Lecture 8: Stated Preferences and Hypothetical Markets

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Environmental Economics

Econ 4075

Revealed vs. Stated Preferences

- So far in class we've learned about revealed preferences. We talked about using variation in travel costs or defensive expenditures to measure people's (dis)tastes for environmental amenities. We've also talked about using variation in housing prices or labor market wages to measure the hedonic value of composite goods. In each of these cases, people "reveal" their preferences through their consumption choices.

- Revealed preferences rely on:
  - Observation of an interaction between private behavior and an environmental good
  - Sufficient variation in public good levels and behaviors to estimate behavioral functions

- What if these data needs are not met? What if the environmental commodity of interest has primarily non-use value? What if our inference objective is outside the range of variability currently provided in available data?

- Our best alternative: ask people how they would respond in **hypothetical** situations.

Stated Preferences

- The approaches captured under the umbrella term “stated preferences” have a long history in environmental economics.

- Different flavors of these approaches are known as “contingent valuation” or “discrete choice experiments”. Regardless of the flavor, these SP approaches share a commonality in asking survey respondents about their preferences.

- SP is both widely used and widely criticized, although many past criticisms have been addressed with careful empirical design of surveys and validity tests.

- Prior to Exxon-Valdez spill in 1989, stated preferences methodology was a relatively obscure topic in environmental economics
  - ~50 published articles and 2 books on the subject

Exxon Valdez Oil Spill 1989

History of SP

Following Exxon-Valdez oil spill:

- Congress stipulates that lost 'passive use' value is compensable in litigation over oil spill damages
- US, Alaska, Exxon hire teams of economists to conduct valuation studies and discredit other side's studies
- Carson et al (1992, 2003): $7.2b in damages
- NOAA Panel 1993 – 'objective' assessment of the contingent valuation method and establishment of 'best practice'
- JEP symposium assessing scientific merit basically poses the question: are these numbers worthless? (Diamond and Hausman, 1994),

History of SP

From 1990-2010: a large, multi-faceted research agenda unfolds investigating the validity of SP approaches applied in many different environmental contexts

2010 BP (Deepwater Horizon) Spill

- This will sound familiar…
- US, Gulf States, BP hire teams of economists to conduct valuation studies and discredit other side's studies
- Bishop et al (2017): $17.2b in damages
- *JEP* symposium assessing scientific merit of the methods…
  - But this time: more than 2,500 published articles, 25 books, much accumulated wisdom on best practices to discuss

Some examples: discrete choice experiments

22. CHOICE 1: Which do you prefer—Trip A, Trip B or "Not Visit"?

Please check ONE box at the bottom of the table to indicate whether you prefer Trip A, Trip B or Not Visit. If you choose Trip A or Trip B, write the number of days you spend on a trip doing only that activity.

Note that we shaded the boxes that are the same for both trips. The conditions and prices described in this question may be different than what the parks are like today.

	Activity	Trip A	Trip B	Not Visit
		Take a guided snowcoach tour to see park sights in Yellowstone starting at the South entrance (near Flagg Ranch)	Take an unguided snowmobile trip in Yellowstone starting from the West entrance (near West Yellowstone)	I would not enter Yellowstone or Grand Teton National Park if these were my only choices
Conditions during day trip	Daily snowmobile traffic at the entrance where you started	High (800 to 1,500 snowmobiles)	Moderate (300 to 600 snowmobiles)	
	Snowmobile traffic at most crowded part of the trip	High (800 to 1,500 snowmobiles)	Moderate (300 to 600 snowmobiles)	
	Condition of snow on the road or trail surface for all or most of the trip	Smooth	Bumpy and rough	
	Highest noise level experienced on trip	Loud (Like a gas-powered lawn mower or a busy highway)	Loud (Like a gas-powered lawn mower or a busy highway)	
	Exhaust emission levels	Very noticeable	Very noticeable	
	Total Cost for DAY per person	$230	$50	
	I would choose… (check only one)	☐ If you planned a trip doing just this activity, how many days would you spend on the trip? _____ days	☐ If you planned a trip doing just this activity, how many days would you spend on the trip? _____ days	☐ **go to Question 22b below**

22b. Answer this question if you chose "Not Visit": What would you likely do instead?

