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AN EMPIRICAL COMPARISON OF TWO MODELS FOR PREDICTING PREFERENCES FOR STANDARD EMPLOYMENT OFFERS

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Introduction

There are two major types of job-choice models in the current literature. One may be called an ideal job model; the other is primarily a linear utility model. This study attempts to compare empirically the predictive capacity of the two types of models.

The concept of the ideal job model was developed by Peer Soelberg in a study in which graduates of the Alfred P. Sloan School of Management at the Massachusetts Institute of Technology were subjects. Among several of Soelberg's conclusions was the following: "The decision maker defines his career problem by deriving an ideal solution to it, which in turn guides his planning on a set of operational criteria for evaluating specific job alternatives" [10, p.22]. Soelberg also suggests that the decision maker believes a priori that he will make his decision by weighting all relevant factors with respect to each alternative job offer and then by adding up the numbers in order to identify the best offer. It turns out, however, that the decision maker does not generally do this, and that if he does add up the numbers it is done <u>after</u> an "implicit favorite" has been selected from among the alternatives. Furthermore, after the decision maker somehow selects an implicit favorite, he does not publicly announce his decision immediately but rather goes through a selective cognition process to confirm that his implicit favorite is the right choice. Soelberg calls this "confirmation processing" and further explains it as an exercise in prejudice whereby the decision maker convinces himself of the rightness of his implicit favorite. Confirmation processing is partly a hedge against the cognitive dissonance which the decision maker will experience when he publicly announces his implicit favorite as his job choice.

Apparently it is easy to identify independently the favorite job alternative (once the decision maker has decided), even though the decision maker will not usually admit he has made an implicit choice. The favorite can usually be identified by considering a small number of the decision maker's most important decision criteria or dimensions of job choice. Furthermore, 25 out of 29 of the graduates in the Soelberg study eventually selected as their final job choice that alternative which had been independently identified as their favorite an average of three weeks earlier.

In a study at the Carnegie Institute of Technology, Vroom was able to identify the implicit favorite using a dimensions weighting system and reportedly predicted 28 out of 37 final job choices (76 percent) [12]. Soelberg suggests, however, that an implicit favorite cannot be identified by a dimensions weighting system before the search for new alternatives has ended. It is not until after the search has ended and an active roster of alternatives is being juggled by the decision maker that an implicit favorite can be identified by weighting and rating job-choice dimensions. Before the search is ended, Soelberg reports that the weightings on various dimensions seem to be very unreliable and shift over short periods of time. He therefore explains the occurrence of more reliable weightings after the end of the search as part of the confirmation processing whereby the decision maker constructs a weighting function which will explain and confirm his implicit favorite.

The above discussion suggests that the decision maker may arrive at his implicit favorite by making a similarity judgment between each of his alternatives and his concept of the ideal job. If this is the case, the prospects for predicting job choice using the concept of an ideal job seem worth exploring, particularly since recent developments in multidimensional scaling techniques employ the concept of an ideal point in a decision space.

The utility models, on the other hand, posit that the decision maker evaluates his alternative job offers along certain dimensions, differentially weights the dimensions, and then combines the evaluations and weights into numbers representing the utility of the various offers. Soelberg suggests that this is a postdecision phenomenon which does not generally capture the actual process of choice. Empirical work using utility models to predict job choice has been conducted by previous researchers and is probably the most widely discussed approach in the current literature [3,4,5].

One of the most predictive utility models was developed by Huber and his associates at Wisconsin and consisted of a two-stage rating procedure. The subjects were persons seeking professional employment in the public schools. Under the two-stage technique, the decision maker assigned utilities to different levels of various factors and weighted the importance of the factors. The utility of a given job was then represented as a linear combination of the factor ratings and weights. This two-stage rating model resulted in the accurate prediction of 60 percent of the first choices for thirty decision makers [4]. The predictability of first choice was also higher for a subset of persons who had experience in making job choices; those inexperienced subjects who were making their initial job choice were not as predictable as experienced decision makers were.

