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Ranking in Science of Science Networks and Market: Algorithm and Analysis

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In this thesis, we primarily introduce two ranking methods in terms of scientific networks and markets, respectively. First, considering the exponential growth in the number of academic researchers, identifying the highest quality papers is a very demanding task for editors of scientific journals. While several measures exist to evaluate a paper's impact post-publication, the challenge of determining the potential impact of a manuscript during the review process remains an understudied issue. In Section 3, I propose a reviewer-reputation ranking algorithm to identify high-quality papers based on paper citations, where a reviewer's repu- tation is computed from the correlation between their past ratings and the current number of citations received by the papers they have evaluated. During the review process, reviewers with high reputation scores are given more weight to determine the quality of papers. I test the algorithm on an artificial network with 200 reviewers and 600 papers, as well as on the American Physical Society (APS) data set, including in the analysis 308,243 papers and 274,154 mutual citations. I compare the approach with two existing methods, demonstrating that the algorithm significantly outperforms the others in identifying manuscripts with the highest quality. The findings have the potential to enhance the impact of scientific journals, thereby contributing to academic and scientific progress.

Second, We focus on a centralized platform in online markets that help buyers and sellers find each other and reduce information asymmetries. To better understand the role of an intermediary on market outcomes, we propose a new platform design model whose foundation rests on the tools developed by physicists working on complex systems. In this model, the platform can decide whether to rank the visibility of products based on the criteria of higher-quality products or higher fees paid by companies. Our framework allows us to study the influence of different platform strategies on player payoffs in a market with partially informed consumers. We find a fundamental market failure: the optimal platform strategy minimizes social welfare. Therefore, consumer search within the platform must be driven by a sub-optimal algorithm that solves the trade-off between the cost of fees charged by the platform and a high transaction volume.

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