A/B Test Shopper Hiring Analysis

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Shopper Hiring Problem

Current State of shopper hiring

- Receive an debit card and activate the card.
- Finish background check
- Finish orientation (optional)
- Finish the first batch - success!

We are running an A/B test in which we tried initiating the background check earlier in the hiring process for the treatment shoppers.

Our goal is to check whether shoppers are more likely to start and start more quickly given the change. We also want to know if the change is cost-effective.

Summary & Conclusion

We conduct exploratory data analysis and survival analysis to understand the data and the results.

- The treatment group shows higher final conversion rates and we are confident to conclude that initiating the required background check earlier in the process will improve the conversion rates.

- Intermediate events occured prior to “first batch completed” also play a role to increase the final conversion rate.

- We are able to achieve positive ROI given background check cost per applicant is $30 and other assumptions. However, we need to bring in more revenue to break even if background check cost becomes $50 or $100.

Recommendations

Based on the results, we propose the following recommendations:

- Hire more shoppers from channel web-search-engine.
- Focus on cities except Helheim, Muspelheim, and Svartalfheim. We don’t have evidence of significant difference between control and treatment for these three cities.
- Work with the background check agency to reduce the processing time.
- Try to launch a new A/B test to understand the impact of required online orientation on final conversion.
- Negotiate with background check agencies to reduce the cost. ROI needs to be positive in order to formally launch the change.

Exploratory Data Analysis

- The raw data has 108,328 rows and 6 columns

- No missing values

- Control sample size: 14,501
- Treatment sample size: 7,197
- Control:Treatment = 2:1. When the control group is big, the power of the study is increased which can detect a significant difference.

- We are aware that shoppers enter our study from different dates. Each shopper has his or her own onboarding process.

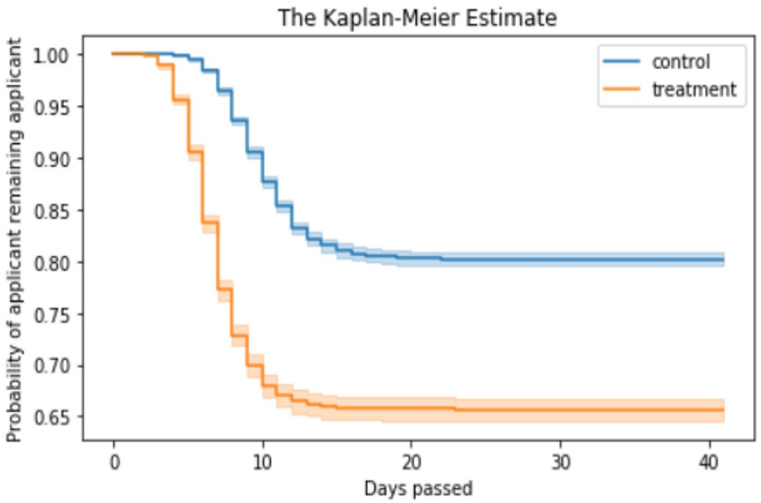
Survival Analysis - Final Conversion Rate

final conversion rate log-rank test results:

t_0	-1
null_distribution	chi squared
degrees_of_freedom	1
test_name	logrank_test

	test_statistic	p	-log2(p)
0	761.97	<0.005	554.76

Text(0.5, 1.0, 'The Kaplan-Meier Estimate')



- Null hypothesis (H0): the survival curves are the same between control and treatment.
- Alternative hypothesis (Ha): the survival curves are different between control and treatment.
- Log-rank test shows a statistically significant difference between control and treatment.
- Cumulative density shows treatment shoppers have higher conversion rates.

Final Conversion Rate by Channel

- Social-media shows the smallest difference between control and treatment while web-search-engine shows the biggest.

final conversion rate log-rank test for social-media:

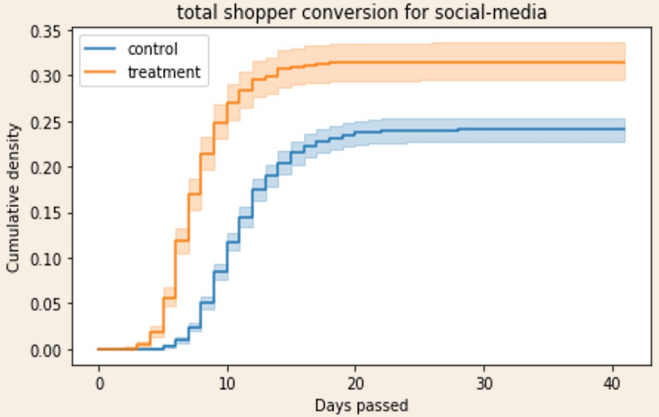
t_0	-1
null_distribution	chi squared
degrees_of_freedom	1
test_name	logrank_test

