2016 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM)

Analysis of Rewards on Reward-Based Crowdfunding Platforms

Yusan Lin* and Wang-Chien Lee†
Department of Computer Science and Engineering
Pennsylvania State University
University Park, Pennsylvania 16802
yusan@psu.edu*, wlee@cse.psu.edu†

Chung-Chou H. Chang
Department of Medicine
University of Pittsburgh
Pittsburgh, Pennsylvania 15213
changj@pitt.edu

***Abstract*—Today, crowdfunding has emerged as a popular means for fundraising. Among various crowdfunding platforms, reward-based ones are the most well received. However, to the best knowledge of the authors, little research has been performed on *rewards*. In this paper, we analyze a Kickstarter dataset, which consists of approximately 3K projects and 30K rewards. The analysis employs various statistical methods, including Pearson correlation tests, Kolmogorov-Smirnow test and Kaplan-Meier estimation, to study the relationships between various reward characteristics and project success. We find that projects with more rewards, with limited offerings and late-added rewards are more likely to succeed.**

I. Introduction

In recent years, crowdfunding has emerged as a new means of fundraising for social causes, entrepreneurial ventures, and for-profit businesses [1]. To meet the need, different types of crowdfunding platforms have surfaced, ranging from the traditional lending-based (e.g., Funding Circle) and equity-based (e.g., Invesdor), to the newer reward-based (e.g., Kickstarter) and donation-based (e.g., GoFundMe) crowdfunding platforms [2]. Among them, reward-based platforms are the most popular [3]. On a reward-based platform, the creators offer a list of rewards at different prices, called *menu pricing*. The backers evaluate the rewards on the list (as incentives) of a project to decide their support of the project. Once decided, the backers fund the project with amounts set on their selections of rewards. Finally, at a later time, the project creators deliver the promised rewards. The process is illustrated in Figure 1.

Rewards are the media for connecting backers and projects. We argue that rewards play an important role determining whether the projects eventually succeed. Time to time, the appeal of rewards may override the appeal of projects themselves due to the *items* (prizes) included in the rewards. For example, a user might not be interested in a project that makes creative portable chargers. However, if one of the rewards offers a 50% discount backing price for three chargers, the user may possibly back the project if she sees it as a good deal. Or, a reward that will list the backers' names on social media to show appreciation may attract backers who find receiving publicity rewarding. Moreover, if a reward limits the offering of a special item, e.g., a charger of rose gold color, to only the first ten backers, it may raise some backer's desire to support the project. In deed, based on our data analysis, we find that rewards with limited offerings usually achieve higher ratios between raised fundings and the targeted goals, whether these projects succeed or not, as shown in Figure 2.

Abundant studies have been conducted to understand how various aspects of projects, such as the project descriptions

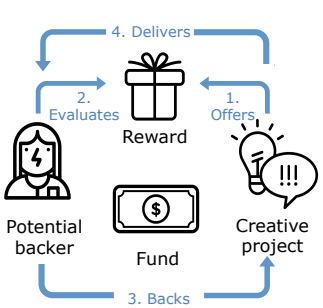

Fig. 1: An illustration of the backing process on reward-based crowdfunding platforms.

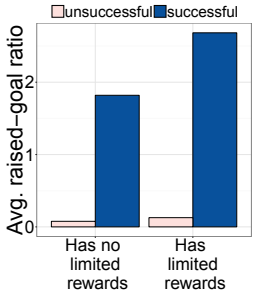

Fig. 2: Comparison of projects with and without limited rewards.

[4], project updates [5], timing of donations [6], and social mentions of projects [7], affect their successes, both quantitatively [2], [8] and qualitatively [9]. While there are hints about the important role rewards may play on reward-based crowdfunding platforms, to the best knowledge of the authors, there exists no data analysis on rewards in crowdfunding projects to understand their impacts on project success. Therefore, in this paper, we aim to analyze the rewards' role on projects in reward-based crowdfunding platforms.

