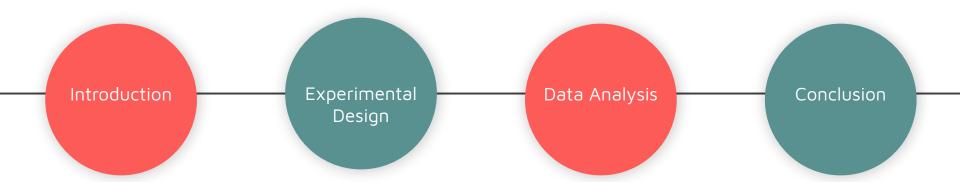
Listing Factors in Classified Advertising Platform

W241 - Final Presentation

Jun Jun Peh, Ava Rezvani

Agenda



Motivation

Research Question

Hypothesis



Motivation

Research Question

Hypothesis

Craigslist (craigslist.com)

- Founded in 1995 by Craig Newmark as an email distribution list among friends
- American advertisement website to post jobs, items, housing, services, etc. A disruptor & behemoth
- 60 millions users, 70 countries, 80 million posts/month

Motivation

- The freedom & power in hand of user (merchant) to maximize their sale
- Allow users to understand marketplace demand, importance of description, and quality of images
- Allow Craigslist's marketplace to grow as a coveted platform for all services



Motivation

Research Question

Hypothesis

Research Question

Do Listing Factors Affect Buyers' Interest in Classified Advertisement Platforms?"



Motivation

Research Question

Hypothesis

Hypothesis

Null: No treatment effect for either photo quality or presence of a description for posting an item for sale in an online marketplace.

Alternative: Positive treatment effect for good photos quality and presence of a good description for posting an item for sale in an online marketplace.

Treatment & Control

Methods



Treatment & Control

Methods

Outcome Measures

Pilot Study

- 1. Posted a camera lens in Craigslist Dallas, with an intentional typo on product description vs photo.
- 2. Outcome:
 - a. Some buyers responded to inquire product details
 - b. 6 valid responses
 - c. Most traffic within first 48 hours



Treatment & Control

Methods

	Experiment 1	Experiment 2	Experiment 3
Methods	Craigslist - TV	Craigslist - Camera Lens	OfferUp - Camera Lens (mobile-driven marketplace to buy/sell good)
Control	Photo: Poor Description: Single line	Photo: Good, Description: None	Photo: Poor, Description: Single line
Treatment	(1) Photo: Poor Description: Full	Photo: Good Description: Full	Photo: Good Description: Full
	(2) Photo: Good Description: Single line		
	(3) Photo: Good Description: Full		

The Three Experiments...

Experimental Design

Treatment & Control

Methods

	Experiment 1	Experiment 2	Experiment 3
Methods	Craigslist - TV	Craigslist - Camera Lens	OfferUp - Camera Lens (mobile-driven marketplace to buy/sell good)
Control	Photo: Poor Description: Single line	Photo: Good, Description: None	Photo: Poor, Description: Single line
Treatment	(1) Photo: Poor Description: Full(2) Photo: Good Description: Single line(3) Photo: Good Description: Full	Photo: Good Description: Full	Photo: Good Description: Full
Challenges 3	Flagged/removed posts Electronics is a very saturated market Low # outcomes per tx group		

Treatment & Control

Methods

Outcome Measures

Experiment #2

	Experiment 1	Experiment 2	Experiment 3
Methods	Craigslist - TV	Craigslist - Camera Lens	OfferUp – Camera Lens (mobile-driven marketplace to buy/sell good)
Control	Photo: Poor Description: Single line	Photo: Good, Description: None	Photo: Poor, Description: Single line
Treatment	(1) Photo: Poor Description: Full(2) Photo: Good Description: Single line(3) Photo: Good Description: Full	Photo: Good Description: Full	Photo: Good Description: Full
Challenges	Flagged/removed posts Electronics is a very saturated market Low # outcomes per tx group		



Treatment & Control

Methods









- posting day & time of day
- product sale price
- product variable
- title of listing

Treatment & Control

Methods

Treatment & Control

Methods

Outcome Measures

Methods

Controlled Variables

- posting day & time of day
- product sale price
- product variable
- title of listing
- product condition

Clustered Design

Targeted posting population clustered at city level. Outcome will be measured on individual level.



