Signals Matter: Understanding Popularity and Impact of Users on Stack Overflow

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1. Summary

This paper primarily focuses on the socio-psychological expectations and impacts of the various digital signals like upvotes, reward points and badges on the users on the Stack Overflow website. The entire research could be summed up to answering 2 questions.

1. According to the Stack overflow users, do the reward points and Badges reflect any social qualities? If yes then what are they?

2. Do the game-elements (Badges, Reward Points etc.) actually reflect the social qualities that the users expect it to? If so, to what extent?

1.1. Hypothesis Tested

Based on the insights of the data-set, the following hypothesis were tested.

- Reputation Scores and Badges are positively correlated with popularity and impact of the users.

- Reputation Scores are better indicators of popularity as well as impact than Badges.

1.2. Research Procedure

The two attributes under observation are **Popularity** and **Impact**. We would realize that the data is Heavily tailed, and would thus use z-score transform to standardize seperate distributions. We would also create three categories namely :

- **Control Model :** Takes in account quantitative data as number of days of joining, questions asked, answers given etc.

- **Reputation Model :** Added Reputation of the user to the Control Features

- **Badges Model :** Added number of badges(of one type) earned by each user per badge to the Control Features.

The model used was Gradient Tree Boosting Regression model, while also calculating the relative importance of individual attributes in the decision tree.

1.3. Results

For the both Impact and Popularity, Badges Model gave highest R^2 followed by Reputation Model and the lowest by Control Model.

> Its worth noting that among Badges, maximum badges are of answer type, which directly relate to reputation. This might suggest how popularity might be more dependent on Reputation points than badges.

2. Analysis of Paper

2.1. Game Theoretic Model - Reward System

The Stack Overflow uses various gaming elements like :

- Reputation, which increases with each unit contribution.

- Badges, given on accomplishing difficult tasks.

- Upvote, to denote helpfulness of answers.

2.2. Adverse Selection

Information Asymmetry is when user on both ends lack complete information of the audience. This asymmetry leads to biased participation by the contributors, like in our case, users tend to solve high quantity of low quality questions.

2.3. *Analysis of Result*

We arrived at the following conclusion :

- Badges are a better indicator of both impact and popularity than Reputation Points, although users expect Reputation points to be a better indicator for both.

- High Popularity Low Impact (HPLI) users had significantly higher statistical significance of answers and reputation score (almost twice) than Low Popularity High Impact users(LPHI). LPHI showed Necromancer and Populist Badges more significant factor than HPLI counterpart.

Important fact to note is that the relative score of Great Answer Badges was almost equal for both HPLI and LPHI users. Also, Badges indicate Impact better than Popularity while Reputation Points indicate popularity more.

> **Opinion:** It is very likely that high reputation points means user has answered many questions. Thus has higher expectancy of views on his profile due to large size of audience. This means high reputation points imply Popularity.

3. Valuable Contributions of the paper

The paper has led to various results. The implications that can be used are :

- The effect of various elements (digital signals) varies, like some provide quantitative while other provide qualitative increase in participation.

- These insights offer guidance on combating inefficiencies arising out of bias towards specific actions.

4. Improvements and Future Work

4.1. *Improvements*

The reductive nature of the metrics of computing popularity and impact scores, and focus only on reward based, instead of content based metrics might lead to inefficacy in

results. This can be improved by use of linguistic analysis of posts.

Opinion: I feel the hypothesis were based on small sample size of survey results (56 respondents) and we extrapolated that to a large size. We need to consider the socio-psychological bias of the users and the deviation due to estimation from small sample size.

4.2. Future Work and Applications

The conclusions motivates towards applications in business strategies like those of Computer Games, Credit Card companies and E-commerce firms, that can implement the Reputation Model to gain consistency in user participation.

Future work in this research can be in the direction of adding Linguistic analysis of Content provided by users, as another category to decide the effect on Popularity and Intent.