To proceed, we intend to analyze the features of project rewards, such as number of rewards in a project, pricing, limited offers, and so on, to better understand their relationships to project success. Using real reward data collected from Kickstarter projects, we perform a series of statistical tests as appropriate on those features, including Pearson correlation estimation between features, Kolmogorov-Smirnov test of equal distributions, Kaplan-Meier estimation on reward sell-out rates, and log-rank test of equal sell-out rates.

Contributions of this work are summarized as follows.

1) We argue for the important role of rewards played in project success in reward-based crowdfunding platforms. To the best knowledge of the authors, this is the first research on analysis of rewards in crowdfunding projects.
2) We conduct a series of statistical analyses on some explicit features of rewards to reveal their implications on project success. It is interesting to find that contradicting to the *choice overload hypothesis* in Marketing, the more choices of rewards offered in a project, the more likely the project succeeds. We also find that projects with limited offerings and late-added rewards tend to receive more fundings.

IEEE/ACM ASONAM 2016, August 18-21, 2016, San Francisco, CA, USA
978-1-5090-2846-7/16/$31.00 ©2016 IEEE

Furthermore, we discover that the distributions of price-goal ratios can better differentiate successful projects from unsuccessful projects, compared with the distributions of raw prices. Finally, through the Kaplan-Meier statistical analysis method, we are able to estimate the likelihood of selling out at any given time point for different price range of a reward.

The rest of this paper is organized as follows. In Section II, we survey related works on crowdfunding and rewards. In Section III, we present the dataset collected for our analysis. In Section IV, we analyze the project and reward and discuss our findings. Finally, we conclude this work in Section V.

II. Background and Related Works

In this section, we provide the background regarding crowdfunding platforms, particularly the reward-based crowdfunding platforms, and survey the related works.

A. Crowdfunding

Crowdfunding has raised $16.2 billion in 2014, $34.4 billion in 2015, and is expected to surpass such amounts in 2016.[1] Nowadays, there are four major types of crowdfunding platforms, including *equity-based, lending-based, donation-based*, and *reward-based*.[2] Among them, the reward-based crowdfunding platforms, considered as the most popular one in recent years, introduce various levels of rewards corresponding to different pledge amounts for the potential backers to choose from as a means of support to the projects.

Among the reward-based crowdfunding platforms, Kickstarter is considered as the representative one. On Kickstarter, creators offer backers with a list of rewards as options to back the projects. How the rewards are designed can potentially affect the decision made by a backer. On Kickstarter, several factors of rewards are worth looking into, including the number of rewards a project offers, the pricing of rewards, the available offerings of rewards, and the items included in each reward. However, little research has been conducted to understand how rewards affect the final results.

Researchers have been studying Kickstarter projects from various angles. One of the most widely studied research questions is: how do different factors affect the success of crowdfunding projects? Xu et al. study how the project updates influence project success [5]. Solomon et al. investigate how the timing of donations affect the final pledging results on Kickstarter [6]. Lu et al. examine how the promotions on social media affect project success [7]. Mitra et al. consider the language used to describe projects, and how they influence the fundraising results [4].

B. Economics, Marketing, and Psychology View on Rewards

While various aspects of reward-based crowdfunding have been studied, we find that a study on the essential aspect of rewards is still missing. As the concept of rewards on reward-based crowdfunding platforms is similar to the items offered on a menu in places such as restaurants, we survey the literature related to the design of *menu pricing* to find correspondence to our study. The effect behind is well examined in the field of Psychology, e.g., from the providers' perspective, how different strategies of pricing design can be explored on menus to maximize profits? From the consumers' perspective, is there a "sweet spot" in the number of items provided that lead to the best results? Is it possible for a merchant to offer "too much" that leads to the phenomenon of *choice overload* [10]?

Other than the overall design, among the menus, what characteristics of an item makes it stand out? Are rewards with limited offerings more tempting than others [11]? Are rewards with discounts more worthy than others without discounts [12]? The above questions are worth looking into.

