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Reflections on Data Science 2023

Social Study: Herding effect on Reddit

1 Introduction

Posts that achieve popularity on social media platforms, like Reddit, often outperform average posts significantly, which indicates a qualitative difference between popular posts and the rest. With this phenomenon an interesting question emerges: is the success of a post attributable to its inherent quality, or is it influenced by the herd effect? The social psychological behaviour that leads individuals to perceive an action as the appropriate course simply because it's what "everyone else" seems to be doing. This effect has already been documented in various studies such as [1] [2]. In this study we aim to investigate the herd effect on the Reddit platform, more concretely, we want to find out to what extent does an initial upvote to a post influence its future score?

2 Experiment implementation

Similar to Muchnik et al. [1], to test the effect of a social influence on upvoting reddit posts we conducted a randomised control trial. For the continuous period of seven days we collected and monitored recently published posts with no upvotes nor comments from the subreddit *r/all*, and randomly assigned them to two categories: *treatment* and *control*. The treatment group received an initial upvote, while the control group did not. The experiment was scheduled to run daily to ensure that the collected posts had at least 24 hour period between the score loggings.

After the experimentation period ended, we aimed to test the following null hypothesis, with a significance threshold α set to 0.05: *A treatment of a post does not influence its score (number of upvotes minus downvotes) in the future.* Before the testing, some pre-processing steps were necessary. First, we removed the posts which were not continuously monitored for a week and secondly, to account for our initial upvote, we subtracted it from the posts' last day scores. This resulted in a total number of 1578 posts, i.e. 789 treated posts and 789 control posts. Finally, since we did not want to make assumptions about the underlying distribution of the data, we used non-parametric tests, namely Empirical bootstrap and Kolmogorov-Smirnov test, to confirm or reject the studied null hypothesis.

3 Results

In this study we investigated the impact of initial positive engagement on the future popularity of Reddit posts and whether such initial engagement can lead to a herd effect amongst users. Below we show the results of our experiment in terms of the scores of the posts that are measured as a difference between the number of upvotes and downvotes.

The analysis began with the examination of basic summary statistics of both the control and treatment groups with a focus on the last day of the monitoring period for each post. Interestingly enough, the mean score of the control group (52.67) was higher than of the treatment group (35.51), which might suggest that the initial upvote had a negative effect on the future score of the posts. However, it is important to note, that the standard deviation of both groups was very high, i.e. 417.63 and 190.21 for the control and treatment groups respectively, which indicates that the scores of the posts were very spread out. So a few outliers that received a lot of upvotes in the control group could have skewed the mean score upwards. This is further supported by the median which was 1 for both groups.

Furthermore, these statistics only describe the distributions within each group. To determine whether there's a significant difference between the two groups, that is whether the initial upvote has a significant effect on the final score a post receives, we need to conduct other in depth statistical tests. Since the skewness in the data could potentially violate assumptions of some popular statistical tests, such as the t-test, we decided to use non-parametric tests.

The null hypothesis that the treatment has no effect on the future score of a post could be tested by looking at the observed difference of the means of both groups and then asking a question, how likely it is to observe such a difference if the null hypothesis is true. If the probability of observing such a difference is low (less than the significance threshold α), then we can reject the null hypothesis. Empirical bootstrap is a statistical technique that uses an empirical distribution function as an estimate of the true distribution of data. Since the observed difference is itself a random variable we can use a bootstrap simulation to estimate the true distribution of mean differences and then calculate the probability. From the 1000 bootstrapped mean values in Figure 1 of both groups we can observe both the mean difference and the larger spread of the control group. In order to test whether our observed difference is significant we used Figure 2, where the 1000 bootstrapped mean differences are plotted with a red and blue lines indicating the 95% confidence interval. Since the confidence interval contains zero, the probability of both means being equal is above the significance threshold $\alpha = 0.05$ and thus the null hypothesis cannot be rejected. To find the exact p -value we can calculate the proportion of bootstrapped mean differences that are greater or equal to the observed difference. The p -value is 0.47 showing that our observed difference could have been observed by chance and

that the initial upvote has no significant effect on the future score of a post.

