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ARE SATISFACTION AND DISSATISFACTION REALLY OPPOSITES? ORDERED VERSUS UNORDERED MODELS OF SATISFACTION WITH MILITARY LIFE

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ABSTRACT

This paper discusses the degree to which satisfaction and dissatisfaction with military life represent directionally opposite aspects of the same basic phenomenon. The analysis approach is to estimate an unordered model of survey responses regarding satisfaction with military life from Marine respondents to the 1985 DOD Member Survey. These estimates can be used to test whether satisfaction and dissatisfaction are opposites with respect to a particular set of variables.

EXECUTIVE SUMMARY

In research based on attitudinal data, there is a pervasive tendency to measure satisfaction and dissatisfaction on the same scale, implicitly assuming that they are degrees of the same thing. The ordinality of attitude survey responses implies that dissatisfaction is a kind of "negative" satisfaction. But, in many instances, there is no necessary logical relationship between satisfaction and dissatisfaction. In fact, satisfaction and dissatisfaction can be different phenomena, caused by different variables.

A key variable in a recent study of Marine Corps family programs was whether family services contribute significantly to the overall satisfaction of Marines with military life. Overall satisfaction was measured by an ordinally scaled variable taking as values "dissatisfied," "neither satisfied nor dissatisfied," or "satisfied." Implicit in this analysis, however, is a basic assumption that dissatisfaction and satisfaction are directionally opposite.

This paper discusses the degree to which satisfaction and dissatisfaction with military life represent directionally opposite aspects of the same basic phenomenon. Using data from Marine respondents to the 1985 DOD Member Survey, a statistical model of satisfaction with military life that does not constrain satisfaction and dissatisfaction to be directionally opposite is estimated. Estimates from this model indicate that satisfaction and dissatisfaction have some similar causes and some dissimilar ones. These results therefore suggest that ordered models of satisfaction are not universally appropriate, and that it may be necessary in particular analyses to consider satisfaction and dissatisfaction as separate variables.

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INTRODUCTION

A key variable in a recent study of Marine Corps family programs [1] was whether family services contribute significantly to the overall satisfaction of Marines with military life. Overall satisfaction was measured by an ordinally scaled variable taking as values "dissatisfied," "neither satisfied nor dissatisfied," or "satisfied." Implicit in this analysis were two basic assumptions. The first, which was examined in another paper [2], was that there is such a thing conceptually as overall satisfaction with the military (specifically the Marine Corps), as opposed to merely some statistical average of a number of specific kinds of satisfaction. This paper focuses on the second basic assumption: that satisfaction and dissatisfaction are directionally opposite aspects of the same basic phenomenon.

This paper will investigate the degree to which satisfaction and dissatisfaction with military life represent directionally opposite aspects of the same basic phenomenon. Using data from Marine respondents to the 1985 DOD Member Survey, a model of satisfaction and dissatisfaction will be estimated that does not constrain these variables to be opposites. (This paper does *not* address the issue considered in the companion paper, of whether "satisfaction" and "dissatisfaction" are distinct variables or represent "averages" of a number of types of satisfaction or dissatisfaction.) The unconstrained model will be compared statistically to a model that constrains satisfaction and dissatisfaction to be opposites. The paper will conclude with some observations on the usefulness of ordered versus unordered response models for attitudinal data.

MODEL

Suppose that satisfaction or dissatisfaction with military service is measured by a survey response variable taking as values "dissatisfied," "neither satisfied nor dissatisfied," or "satisfied." Let these responses be represented by an index variable, R, which takes values as follows:

If response = "neither satisfied nor dissatisfied," then $R = 0$;

If response = "dissatisfied," then $R = 1$;

If response = "satisfied," then $R = 2$.

(This coding scheme emphasizes that R is an index variable with no ordinality.)

Let the following model express the probabilities of each outcome as a function of a vector of independent variables, x:

$$P(R=0) = \frac{G(\beta_0\ x)}{G(\beta_0\ x) + G(\beta_1\ x) + G(\beta_2\ x)}\ , \qquad (1)$$

$$P(R=1) = \frac{G(\beta_1\ x)}{G(\beta_0\ x) + G(\beta_1\ x) + G(\beta_2\ x)}\ , \text{ and}$$

$$P(R=2) = \frac{G(\beta_2\ x)}{G(\beta_0\ x) + G(\beta_1\ x) + G(\beta_2\ x)}\ ,$$

where G is a probability distribution function. A computationally convenient distributional assumption is that G is the logistic distribution, in which case equation 1 specifies a familiar multinomial logit (MNL) model.[1]

If one can estimate the parameters of this model, the hypothesis that satisfaction and dissatisfaction are opposites can be tested. Outcomes $(R = 1)$ and $(R = 2)$ will be said to be *opposites with respect to* x if $\beta_1 = -\beta_2$.

