

## *Obituary*

### **Dr. Jeffrey Scot Banks**

Jeffrey Scot Banks, Professor of Political Science at the California Institute of Technology, died of complications of a bone marrow transplant December 21 at the City of Hope Hospital in Duarte, California.

Banks was born on December 15, 1958 in San Diego, California. He received his bachelor's degree at UCLA in 1982, and his PhD at California Institute of Technology in 1986. He was a professor of political science and economics at the University of Rochester from 1986–1997 before joining the Caltech faculty. He was also a visiting professor at the University of Arizona in 1989 and at the University of Michigan in 1997. Banks taught at Caltech since 1998, and had served as executive officer for the social science faculty since 1999.

Jeff's academic career spanned only fifteen years. But in that time, he wrote many important papers, became highly regarded in his field, and received numerous honors for his work. Jeff was a National Science Foundation Presidential Young Investigator, 1989–1994, received the National Academy of Sciences Award for Scientific Reviewing in 1996, was elected a fellow of the Econometric Society, 1996, was a Fellow of Stanford University's Center for Advanced Study in Behavior Sciences in 1997–1998, and was the recipient of several National Science Foundation Grants to support his research. He also served in editorial positions on numerous professional journals (including this one).

Much of Jeff's research centered on advancing our understanding of the role of incomplete information and repeated play on strategic behavior in political and economic settings. In studying these questions, Jeff made major contributions to the three related fields of Positive Political Theory, Economics, and Game Theory. Especially within the Political Science profession, Jeff's work became very influential because it was some of the first work to move beyond the study of static, one shot, full information models of political behavior (where everyone was assumed to know everything about everyone else's preferences) to multi stage, dynamic, incomplete information models of these processes (where agents might be uncertain about other agents' preferences.)

#### *Incomplete information*

One of Jeff's first publications became an important contribution to the theory of games of incomplete information. This was his development with Sobel [2] of an equilibrium refinement for signaling games (called *divine equilibrium*), in which an informed player can signal information to an uninformed player with different preferences. This refinement is now a standard tool in the lexicon of

game theorists, and is used to great advantage in many of Jeff's own subsequent papers on incomplete information.

Jeff used the theory of incomplete information games to study a variety of specific problems. One of his favorite topics was candidate competition, where he tried to get away from the older school of "prospective voting" models, in which candidates would make any promise they had to to get elected, which they would carry out when elected. Jeff did not take it as given that candidates would carry out their promises, but instead tried to explain when, and under what circumstances they would do so. He assumed [5] that candidates have policy preferences, are not bound by their promises and that voters have incomplete information about candidate preferences and there are only reputation effects to hold candidates to their promises. He obtained an equilibrium where candidates near the median pool at the median, and those far from the median separate, revealing their true type. A series of other articles followed up on these ideas. He also applied the theory of incomplete information games to topics in international relations [7] and to explaining political control of bureaucracies [11]. His monograph [9] on signaling games nicely summarized some of the early applications of incomplete information games to political science.

One of his most influential papers on incomplete information was his work with Austen-Smith [15], in which he challenged the foundations of the Condorcet Jury Theorem, one of the oldest results in voting theory. The Condorcet Jury Theorem states that in situations where all voters share the same preferences (they want to convict the guilty and acquit the innocent), but have different information, and hence different probabilities of making the correct decision, that for any decision rule, groups will make better decisions than individuals, and that as the group size grows, the probability of making the correct decision goes to one. Austen-Smith and Banks showed that the Condorcet Jury Theorem has no consistent game theoretic foundation, and that when one starts with a consistent foundation, voters will not necessarily vote purely based on their own information, as is assumed in the Condorcet Jury Theorem. This work led to an explosion of subsequent papers on this topic.

### *Repetition and multistage play*

Jeff's second major research focus was on the role of repetition and multistage play. Here, the focus was not always on multistage games in the traditional game theoretic understanding of the term. Rather, his research reflected an interest in the role of time in strategic behavior – i. e., the idea that what you do now must be governed by the implications for what may happen next period. No decision is made in a vacuum; usually it is embedded in a larger game, and decisions you make now may be affected by what you think will happen next.

As with incomplete information, so also in this area, Jeff started his work with a bang. In his first published paper [1], he characterized the set of alternatives that are achievable under binary amendment agendas, and showed that it was equal to the set of maximal elements of maximal chains. This set has subsequently

become known as the “Banks Set”, and spurred much further development of literature on endogenous agendas.

Jeff used a multi-stage game approach in work with Austen-Smith [4] to give an alternative, reputation based explanation for why candidates might carry out campaign promises. In an article with Austen-Smith [3], he develops a dynamic model of voting and coalition formation in a parliamentary system. This stands out as the first article in the literature to simultaneously solve the voter and coalition formation problems in a full equilibrium analysis. They obtain an equilibrium in which the largest and smallest party form a government, and candidates separate in policy space.

