1. Appropriate task to perform A/B test

Which of the following use cases can you reliably conduct an A/B test? (True/False)

T 1.1. Frontend person wants to change color of the 'Go' button on a search bar. Will it increase conversion rate?

T 1.2. The data team created four versions of machine learning model for product recommendations to new users of an app. Which one is the best?

F 1.3. Two managers from different factions have Layout A and Layout B for a physical convenience store. Which one should we use?

F 1.4. Mr. Rabbito thinks offline stores are the best channel to distribute our products, whereas Ms. Rakko thinks online websites are the way to go. Who is right?

F 1.5. Your boss wants to add a premium version to your freemium service. Is it a good idea?

T 1.6. The backend team came up with a new setup that they think will speed up the website load time. Should we implement this change?

F 1.7. Kuruma Inc., a car dealer, wants to change the banner on their homepage to see if it will attract more repeated customers. Average time between purchase of the car company is 5 years. How do you know if the banner change has an effect?

F 1.8. Your company undergoes a total revamp of its corporate identity. Is it the right call?

T 1.9. Elastic ninja at your company wants to show 15 products on the first page of search results instead of 20 products. Should you allow them?

F 1.10. Marketing person wants to know who respond better to our ads campaigns between iOS users and Android users. How to tell?

2. Choose the method

What are the metrics you should use for the following A/B tests? Assume that the granularities are: page views and unique visitors.

2.1. Which button colors will make customers find it more easily? clicks / Page views

2.2. Which sets of products on a landing page will make customers more likely to buy? purchases / Unique visitors

2.3. Which types of promotion coupons will be more effective? purchases / Unique visitors

2.4. Which website layouts will attract more customers to click on sign up button? clicks / Unique visitors

3. Choose the period

Based on the transaction table below,

3.1. what are the event-based conversion rate of 2020-11?

3.2. what are cohort-based conversion rate of 2020-11?

Assume 7-day attribution period. Conversion rate is calculated by purchases / unique users.

date	user	event
2020-11-01	A	visit
2020-11-01	A	purchase
2020-11-05	B	visit
2020-11-13	B	visit
2020-11-30	C	visit
2020-12-05	C	purchase

3.1) event-based conversion rate = $\frac{\text{total purcheses in November}}{\text{total unique visitors in November}} = \frac{1}{4} = 0.25$

3.2) cohort-based conversion rate = $\frac{\text{total purcheses}}{\text{total unique visitors in November}} = \frac{2}{4} = 0.5$

9. Hamster Inc. and His Color Package

Hamster Inc. once again wants to test the conversion rates between package colors of its sunflower seeds; this time it is Red Package vs Gold Package. The Red Package is the existing group with average conversion rate of 11%. If they think the minimum detectable effect is 1% and want to make a 80/20 control/test split, how many unique users should see each package color before we decide which one performs better? Assume that they are testing at significance level of 15%. Show your work.

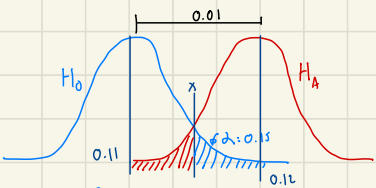
$n = \frac{m+1}{m}\left(\frac{(z_\alpha + z_\beta)\sigma}{MDE}\right)^2$; m: the ratio of A and B

$m=4$, $\alpha = 0.15$, $MDE = 0.01$

Mean: $E[X] = p = 0.11$

Variance: $Var[X] = pq$

$\sigma^2 = 0.11 \cdot (0.89) = 0.0979$



$P(z_\alpha) = 0.15$

$z_\alpha = 0.15$

$1.04 = \frac{\bar{x} - 0.11}{\sqrt{0.0979}}$

$\bar{x} \approx 0.935$

$z_\beta = \frac{\bar{x} - \mu_0}{\sigma_0}$

$z_\beta = \frac{0.935 - 0.12}{\sqrt{0.12 \cdot 0.88}}$

$z_\beta = 0.969$

$\beta = 0.834$

$n = \frac{4+1}{4}\left(\frac{(1.036 + 0.969)(\sqrt{0.0979})}{0.01}\right)^2 \approx 4910$

จำนวน unique user ที่จะเห็น Package สีแดงก็จะ 4910 คน

จำนวน unique user ที่จะเห็น Package สีเหลืองก็จะ 19680 คน

10. Hamster Inc. and His A/B Testing Experiment

Let us say Hamster Inc. ran the experiment and got the following results.

10.1. At significance level of 7%, which variation should be chosen to run at 100% traffic? Show your work.

10.2. What are the confidence intervals at 7% significance of conversion rates for Red and Gold? Show your work.

campaign_id	clicks	conv_cnt	conv_per
Red	59504	5901	0.099170
Gold	58944	6012	0.101995

10.1)

H_0 : campaign_id gold ไม่ได้ขายดีกว่า Red

H_A : campaign_id gold ขายดีกว่า Red

เป็นการทดลองแบบ bernoulli ซึ่ง $Var[X] = pq = p(1-p)$

$$s^2_{Red} = 0.099170(1-0.099170) = 0.089335$$

$$s^2_{Gold} = 0.101995(1-0.101995) = 0.091592$$

และ $E[X] = p$

$$\bar{x}_{Red} = 0.099170$$

$$\bar{x}_{Gold} = 0.101995$$

ทดสอบโดยใช้ $z = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

$$z = \frac{(0.101995 - 0.099170) - 0}{\sqrt{\frac{0.089335}{59504} + \frac{0.091592}{58944}}}$$

$$\approx 1.616$$

$$P(z > 1.616) \approx 0.053$$

เนื่องจาก 0.053 < significant level (0.07) ดังนั้น Reject H_0 (Gold ขายดีกว่า) //

10.2) Conversion Rate uplift : $CR_U = CR_{Gold} - CR_{Red} = 0.101995 - 0.099170 = 0.002825$

$$x = 0.002825 - z_{\frac{0.07}{2}} \sqrt{\frac{0.099170(1-0.099170)}{59504} + \frac{0.101995(1-0.101995)}{58944}} = -0.000034$$

$$y = 0.002825 + z_{\frac{0.07}{2}} \sqrt{\frac{0.099170(1-0.099170)}{59504} + \frac{0.101995(1-0.101995)}{58944}} = 0.005684$$

∴ confidance interval คือ $[-0.000034, 0.005684]$ //