By estimating the parameters β_1 and β_2 one can construct a generalized Wald test (see Amemiya [3]) for the hypothesis that $\beta_1 = -\beta_2$.

The test statistic

$$GW = h(\tilde{\beta})^T \left[\frac{\delta h}{\delta \beta^T} \Big|_{\tilde{\beta}} V \frac{\delta h^T}{\delta \beta} \Big|_{\tilde{\beta}} \right]^{-1} h(\tilde{\beta})\ , \qquad (2)$$

where $h(.)$ is a differentiable constraint function, $\tilde{\beta}$ is the vector of estimated parameters, and V is the

1. This paper presents a rather narrowly defined test of whether the β parameters for satisfaction and dissatisfaction are equal to the negative of each other (i.e., whether satisfaction and dissatisfaction are opposites). Clearly, in a more comprehensive effort, the appropriateness of the MNL distributional assumption should be examined. The logistic specification for this multinomial model was made purely as a matter of convention, based on computational convenience.

estimated covariance matrix of the parameters, is distributed as χ^2 (q) where q is the number of constraints represented by $h(\beta)$.

DATA

The data used for this study are the same used in the original study of Marine Corps Family Programs. The 1985 DOD Member Survey was based on a random stratified sample of all military members who were on active duty on 30 September 1984. The primary sampling stratum was branch of service; other strata within service were sex and, for enlisted personnel only, length of service (4 to 47 months of service, and 48 months or more). Within these strata, service members were selected randomly. By using a stratified sample design, it was possible to obtain larger samples of Marine officers and females than would be drawn using an unstratified sample, thus permitting more precise analyses of these groups. A 10-percent random sample of Marine respondents to the 1985 DOD Member Survey was drawn to yield a dataset of approximately 1,700 observations.

Table 1 presents descriptive statistics on the variables included in the analysis. The independent variables included are the respondent's age, perceptions regarding civilian alternatives available to the respondent, quality of military effect on family life, and scaled measures of satisfaction with his military job.[1] The dependent variable, which measures satisfaction and dissatisfaction with military life overall, takes the values "neither satisfied nor dissatisfied," "dissatisfied," and "satisfied" with military life.

ESTIMATION RESULTS

Table 2 presents maximum likelihood estimates of the MNL model specified above. The model fits the data reasonably well, with a pseudo R-squared measure of 0.358.[2] Visually comparing the parameter vectors pairwise for the $Y=1$ and $Y=2$ outcomes (i.e., β_1 and β_2), one can see that statistically significant elements of these vectors generally tend to have opposite signs and are approximately equal in absolute magnitude. Intuitively, this should indicate that satisfaction and dissatisfaction are opposites with respect to those variables. On the other hand, there are two significant violations of this pattern, which suggest dimensions of greater independence between the factors determining satisfaction and dissatisfaction with military life. Specifically, perceived chances for a good civilian job have a strong effect on dissatisfaction with military life and no effect on satisfaction, while age exhibits precisely the opposite pattern.

Table 1. Descriptive statistics for survey data included in satisfaction model

Variable	Mean	Standard deviation
Independent variables:		
Satisfaction with pay and allowance[a]	3.00	1.10
Job satisfaction[a]	3.60	1.20
Age	28.20	6.50
Chances for a good civilian job[b]	8.60	2.60
Dependent variable:		
Neither satisfied nor dissatisfied with military life	0.27	
Dissatisfied with military life	0.25	
Satisfied with military life	0.48	
Number of observations	1,652	

a. Scaled satisfaction variable, where
1 = Very dissatisfied
2 = Somewhat dissatisfied
3 = Neither satisfied nor dissatisfied
4 = Somewhat satisfied
5 = Very satisfied

b Scaled perception variable, where 0 = no chance of good civilian job and 10 = certainty of good civilian job, if member were to leave service.

1. These variables basically are the same as those included in the ordered model of satisfaction with military life estimated in [1].

2. The concept of goodness-of-fit used is whether the independent variables included in the model contribute significantly to the likelihood ratio of the MNL model. It does not address, except indirectly, the reasonableness of the logistic distributional assumption.