Treatment & Control

Methods

Outcome Measures

Methods



- posting day & time of day
- product sale price
- product variable
- title of listing
- product condition

Clustered Design

Targeted posting population clustered at city level. Outcome will be measured on individual level.

Block Randomization

Researched* and compiled list of different levels of traffic for cities on Craigslist. Developed 5 blocks based on traffic %



Treatment & Control

Methods

Outcome Measures

Methods



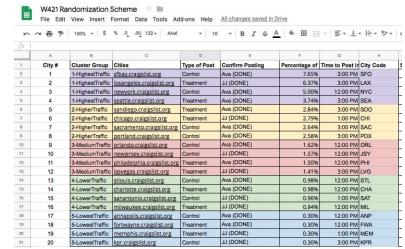
- posting day & time of day
- product sale price
- product variable
- title of listing
- product condition

Clustered Design

Targeted posting population clustered at city level. Outcome will be measured on individual level.

Block Randomization

Researched* and compiled list of different levels of traffic for cities on Craigslist. Developed 5 blocks based on traffic %



Blocks

- 1-Highest Traffic (7.65% 3.74%)
- 2-Higher Traffic (2.84%-2.58%
- 3-Medium Traffic (1.62%-1.41%
- 4-Lower Traffic (0.98%-0.94%) 5-Lowest Traffic (0.30%)



Number of responses received associated with each posting

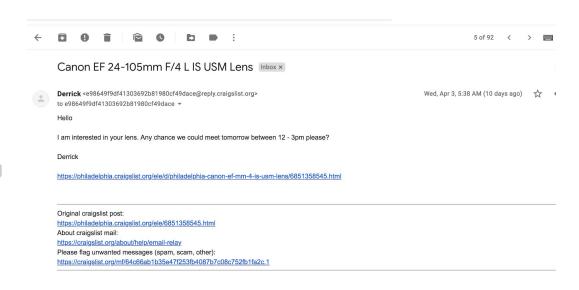
- includes filtering out for spam as well as for product inquiries

Experimental Design

Treatment & Control

Methods

Randomization & Clustering





Treatment & Control

Methods

	Experiment 1	Experiment 2	Experiment 3
Methods	Craigslist - TV	Craigslist - Camera Lens	OfferUp – Camera Lens (mobile-driven marketplace to buy/sell good)
Control	Photo: Poor Description: Single line	Photo: Good, Description: None	Photo: Poor, Description: Single line
Treatment	(1) Photo: Poor Description: Full(2) Photo: Good Description: Single line(3) Photo: Good Description: Full	Photo: Good Description: Full	Photo: Good Description: Full
Challenges	Flagged/removed posts Electronics is a very saturated market Small n's per tx group		



Treatment & Control

Methods

Outcome Measures

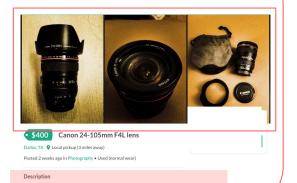
OfferUp

Experiment #3 (OfferUp)

Treatment Variability

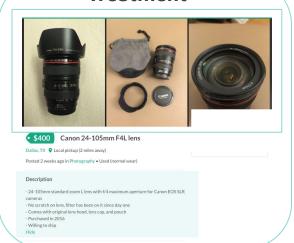
- photo quality
- description/content

Control



Treatment

Canon lens



Treatment & Control

Methods

Outcome Measures

OfferUp

Experiment #3 (OfferUp)

Treatment Variability

- photo quality
- description/content

Controlled Variables

- product sale price
- product variable
- title of listing

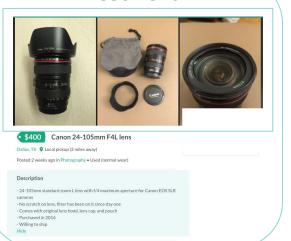
Generalization

Listings were created for local pick up in Dallas, at the same time being posted to nationwide (with shipment available)

Control



Treatment



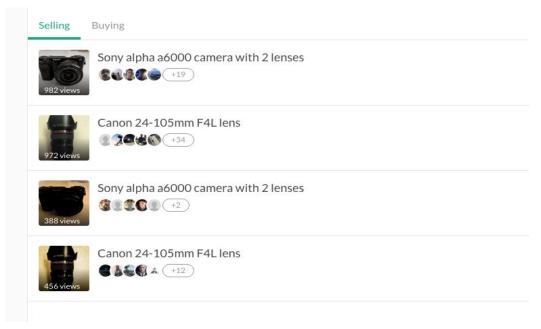
Treatment & Control

Methods

Outcome Measures

Outcome Measures for Alternative Experiment 3 (OfferUp)

- 1. Number of Views -> effect of photo
- 2. Number of Responses -> effect of description (and photo)
- Camera listings served as controlled product to validate the experiment is replicable to other products.



