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Personnel Mobility Assessment Using Survival Models for Strategic Workforce Management

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Abstract

Regardless of sector, purpose, environment or business model, enduring organizations experience a continuous flow of personnel entering, exiting, moving within the organizational structure. These flows are commonly considered in the contexts of hiring, retention, and personnel development, where organizational effectiveness depends on crafting working conditions and incentives that encourage appropriate rates of movement. Short-term aggregate measures of these rates are often misleading due to sample size and fluctuations in the business environment. Such movements can be viewed as a series of transitions between job situation states, with associated residence durations, the endpoints of which may be known or bounded. Consequently they are suitable for analysis using survival methods to yield probabilistic models reflecting persistent organizational characteristics. The application of parametric survival models to personnel transition data enables exploration of environmental or demographic influences on employee behavior. Practical benefits of this approach include a deeper understanding of the relationship between personnel flows, management decisions, and environmental shifts.

Objectives

- Frame personnel movements analysis as corollary to survival analysis
- Outline duration extraction from personnel records
- Demonstrate analysis using open source data to explore gender bias in a mid-sized firm
- Use derived models to depict organizational behavior patterns and challenges

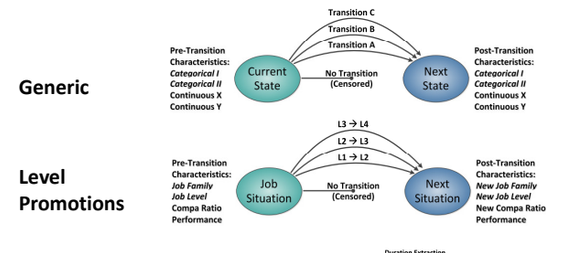
Modeling Approach

- Survival analysis methods address transition times between defined states bounded by observable transitions (*e.g.*, "alive" to "dead")
- Personnel records of transitions between job situation states enable duration calculations
- Situation and transition identification are guided by analytical objectives and the quantity and qualities of available data

Personnel Data

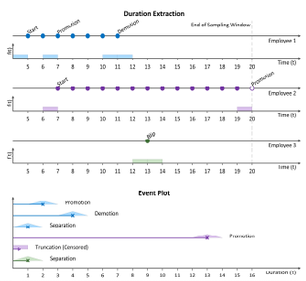
Given the proprietary nature and sensitivities of recent personnel data for operating firms, the publication of analyses using such data faces many challenges and disincentives. Fortunately, Baker, Gibbs, and Holmstrom made extensive study of the annual management personnel records from 1969 – 1988 for an unstated mid-sized U.S. corporation, referred to herein as BGH Organization or BGHO. An eight-level hierarchical structure pertaining to most of the management jobs in that organization was developed (Baker, 1993), enabling structured analysis of a simple career progression. An anonymized version of the BGHO data has been made available for research purposes, and that data is the basis for the analyses shown here.

State Transitions

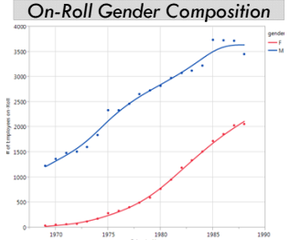


The BGHO data set provides an annual record of employee status for 20 successive years. Extraction of duration data for survival analysis necessitates the application of path-dependent logic on each successive employee record as indicated in the graphic above.

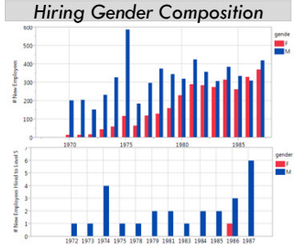
Moreover, the resulting discretization error in durations must be addressed. These errors are depicted as distributions around the simple estimates in the Event Plot at right. Reconstituted data were simulated using these approximate distributions for ease of analysis.