- ☐ Stay at home; I would not travel to the Greater Yellowstone Area
- ☐ Travel to the Greater Yellowstone Area to snowmobile outside the Parks.
- ☐ Travel to the Greater Yellowstone Area to cross-country ski outside the Parks.
- ☐ Travel to the Greater Yellowstone Area to downhill ski at Big Sky or one of the ski areas near Jackson Hole.
- ☐ Other, please describe activity _____
  location _____

Some examples: contingent valuation

Abbreviated Water Quality Descriptions from Phaneuf et al. survey

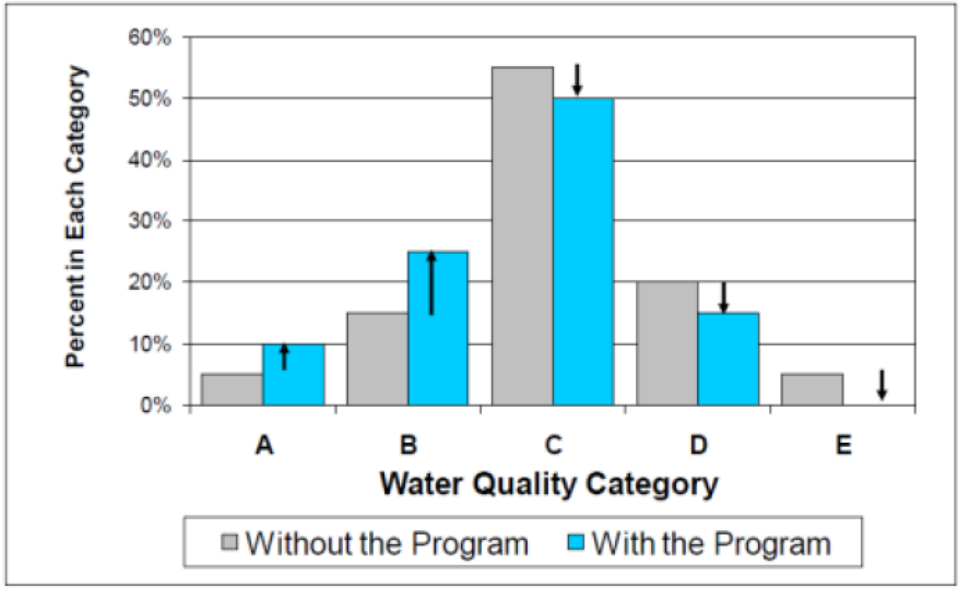
CATEGORY	A	B	C	D	E
COLOR	Blue	Blue/brown	Brown/green	Brown/green	Green
CLARITY	Can see 5 feet deep or more	Can see 2–5 feet deep	Can see 1–2 feet deep	Can see at most 1 foot deep	Can see at most 1 foot deep
FISH	Abundant game fish and a few rough fish	Many game fish and a few rough fish	Many rough fish and a few game fish	A few rough fish but no game fish	A few rough fish but no game fish
ALGAE BLOOMS	Never occur	Small areas near shore; some years, 1–2 days	Small areas near shore; most years, 1 week	Large areas near shore; once a year, 2–3 weeks	Large, thick areas near shore; every year, most of summer
ODOR	No unpleasant odors	1–2 days a year, faint odor	1–2 days a year, faint odor	3–4 days a year, noticeable odor	Several days a year, noticeable odor

Some examples: contingent valuation

"Imagine that the state agency in charge of water resources in NC is considering a program to improve lake water quality. Under the program being considered, efforts to reduce nitrogen and phosphorus would spread among many different groups. For example,

- *sewage treatment plants would have to install better treatment systems;*
- *residents using septic tanks would have to inspect these systems for leakage;*
- *towns and housing developments would have to install improved systems for managing water runoff from storms;*
- *farms would have to reduce fertilizer runoff from fields*

The changes required by the program would have a cost for all North Carolina households. Some of the basic things people spend money on would become more expensive. For example, for homeowners, water bills or costs for maintaining septic systems would go up. For renters, rent or utility bills would go up. ***Imagine that for households like yours, starting next year, the program would permanently increase your cost of living by $B per year."***



Estimation: the Random Utility Model (RUM)

$$U_{ijt} = -\alpha price_{jt} + \beta x_{ijt} + \varepsilon_{\mathrm{ijt}}$$

The RUM is not specific to environmental economics. In fact, it originated in the Industrial Organization literature (cereal demand and modes of transportation!). It is often used in housing location models, transportation decision models, and many other things that have a "discrete" choice setting.

The model predicts the probability that an individual makes a particular choice based on a set of explanatory variables ("right hand side").

$$P_{ijt} = Prob\left(U_{ijt} > U_{ikt}\right) = \frac{\exp\left(U_{it,j=1}\right)}{\sum_{j}^{J} \exp\left(U_{ijt}\right)}$$

Estimation: the Random Utility Model (RUM)

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Some questions to check your understanding:

1) How could we find the average MWTP for an environmental characteristics, x^{env}?

2) Applying the RUM to the contingent valuation example from a few slides ago (lakes of category A, B, C, D, E, with a payment bid of B), any ideas how we could modify the model to estimate the per trip willingness to pay for an improvement in water quality from level E to level D?

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$$U_{ijt} = -\alpha price_{jt} + \sum_{k=A}^{E} \gamma_k D_{ijkt} + \varepsilon_{\text{ijt}}, \qquad WTP_{E \to D} = \frac{(\gamma_D - \gamma_E)}{\alpha}$$

The (major) thorn in the side: Hypothetical Bias

Term used to describe empirical regularity showing that hypothetical values are larger than real payment values.