Table 2. Estimated parameters of multinomial logit model of overall satisfaction with military life

Independent variable	Outcome variable: Dissatisfied	Outcome variable: Satisfied
(1) Quality of family environment	−0.193[a]	0.289[a]
(2) Satisfaction with pay and allowances	−0.283[a]	0.528[a]
(3) Job satisfaction	−0.349[a]	0.403[a]
(4) Age	0.007	0.078[a]
(5) Chances for a good civilian job	0.080[a]	0.022
Intercept	1.804[a]	−5.924[a]

Pseudo R-squared:[b] 0.358

Number of observations: 1,652

Test statistic of hypothesis that $\beta_1 = -\beta_2$ for all variables: $24.89 \sim \chi^2(5)$

Test statistic of hypothesis that $\beta_1 = -\beta_2$ for variables (1), (2), and (3): $7.25 \sim \chi^2(3)$.

NOTE: The omitted category for the outcome variable is "neither satisfied nor dissatisfied." One such category must be omitted to identify the remaining parameters, which are subject to the normalization that $\beta = 0$ for the omitted category.

a. Statistically significant at the 1-percent level.

b. As suggested by Maddala, pseudo R-squared is defined as

$$\frac{1-(L_\omega/L_\Omega)^{2/n}}{1-L_\omega^{2/n}} ,$$

where L_ω is the sample likelihood of a null model (with only constant terms) and L_Ω is the sample likelihood of the model as estimated.

A statistical test of the hypothesis that satisfaction and dissatisfaction are opposites with respect to all of the explanatory variables rejects that hypothesis: the value of the generalized Wald statistic exceeds the 95 percentile point of the χ^2 distribution. However, the hypothesis that satisfaction and dissatisfaction are opposites with respect to quality of family environment, satisfaction with pay and allowances, and job satisfaction cannot be rejected (at the 5-percent level of significance).

Therefore, it appears that perceptions of higher quality family environment, satisfaction with pay and allowances, and job satisfaction are variables that affect overall satisfaction with military life symmetrically, in the sense that a higher value of these variables generates greater overall satisfaction and a lower value, more dissatisfaction. On the other hand, older Marines tend to be more satisfied, but younger Marines are not, other things equal, correspondingly more dissatisfied. Furthermore, Marines who perceive better chances for a good civilian job tend to be more dissatisfied, while Marines who perceive poorer chances are not more satisfied. These observations suggest dimensions in which satisfaction and dissatisfaction with military life are independent.

ORDERED VERSUS UNORDERED MODELS

In this particular case, it appears that an ordered model is not an unreasonable way to represent the variable of interest, because satisfaction and dissatisfaction with military life are directionally opposite with respect to the majority of the key independent variables. But what of the more general question of when to use an ordered model in preference to an unordered one? Of course, one should require as a necessary condition for using an ordered model that the underlying phenomenon be consistent with some kind of natural ordering. But beyond this, one way to proceed is to consider the consequences of imposing the wrong structure [3]. Suppose that the loss function for incorrect estimates of the true β_1 and β_2 parameters is of the usual squared-error type

$$l(\tilde{\beta}; \beta) = (\tilde{\beta} - \beta)^2 . \quad (3)$$

Then the associated risk of incorrect estimates is

$$E[l(\tilde{\beta}; \beta)] = E(\tilde{\beta} - \beta)^2 , \quad (4)$$

which is the usual mean-squared error (MSE). It is easy to show that the risk can be decomposed into two components: the variance of the estimate $\tilde{\beta}$ around its expected value and the squared deviation of $E(\tilde{\beta})$ from β (i.e., the squared bias).

$$E[1(\tilde{\beta};\beta)] = E[\tilde{\beta} - E(\tilde{\beta})]^2 + [E(\tilde{\beta}) - \beta]^2 \ . \quad (5)$$

This example illustrates the point that the expected estimation error has two components, variance and bias, that (often) must be balanced against each other.

If an unordered model is used when an ordered model is appropriate, the consequence is lost statistical efficiency (i.e., greater variance), since more parameters will be estimated than necessary. On the other hand, if additional structure, in terms of ordering, is improperly imposed, the parameter estimates in general will be biased. If there are relatively few observations for each discrete outcome or significant uncertainty about model specification, it may be best to accept some bias from using an ordered specification and minimize the number of parameters to be estimated (i.e., to trade reduced variance against some bias). However, when using large data sets in which each discrete outcome is represented by a number of observations that are large in relation to the number of parameters to be estimated, it probably is best to use an unordered model and investigate empirically the dependence structure among the discrete outcomes.

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