Nonlinear Meta-Regression for Benefit Transfer

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Intro


RESOURCE and ENERGY ECONOMICS
Resource and Energy Economics 20 (1998) 179–196
ICES Journal of Marine Science
Public perceptions of wetland
Tae-Goun Kim and Daniel R. Petrolia
America's Wetland? A National Survey of Willingness to Pay for Restoration of Louisiana's Coastal Wetlands
Final Project Report
Department of Agricultural Economics
Mississippi State University
Revised April 1, 2013
Daniel R. Petrolia
COMBINING ECONOMIC AND ECOLOGICAL INDICATORS TO PRIORITIZE SALT MARSH RESTORATION ACTIONS
ROBERT J. JOHNSTON, GISELE MAGNUSSON, MARISA J. MAZZOTTA, AND JAMES J. OPALUCH
Amer. J. Agr. Econ. 84 (Number 5, 2002): 1362–1370
Copyright 2002 American Agricultural Economics Association

10. Suppose your city could do a project that would change features of stormwater control near you. Options A and B are the **only** choices you can have instead of your **current situation.** Which option would you choose? Please read all the features of each option and then check the box that represents your choice **below.** If you don't like option A or B, then choose the box "current situation" - that means no project is done, so flooding and environmental quality stay the same and there is no cost.

	Option A	**Option B**	**Current situation**
Number of street floods within 1 block of your house 	25% less frequent than current	50% less frequent than current	No change
Number of floods in your backyard 	50% less frequent than current	50% less frequent than current	No change
Number of floods in your basement 	50% less frequent than current	25% more frequent than current	No change
Change in quality of water in nearby streams 	better quality: fishable	better quality: swimmable	No change: boatable
Water infiltration 	less infiltration: very low	more infiltration: high	No change: medium infiltration
Annual stormwater utility bill 	$20	$40	$0
I would choose:	❐ A	❐ B	❐ Current situation

	id	origstudy	studyid	wtp	Q0	Q1	choiceexp	thesis	lnyear
1	1004.1	1004	1	180.7128	70	50	0	0	1.0986123
2	1017.1	1017	2	240.93441	50	70	0	0	1.3862944
3	1017.2	1017	2	75.665351	50	70	0	0	1.3862944
4	1041.1	1041	3	36.252	25	50	0	0	0
5	1041.11	1041	3	19.836	50	70	0	0	0
6	1041.12	1041	3	57.228	25	70	0	0	0
7	1041.14	1041	3	84.132	25	50	0	0	0
8	1041.15	1041	3	42.864	50	70	0	0	0
9	1041.16	1041	3	137.256	25	70	0	0	0
10	1041.2	1041	3	40.128	25	50	0	0	0
11	1041.3	1041	3	28.272	50	70	0	0	0
12	1041.4	1041	3	71.136	25	70	0	0	0
13	1041.6	1041	3	66.804	25	50	0	0	0
14	1041.7	1041	3	28.5	50	70	0	0	0
15	1041.8	1041	3	97.812	25	70	0	0	0
16	1063.1	1063	4	390.6781	50	70	0	0	1.6094379
17	1063.2	1063	4	404.19484	50	90	0	0	1.6094379
18	1070.1	1070	5	255.00884	50	90	0	0	2.7080502
19	1070.2	1070	5	262.28511	50	90	0	0	2.7080502
20	1085.1	1085	6	124.03994	25	45	0	0	1.9459101

$$log\left(wtp\right) = A + \beta log(y) + \gamma_0 q_0 + \gamma_\Delta \left(q_1 - q_0\right), \quad \text{or}$$
$$wtp = y^\beta exp\left(A + \gamma_0 q_0 + \gamma_\Delta \left(q_1 - q_0\right)\right)$$

Sensitivity to scope?

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$$\frac{\partial wtp}{\partial q_1}|q_0 = \gamma_\Delta * wtp,$$

$$\gamma_\Delta > 0?$$

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$$\begin{aligned}
&y^{\beta} exp\left(A\right) exp\left(\gamma_0 q_0 + \gamma_\Delta\left(q_2 - q_0\right)\right) \neq \\
&y^{\beta} exp\left(A\right) * \\
&\left(exp\left(\gamma_0 q_0 + \gamma_\Delta\left(q_1 - q_0\right)\right) + exp\left(\gamma_0 q_1 + \gamma_\Delta\left(q_2 - q_1\right)\right)\right),
\end{aligned}$$

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- First raised in the peer-reviewed literature by Newbold et al. (2018)

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$$q_0 = 2.5, \quad q_1 = 5.1, \quad q_2 = 7.0$$

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$$\frac{wtp\left(q_1 - q_0\right) + wtp\left(q_2 - q_1\right)}{wtp\left(q_2 - q_0\right)} = 1.09$$

