

Valuing Environmental and Natural Resources

The Econometrics of Non-Market Valuation

Timothy C. Haab
The Ohio State University

Kenneth E. McConnell
University of Maryland at College Park

NEW HORIZONS IN ENVIRONMENTAL ECONOMICS

Edward Elgar
Cheltenham, UK • Northampton, MA, USA

Contents

Preface	xiv
1 Welfare Economics for Non-market Valuation	1
1.1 The Background for Valuation	1
1.2 The Theoretical Background	4
1.2.1 The Value of Public Goods	4
1.2.2 Willingness to Pay versus Willingness to Accept	8
1.3 Theoretical Support for Behavioral Methods	10
1.4 Conclusions	15
2 Parametric Models for Contingent Valuation	16
2.1 Introduction	16
2.1.1 NOAA Panel Guidelines for Value Elicitation Surveys	20
2.2 Parametric Models for Dichotomous Choice Questions	23
2.2.1 The Random Utility Model	24
2.2.2 The Random Willingness to Pay or Expenditure Difference Model	50
2.3 Conclusion	57
3 Distribution-Free Models for Contingent Valuation	59
3.1 Introduction	59
3.2 The Turnbull Estimator	59
3.2.1 An Unrestricted Distribution-Free Estimator	60
3.2.2 The Turnbull Estimator	65
3.3 Variance-Covariance Matrix	70
3.4 Lower Bounds for Mean and Median Willingness to Pay	71
3.4.1 Median Willingness to Pay	72
3.4.2 A Lower Bound Estimate for Willingness to Pay	72
3.5 A Distribution-Free Estimate of WTP	78
3.6 Covariate Effects in the Turnbull Model	80
3.7 Conclusion	83
4 The Distribution of Willingness to Pay	84
4.1 Introduction	84

4.2	Central Tendency for Willingness to Pay	84
4.2.1	Criteria for a Valid Measure of WTP	85
4.2.2	Implications of Assuming Standard Forms	88
4.2.3	Bound Probit and Logit Models	97
4.2.4	WTP and the Tails of the Distribution	102
4.2.5	Summary of Bounding WTP	106
4.3	The Dispersion of Willingness to Pay	106
4.3.1	Uncertainty from Randomness of Preferences	107
4.3.2	Variation across Individuals in the Sample	108
4.3.3	Uncertainty from Randomness of Parameters	110
4.4	Conclusion	113
5	Topics in Discrete Choice Contingent Valuation	114
5.1	Introduction	114
5.2	Contingent Valuation with Follow-Up Questions	114
5.2.1	The Bivariate Dichotomous Choice Model	115
5.2.2	Payment Cards	125
5.2.3	Open-Ended Questions	128
5.3	Bid Design Issues	128
5.4	Spikes, Indifference and Uncertainty	131
5.4.1	A General Spike Model	133
5.5	Conclusion	136
6	Modeling the Demand for Recreation	137
6.1	Introduction	137
6.2	The Generic Travel Cost Problem	139
6.2.1	The Demand for Quality	140
6.2.2	Travel Cost Modeling and Contingent Valuation	141
6.3	Construction of Demand Models	142
6.3.1	The Role of Time	145
6.3.2	Basic Assumptions of the Travel Cost Model	148
6.4	Conclusion	150
7	Single Site Demand Estimation	151
7.1	Introduction	151
7.2	Estimation of Censored Models	152
7.2.1	Estimating Tobit Models of Recreational Demand	154
7.2.2	Marginal Effects in the Tobit	155
7.3	Welfare Measurement in the Single Site Model	158
7.3.1	Welfare Measurement in the Tobit	161
7.3.2	Welfare with Measurement Error	162
7.3.3	Welfare with Specification Error	162

7.4	Count Models of Recreational Demand	164
7.4.1	The Poisson Model	164
7.4.2	The Negative Binomial Model	169
7.5	Models for On-Site Sampling	174
7.5.1	Truncation	174
7.5.2	Endogenous Stratification	175
7.6	Zonal Travel Cost Models	181
7.7	Differentiating between Participation and the Demand Level	183
7.7.1	The Cragg Model	183
7.7.2	Sample Selection Models for Recreation Demand .	186
7.8	Conclusion	189
8	Site Choice Models	190
8.1	Introduction	190
8.2	Choices among Alternatives	191
8.2.1	Conditional Logit versus Multinomial Logit	193
8.3	Some Results for Nested Models	194
8.3.1	Notation for Two Level Models	194
8.3.2	The Choice Probability	195
8.3.3	Expected Maximum Utility	198
8.4	The Basics of Logit Models	199
8.4.1	The Nested Logit Probability	199
8.4.2	Specifying the Utility Function	201
8.4.3	The Conditional Logit Model	203
8.5	Independence of Irrelevant Alternatives	204
8.6	Estimating the Models	206
8.6.1	Procedure for two-stage (LIML) estimation	208
8.6.2	FIML Estimation	208
8.7	Estimation with On-site Sampling	213
8.7.1	A Solution to On-Site Sampling	214
8.7.2	The On-site Conditional Logit	217
8.7.3	Consequences and Solutions in Practice	218
8.8	Welfare Calculations	220
8.8.1	Welfare Measures for Quality Changes	222
8.8.2	The Loss of Sites	226
8.8.3	Summary: Welfare Measures	232
8.8.4	Statistical Properties of WTP	232
8.9	Linking the Site Choice with the Quantity of Trips	234
8.10	Estimation Issues	236
8.10.1	Nesting Structures	236
8.10.2	Choice Sets	238
8.10.3	Sampling Alternatives	240

8.10.4	Aggregation of Sites	243
8.10.5	Socioeconomic Variables	244
8.11	Conclusions	244
9	Hedonic Price Equations	245
9.1	Introduction	245
9.2	Welfare Measurement in Hedonic Models	248
9.3	The Identification Problem	250
9.4	Estimating Hedonic Price Equations	251
9.4.1	The Box-Cox Function	254
9.4.2	Estimating Box-Cox Models	255
9.4.3	Randomness of Willingness to Pay Estimates in Hedonic Models	265
9.5	Conclusion	267
10	New Directions in Non-market Valuation	268
10.1	Stated Preferences for Multiple Attributes	268
10.2	Mixed Logit Models	273
10.3	Combining Stated and Revealed Preferences	275
10.4	Preview	277
	References	278
A	Maximum Likelihood Estimation	298
A.1	The Likelihood Function	300
A.2	Maximization	300
A.2.1	Maximum Likelihood Algorithms	301
A.3	Properties of Maximum Likelihood Estimates	303
A.3.1	Consistency	303
A.3.2	Asymptotic Normality	304
A.4	Diagnostic Statistics and Tests for Maximum Likelihood	304
A.4.1	Likelihood Ratio Statistic	304
A.4.2	A Special Case: $\hat{\theta}_r = 0$	305
B	Some Useful Results	307
B.1	Basic Probabilistic Relations	307
B.1.1	$\Pr(x > a)$	307
B.1.2	$\Pr(x > -a)$	307
B.1.3	Symmetry	308
B.1.4	Summary of Results on Probabilities	309
B.2	Exponential Logistic Distribution	309
B.3	Properties of Truncated Normal	310

B.4 The Poisson and Negative Binomial 312

B.5 The Type-I Extreme Value (Gumbel) 313

 B.5.1 The McFadden RUM Probability 314

 B.5.2 Conditional Probability Relation 315

B.6 Generalized Extreme Value Distribution 315

 B.6.1 *Probability Derivation* 316

 B.6.2 *Expected Maximum Utility* 318

Index **323**