[1] http://dazeinfo.com/2016/01/12/crowdfunding-industry-34-4-billion-surpass-vc-2016/

[2] https://www.fundable.com/crowdfunding101/types-of-crowdfunding

TABLE I: Dataset statistics of the Kickstarter dataset.

	# of projects	# of rewards	Amount raised	# of backers
Successful	1,399	15,472	$27,534,852	180,418
Unsuccessful	1,705	14,866	$3,758,628	39,483
Total	3,104	30,338	$31,293,480	219,901

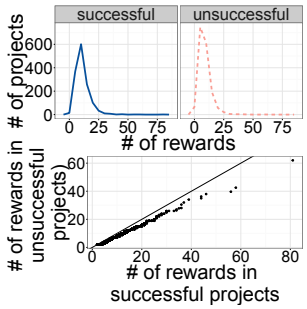

Fig. 3: Distributions and Q-Q plot of number of rewards.

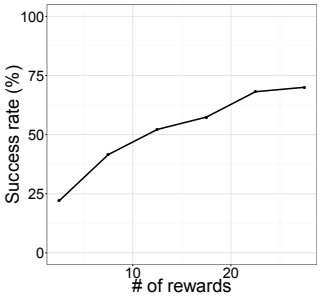

Fig. 4: Number of rewards per project versus success rate.

III. Data Source

Kickstarter is currently the most popular reward-based crowdfunding platform. Creators with creative ideas launch projects on the Kickstarter website by describing the projects, setting pledging goals, and designing the rewards that backers receive in return if the projects succeed. Potential backers then decide whether to support the projects by evaluating the project descriptions and the rewards offered. Such a mechanism has shown to be effective in collecting funds. Since founded in April, 2009, Kickstarter has helped 103K project creators pledge over $2.29 billion. 10 million backers have been involved, and 29 million backings have been made.[3] Being such an enormous platform for brewing creative ideas, we choose it as the source of our data analysis.

We collect data from December 15th, 2013 to March 23rd, 2014. Then we process the data to remove noises by eliminating the projects canceled, suspended, or unfinished when we end the data collection. The statistics of the final dataset are summarized in Table I.

IV. Reward Data Analysis

Here we present our statistical analyses on some features of project rewards on Kickstarter. These features include the number of rewards that a project offers, the prices of rewards, the limited offerings of rewards, and the later added rewards in projects' pledging time.

A. Number of rewards

We first observe how the number of rewards offered in a project correlates with its success rate. Intuitively, one may think that the more rewards being offered, the harder it is

[3] https://www.kickstarter.com/help/stats

TABLE II: Price range criteria for rewards.

		1st quantile		3rd quantile	
Raw price	low	$10	middle	$200	high
Price-goal ratio		0.00143		0.03636	

for the backers to choose from. This is known as the *choice overload hypothesis* [10]. In Psychology, how the number of options offered to a person affects their decision making is studied [13], [14]. In Marketing, some believe that a large number of options tends to make the purchase decisions of products harder for the consumers, and therefore leading to less desire to purchase the product [15]. Scheibehenne et al. state that "extensive assortments include a decrease in the motivation to choose, to commit to a choice, or to make any choice at all [10]."

In the dataset, the number of rewards offered by the projects ranges from 2 to 81, with an average of 11 rewards per project. The distribution of the number of rewards for successful and unsuccessful projects, along with the quantile-quantile (q-q) plot for the two distributions are shown in Figure 3. Notice that the q-q plot compares the distributions of number of rewards for successful projects and unsuccessful projects. The result shows that the successful projects offer significantly more rewards than the unsuccessful projects do.[4] As shown, there are very few projects with more than 30 rewards. Therefore, we discard the projects with more than 30 rewards because they are not statistically significant. Figure 4 plots the success rate corresponding to the number of rewards ranging from 1 to 30. As shown, the higher the number of rewards offered by a project, the more likely the project succeeds. The Spearman correlation between the number of rewards offered and the project success rate is 0.964. According to our analysis, users' backing behaviors on reward-based crowdfunding platforms go against the choice overload hypothesis.