- People are uncertain or unsure?
- Absence of market 'discipline' from repeated interactions

Meta-analysis results of ~30 lab and field studies:

- List et al. (2001) – mean hypothetical > real by factor of 3
- Murphy et al. (2005) – median hypothetical > real by factor of 1.5

Methods research focused on mitigating hypothetical bias:

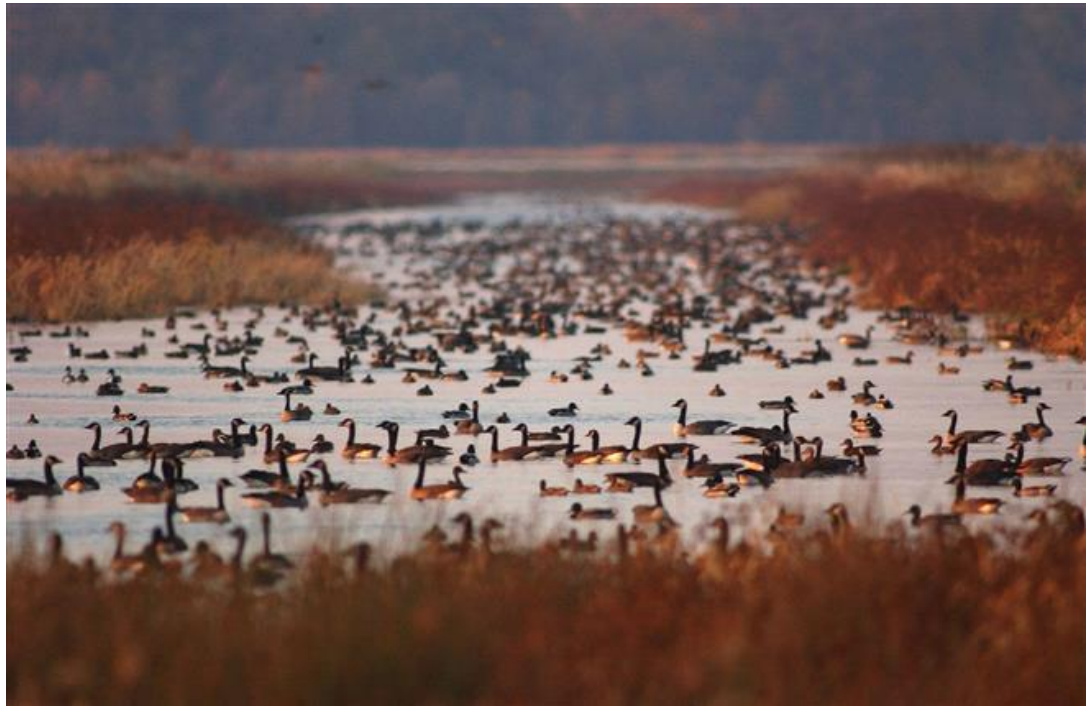
- Cheap talk
- Certainty scales – recode 'uncertain yes' to 'no'
- Consequentiality

Does hypothetical bias always imply invalidity?

Example of hypothetical bias and a wedge between WTP/WTA: “The value of goose hunting in the Horicon Marsh”, Bishop and Heberlein (1979)

Horicon Marsh (WI): huge flocks of Canada Goose migrate through each year in September and October, but in the 1970s populations were low, population recovered sufficiently for hunting in 1978. Around 200K annually go through the marsh now.

At over 33,000 acres in size, Horicon Marsh is one of the largest freshwater marshes in the United States. The marsh provides critical habitat for over 300 species of birds as well as muskrats, red foxes, turtles, frogs, bats, dragonflies, fish and much more. Fall migration on the refuge offers impressive numbers of Canada geese, ducks and sandhill cranes.



Example of hypothetical bias and a wedge between WTP/WTA: "The value of goose hunting in the Horicon Marsh", Bishop and Heberlein (1979)

Bishop and Heberlein ran an experiment in 1978 on hunters at the Marsh.

Calculated MWTP/MWTA curves for 3 separate groups:

1. **[CV – WTP]** Used contingent valuation to ask hunters who did not get a permit what they would have been willing to pay: ("If a permit were offered at $X, would you buy it?")

2. **[CV – WTA]** Used contingent valuation to ask hunters who applied for permit and won it what price they would sell it for: ("If you were offered $Z for your permit, would you sell it?")

3. **[Actual - WTA]** Made actual, real offers to buy permits from hunters who applied and received a permit. ("Here's a check for $Y. Keep the check and send us your permit, or send back the check.")

