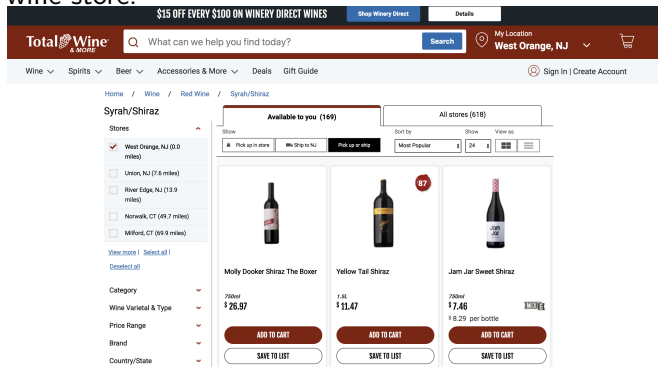# Advanced AB Testing

Test Analysis Basics

6/16/2019

Test data
Example email A/B test

The email A/B test we will analyze was conducted by an online wine store.

Source: Total Wine & More

Wine retailer email test
Test setting: email to retailer email list
Unit: email address
Treatments: email version A, email version B, holdout

Analysis of A/B tests

What is the first question you should ask about an A/B test?
~~Did the treatment affect the response?~~
Was the randomization done correctly?

How could we check the randomization with the data?

Randomization checks
Randomization checks confirm that the baseline variables are
distributed similarly for the treatment and control groups.
Averages of baseline variables by treatment group

```
d %>% group_by(group) %>% summarize(mean(days_since), mean(
```

```
## # A tibble: 3 x 4
##   group   `mean(days_since)` `mean(visits)` `mean(past_p
##   <fct>                <dbl>          <dbl>
## 1 ctrl                  90.0           5.95
## 2 email_A               90.2           5.95
## 3 email_B               89.8           5.94
```

Randomization checks out! On to the treatment effects.
Did the treatments affect the responses?

```
d %>% group_by(group) %>% summarize(mean(open), mean(click)
```

```
## # A tibble: 3 x 4
##   group   `mean(open)` `mean(click)` `mean(purch)`
##   <fct>          <dbl>         <dbl>         <dbl>
## 1 ctrl               0             0          12.4
## 2 email_A        0.718         0.132          25.6
## 3 email_B        0.652        0.0934          25.9
```

Email A looks better for opens and clicks, but maybe not purchases.
Both emails seem to generate higher average purchases than the
control.

Does email A have higher open rate than B?

Create a new data set with just the customers who received emails.

```
d_treat <- d[d$group != "ctrl",]
d_treat$group <- droplevels(d_treat$group)
xtabs(~ group + open, data=d_treat)
```

Design of A/B tests
Seven key questions

1. Business question
2. Test setting (lab v. field)
3. Unit of analysis (visit, customer, store)
4. Treatments
5. Response variable(s)
6. Selection of units
7. Assignment to treatments
8. Sample size

If you can answer these questions, you have a test plan.

Email test

Business questions: Does email work? If so which email is better?
Test setting: email to retailer customers
Unit: email address
Treatments: email version A, email version B, holdout
Reponse: open, click and 30-day purchase ($)
Selection: all active emails on email list (open in last 12 months)
Assignment: randomly assigned (1/3 each)

Things you just learned (or reviewed)

- ▶ Three types of variables in test data
    - ▶ Treatment (x's)
    - ▶ Response (y's)
    - ▶ Baseline variables (z's)
- ▶ Analyzing tests with binary response
    - ▶ Bar plot or mosaic plot
    - ▶ `prop.test()` for significance
- ▶ Analyzing tests with continuous response
    - ▶ Dot plots or violin plots
    - ▶ `t.test()` for significance
- ▶ Eight key questions that define a test plan
- ▶ Sample size calculations
    - ▶ Continous responses
    - ▶ Binary responses