B. Pricing

Most of the time, backers decide whether to back a project not only based on whether they are interested in the project, but also whether they are willing to pay for the project with the provided reward options. Gerber et al. and Mollic claim that backers on crowdfunding platforms primarily decide their backings based on the different sizes of funding rewards for the projects [16], [17]. We therefore examine the potential relationships between rewards' prices and the number of backings they receive. In our dataset, the minimum cost of a reward is $1, and the maximum is $10,000, with an average of $390, and 75% of the rewards fall between the prices $1 and $200. However, the distributions of reward prices are extremely right-skewed for both successful and unsuccessful projects. Thus, instead of directly analyzing the prices, we approach our analysis on prices from the following two perspectives: (1) price range, and (2) price-goal (p/g) ratio.

When considering the price range of rewards, we group rewards based on their prices into *low price*, *middle price*, and *high price*, by following a methodology in marketing research [18]. How the rewards are grouped into price ranges are shown in Table II. When comparing the distributions of reward raw price ranges between successful and unsuccessful projects, we find there is no significant difference between the two groups.[5] However, when we perform the same analysis on price-goal ratio instead of the raw price of rewards, the difference between the distributions of successful and unsuccessful projects are obvious, as shown in Figure 5.

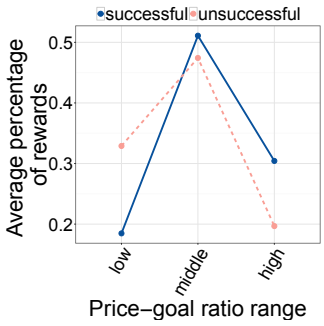

Fig. 5: Distribution of reward price-goal ratio range.

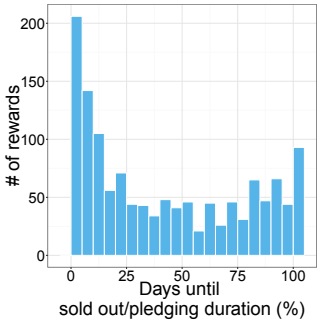

Fig. 6: Distribution of days for rewards to sell out.

C. Limited Offerings

When consumers are exposed with limited-edition products, they tend to purchase them more than non-limited editions. In marketing literature, it is shown that the romantic desires of consumers on *scarcity appeals* (i.e., limited editions) are stronger than they actually are [19]. It is also shown that limited-edition products tend to result in irrational purchases and faster sales [11]. Creators on Kickstarter may set limits on rewards, by specifying the upper bound of offerings. This potentially gives the backers a sense of urgency to support a project before the offerings run out. In our dataset, there are 9,296 limited rewards with an average of 127.1 offerings. The minimum number of offerings is 1, and the maximum number of offerings is 100,000.

We find that both successful and unsuccessful projects with limited rewards have higher raised-goal ratios, as shown in Figure 2 (see Page 1). For successful projects, those with limited rewards have a raised-goal ratio 1.47 times of those without limited awards. For unsuccessful projects, those with limited rewards have a raised-goal ratios 1.65 times of those without limited rewards.

If reward offerings are limited, they might run out during the pledging. We hence are interested in finding how many days it will take for a reward to sell out after it is offered. Among the limited rewards, only 14.20% of them sell out, which take an average of 13.37 days. The minimum days a reward takes to sell out is one day, while the maximum days is 60 days. Figure 6 shows the histogram of the amount of time taken for rewards to sell out, relative to the pledging time of their corresponding projects. Note that we normalize the days to sell out because the pledging durations of projects on Kickstarter vary. We find that on average the rewards that sell out take 42.4% of the project's duration time. Also, interestingly, we find a U-shape distribution, indicating that most sold-out rewards sell out at the beginning or at the very end of the pledging.