Which of these average value/permit measures do you think was the highest?…

Assessing the validity of SP estimates

Table 1

Summary of Validity Concepts for Stated Preference Methods

Criterion	*Generic question*	*Specific question*
Criterion validity	Does the measure relate favorably to other measures that are considered legitimate criteria (i.e., are believed to be accurate)?	Is the estimate generated by stated preference methods the same as a willingness-to-pay value that would be generated if real payment was made?
Convergent validity	Does the measure correlate well with other measures of the same thing?	Is the estimate generated by a stated preference method the same as the willingness-to-pay value that is estimated from a revealed preference method?
Construct validity	Does the measure correlate as expected to other measures as predicted by theory?	Does the estimate generated by a stated preference method relate to income, prices, and other variables in the way economic theory predicts?
Content validity	Does the measure adequately cover the construct's domain?	Does the estimate arise from the best study design practices—including scenario description, econometric analysis, elicitation format, follow up questions, etc.?

Criterion Validity

The gold standard of validity:
Does the SP prediction match something we assert to be a suitable benchmark?

1) Lab experiments
- Ask lab respondents hypothetical value for a good (e.g. “tree planting”), then perform a binding vote for which payment is made and good is provided if majority vote yes.

2) Field experiments
- Real vs. hypothetical payments in field context (e.g. Blumenschein et al, 2008)

3) Referendum experiments
- SP survey timed to match a real, binding referendum (e.g. Johnston, 2006)

Convergent Validity

Do estimates from different methods (e.g. stated and revealed preference or different types of stated preference methods) give similar predictions?

- Travel cost vs. contingent valuation (RP vs. SP)
- Hedonics vs. choice experiments (RP vs. SP)
- Choice experiments vs. contingent valuation (SP vs. SP)

Generally, the we observe convergence between RP and SP estimates. When gaps do remain, there is often a common economic phenomena that can explain it.

More recent emphasis:

- Combining information from both RP and SP elicitations to harness strengths of both

Content Validity

Is best practice being followed?

- Defining ‘best practice’ today is generally easier than defining it in 1990
- 1000s of case studies, lots of folk wisdom on what ‘works’

Things that seem to matter a lot:

- payment vehicles people do not object to
- consequentiality
- budget constraint reminders (cheap talk)
- premium on specificity of context
- premium on realism
- communicating scientific concepts in lay language
- importance of focus groups and pretesting

Construct Validity

Early validity tests looked at violations of theory inherent in SP data:

- scope tests/imbedding
- income elasticity tests
- downward sloping demand tests
- approximately equal WTP and WTA

Well-executed SP studies today usually produce results that are consistent with theory – perhaps because modern theory can rationalize many outcomes.

Overlooked Benefits of Nutrient Reductions in the Mississippi River Basin
By: Parthum and Ando (2020)

Abstract: Improvements in local surface water quality in the Mississippi River Basin (MRB) can contribute to the regional environmental goals of reducing hypoxia in the Gulf of Mexico. To inform estimates of the benefits of water quality policy, we use a choice experiment survey in a typical sub-watershed of the MRB to estimate willingness to pay for local environmental improvements and helping to reduce hypoxia far downstream. We find that residents place large values on reduced local algal blooms, improved local fish populations and diversity, and meeting local commitments to help with the regional environmental problem.

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1. What is the value of reducing nutrient pollution in the Mississippi River Basin?

2. How are those values distributed across geography and do they differ among rural and urban areas (does the “rural-urban divide” exist in nonmarket values)?

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Research Questions:

1. What is the value of reducing nutrient pollution in the Mississippi River Basin?
   - $9 - $62 per household per year (depends on the policy) and $3.6m to $9.7m total in the watershed

2. How are those values distributed across geography and do they differ among rural and urban areas (does the "rural-urban divide" exist in nonmarket values)?
   - Rural household value reductions just the same as urban households, and the total WTP depends more on the location of the improvement than on the demographics of that location.

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The Data:

1. Survey of 343 respondents. Each answered 6 survey questions.

Survey Design:

1. Each individual was shown a map of the area and where they live in comparison to the ecological improvements.
2. Among other measures taken ("cheap talk script", certainty questions, etc.), the maps help reduce respondent error and cognition, improving the overall efficiency of the coefficient estimates.

Concern: Internal Validity

- A common criticism of stated preference research involves the internal validity of the survey responses. After all, people are simply stating what they will choose, not actually buying.

1. "Cheap talk" script, or the "please try hard and please be honest" script

> "Experience from previous similar surveys is that people often say they would be willing to pay more money for something than they actually would. For example, in one study, 80% of people said they would buy a product, but when a store actually stocked the product, only 43% of people actually bought the new product. It is important that you make each of your upcoming selections like you would if you were actually facing these exact choices in reality. Note that paying for environmental improvement means you would have less money available for other purchases."