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$$wtp = \int_{q_0}^{q_1} y^{\beta} exp\left(A\right) exp\left(\gamma q\right) dq =$$

$$y^{\beta} exp\left(A\right) \left(\frac{1}{\gamma} \left(exp\left(\gamma q_1\right) - exp\left(\gamma q_0\right) \right) \right)$$

$$log\left(wtp\right) = A + \beta log\left(y\right) + log\left(\frac{1}{\gamma} \left(exp\left(\gamma q_1\right) - exp\left(\gamma q_0\right) \right) \right)$$

$$y_{is} = \mathbf{x}'_{is}\boldsymbol{\beta} + log\left(\gamma^{-1}\left(exp\left(\gamma q_{1,is}\right) - exp\left(\gamma q_{0,is}\right)\right)\right) + u_s + \epsilon_{is}$$
$$u_s \sim n\left(0, \sigma_u^2\right),$$
$$\epsilon_{is} \sim n\left(0, \sigma_\epsilon^2 \omega_{is}\right), \quad \text{where} \quad \omega_{is} \sim ig\left(\tfrac{\nu}{2}, \tfrac{\nu}{2}\right)$$

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- used by EPA to inform steam electric rule revision (ongoing)

Model comparison via Bayes Factors

NL-MRM vs:	log-Bayes Factor
MRM1linlin	-24.285
MRM1linlog	-20.958
MRM1loglog	-23.742
MRM2	-6.560
MRM2Slin	-9.053
MRM2Slog	-23.870

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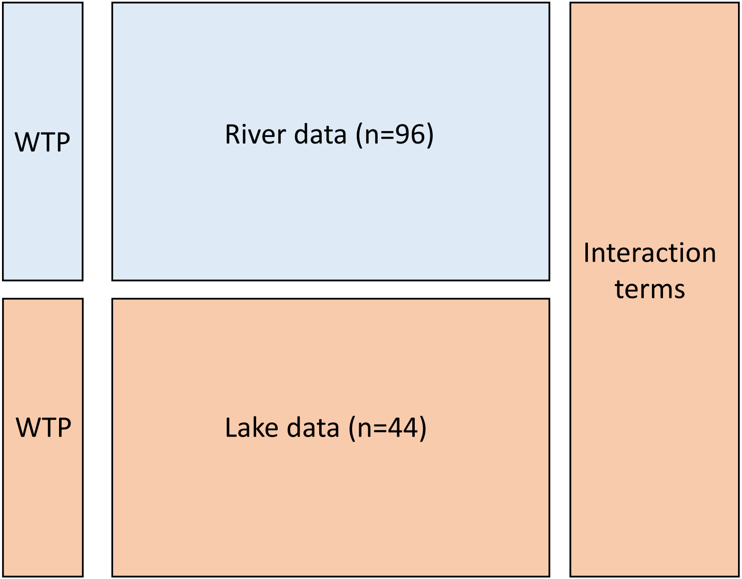
- Bayesian Stochastic Search Variable Selection


WTP
River data (n=96)
WTP
Lake data (n=44)
Interaction terms

$$\mathbf{y}_s = \mathbf{X}_{1s}\boldsymbol{\beta}_x + \mathbf{M}_s\boldsymbol{\beta}_m + \mathbf{Z}_s\boldsymbol{\delta} +$$
$$log\left(\left(\gamma + \delta_\gamma \mathbf{d}_s\right)^{-1}\left(exp\left(\left(\gamma + \delta_\gamma \mathbf{d}_s\right)\mathbf{q}_{1,s}\right) - exp\left(\left(\gamma + \delta_\gamma \mathbf{d}_s\right)\mathbf{q}_{0,s}\right)\right)\right)$$
$$+ \mathbf{i}_s u_s + \boldsymbol{\epsilon}_s$$

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$$+ \mathbf{i}_s u_s + \boldsymbol{\epsilon}_s$$

$$p\left(\delta_j\right) = p_0 * n\left(0, c^2 t^2\right) + \left(1 - p_0\right) n\left(0, t^2\right),$$

Scenario 1: WQI 25-51, 51-70 (boatable, fishable, swimmable)

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BT results, SSVS, total WTP ($)

	NL-MRM			MRM1linlin		
scenario (WQI)	low	mean	high	low	mean	high
25 to 51	0.00	50.99	156.53	0.72	32.33	85.59
51 to 70	0.00	26.33	80.10	0.94	24.08	63.65
25 to 70	0.00	77.19	235.89	0.91	41.12	108.12
adding-up error		0.17%			37.18%	

Scenario 2: WQI 73-73.5, 73.5-74
(option D of Steam Electric rule)

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BT results, SSVS, total WTP ($)

	NL-MRM			MRM1linlin		
scenario (WQI)	low	mean	high	low	mean	high
73 to 73.5	0.00	0.57	1.74	0.46	16.26	43.89
73.5 to 74	0.00	0.57	1.73	0.47	16.21	43.79
73 to 74	0.00	1.14	3.47	0.28	16.36	43.98
adding-up error		0.18%			98.40%	

- Option D of SER: $ 1.14/HH

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- Benefits: $96 million (2007 dollars)

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THANK YOU!