The Three Experiments...

Experimental Design

Treatment & Control

Methods

	Experiment 1	Experiment 2	Experiment 3
Methods	Craigslist - TV	Craigslist - Camera Lens	OfferUp - Camera Lens (mobile-driven marketplace to buy/sell good)
Control	Photo: Poor Description: Single line	Photo: Good, Description: None	Photo: Poor, Description: Single line
Treatment	(1) Photo: Poor Description: Full(2) Photo: Good Description: Single line(3) Photo: Good Description: Full	Photo: Good Description: Full	Photo: Good Description: Full
Challenges 3	Flagged/removed posts Electronics is a very saturated market Low # outcomes per tx group	Flagged/removed posts No insight into page views	Not city specific Only 2 posting per experiment group

Aggregation & Clean Up

Analysis

Results

Aggregation & Clean Up

1. Experiment 2 aggregated data after 1 week of posting

City # Cluster Group Percentage of Traffic Time to Post in CA City Code Cities Condition Response_Count 3:00 PM SFO 1-HighestTraffic sfbay.craigslist.org Control 7.65% 1-HighestTraffic losangeles.craigslist.org Treatment 6.37% 3:00 PM LAX 5.00% 12:00 PM NYC 1-HighestTraffic newyork.craigslist.org Control 3:00 PM SEA 3.74% 1-HighestTraffic seattle.craigslist.org Treatment 2.84% 3:00 PM SDO 2-HigherTraffic sandiego.craigslist.org Treatment 1:00 PM CHI 2-HigherTraffic 2.79% chicago.craigslist.org Treatment 2-HigherTraffic sacramento.craigslist.org Control 2.64% 3:00 PM SAC 2-HigherTraffic portland, craigslist, org Control 2.58% 3:00 PM PDX 3-MediumTraffic orlando.craiaslist.org Control 1.62% 12:00 PM ORL 1.57% 12:00 PM JSY 3-MediumTraffic newjersey.craigslist.org Control philadelphia.craigslist.org 12:00 PM PHI 3-MediumTraffic Treatment 1.50% 1.41% 3:00 PM LVG 3-MediumTraffic lasvegas.craigslist.org Treatment 12:00 PM STL 4-LowerTraffic stlouis.craigslist.org Control 0.98% 0.98% 12:00 PM CHA 4-LowerTraffic charlotte.craigslist.org Treatment 1:00 PM SAT 4-LowerTraffic 0.96% sanantonio.craigslist.org Control 12:00 PM MIL 4-LowerTraffic 0.94% milwaukee.craigslist.org Treatment 12:00 PM ANP 5-LowestTraffic annapolis.craigslist.org Control 0.30% 12:00 PM FWA 5-LowestTraffic fortwayne.craigslist.org Treatment 0.30% 5-LowestTraffic memphis.craigslist.org Treatment 0.30% 1:00 PM MEM 3:00 PM KPR 20 5-LowestTraffic kpr.craigslist.org Control 0.30%