Based on the above observations, we further analyze the potential effect of reward prices on sales of limited rewards. We conduct a Kaplan-Meier survival test on the limited rewards. Kaplan-Meier is a non-parametric statistical test often

[4]The Kolmogorov-Smirnov D test statistics value is 0.20261, with a p-value of 2.2e-16.

[5]The Pearson correlation between price range distributions of successful and unsuccessful projects is 0.9763651, with p-value of 0.1387.

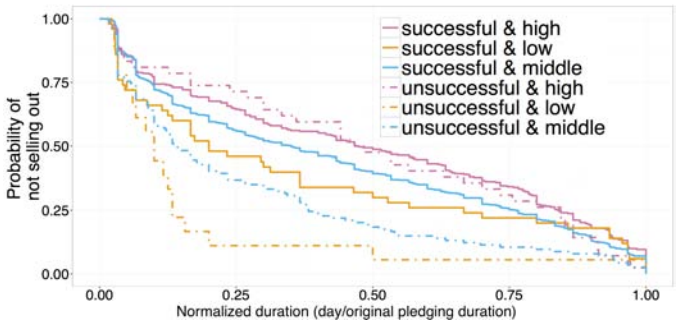

Fig. 7: Kaplan-Meier curves of limited rewards selling out during project pledging.

used to estimate the likelihood of patients' living after a certain treatment in the medical field [20]. In medical research, the Kaplan-Meier metric, S, of an observed patient at time t, based on the number of patients at risk n and the number of deaths d, is measured as follows.

$$S(t) = \prod_{t_i < t} \frac{n_i - d_i}{n_i} \tag{1}$$

where n_i is the number of patients at risks before time t_i, and d_i is the number of deaths at time t_i in the medical applications. To apply this metric onto our application, n is the number of rewards that have not sold out, and d is the number of rewards that have sold out. We use Kaplan-Meier to assess the relationship between the rewards' selling-out rates and the rewards' price ranges (see Figure 7). In the test, the rewards are grouped by project success and price ranges.

We find that regardless of the project success, the reward sell-out rate is inversely associated with the price of rewards. That is, a higher price range is associated with a slower sell-out rate of the rewards.

D. Late Added Rewards

According to Kickstarter, while a project is alive, the creators can add new rewards any time during the pledging. An example of a late-added reward from *The HERO Belt Project* is shown in Reward Example 1.

In our dataset, 2.9% of all the rewards are late-added to the pledging, and 11.5% of projects have late-added rewards. The comparison between projects with and without late-added rewards is shown in Figure 8. We find that, similar to designing rewards with limited offerings, both successful and unsuccessful projects benefit from the late-added rewards. Especially for successful projects, projects with late-added rewards on average receive 1.4 times more of raised-goal ratios than those without.

V. Conclusion and Future Work

In this paper, we argue for the importance of rewards on reward-based crowdfunding platforms. We perform statistical data analysis on Kickstarter data to better understand the importance of rewards to project success. We find that projects with more rewards, late-added and limited-edition rewards are more likely to achieve pledging goals.

For the future work, we aim to categorize reward item types, and explore the project success prediction with the reward features. We also plan to tie the analyses on rewards and projects with information on backers, in order to study the backers' preferences not only on projects, but also on rewards.

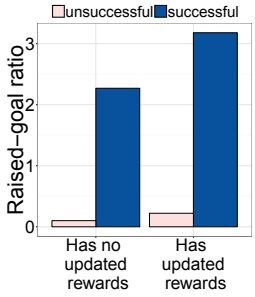

Fig. 8: Comparison of projects with and without late-added rewards.

Reward Example 1: *JUST ADDED! - A brand new belt just added!! We just got a new roll of hose unlike anything we've seen yet and we're excited to share this new belt with our Kickstarter backers. It has a WHITE HOT front and it flips to a flame yellow back with a Navy stripe showing on both sides. Get your hands on one while they last!*

Moreover, we plan to study the rewards across different platforms to see the different effect they potentially have.

References

[1] J.-H. Kim, P. W. Newberry, and C. Qiu, "An empirical analysis of a crowdfunding platform," *Available at SSRN*, 2015.

