

Improving the Efficiency of Allocating Crowd Donations with Agent-Based Simulation Model

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Abstract. Crowdfunding platforms are emerging as an important online social platform to raise capital and awareness for innovative projects. When considered as a general online social system, the goal of a crowdfunding platform is to efficiently allocate a large number of small funds to promising new projects. However, the efficiency of donation allocation and the success rate of projects can be influenced by the behavior of donors, such as how they evaluate each project and choose the projects to donate. To understand how such behavior could impact crowdfunding market, we developed an agent-based model of crowdfunding to investigate three factors, i.e., project visibility, noise of perceived project quality, and donor strategies. These factors may impact the efficiency of a crowdfunding platform.

Keywords: Crowdfunding · Fundraising · Algorithm · Simulation · Social

1 Introduction

Crowdfunding platforms such as DonorsChoose and GiveForward have been receiving growing numbers of projects and donations as they become more popular. Crowdfunding platforms have also been used by philanthropic organizations to raise money from a community of potential donors and promote various campaigns [7]. Similar to other forms of social media platforms, the success of crowdfunding depends critically on how well the platforms support interactions among the online community of donors and project creators. In fact, research has shown that enhancing interactions between creators and donors can increase the success rates of crowdfunding campaigns [5] because donors will more likely engage with the community and donate to the projects.

In addition to fostering an online community, a crowdfunding platform also serves as a marketplace that allows a large number of donors to collectively use their small donations to “vote” for high projects, in ways such that resources from the community can be efficiently allocated. Recent studies on existing crowdfunding platforms, however, showed that the process of matching donations to projects is not always efficient. For example, Solomon et al. [1] argued

that these superstar projects might have attracted too much attention from the crowd, in the sense that the amount of attention (and donations) is not proportional to their quality relative to other projects. In fact, research has shown that donations dynamics, social media activities, and project updates could influence donors' behavior, which eventually impact the successes of crowdfunding campaigns [1, 4]. Consistent with previous research on similar online marketplaces, these results suggest that the collective "voting" by donors may be inefficient in selecting high quality projects [3].

In regard to the efficiency of donation allocation, recently a study [6] proposed a donation method, which allows a donor to put multiple projects in a donation, and the crowdfunding system can reallocate money based on the donor's preference. They used an agent-based model to prove their donation method can efficiently distribute donations and increase overall success rate of crowdfunding. However, it was no clear how different donation dynamics would affect donors' donation behavior in their work. Therefore, we developed an agent-based model based on their model [6] and aim to understand further how different donors with using different strategies to choose projects may play a role impacting outcomes of crowdfunding campaigns.

1.1 Research Question

This paper is motivated by one main research question: *How do donation dynamics interact impact the success rates of low and high perceived quality projects as donors use different strategies to choose projects to donate?*

Specifically, we are studying the effects of three factors: (1) *visibility*, how many projects a donor could review before he or she makes a decision, (2) *noise of perceived quality*, how sensitive a donor is when evaluating the quality of projects, and (3) *donating strategy*, whether a donor is looking for high quality projects to donate or high funded projects.

The three factors are chosen because they reflect the behavior characteristics of the donors in a real crowdfunding platform. First, donors may have limited time and effort to go through all of the projects on a website, which limit their visibility and thus may impact the overall donation efficiency. Second, donors may have difficulties to accurately distinguish high quality and low quality projects, introducing noise into their perceived quality. In the simulation, we defined the quality of a project as an objective measurement of how much a project should be funded based on its presentation quality, motivation, educational benefits, etc. We then controlled the noise of the perceived quality when each donor is evaluating a project to simulate how quality sensitivity could impact market outcome. Third, donors may use different strategies to decide which projects to donate, such as high quality project seekers or high funded project seekers. All of the factors may influence the overall efficiency and impact the success rate of high quality and low quality projects differently.

2 Agent-Based Model

2.1 Model Description

Three main components: agents, crowdfunding projects, and mechanism. In our proposed system, each donor can select multiple projects at the same time with consideration of different factors.

Agents (Donors). Based on the model [6], a donor to put multiple projects in a donation and group them into different preference levels, within which levels all projects are treated as equally preferred. This is a general way to structure their preference toward the selected projects. We investigated two kinds of choosing project strategies as follows,

1. **Quality seeker:** Donors prefer to donate to projects which have high project quality. For example, a project has comprehensive information and convincing contents.
2. **Success seeker:** Donors prefer to choose projects which are close to their project deadline and have already received high proportion of their donation goals.

To test the influence of different strategies to choose projects on the success rate of crowdfunding, we ran multiple simulations with donors using these two different strategies, and controlled the ratio of donors who have these two strategies.

Given that donors cannot review all projects in reality, we also controlled the visibility (V) of each donor. Because our current focus is not on how projects are presented on the platform (e.g., they could be ranked by popularity, dates, etc.), we randomly selected V ongoing projects from the set of all possible projects in each decision cycle, from which the donors would consider and choose to donate using either the quality or success strategy. Given that the perception of project quality is likely noisy, we added a noise error function (E) to each project when it is evaluated by each agent. We assume that the function follows a Normal (Gaussian) distribution $N(0, E_\sigma)$ (i.e., mean of 0 and standard deviation E_σ). We tested the effects of E_σ as it varies from 0 to 5.

In our simulation, 2000 donors per month are randomly generated. Each donor will donate once and the donation amount is drawn from a uniform distribution from \$10 to \$150, where the average (\$80) is close to the average donation amount in real world.

Crowdfunding Projects. In the simulation, we randomly created 1000 new projects per month for 12 months, with a total of 12000 projects. Each generated project was randomly assigned a quality score drawn from a standard normal distribution $N(0, 1)$. Each project had a donation goal of between US\$100 and US\$5000 and a duration of 7 to 30 days (both following uniform distribution).