The differences between the approaches of Soelberg and Huber present an interesting question regarding the process of formulating preferences for jobs. The Soelberg thesis suggests an aggregate comparative judgment between each alternative job offer and some ideal job. The thrust of the work by Huber and his associates envisions a process of evaluating alternative jobs along differentially important dimensions and then adding up the numbers according to some objective function.

Background

A multidimensional scaling procedure was used to construct the ideal job model for each subject in the present research, and a two-step rating procedure was used to develop the linear utility model. The job offers studied consisted of a set of standardly described employment offers, as shown in Appendix A. These offers were extracted from descriptions of approximately one thousand actual offers made to the students in the Krannert Graduate School of Industrial Administration at Purdue University.

Thus the job offers in this study are common to all decision makers and are not the offers which each decision maker ultimately generated for actual employment. Ninety students working toward a Master of Science degree in the Krannert Graduate School of Industrial Administration in the spring of 1969 served as the subjects (decision makers).

Development of the ideal job model

The ideal job model was constructed from questionnaire data which served as input to the KRUSKAL Nonmetric Multidimensional Scaling Program [7,8]. Input data for the ideal job model were obtained by asking the subject to make pairwise similarity judgments on all pairs of the nine standard offers. A sample pair and the similarity scale from the original questionnaire are shown in Appendix B. In addition, similarity judgments were also made between each standard and the subject's ideal job concept; an example is shown in Appendix B. Thus each subject was actually making comparative similarity judgments on ten jobs--nine standards plus an ideal.

Since there are forty-five possible pairs of ten jobs, each subject completed forty-five similarity ratings and a joint perceptual-preference space was developed for each using these data as input to the

KRUSKAL multidimensional scaling procedure. This is a rather unique procedure for locating an ideal point in perceptual space because all the input data consist of similarity judgments. Ideal points are usually located by using both similarity and preference data as input to scaling algorithms [1,2]. David Klahr, however, has provided some prior empirical data to substantiate the theoretical construct of predicting preference using multidimensionally scaled similarity judgments [6]. It should be pointed out that the subject never writes down or otherwise makes his ideal job concept explicit. He is simply told to consider mentally what his ideal job would be and then to make similarity ratings between his ideal and each of the nine standards. The resulting multidimensional scaling solution is an n-dimensional space which contains nine points representing the standard jobs and a tenth point representing the ideal job. The point representing the ideal job is referred to simply as the ideal point in the space. This process of making comparative judgments between alternatives and an ideal would seem to capture the choice phenomenon described by Soelberg [10]. Under the ideal job model, preference for a particular offer is stronger the closer the offer is to the ideal point in the decision space. Preference for a given alternative offer is then expressed as the inverse of the distance between the given offer and the ideal point. In an n-dimensional orthogonal euclidean space, distance between any job offer, A, and the ideal point, I, is represented by the following:

$$d_{AI} = \left[\sum_{i=1}^{n} (A_i - I_i)^2 \right]^{\frac{1}{2}} \qquad (1)$$

where

d_{AI} = distance between job A and the ideal point

A_i = coordinate of job A on axis i

I_i = coordinate of the ideal point on axis i

n = number of dimensions in the space

The above distance formula is simply an n-dimensional extension of the Pythagorean theorem from plane geometry. The model is thus mathematically represented as a distance function in an n-dimensional orthogonal space. The model predicts that the standard job closest to the ideal is the subject's first choice, the second closest offer is his second choice, and so forth. Thus an order of preference for the standards can be derived by calculating distances from the ideal in the multidimensional scaling solution space.