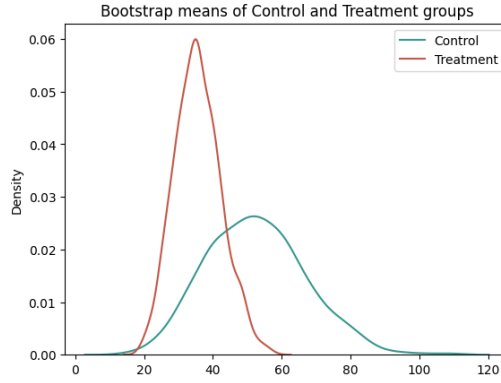


Figure 1: Bootstrapped means of control and treatment groups

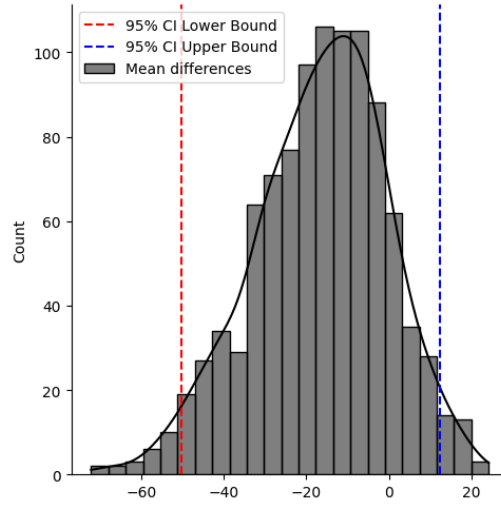


Figure 2: Bootstrapped means differences of control and treatment groups

Since the empirical bootstrap is looking at a single statistic (e.g. the mean difference) it does not take into account the whole distribution of the data. For this purpose we used the Kolmogorov-Smirnov (KS) test, which evaluates whether the overall distributions of both groups are the same. The KS test showed a p -value of 6.77×10^{-23} which indicates that the control and treatment groups come from different distributions, as their Empirical Cumulative Distribution Function (ECDF) significantly differ. To further convince ourselves we plotted the ECDFs of both groups in Figure 3, which don't seem to differ much. If we were to remove the low end of the scores (e.g. scores equal or less than 1) the p -value jumps to 0.17 suggesting that the difference is primarily driven by the posts that have scores of 1 or less, so there is no significant difference for the posts with the score of 2 or more. This difference may thus be attributed to the randomness of vote fuzzing that will be further discussed in the next section.

To summarise, according to our experiment and the data collected, one could not confidently say that the initial upvote has any significant effect on the final score of a reddit post. This, together with

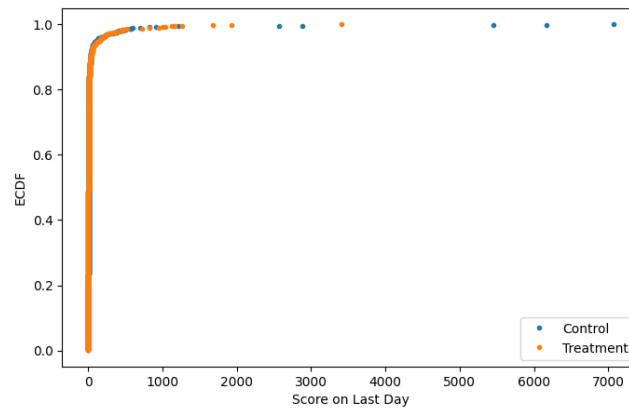


Figure 3: ECDF of control and treatment groups

the experiment limitations will be further discussed in the next section.

4 Discussion

Discuss your findings in light of the theories and concepts covered in the course (e.g., causality, experimental designs, extraneous variables, social influence, reproducibility, etc.)

Since we learned a bit too late about the vote fuzzing our experiment only recorded the overall score of the posts, while not looking at changing number of comments which might have been a better indication (no comment count fuzzing).

5 Conclusion

References

- [1] Lev Muchnik, Sinan Aral, and Sean J. Taylor. Social influence bias: A randomized experiment. *Science*, 341(6146):647–651, 2013.
- [2] Matthew J. Salganik, Peter Sheridan Dodds, and Duncan J. Watts. Experimental study of inequality and unpredictability in an artificial cultural market. *Science*, 311(5762):854–856, 2006.
- [3] C.T. Bergstrom and J.D. West. *Calling Bullshit: The Art of Skepticism in a Data-Driven World*. Random House Publishing Group, 2020.