[2] V. Rakesh, J. Choo, and C. K. Reddy, "Project recommendation using heterogeneous traits in crowdfunding," in *ICWSM*, 2015.

[3] S. Bannerman, "Crowdfunding culture," *Wi Journal of Mobile Media Sound Moves*, vol. 7, no. 1, 2013.

[4] T. Mitra and E. Gilbert, "The language that gets people to give: Phrases that predict success on kickstarter," in *CSCW*. ACM, 2014, pp. 49–61.

[5] A. Xu, X. Yang, H. Rao, W.-T. Fu, S.-W. Huang, and B. P. Bailey, "Show me the money!: An analysis of project updates during crowdfunding campaigns," in *SIGCHI*. ACM, 2014, pp. 591–600.

[6] J. Solomon, W. Ma, and R. Wash, "Don't wait!: How timing affects coordination of crowdfunding donations," in *CSCW*. ACM, 2015, pp. 547–556.

[7] C.-T. Lu, S. Xie, X. Kong, and P. S. Yu, "Inferring the impacts of social media on crowdfunding," in *WSDM*. ACM, 2014, pp. 573–582.

[8] M. D. Greenberg, B. Pardo, K. Hariharan, and E. Gerber, "Crowdfunding support tools: predicting success & failure," in *SIGCHI*. ACM, 2013, pp. 1815–1820.

[9] E. M. Gerber, J. S. Hui, and P.-Y. Kuo, "Crowdfunding: Why people are motivated to post and fund projects on crowdfunding platforms," in *Proceedings of the International Workshop on Design, Influence, and Social Technologies: Techniques, Impacts and Ethics*, 2012.

[10] B. Scheibehenne, R. Greifeneder, and P. M. Todd, "Can there ever be too many options? a meta-analytic review of choice overload," *Journal of Consumer Research*, vol. 37, no. 3, pp. 409–425, 2010.

[11] S. Balachander and A. Stock, "Limited edition products: When and when not to offer them," *Marketing Science*, vol. 28, no. 2, pp. 336–355, 2009.

[12] H. Dittmar and R. Bond, "I want it and i want it now: Using a temporal discounting paradigm to examine predictors of consumer impulsivity," *British Journal of Psychology*, vol. 101, no. 4, pp. 751–776, 2010.

[13] B. Schwartz, "The paradox of choice: Why more is less." Ecco New York, 2004.

[14] S. S. Iyengar and M. R. Lepper, "When choice is demotivating: Can one desire too much of a good thing?" *Journal of personality and social psychology*, vol. 79, no. 6, p. 995, 2000.

[15] T. A. Burnham, J. K. Frels, and V. Mahajan, "Consumer switching costs: a typology, antecedents, and consequences," *Journal of the Academy of Marketing Science*, vol. 31, no. 2, pp. 109–126, 2003.

[16] E. M. Gerber and J. Hui, "Crowdfunding: Motivations and deterrents for participation," *ACM Transactions on Computer-Human Interaction (TOCHI)*, vol. 20, no. 6, p. 34, 2013.

[17] E. Mollick, "The dynamics of crowdfunding: An exploratory study," *Journal of Business Venturing*, vol. 29, no. 1, pp. 1–16, 2014.

[18] V. Gaur and M. L. Fisher, "In-store experiments to determine the impact of price on sales," *Production and Operations Management*, vol. 14, no. 4, pp. 377–387, 2005.

[19] V. Griskevicius, N. J. Goldstein, C. R. Mortensen, J. M. Sundie, R. B. Cialdini, and D. T. Kenrick, "Fear and loving in las vegas: Evolution, emotion, and persuasion," *Journal of Marketing Research*, vol. 46, no. 3, pp. 384–395, 2009.

[20] E. L. Kaplan and P. Meier, "Nonparametric estimation from incomplete observations," *Journal of the American statistical association*, vol. 53, no. 282, pp. 457–481, 1958.