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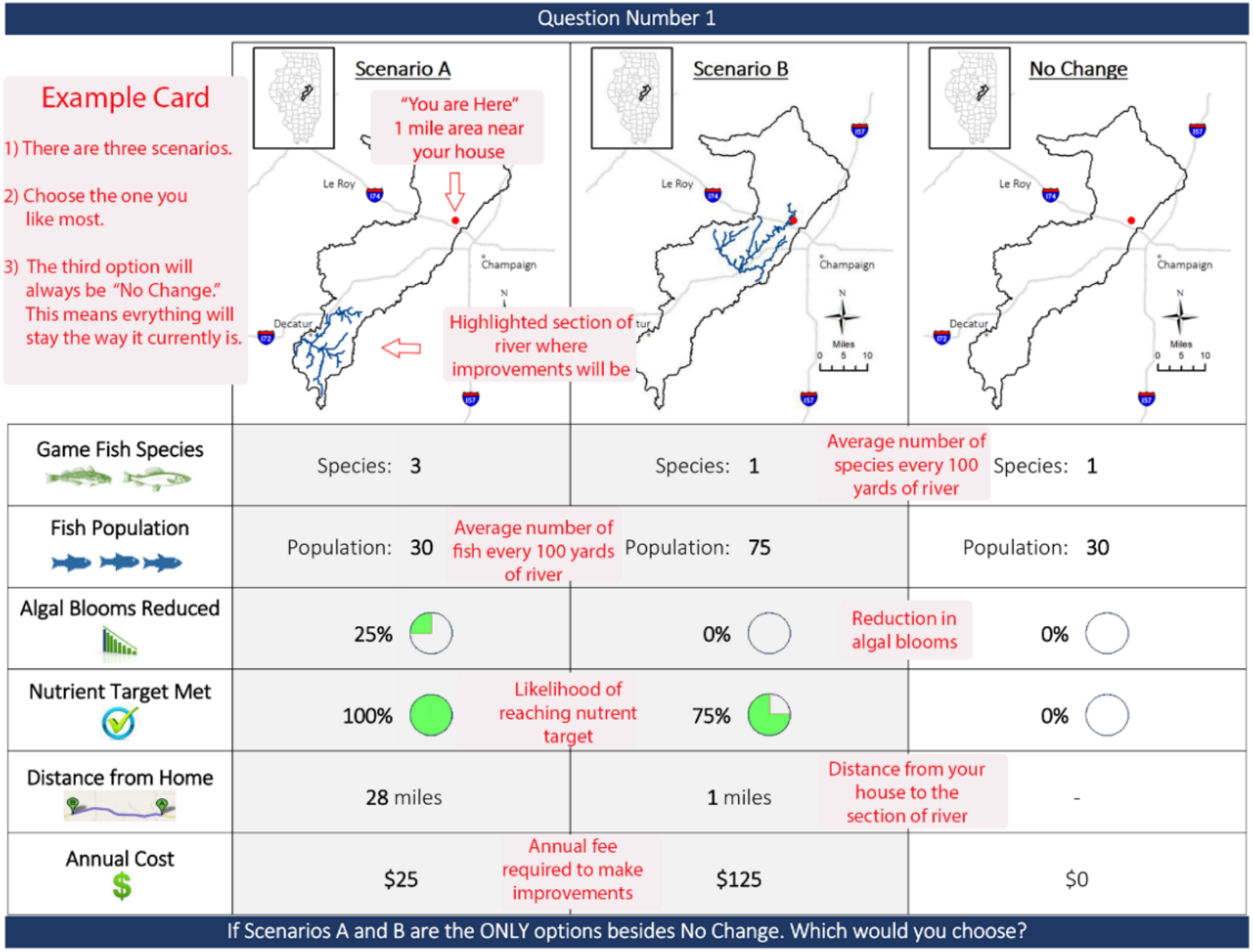
2. Certainty follow-up questions:

> "How confident are you in your answer?" With the range: "0 - not at all confident"; "1- somewhat confident"; and "2 - very confident."

Concern: Respondent Comprehension



- A second common criticism involves the respondent's comprehension of the survey.
- Here, this concern is addressed by providing place-specific improvements with individual-specific maps that show the respondent exactly where they live in comparison to the improvement.

Concern: Representativeness of the Sample

- A third common criticism involves both the internal and external validity of the survey.
- How comparable is the sample to the population?
- Researchers will often provide a table that summarizes the similarities and differences across key dimensions such as sex, age, income, and education.