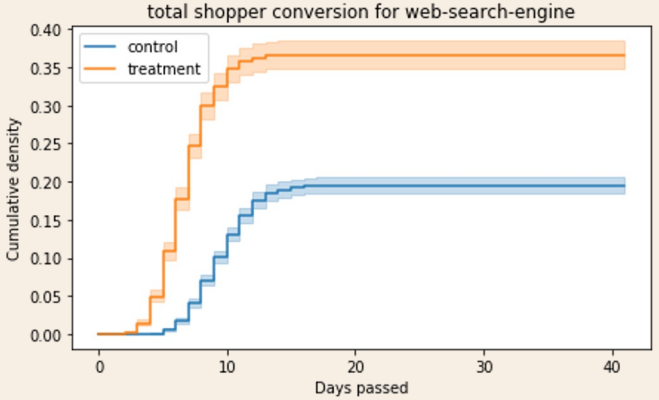
	test_statistic	p	-log2(p)
0	67.98	<0.005	52.43

final conversion rate log-rank test for web-search-engine:

t_0	-1
null_distribution	chi squared
degrees_of_freedom	1
test_name	logrank_test

	test_statistic	p	-log2(p)
0	389.11	<0.005	285.31





Final Conversion Rate by City

- City Midgard shows the largest significant difference between control and treatment while city Svartalfheim rejects the null hypothesis H0.

final conversion rate log-rank test for Midgard:

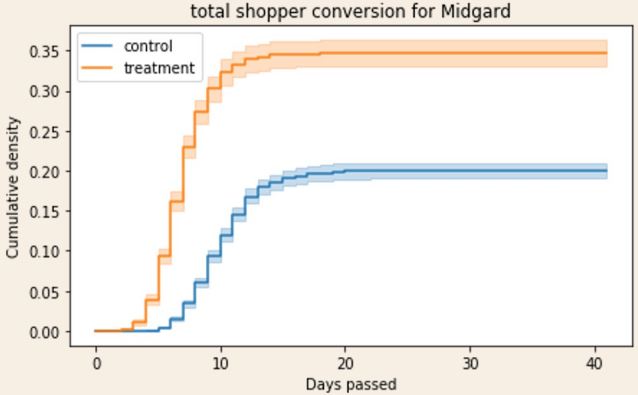
t_0	-1
null_distribution	chi squared
degrees_of_freedom	1
test_name	logrank_test

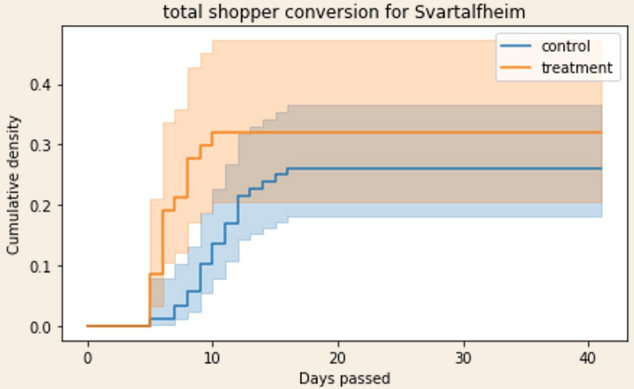
	test_statistic	p	-log2(p)
0	356.23	<0.005	261.53

final conversion rate log-rank test for Svartalfheim:

t_0	-1
null_distribution	chi squared
degrees_of_freedom	1
test_name	logrank_test

	test_statistic	p	-log2(p)
0	1.25	0.26	1.93

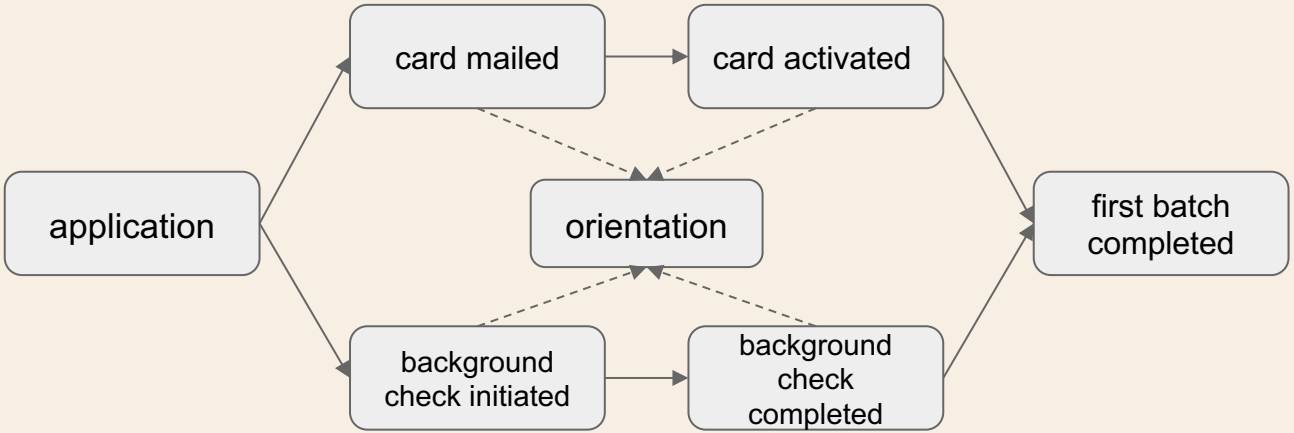




Recruiting funnel

- The end-to-end recruiting funnel consists of multiple steps (events).

- Each step can have an effect on final conversion rates.



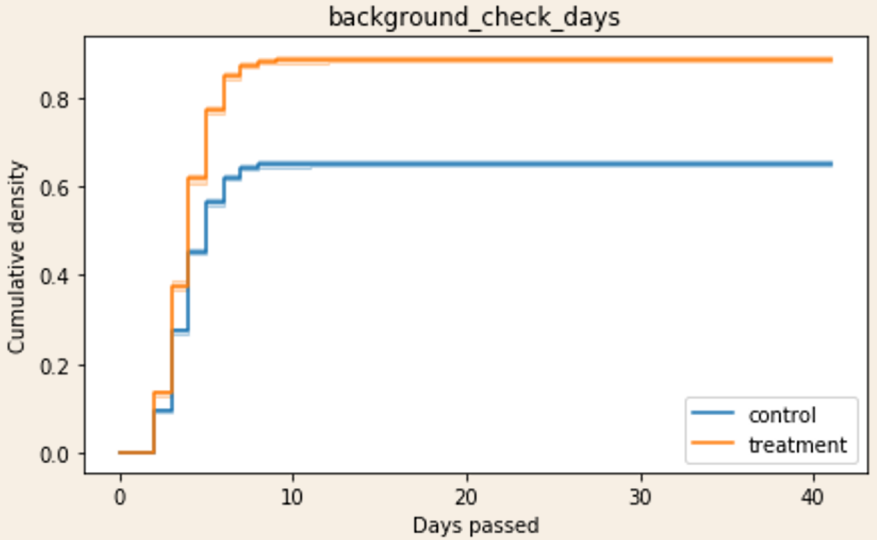
Recruiting funnel - Background Check

- Background check processing is an intermediate event between application and first_batch_completed.
- Shorten the waiting time will lead to higher conversion rate.
- "Background_check_days" is the variable name of waiting time.

background_check_days Log-Rank test summary:

t_0	-1
null_distribution	chi squared
degrees_of_freedom	1
test_name	logrank_test

	test_statistic	p	-log2(p)
0	1318.30	<0.005	956.46



Cost effectiveness

- At the end of study period, the conversion probability increased by 0.1452 from control shoppers (more likely to start).

- Initiating the required background check earlier would let shoppers to start 3.0705 days earlier (start more quickly).

- Assume 100 new shoppers
- Extra cost = $30 * delta_prob * 100
- Extra revenue = 100 * delta_days * avg(# of orders/day) * avg(per order value) * service fee.
- If revenue is greater than cost, we achieve cost-effective and ROI is positive.

- We define ROI = (revenue - cost)/cost

Cost effectiveness - cont'd

- Assume an average shopper completes 4 orders per day, $75 each order value, and 0.5% service fee.
  When cost = $30, ROI = 0.0572
  When cost = $50, ROI = -0.3657
  When cost = $100, ROI = -0.6828

- Assume an average shopper completes 4 orders per day, $150 each order value, and 0.5% service fee.
  When cost = $30, ROI = 1.1145
  When cost = $50, ROI = 0.2687
  When cost = $100, ROI = -0.3657

- ROI is sensitive to high background check cost. Given $30 background check cost, we are able to achieve positive ROI. However, when background check cost increased to $50, we need more orders or larger order values in order to break even.