Data Analysis

Aggregation & Clean Up

Analysis

Results

Aggregation & Clean Up

Analysis

Results

Aggregation & Clean Up

1. Experiment 2 aggregated data after 1 week of posting

City #	Cluster Group	Cities	Condition	Percentage of Traffic	Time to Post in CA	City Code	Response_Count
1	1-HighestTraffic	sfbay.craigslist.org	Control	7.65%	3:00 PM	SFO	11
2	1-HighestTraffic	losangeles.craigslist.org	Treatment	6.37%	3:00 PM	LAX	6
3	1-HighestTraffic	newyork.craigslist.org	Control	5.00%	12:00 PM	NYC	3
4	1-HighestTraffic	seattle.craigslist.org	Treatment	3.74%	3:00 PM	SEA	4
5	2-HigherTraffic	sandiego.craigslist.org	Treatment	2.84%	3:00 PM	SDO	5
6	2-HigherTraffic	chicago.craigslist.org	Treatment	2.79%	1:00 PM	CHI	3
7	2-HigherTraffic	sacramento.craigslist.org	Control	2.64%	3:00 PM	SAC	0
8	2-HigherTraffic	portland.craigslist.org	Control	2.58%	3:00 PM	PDX	2
9	3-MediumTraffic	orlando.craigslist.org	Control	1.62%	12:00 PM	ORL	0
10	3-MediumTraffic	newjersey.craigslist.org	Control	1.57%	12:00 PM	JSY	0
11	3-MediumTraffic	philadelphia.craigslist.org	Treatment	1.50%	12:00 PM	PHI	0
12	3-MediumTraffic	lasvegas.craigslist.org	Treatment	1.41%	3:00 PM	LVG	6
13	4-LowerTraffic	stlouis.craigslist.org	Control	0.98%	12:00 PM	STL	0
14	4-LowerTraffic	charlotte.craigslist.org	Treatment	0.98%	12:00 PM	CHA	6
15	4-LowerTraffic	sanantonio.craigslist.org	Control	0.96%	1:00 PM	SAT	5
16	4-LowerTraffic	milwaukee.craigslist.org	Treatment	0.94%	12:00 PM	MIL	5
17	5-LowestTraffic	annapolis.craigslist.org	Control	0.30%	12:00 PM	ANP	0
18	5-LowestTraffic	fortwayne.craigslist.org	Treatment	0.30%	12:00 PM	FWA	2
19	5-LowestTraffic	memphis.craigslist.org	Treatment	0.30%	1:00 PM	MEM	0
20	5-LowestTraffic	kpr.craigslist.org	Control	0.30%	3:00 PM	KPR	1

2. Experiment 3 aggregated data

Dundunt	Dhata Oualita	Description	Candisian	D	Minus
Product	PhotoQuality	Description	Condition	kesponse	views
Lens	Good	Full	Treatment	24	982
Lens	Bad	Single	Control	7	338
Camera	Good	Full	Treatment	39	972
Camera	Bad	Single	Control	17	456

Analysis on Experiment 2 (Craigslist)

<u>Statistical Power using two-sample T-test</u>

1. Obtained power = 0.1853525

Data Analysis

Aggregation

Analysis

Results

```
# Calculate effect size
cohens d <- function(x, y) {
  lx <- length(x) - 1
  ly <- length(y) - 1
  md <- abs(mean(x) - mean(y))
                                       ## mean difference (numerator)
  csd \leftarrow lx * var(x) + ly * var(y)
  csd <- csd/(lx + ly)
  csd <- sqrt(csd)
                                       ## common sd computation
  cd <- md/csd
                                       ## cohen's d
exp2 cohens d <- cohens d(
  exp2_df[exp2_df$Condition == 'Control', 'Response_Count'],
  exp2 df[exp2 df$Condition == 'Treatment', 'Response Count']
exp2 cohens d
## [1] 0.5004636
```

```
##
## Two-sample t test power calculation
##
## n = 10
## d = 0.5004636
## sig.level = 0.05
## power = 0.1853525
## alternative = two.sided
##
## NOTE: n is number in *each* group
```

Aggregation

Analysis

Results

Analysis on Experiment 2 (Craigslist)

Control vs Treatment

- 1. Control (no description) has avg of 2.2 responses
- 2. Treatment (full description) has avg of 3.7 responses
- 3. ATE = 1.5

```
## # A tibble: 2 x 3
## Condition avg sd
## <chr> <dbl> <dbl>
## 1 Control 2.2 3.521363
## 2 Treatment 3.7 2.359378
```



Aggregation

Analysis

Results

Analysis on Experiment 2 (Craigslist)

Regression

P-value of 0.2778 on treatment (not statistically significant)

```
summary(lm(Response_Count ~ Condition, data=exp2_df))
```

```
##
## Call:
## lm(formula = Response Count ~ Condition, data = exp2 df)
##
## Residuals:
     Min
             10 Median
                                Max
   -3.70 -2.20 -0.45 1.55 8.80
## Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)
                       2,2000
                                 0.9478 2.321
                                                 0.0322 *
## ConditionTreatment 1.5000
                                1.3404 1.119 0.2778
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 2.997 on 18 degrees of freedom
## Multiple R-squared: 0.06505, Adjusted R-squared: 0.01311
## F-statistic: 1.252 on 1 and 18 DF, p-value: 0.2778
```