Table B.2: Differences between Survey Respondents and U.S.Census (2019)

	(1) Respondents	(2) Census	(3) Difference
Works in Agriculture	0.15 (0.00)	0.05 (0.03)	-0.10*** (0.01)
Male	0.32 (0.00)	0.50 (0.04)	0.18*** (0.01)
White	0.77 (0.00)	0.94 (0.10)	0.16*** (0.02)
Homeowner	0.57 (0.00)	0.75 (0.16)	0.18*** (0.03)
Age			
18 - 29	0.22 (0.23)	0.18 (0.04)	-0.05 (0.04)
30 - 44	0.30 (0.31)	0.23 (0.04)	-0.07 (0.06)
45 - 64	0.36 (0.35)	0.38 (0.04)	0.02 (0.06)
> 65	0.12 (0.20)	0.21 (0.05)	0.09** (0.04)
Household income ($k)			
< $25,000	0.06 (0.10)	0.12 (0.17)	0.07* (0.03)
$25,000 - $34,999	0.01 (0.03)	0.07 (0.03)	0.07*** (0.01)
$35,000 - $49,999	0.15 (0.24)	0.13 (0.08)	-0.02
$50,000 - $74,999	0.20 (0.31)	0.20 (0.06)	0.00 (0.06)
$75,000 - $99,999	0.22 (0.31)	0.18 (0.07)	-0.04 (0.06)
$100,000 - $149,999	0.18 (0.27)	0.17 (0.07)	-0.00 (0.05)
$150,000 - $199,999	0.18 (0.22)	0.07 (0.05)	-0.11*** (0.04)
> $200,000	0.01 (0.02)	0.04 (0.04)	0.04*** (0.01)
Education			
Less than high school	0.22 (0.29)	0.06 (0.04)	-0.16*** (0.05)
High school/GED	0.12 (0.27)	0.35 (0.09)	0.23*** (0.05)
Some college	0.21 (0.22)	0.24 (0.04)	0.03 (0.04)
Two-year degree	0.08 (0.21)	0.09 (0.02)	0.01 (0.04)
Four-year degree	0.19 (0.20)	0.16 (0.07)	-0.03 (0.04)
Graduate degree	0.18 (0.33)	0.08 (0.07)	-0.10 (0.06)
Zip Codes	42	42	42

Standard errors in parentheses *p<0.1; **p<0.05; ***p<0.01

Results

Table 2: MWTP to Reduce Nutrient Transmission to the Gulf of Mexico

	(1) Full Sample		(2) ASC Heterogeneity	
	Mean MWTP	Std. Dev.	Mean MWTP	Std. Dev.
Distance (miles)	-0.67***	92.57***	-0.68***	1.22***
	(0.15)	(18.69)	(0.15)	(0.26)
Fish Species	4.73**	1.06***	4.72**	12.32***
	(1.48)	(0.26)	(1.55)	(2.14)
Fish Population	0.17**	6.58***	0.16**	0.38***
	(0.06)	(2.12)	(0.06)	(0.08)
Algal Blooms (%)	0.77***	0.35**	0.88***	0.96***
	(0.11)	(0.09)	(0.1)	(0.13)
Nutrient Target (%)	0.95***	0.85***	1.14***	0.89***
	(0.13)	(0.16)	(0.13)	(0.12)
Status Quo (No Program)	-69.49***	1.42***	-20.25	77.02***
	(14.78)	(0.23)	(13.48)	(21.19)
Status Quo × Rural			-48.79***	171.45***
			(14.33)	(26.29)
Status Quo × Aware of Water Issues			-65.82***	106.84***
			(16.34)	(21.01)
λ (cost coefficient)	-3.17***	0.85***	-2.71***	0.77***
	(0.32)	(0.13)	(0.42)	(0.12)
Observations (Respondents)	2058 (343)		2058 (343)	
Log-likelihood	-1717.19		-1717.77	
AIC	3506.38		3527.54	
McFadden ρ^2	0.15		0.15	

Note: Column 1 provides the results of the WTP-space model for the pooled (full) sample. Column 2 introduces an interaction between the Status Quo dummy and respondent characteristics. Correlation matrices of the random parameters can be found in the appendix (Table B.7). Standard errors in parentheses where $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$.