In basic work on decision theory with Sundaram [10], they obtained a characterization of optimal behavior for denumerable armed bandit problems, showing that an arm will never be revisited once it has been tried and abandoned, and that eventually the decision maker will settle on one arm and stay there for ever. This work was subsequently applied to study repeated elections [12]. Jeff continued his work on repeated elections with Jeff Duggan [19, 20], obtaining a characterization of policy outcomes under retrospective voting.

### *Other work*

In addition to his main areas of research, Jeff had several other interests. Jeff contributed to the theory of bounded rationality in games: His work with Sundaram [6] upset a developing literature that used finite automata to model bounded rationality in repeated games by showing that if the complexity of a strategy is measured by the number of paths rather than the number of states in an automaton’s algorithm, then the iterated elimination of complexity also eliminates all except the myopic equilibria in the standard repeated games.

Jeff was also involved in experimental work testing some of the inferences coming out of his work on equilibrium refinements [13] and multi-arm bandit problems [16].

Also, Jeff made contributions in social choice theory on the question of dimensionality of core existence in the spatial model by exposing a flaw [14] in work of McKelvey and Schofield, thus opening the problem up again until it was subsequently answered by Saari. He was also coauthor of the book *Positive Political Theory I, Collective Preference* [18] with David Austen-Smith, published in 1999, which has become a standard graduate text for political theory.

Jeff’s many contributions came despite recurring medical problems. He was diagnosed with leukemia in 1995, at which time he underwent a bone marrow transplant for treatment. Despite gradually failing health in recent years, Jeff continued to work actively, producing many new manuscripts up until his final illness. In addition to his stellar academic career, Jeff was a warm and generous person, who enjoyed life, refused to take it too seriously, and who gave freely of his time and his ideas to his students and colleagues.

Jeff is survived by his wife Shannon, sons Bryan, 15, and Daniel, 13, mother Sandra Jacobs, father James Banks, and brothers Michael and Timothy.

### Selected publications of Jeff Banks

1. Sophisticated voting outcomes and agenda control. *Social Choice and Welfare* 1: 295–306 (1985)
2. With Joel Sobel, Equilibrium selection in signaling games. *Econometrica* 55: 647–661 (1987)
3. With David Austen-Smith, Elections, coalitions, and legislative outcomes. *American Political Science Review* 82: 405–442 (1988)
4. With David Austen-Smith, Electoral accountability and incumbency. In: Ordeshook P.C. (ed.) *Models of Strategic Choice in Politics*. University of Michigan Press, Ann Arbor 1989
5. A model of electoral competition with incomplete information. *Journal of Economic Theory* 50: 309–325 (1990)
6. With Rangarajan Sundaram, Repeated games, finite automata, and complexity. *Games and Economic Behavior* 2: 97–117 (1990)
7. Equilibrium behavior in crisis bargaining games. *American Journal of Political Science* 34: 599–614 (1990)
8. With David Austen-Smith, Stable governments and the allocation of policy portfolios. *American Political Science Review* 84: 891–906 (1990)
9. *Signaling Games in Political Science* in the series *Fundamentals of Pure and Applied Economics*. Harwood Academic Publishers, Chur 1991
10. With Rangarajan Sundaram, Denumerable-armed bandits. *Econometrica* 60: 1071–1096 (1992)
11. With Barry Weingast, The political control of bureaucracies under asymmetric information. *American Journal of Political Science* 36: 509–524 (1992)
12. With Rangarajan Sundaram, Adverse selection and moral hazard in a repeated elections model. In: Schofield, N. et al. (eds.) *Political Economy: Institutions, Information, Competition and Representation*. Cambridge University Press, New York 1993
13. With Colin Camerer and David Porter, An experimental analysis of nash refinements in signaling games. *Games and Economic Behavior* 6: 1–31 (1994)
14. Singularity theory and core existence in the spatial model. *Journal of Mathematical Economics* 24: 523–536 (1995)
15. With David Austen-Smith, Information aggregation, rationality, and the condorcet jury theorem. *American Political Science Review* 90: 34–45 (1996)
16. With Mark Olson and David Porter, An experimental analysis of the two armed bandit problem. *Economic Theory* 10: 55–78 (1997)
17. Committee proposals and restrictive rules. *Proceedings of the National Academy of Sciences* 96: 8295–8300 (1999)
18. With David Austen-Smith, *Positive Political Theory I, Collective Preference*. University of Michigan Press, Ann Arbor 1999
19. With John Duggan, A bargaining model of collective choice. *American Political Science Review* 94: 73–88 (2000)
20. With John Duggan, A multidimensional model of repeated elections. *mimeo* 2000

*Richard D. McKelvey*  
 California Institute of Technology  
 Mail Code 228–77  
 Pasadena, CA 91125, USA  
 (e-mail: rdm@hss.caltech.edu)