Analysis on Experiment 2 (Craigslist)

<u>Comparison of Robust Standard Error</u>

Data Analysis

Aggregation

Analysis

Results

```
# 8) Calculate f1 score and robust standard error

# We are using the `vcovHC` function from the library `sandwich`
# to estimate the white heteroskedastic-consistent standard errors
m1 <- lm(Response_Count ~ Condition, data = exp2_df)
m1.vcovHC <- vcovHC(m1) # from library(sandwich)

# With these, we can use the `coeftest` function from the `lmtest`
# package to perform hypothesis tests.
# these are the `robust` standard errors.
coeftest(m1, vcov = m1.vcovHC)</pre>
```

```
##
## t test of coefficients:
##
## Estimate Std. Error t value Pr(>|t|)
## (Intercept) 2.2000 1.1738 1.8743 0.07722 .
## ConditionTreatment 1.5000 1.4129 1.0616 0.30243
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Compares robust vs non-robust standard errors
r1 <- coeftest(m1, vcov = vcovHC(m1, type = "const"))
r2 <- coeftest(m1, vcov = vcovHC(m1, type = "HC3"))
stargazer(r1, r2, type = "text")</pre>
```

```
##
##
Dependent variable:
##
##

(1) (2)
##

ConditionTreatment 1.500 1.500
##
(1.340) (1.413)
##

## Constant 2.200** 2.200*
## (0.948) (1.174)
##

##
##

Note: *p<0.1; **p<0.05; ***p<0.01
```



Aggregation

Analysis

Results

Analysis on Experiment 3 (OfferUp)

1. Combined effect of responses on people who view

```
# combined_effect = (total views) / (total responses) for each control and treatment. this is the number of peo
  ple view the listing wrt responses we get.
  exp3 df$combined effect <- exp3 df$Views / exp3 df$Response
    Condition Response Views combined effect
  ## 1 Treatment
                 24 982
                             40.91667
                 7
                    338
                             48.28571
       Control
  ## 3 Treatment
                 39
                    972
                             24.92308
  ## 4 Control
                             26.82353
t.test(exp3_df$Response ~ exp3_df$Condition, var.equal = TRUE)
    Two Sample t-test
## data: exp3 df$Response by exp3 df$Condition
## t = -2.1633, df = 2, p-value = 0.163
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -58.28359 19.28359
## sample estimates:
     mean in group Control mean in group Treatment
##
                        12.0
                                                   31.5
t.test(exp3 df$combined effect ~ exp3 df$Condition, var.equal = TRUE)
    Two Sample t-test
## data: exp3 df$combined effect by exp3 df$Condition
## t = 0.34632, df = 2, p-value = 0.7621
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -52.94771 62.21721
## sample estimates:
     mean in group Control mean in group Treatment
                    37.55462
                                               32.91987
```

Aggregation

Analysis

Results

Analysis on Experiment 3 (OfferUp)

<u>Statistical Power using two-sample T-test</u>

1. Obtained power = 0.2438

```
# Calculate effect size
cohens_d <- function(x, y) {
 lx <- length(x) - 1
 ly <- length(y) - 1
 md <- abs(mean(x) - mean(y))
                                        ## mean difference (numerator)
 csd \leftarrow lx * var(x) + ly * var(y)
  csd <- csd/(lx + ly)
 csd <- sgrt(csd)
                                       ## common sd computation
  cd <- md/csd
                                        ## cohen's d
# Description - Response
exp3_cohens_d <- cohens_d(
  exp3 df[exp3 df$Condition == 'Control', 'Response'],
  exp3_df[exp3_df$Condition == 'Treatment', 'Response']
exp3 cohens d
```



Control vs Treatment

- ATE of photo quality (views): 580
- ATE of responses (description): 19.5
- ATE of responses (description): -4.63