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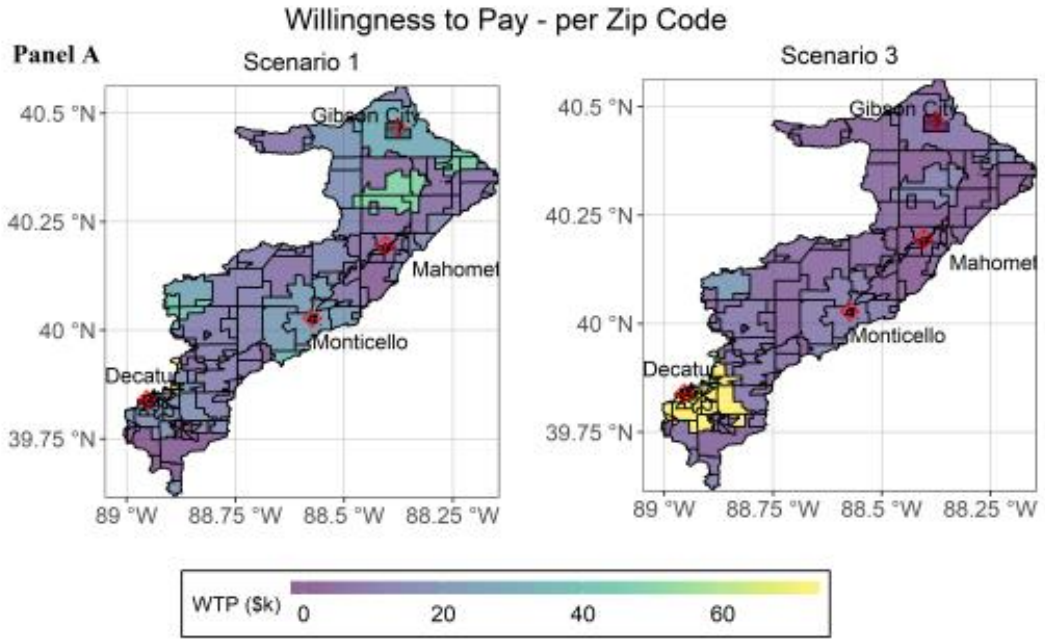
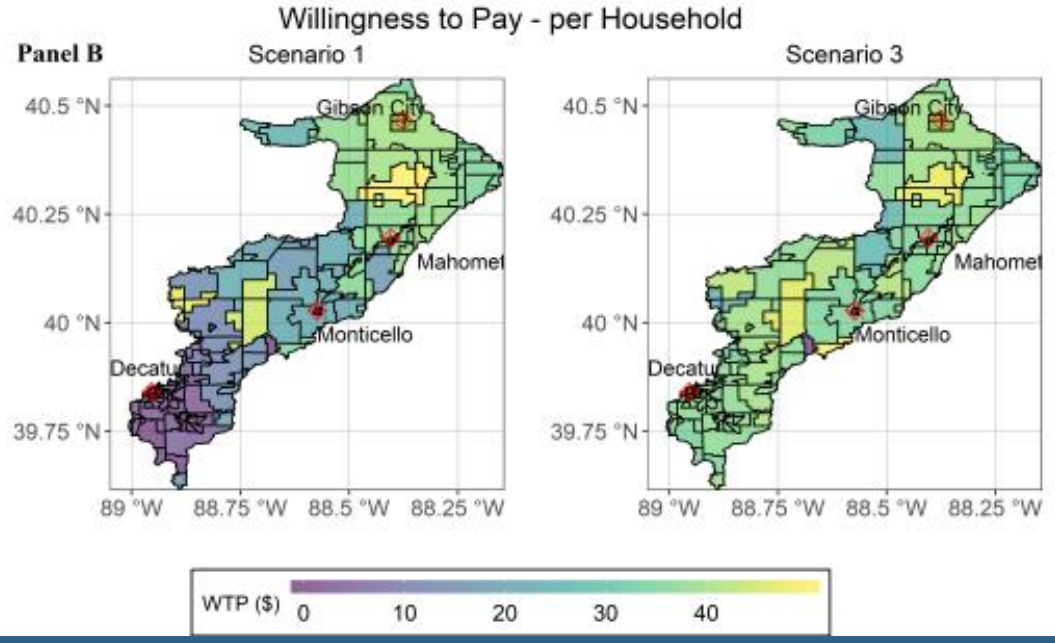
Log-likelihood	-1717.19		-1717.77	
AIC	3506.38		3527.54	
McFadden ρ^2	0.15		0.15	

Note: Column 1 provides the results of the WTP-space model for the pooled (full) sample. Column 2 introduces an interaction between the Status Quo dummy and respondent characteristics. Correlation matrices of the random parameters can be found in the appendix (Table B.7). Standard errors in parentheses where $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$.