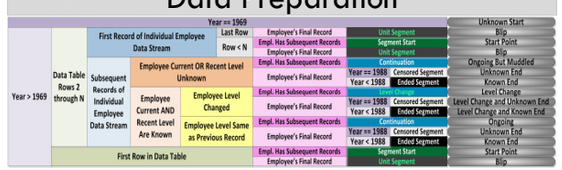
On-Roll Gender Composition



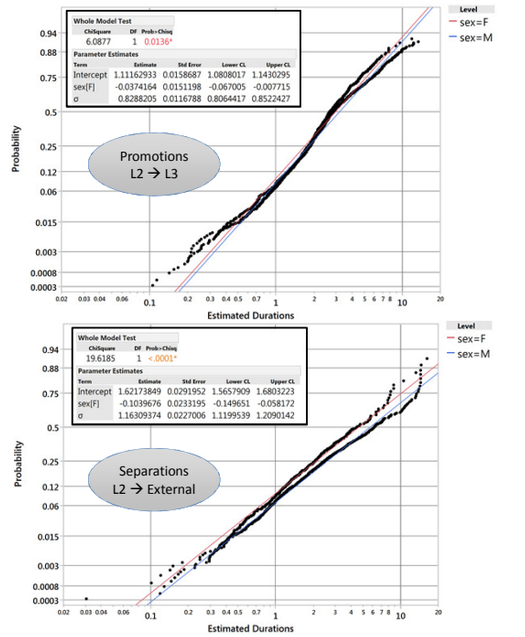
Hiring Gender Composition



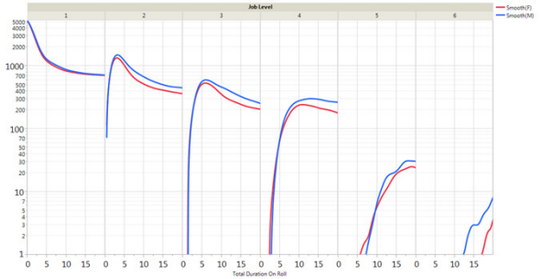
Data Preparation



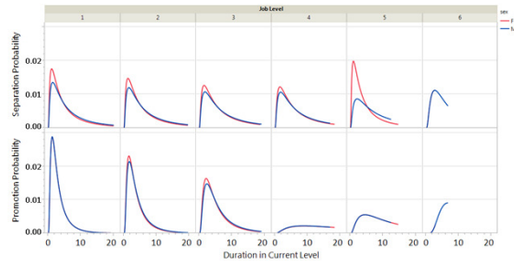
Parametric Survival Modeling Outcomes



Extracted Model Progression



Probability Comparison by Level



Discussion

- Modeled level progressions illustrate impact of gender on probability *vs.* time of an individual starting at Level One achieving higher job levels
- Progression Scenario assumes 10,000 managers, evenly split between Male and Female, all starting at the same time
- The Level Progression Scenario applies the extracted Promotion, Demotion, and Separation transition models by level to the progression of Level 1 managers over 20 years
- Simulation progresses by small time increments (*e.g.*, 0.1 years) calculating incremental probabilities of transition pathways out of current Job Level, checking all pathways simultaneously against a unit random value, then updating each individual
- The population impact of external hiring is not included in the Progression Scenario – only internal progression is addressed
- Logarithmic scale is used due to the high rate of attrition between Levels 1 - 6

Analysis of BGH Organization data shows that despite comparable promotion rates for Male and Female managers throughout the lower levels, few women occupied positions in Level 5 or above. Separation rates were slightly higher for women than men throughout the lower levels of management, but dramatically higher for the few women reaching Level 5. Since few women were hired into BGHO at Level 5 or above, the upper ranks of management were primarily occupied by men. It would have been reasonable for Female managers at BGHO to perceive a glass ceiling, possibly explaining the rapid separation rate among Female Level 5 managers.

The application of survival analysis methods to the BGHO data illuminated the underlying mechanisms behind the organization's gender imbalances that would not be readily discerned from review of the annual results alone. Abstraction of transition data to probabilistic models enabled systematic what-if simulation for insight into the relative treatment of men and women at BGHO.

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Baker, George, Michael Gibbs, and Bengt Holmstrom, "Hierarchies and Compensation: A Case Study," *European Economic Review*, 37, pp. 366 – 378, 1993.

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