources) so we would want to do a pilot with 1/3rd th of the intended survey and sample size (with the same subject population though). We'll try to find out the following through the pilot:

1. Accessible users of the "commodity" (like music or audio) in our subject population
2. Feasibility of a survey to the subject population
3. The ratio of respondents
4. ATE with the same randomization and blocking methods

5. Statistical power of the experiment and analysis
6. Expense for this version of the experiment

5 & 6 would be the most important factors and ones that can cause significant complications. We may find our expense on the service mounting (because of usage) and may have to find a way to limit it. This would be a first world problem (our experiment is going really well). A different problem would be that the measured effect is so small that we cannot really make an inference based on the results of the experiment (low statistical power). We may have to innovate on the “commodity” (the service we are providing) to find the right one for the target population in the context of the experiment.

There are other confounding factors that we may not be able to control or account for. One significant one would be self selection i.e. the respondents to our survey may be enthusiasts or super users that are already finding any excuse to increase there interaction with the service at a low cost. We may want to increase the size of the survey or choose a different survey population if that happens.

In summary, knowing if “subscription” is causal for “usage” can help both the subscriber and the provider. It’s best concluded with an experiment which is easier with an actual service. A class experiment can be designed as a model that can later lead to building a much more effective experiment with the real service.