Development of the linear utility model

The data for constructing a linear utility representation of preference for the standards were also collected through questionnaires. The subjects were asked to rate the perceived desirability of each job on a sixty-point Likert-type scale with respect to the following six factors:

1. Opportunity for advancement
2. Challenge of the position
3. Salary and other economic benefits

4. Overall prestige of the position

5. Geographic location

6. Job content

The subjects also rated the importance of each dimension to their own job choice on a thirteen-point Likert-type scale. The overall utility for a given job for a particular subject was then derived by the following linear combinations of weights and factor ratings:

$$U_{ij} = \sum_{k=1}^{6} w_{kj} r_{kj} \quad (2)$$

where

U_{ij} = utility of the i^{th} subject for the j^{th} job

w_{kj} = weight assigned to the k^{th} factor for the j^{th} job

r_{kj} = rating on the k^{th} factor for the j^{th} job

Nine utility values, or U_{ij}s, were derived for each subject since there are nine jobs. The order of preference for jobs predicted by the model is obtained by ranking the job with the highest utility number as first, the job with the next highest utility number as second, and so forth.

The utility model was constructed using a two-stage rating procedure and is similar to the one Huber et al. determined as most predictive of actual job-choice behavior of the five they compared [4].

Procedure

The ninety subjects were asked to complete the ideal job model questionnaire (see Appendix B) and make the ratings for the linear utility model under supervised group conditions. Three days later they were asked to indicate their actual rank ordering of the nine standard offers. Derived rank orderings of the offers were calculated for each subject using the two different models, and these orderings were correlated with the actual rankings using the Spearman rank order correlation coefficient (rho) [9, p.202]. In addition, the number and percentage of first choices correctly predicted by each model were tabulated. Five dimensional scaling solutions were used for the ideal job model since the goodness of fit index (stress) indicated a good fit between the input data and the five solutions. In addition, the solutions were also highest on predictability compared to solutions of other dimensionality.

Results

Table 1 shows Spearman rhos for each of the ninety subjects using both the ideal job model and the utility model. Table 2 shows mean rhos for both models, as well as other comparative statistics, and is a summarization of Table 1. Table 2 indicates that the ideal job model is generally superior to the utility model in predicting actual preference for the standard jobs. The average rho and number of rhos significant at the 1 percent and 5 percent levels are larger for the ideal job model. Rho must be equal to or larger than .78 to be significant at the 1 percent level and equal to or greater than .60 to be significant at the 5 percent level. The nonparametric sign test can be used to compare the two samples as to central tendency [10, p.68]. A t-test between the two mean rhos was not used because the distribution of rhos was not normal. Using the nonparametric sign test for matched samples, a Z value of -3.3 was obtained after comparing the average rhos for the two models. This Z value was significant at the .0005 probability level and indicates a distinct difference in the predictability of the two models.

TABLE 1

Spearman Rhos between Predicted and Actual Rank Orders for the Ideal Job and Utility Models

Subject	Spearman Rho	
	Ideal Model	Utility Model
1	.83	.82
2	.93	.90
3	.75	.75
4	.80	.38
5	.77	.60
6	.72	.92
7	.98	.77
8	.90	.92
9	.97	-.50
10	.92	.70
11	.80	.50
12	.87	.80
13	.38	.70
14	.80	.93
15	.78	.67
16	.68	.02
17	.83	.92
18	.72	.28
19	.83	.73
20	.70	.82
21	.43	.68
22	.02	.47
23	.93	.68
24	.88	.55
25	.60	.58
26	.77	.88
27	.68	.55
28	.77	.60
29	.92	.82
30	.87	.77
31	.30	.80
32	.63	.33
33	.83	.72
34	.72	.55
35	.78	.30
36	.88	.73
37	.88	.55
38	.95	.85
39	.80	.73
40	.92	.73
41	.73	.38
42	.93	.62
43	.88	.85
44	.88	.70

Table 1 (cont.)

