Experimental Design for Discrete Choice Voter Preference Surveys

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KEYWORDS: CONTINGENT VALUATION, MEDIAN VOTER, CENSORED DATA

ABSTRACT

To determine voter's willingness to pay for certain public goods we introduce a new approach in contingent valuation surveys. Respondents are asked whether they are willing to pay at least a randomly determined amount for the good (or bear a certain tax burden for a bond issue or referendum). If the response is positive, the question is asked again for a higher randomly determined number; otherwise the question is asked again for a randomly determined lower number. The results, which are easily gathered in telephone surveys provide interval censored data which can be analyzed nonparametrically or parametrically with covariates. The method is employed in valuing a reliable water supply for California.

I. Introduction.

In assessing the political and economic wisdom of certain public expenditures it is desirable to measure the willingness of voter's to pay for the proposed good or service. Over the last twenty years such measurement has been conducted via contingent valuation surveys, in which respondents are directly asked how much the would be willing to pay for some defined benefit. Such studies have been conducted to measure the economic value of fisheries, natural parks, clean air, and reliable water supplies, among others; see Mitchell and Carson (1989) for a thorough review. In the present paper we introduce a new approach to the design of such surveys which is very simple to implement and can yield reliable results in a wide range of survey settings.

The measurement problem we address, a voter's willingness to pay, can be thought of as similar to that of bioassay. With price as the dose that kills off interest in a good, identifying the median voter's willingness to pay is equivalent to finding the LD50. If we are interested in the entire distribution of willingness to pay, we can borrow further from biomterics and use survival analysis. In this paper, we introduce some new design ideas which exploit survival analysis techniques to analyze the resulting censored survey data.

II. A New Survey Design

It is well known that there can be problems in eliciting information from an open ended question such as "How much would you be willing to pay for a reduction in the probability of a severe water shortage"? Such questions are even more problematic in telephone surveys where props such as payment cards and categories of answers cannot be used. Our solution is to ask a closed-end question instead, of the form:

(1) "Would you be willing to spend $X for a reduction in the probability of a severe water shortage"?

The response to this closed-end question would be either yes or no, and would yield results similar to that gathered in a bioassay or clinical trial.

The critical design questions for such a survey are how the cut points X are to be determined, and how many cut points there should be per respondent. In our study of the California water supply we used two cut points per person, randomly determined as follows: first, each respondent had several water shortage scenarios explained, and key terms were defined. Then, a question of the form of (1) was asked, with the amount X (which we call a cut point) being randomly determined. If the answer to the question was affirmative, the question was asked again with a new value X+R, where R was randomly determined. If the response was negative, a second question was asked with an amount Y randomly determined, with Y <X.

This data collection strategy yielded the following pattern of interval censored information on the distribution of willingness to pay W:

Responses Q1	Q2	Interval Information	Data Type
Yes	Yes	$X+R < W$	Right Censored
Yes	No	$X < W < X+R$	Interval Censored
No	No	$W < Y$	Left Censored
No	Yes	$Y < W < X$	Interval Censored

As an alternative to random cut points, the cut points could be pre-determined. Carson and Alberini (1989) show that given parametric assumptions about the underlying distribution, the number and location of the cut points are dependent on the assumed distribution.

III. Analysis and Exemplary Results

Given interval censored data, we can proceed with Turnbull's extension of the Kaplan-Meier estimator to obtain a non-parametric estimate of the survivor distribution characterizing willingness to pay. Further, if the results resemble one of the popular waiting time distributions, we can then proceed with parametric modelling, taking covariates into account in a regression model.

To test our methods, we used the data from a contingent valuation survey of approximately 1,000 California households designed to elicit willingness to pay to avoid various severities of water shortage. The survey is described in detail in Carson (1988). Besides the core contingent valuation questions, data on demographic characteristics, water consumption, income and location of residence were also obtained.

Using the Turnbull estimator to analyze the results of one of the scenarios, we obtain: (1) a set of nonoverlapping intervals on which survivor function may take an arbitrary shape; and, (2) the change in the survivor function between the endpoints of the interval (listed as the interval probability below. We used the SURVIVAL module (Steinberg and Colla (1988) of SYSTAT (Wilkinson (1989) to obtain our results.)

The distribution of willingness to pay in dollars per year is then estimated in the table below.

TURNBULL K-M ESTIMATION

LOWER	UPPER	SURVIVAL PROB	INTERVAL PROB
0	10	0.850	0.150
10	25	0.748	0.102
25	60	0.685	0.063
60	120	0.529	0.156
120	200	0.259	0.270
200	300	0.148	0.110
300	500	0.101	0.048
500	750	0.086	0.015
750	1000	0.070	0.015
1000	1250	0.060	0.011
1250	INFINITY	0	0.060

The median voter is estimated to be willing to pay more than $120 per year to avoid the water shortage of the scenario. When the same data was fit to a Weibull model without covariates, the median was estimated to be $114 and the distribution was quite similar to the Turnbull results. We thus decided to fit Weibull models with covariates to see how background variables effect willingness to pay.

The results appear in the Table below.

WEIBULL EQUATION WITH COVARIATES

	parameter	standard error	"t" -stat
constant	180.618	45.111	4.04
hmem	0.088	0.036	2.46
income	0.003	0.002	2.05
age	-0.006	0.003	-1.97
cwspdum	0.393	0.103	3.81
pwbdum	-0.210	0.103	-2.04
y77dum	-0.243	0.118	-2.05
sfbdum	-0.340	0.132	-2.58
shape	0.711	0.021	33.63

Log Likelihood -1268 N 1000

All of the variables in the equation are significant and have the expected signs. The larger the number of household members(hmem), the wealthier the household, the younger the respondent and the more concerned about the water supply(cwspdum) the more the household is willing to pay to avoid the damages of a severe water shortage. Those not paying the water bill (primarily renters), those experiencing the 1977 shortage, and those living in the San Francisco Bay area were willing to pay somewhat less but as these are dummy variables the effects are not very pronounced.

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