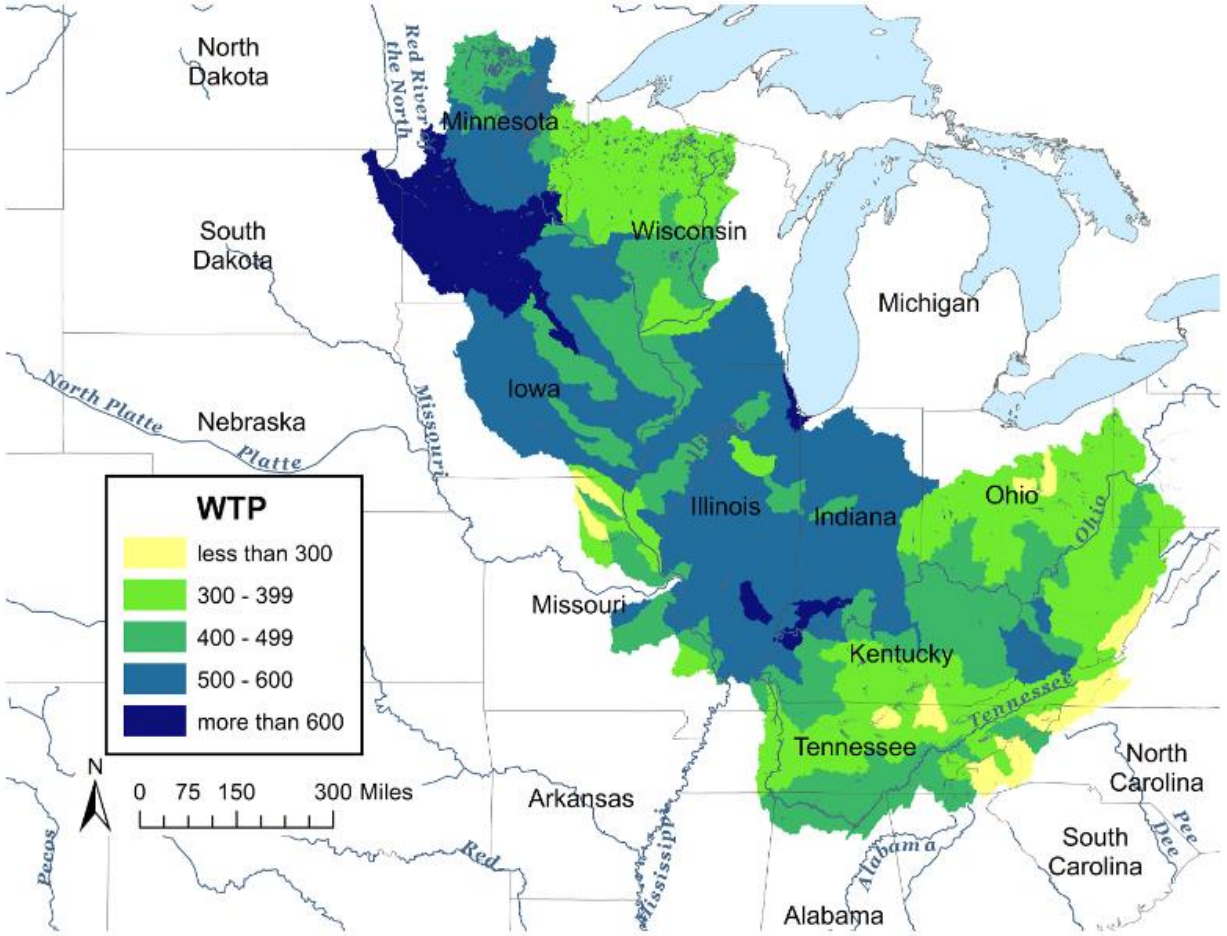


- While the total value from reductions in nutrient pollution accrues to urban population centers, the marginal willingness to pay is uniform throughout the watershed.
- We do not find evidence of a “rural-urban divide” in willingness to pay for surface water quality improvements.

- Can we expand the spatial resolution at which we apply this general methodology?

- "Valuing improvements in the ecological integrity of local and regional waters using the biological condition gradient", Vossler et al. (2023, PNAS)

Fig. 5.



Spatial distribution of local WTP for a minimum BCG level 2 policy ($ per household in the affected watershed, annual payment for 5 years).

Where else is the SP paradigm applicable?

“Valuing a reduction in the risk of infertility: A large scale multi-country stated preference approach”, Dussaux et al. (2023)

While fertility decline is a global phenomenon that has many causes, part of it can be explained by exposure to substances linked to reproductive toxicity that are produced and lead to human exposure through the environment and products. Authorities face challenges in regulating reprotoxic substances through actions such as bans and prohibitions, because of the difficulty in explicitly considering the economic benefits and costs of such regulations…

The present paper details a stated preference survey **estimating WTP to reduce the risk of infertility**, filling an important gap in the valuation literature and addressing a need for applied benefits analysis for chemicals regulation…

The estimated mean Value of a Statistical Case (VSC) of infertility equals USD2022 Purchasing Power Parity (PPP) 91 000 and the median VSC equals USD2022 PPP 50 000…

SP elicitation is directly related to other mechanism design work focused on truthful elicitation of information/preferences.

Honesty via Choice-Matching
Cvitanić, Prelec, Riley and Tereick (2019, AER:I)

We introduce choice-matching, a **class of mechanisms for eliciting honest responses to a multiple choice question (MCQ), as might appear in a market research study, opinion poll, or economics experiment**. Under choice-matching, respondents are compensated through an auxiliary task, e.g., a personal consumption choice or a forecast. Their compensation depends both on their performance on the auxiliary task, and on the performance of those respondents who matched their response to the MCQ. **We give conditions for such mechanisms to be strictly truth-inducing, focusing on a special case in which the auxiliary task is to predict the answers of other respondents**.

(This is way, way beyond the scope of our course, but other applications perhaps of interest to some…)

Next class

- Wednesday we'll discuss an approach to estimate climate damages
    - DICE Model (2017) by Nordhaus
        - You are going to run a simple version of this model in R next week, so I might suggest coming to class prepared and with questions ☺
    - A pair of videos listed on syllabus