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Scholarly Communication's Mess: A Game-Theoretic Approach to Analysis

Abstract: This presentation constitutes a trial of a game-theory-based model that is intended to estimate the publication rate and costs of publications by faculty members at research universities. The data used here are taken from journals in five social science disciplines and are used to create the mathematical model. The presentation is intended to fit within the information management theme of the conference.

Résumé : Cette communication constitue un essai d'un modèle basé sur la théorie des jeux dont l'objectif est d'estimer le taux de publication et les coûts de publication du corps professoral dans les universités de recherche. Les données utilisées proviennent de publications issues de cinq disciplines des sciences sociales afin de créer un modèle mathématique. Cette communication s'inscrit dans le thème de gestion de l'information.

The system of tenure and promotion of college and university faculty members is frequently referred to colloquially as a game. Playing the game well, for the faculty members, results in a positive tenure decision. At universities the game may have publication at its center. If the decision were reduced to a two-player game (the individual faculty member and the university) a straightforward game model could be applied. For example, if the norm—stated or tacit—for numbers of publications needed for an assistant professor in, say, the sociology department to earn tenure were twelve refereed articles in first- and second-tier journals over the probationary period, that faculty member would know what to do. In other words, the rules would be simple. Suppose, though, that the tacit norm in the sociology department is six articles in first-tier and six in second-tier journals. Suppose further that the individual faculty member in question has published eight articles in first-tier and two articles in second-tier journals. The decision process at most universities is not rigidly prescribed, so it is not certain that the individual faculty member would or would not earn tenure.

There are more complications to scholarly communication, not the least of which is the reality that it is not a two-player game. In some departments at time t_1 a total of v_n (where v is number of candidates and n is the number of departments) candidates for tenure might be competing for $v - 1$ slots in any or all of the departments. The number of players is raised to $v_n + 1$ (the number of candidates plus the university). In actuality this game is much more complicated, because there is a finite number of first-tier journals in any discipline, publishing a finite number of articles per year. Also, the university's library is able to provide access to a limited number of journals, and that limitation could affect the pace and kind of work done by the faculty at a given university. One factor that has to be acknowledged is that a portion of this game is rational; each individual faculty member wants to earn tenure and does what she or he can in order to do so. The library is in the unfortunate predicament of being akin to the conventional Commons, with the expectations of many visited upon it. That the many pay little or no attention to the library's (or Commons) available resources is a consequence of the structure of the game

and does (although some rational choice theory proponents may deny it) represents a systemic irrationality inherent in the game.

The irrationality occurs when the states of all players are examined. For faculty members seeking tenure, their rational objective is to publish the optimal number of articles to ensure a decision is positive for them. The university tends to be indifferent to the outcome of the game; it is usually more concerned that a process's execution is regulated and is consistent. The journal producers have the dual objective of optimizing marginal revenue (profit) which includes optimizing articles published (so long as that objective does not affect marginal revenue negatively). The library has no choice but to expend only what is appropriated to it, so some specific acquisitions, subscriptions, and access decisions must be made, not independent of the objectives of the faculty members. The multi-player game carries complex evaluations, not merely of success but also of aggregate rationality, of the varied, and possibly competing, objectives of the players.

The analysis here is based on some functions that are derived from game theory. One of the elements entails estimating a value for the number of articles that may be published by university faculty members as they complete their probationary period en route to a tenure and promotion decision. The first equation is expressed as the following:

$$\Phi_m = (\sum v_1x + v_24x + v_38x) / 6 (K)$$

where ϕ is the number articles published by faculty candidates for tenure at time t_n ; v is the number of tenure candidates at t_n in the three major disciplines (humanities (v_1), social sciences (v_2), and sciences (v_3)) at each research university; x is the number of articles published per faculty member; 6 is the typical probationary period; and K is a constant signifying the number of research universities.

A second equation is expressed as:

$$\Delta_m^\alpha = (p(\tau) / s$$

where Δ is a normalized value for the cost of an article in discipline, α at time, t_n ; p is the price of journal τ ; and s is the number of articles published in journals $\Sigma\tau$.

The prices are determined by the producers, the companies, institutions, and associations that publish the journals. Therefore, the producers become actors in a multiplayer game. The producers, as actors, do not have a direct interest in the tenure game, but the rules and the playing of the tenure game influence the producer. If more individuals are seeking tenure, and if the rules include certain numbers of publications in first- and second-tier journals, then the producers will insert themselves into the multiplayer game. The producers will, as players, respond to a demand for outlets for published works. University's libraries are also players in a multiplayer game. They are expected—by individuals and institutions—to provide access to first-, second-, and third-tier, as well as other journals. The libraries do not and cannot establish their own resource bases; the universities, or the administrators of the universities do that. An index for a university's library as Commons can be expressed as: $\Sigma\Theta_m$, where Θ is the number of articles that candidates at each research university would be required to published in t_n .

The paper will present application of the above game-theoretic approach for a selection of social science disciplines: management, finance, economics, political science, and sociology. For the application, ten journals from each of the five fields that have been

identified as first-tier journals are used. For the purposes of this abstract, the data related to the ten political science journals are reported. The population of research universities used here will be members of the Association of Research Libraries, since that group includes universities in the United States and Canada. For that group, $K = 113$. Using the social sciences for illustration and testing here, and assuming three tenure candidates in political science at each research university in a given year, $\Phi = (v_2 4x / 6) (K) = ((3) 12 / 6) (113) = 678$. The ten first-tier political science journals published 289 articles in 2008. Using these estimates, the tenure candidates in political science would be required to produce more articles than could be published in the top ten journals. If we suppose that there were consensus opinion that those journals with an impact factor of 2.0 or higher constitutes first-tier political science journals, there are (according to blank) twenty-three first-tier journals. Using 30.5 as a mean number of articles published per journal, the first-tier journals would publish approximately 701.5 articles per year. The tenure candidates are not the only political science faculty trying to publish in those journals, so space in first-tier journals would be especially prized by tenure candidates.