Data Analysis

Aggregation

Analysis

Results

```
## # A tibble: 2 x 3
## Condition avg sd
## <fctr> <dbl> <dbl>
## 1 Control 397 83.438600
## 2 Treatment 977 7.071068
```

```
## # A tibble: 2 x 3
## Condition avg sd
## <fctr> <dbl> <dbl> ## 1 Control 12.0 7.071068
## 2 Treatment 31.5 10.606602
```

```
## # A tibble: 2 x 3
## Condition avg sd
## <fctr> <dbl> <dbl>
## 1 Control 37.55462 15.17606
## 2 Treatment 32.91987 11.30918
```



Aggregation & Clean Up

Analysis

Results

Analysis on Experiment 3 (OfferUp)

Regression

1. P-value of 0.817 on treatment

```
# 6) Regression
# CHECK: response is dependent on condition and views? or should be separated
summary(lm(Response ~ Condition + Views, data=exp3 df))
## Call:
## lm(formula = Response ~ Condition + Views, data = exp3 df)
## Residuals:
## -7.8672 -0.6667 7.8672 0.6667
## Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
                      -17.15787 53.52266 -0.321
## ConditionTreatment -23.09840 78.14073 -0.296
## Views
                       0.07345
                                  0.13334 0.551
## Residual standard error: 11.17 on 1 degrees of freedom
## Multiple R-squared: 0.7703, Adjusted R-squared: 0.3109
## F-statistic: 1.677 on 2 and 1 DF, p-value: 0.4793
# You can model a t.test as a simple linear regression with
# a dummy-coded variable for the condition factor.
# This is equivalent to a two-sample T-test
t.test(exp3_df$Response ~ exp3_df$Condition, var.equal = TRUE)
##
   Two Sample t-test
## data: exp3 df$Response by exp3 df$Condition
## t = -2.1633, df = 2, p-value = 0.163
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -58.28359 19.28359
## sample estimates:
    mean in group Control mean in group Treatment
##
                      12.0
                                              31.5
```

Aggregation & Clean Up

Analysis

Results

Analysis on Experiment 3 (OfferUp)

<u>Comparison of Robust Standard Error</u>

these are the `robust` standard errors.
coeftest(m1, vcov = m1.vcovHC)

```
## t test of coefficients:
## ## t test of coefficients:
## ## Estimate Std. Error t value Pr(>|t|)
## (Intercept) 12.0000 7.0711 1.6971 0.2318
## ConditionTreatment 19.5000 12.7475 1.5297 0.2657
```

```
# Compares robust vs non-robust standard errors
r1 <- coeftest(m1, vcov = vcovHC(m1, type = "const"))
r2 <- coeftest(m1, vcov = vcovHC(m1, type = "HC3"))
stargazer(r1, r2, type = "text")</pre>
```

```
______
              Dependent variable:
              (1)
                       (2)
  ------
## ConditionTreatment
              19.500
                      19.500
             (9.014)
                     (12.748)
## Constant
              12,000
                      12.000
             (6.374)
                      (7.071)
  ______
## -----
## Note:
            *p<0.1; **p<0.05; ***p<0.01
```

Aggregation & Clean Up

Analysis

Results

Summary of Results

- Experiment 2:
 - a. No significant difference between control vs treatment responses with different description condition
- Experiment 3:
 - a. Significant positive treatment effect on listing views and responses when assessing individually. However, when combined effect is accounted, we saw reverse effect on treatment.

** We are not able to reject the null hypothesis due to low statistical power.

Conclusion

Concerns & Challenges

Concluding Thoughts

Conclusion

Concerns

Concluding Thoughts

Concerns & Challenges

- Major limitations with Craigslist as methods for study, resulting in multiple data collection efforts & reposting when posts were taken down
- Response window was limited to 7 days due to Craigslist posting windows for larger cities (SF, NYC), hence data collected was limited to 1 week
- Low statistical power due to small number of responses and limited time of data collection.
 - calculate the sample size needed prior to starting experiment
- More thorough pilot study on a larger scale to include different product categories and platforms.

Conclusion

Concerns

Concluding Thoughts

Concluding Thoughts

- How does this translate across other product markets?
 - Future suggestions: furniture, clothing, etc...
 - experiments in both saturated and unsaturated markets
- How would this translate in an auction like situation?
 - Future suggestions: eBay
- Why does Craigslist not include a page view counter for merchants?
 - Future suggestions: more studies with OfferUp