Spearman Rhos between Predicted and Actual Rank Orders
for the Ideal Job and Utility Models

Subject	Spearman Rho Ideal Model	Spearman Rho Utility Model
45	.80	.67
46	.77	.72
47	.77	.60
48	.32	.67
49	.67	.92
50	.67	.90
51	.68	-.15
52	.73	.78
53	.90	.80
54	.97	.52
55	.80	.92
56	.92	.88
57	.58	.22
58	.83	.55
59	.55	.77
60	.92	.47
61	.83	.78
62	.80	.88
63	.60	.82
64	.97	.78
65	.38	-.10
66	.70	.80
67	.72	.72
68	.88	.27
69	.60	.65
70	.20	-.27
71	.92	.68
72	.73	.53
73	.54	.64
74	.50	.70
75	.37	.47
76	.83	.83
77	.70	.63
78	.92	.87
79	.95	.65
80	.43	.02
81	.87	.65
82	.57	.35
83	.73	.90
84	-.07	.00
85	.93	.45
86	.82	.78
87	.48	.88
88	.88	.58
89	.85	.28
90	.73	.65

TABLE 2

Mean Spearman Rhos and Other Comparative Statistics for Ideal Job and Utility Models

	Ideal Job Model	Utility Model
Mean Spearman Rho	.74	.62
Number of rhos significant at the 1% level (No. ≥ .78)	48 (53%)	29 (32%)
Number of rhos significant at the 5% level (No. ≥ .60)	75 (83%)	59 (66%)
Number of first choices predicted	44 (49%)	34 (38%)
n	90	90

In addition to the mean rho, the ideal job model is superior with regard to the number of first choices accurately predicted. The ideal job model accurately predicted 44 first choices (49 percent) as compared to 34 (38 percent) for the utility model. Ability to predict first choice among a set of alternative job offers is important since potential uses for the models include computerized man-job matching systems.

Conclusions

The ideal job model as operationalized in the present research is superior to a linear utility model for predicting preferences among a set of standard job offers. The results lend empirical evidence to Soelberg's notion that job choice involves comparative similarity judgments between alternatives and the individual's ideal job.

Knowledge of the job-choice process has potential application to computerized man-job matching systems. The linear utility model has been most extensively investigated since it is operationally feasible to adapt this model to computer applications. It is not as yet clear how the ideal job model could be operationalized for computerized matching systems. This is an area for future research. However, one approach might be to store a subject's description of his ideal job as well as his alternative job offers in some form amenable to computerization and then develop similarity measures between the ideal and alternative jobs for given subjects. This similarity index might be a Tanimoto matching coefficient, for instance, and the higher the similarity, the higher the subject's preference for that particular job [1, p. 185].

In an article on computer-aided approaches to employment service placement and counseling, Holt and Huber note:

> By programming decision models into the computer which approximate those of the persons involved, the computer can rapidly and efficiently 'consider' a great deal of information about many alternative jobs and candidates. In this way interviews can be proposed which hopefully are better than those resulting from manual file searches or machine searches that seek simply acceptable pairings of candidates and vacancies [3, p. 573].

The present study suggests that the ideal job model indeed approximates the choice process involved and is therefore worthy of further research efforts to adapt it for computer applications.

APPENDIX A

Nine Standardly Described Employment Offers

Offer A

Electronics component manufacturer

Production supervision training program; first-line supervisor, 1-2 years; 2nd and 3rd level supervisor, 3-7 years

Work primarily in plants in East; start at Wilmington, Delaware

Young management, medium-sized firm

Salary: $1,000 per month

Offer B

Nationwide insurance firm; systems analysis work with computer applications; work at corporate headquarters; first assignment would involve the development of a new company-wide system for processing life insurance policies

Chicago, Illinois

Middle-aged to older management

Reduced rates on all types of personal and property insurance

Opportunity to move to other branches in Midwest as section manager within 3 to 5 years

Salary: $950 per month

Offer C

International oil firm

Financial and cost analysis and capital budgeting; first year primarily entails "make or buy" analysis