Donation Distribution. Because this model allows a donor (agent) to select multiple projects in a donation, we designed a donation distribution algorithm to assign donation to crowdfunding projects [6].

3 Simulation Result and Discussion

We ran three simulation experiments to understand how success rate will be impacted by visibility, perceived quality noise, and strategies the donors use. In the first simulation, there were only donors who are quality seekers with $E_\sigma = 1$. We controlled visibility (V) from 10 to 100 in order to see how the number of projects each donors could see would influence the project success rate. In the second simulation, we controlled the perceived quality of the donors ($E_\sigma = 0$ to 4) and set visibility as 10 to investigate how sensitive of quality seeker would have an impact on the crowdfunding success rate. In the final simulation experiment, we set a fixed visibility ($V = 10$) and quality noise ($E_\sigma = 1$). We added success seekers into the simulation and controlled the percentage of quality seekers from 0% to 100% to help us understand the impact of different strategies on the market.

Each data point shown in the figures is an average of 100 repetitive simulation runs, with an error bar of the standard deviation. In each simulation run, 1200 projects and 24000 donors were generated.

1. Visibility: Figure 1 shows the success rate of all projects, high-quality projects (projects that has a quality score higher than average by one standard deviation), and low-quality projects (quality score is lower than average by one standard deviation). The figure also shows the coefficient of quality in a logistic regression model, where the independent variable is quality and the dependent variable is whether a project succeeds or not (with respect to the right y axis). We found that if agents (quality seeker) are able to view more projects and pick out the high-quality ones, the overall success rate will decrease from 64% to 48%. The reason may be that when visibility increases, the donors

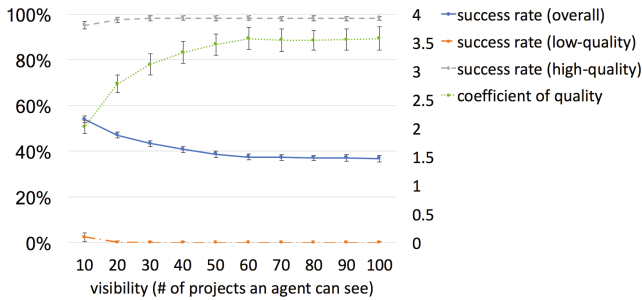


Fig. 1. The trend of success rates and coefficient of quality with respect to visibility (from \$10 to \$100).

will be more likely to view the same high-quality projects and donate to them. In addition, because our simulation model only allowed an agent to select up to five projects and all agents are using quality strategy, donations may be easily concentrated on a small set of high-quality projects. However, the advantage of increased visibility is that more high-quality projects can be successful.

These findings may be used to improve project recommendation systems in a crowdfunding platform. Because the advantage of increased visibility is that more high-quality projects can be successful, the platform can recommend proper number of projects to the donors and further control frequency of exposure of each project, which could prevent to generate many super star projects, and donations can be allocated more efficiently.

2. Noise of Perceived Quality: Figure 2 presents the trend when E_σ is increased from 0 to 4. When E_σ is low, the coefficient of quality is high and the success rate of high-quality projects is much higher than that of low-quality projects, because the agents can select the good projects accurately. On the other hand, when noise is higher (higher E_σ), more and more low-quality projects are selected, resulting in a decreased coefficient. However, the overall success rate is slightly higher. Once again, the reason is that the projects with highest quality scores are more easily to be overfunded when the noise is low.

3. Ratio of Different Seekers: In this simulation, we set visibility (V) as 10, because it is closer to the real world situation (e.g., most users do not review more than 10 projects before making decision). Also, we set E as 1 because it balances between the success rate of all projects and high-quality projects. In Fig. 3, the overall success rate only slightly decreases when the proportion of quality seekers increases, while the success rates of good and bad projects deviate fast and significantly, which is a desirable outcome for a crowdfunding platform. If half of the donors are quality seekers, more than 85% of high-quality projects will succeed while the overall success rate only decreases 3%, compared to the case that everyone is a success seeker. This result may suggest practitioners of

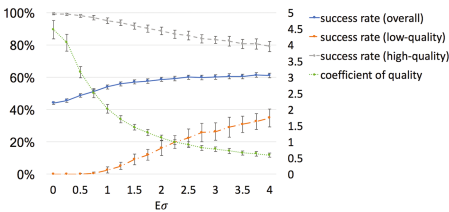


Fig. 2. The trend of success rates and coefficient of quality with respect to perceived quality noise (E_σ from 0 to 4).

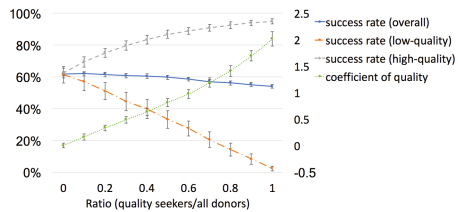


Fig. 3. The trend of success rates and co-efficient of quality with respect to the ratio of quality seekers to success seekers.

crowdfunding websites can encourage donors to focus on the high quality projects or give them some rules to find out high quality projects.

4 Conclusion

In this study, we have presented an agent-based model for crowdfunding platforms, and we investigate the impact of different strategies to choose projects on the efficiency of crowdfunding. The efficiency of a crowdfunding platform is crucial, which depends on how a crowdfunding platform increase overall successful rate and help high quality projects achieve their donation goals in the same time. Based on the findings of the simulations, we found that encouraging donors to choose projects based on the project quality may improve the efficiency of allocating donations. In addition, the visibility and sensitivity of the high quality projects would also impact the successful rate of crowdfunding. The results of this research may provide an indicator to future crowdfunding platforms to redesign their donation methods for improving efficiency of crowdfunding.

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