Baton Rouge, Louisiana

Later possibilities to move into either staff or line management

Centralized management

Salary: $1,050 per month

Very new facilities; new office buildings

Offer D

Computer and software firm, listed on NYSE

Technical field sales; normally progress to district sales manager in 5 to 10 years

Automobile furnished

Santa Monica, California

Company recreational and country club is provided free--dining facilities, golf, tennis, swimming, basketball, softball, picnicking, hiking

Wide diversity of ages in management

Decentralized operation

Salary: $990 per month for 1 to 2 years, then straight commission basis

- -

Offer E

Old-line industrial manufacturer; industrial gauges, pumps, gears, ball bearings and metal-stamped products

Marketing analysis and new product market research; chance to move into other functional areas of management later; first project involves responsibility for conducting market potential studies of selected products

Houston, Texas

Middle-aged to older management

500 employees

Real estate is very reasonable

Salary: $1,025 per month

- -

Offer F

Small management consulting firm

Work on wide variety of problems in financial analysis, marketing analysis, and operations research

Special work with Negro-owned businesses in Black Capitalism Program; some teaching of management techniques to groups of clients is available in the Black Capitalism Program

Middle-aged management; team approach to consulting problems; opportunity to become partner in the firm after 10 years if have the ability; one in five men makes it

Cincinnati, Ohio

Salary: $1,100 per month

Offer G

Work for the City of Denver, Colorado

Department of City Planning and Urban Development; department is new and growing

Job involves cost analysis and systems simulation; would lead to design of traffic systems and zoning areas in 4 to 5 years; work with variety of urban problems in addition

Excellent vacation plan; scenic surroundings

Salary: $900 per month, covered by State Civil Service codes

Offer H

Chemical concern, listed in Fortune's 500

Very selective and intensive management training program; requires trainee who is willing to work hard

Trainee is rotated through all functional areas of management for two years and groomed for general management responsibilities

Decentralized management structure

Philadelphia, Pennsylvania

Salary: $1,125 per month

Offer I

Pharmaceutical firm, 1,000 employees

Production control and scheduling; work directly with vice-president of production operations; would be responsible for new computerized production scheduling system

Firm presently has plans to expand into new product area of food processing; will create several high-level positions

Wide range of management ages

Peoria, Illinois

Salary: $1,075 per month

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APPENDIX B

Examples of Pairwise Similarity Judgments from Ideal Job Model Questionnaire

Small management consulting firm

Work on wide variety of problems in financial analysis, marketing analysis, and operations research

Special work with Negro-owned businesses in Black Capitalism Program; some teaching of management techniques to groups of clients is available in the Black Capitalism Program

Middle-aged management; team approach to consulting problems; opportunity to become partner in the firm after 10 years if have the ability; one in five men makes it

Cincinnati, Ohio

Salary: $1,100 per month

Work for the City of Denver, Colorado

Department of City Planning and Urban Development; department is new and growing

Job involves cost analysis and systems simulation; would lead to design of traffic systems and zoning areas in 4 to 5 years; work with a variety of urban problems in addition

Excellent vacation plan; scenic surroundings

Salary: $900 per month, covered by State Civil Service codes

Please rate how similar you feel these two job offers are on the scale below by circling one number.

Very Similar			Moderately Similar					Moderately Dissimilar				Very Dissimilar
1	2	3	4	5	6	7	8	9	10	11	12	13

Chemical concern, listed in Fortune's 500

Very selective and intensive management training program; requires trainee who is willing to work hard

Trainee is rotated through all functional areas of management for two years and groomed for general management responsibilities

Decentralized management structure

Philadelphia, Pennsylvania

Salary: $1,125 per month

Your personal concept of the "ideal job" for you.
Your ideal job should reasonably be expected to exist.

Please rate how similar you feel this job offer is to your concept of your "ideal" job by circling one number on the scale below.

Very Similar		Moderately Similar						Moderately Dissimilar				Very Dissimilar
1	2	3	4	5	6	7	8	9	10	11	12	13

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