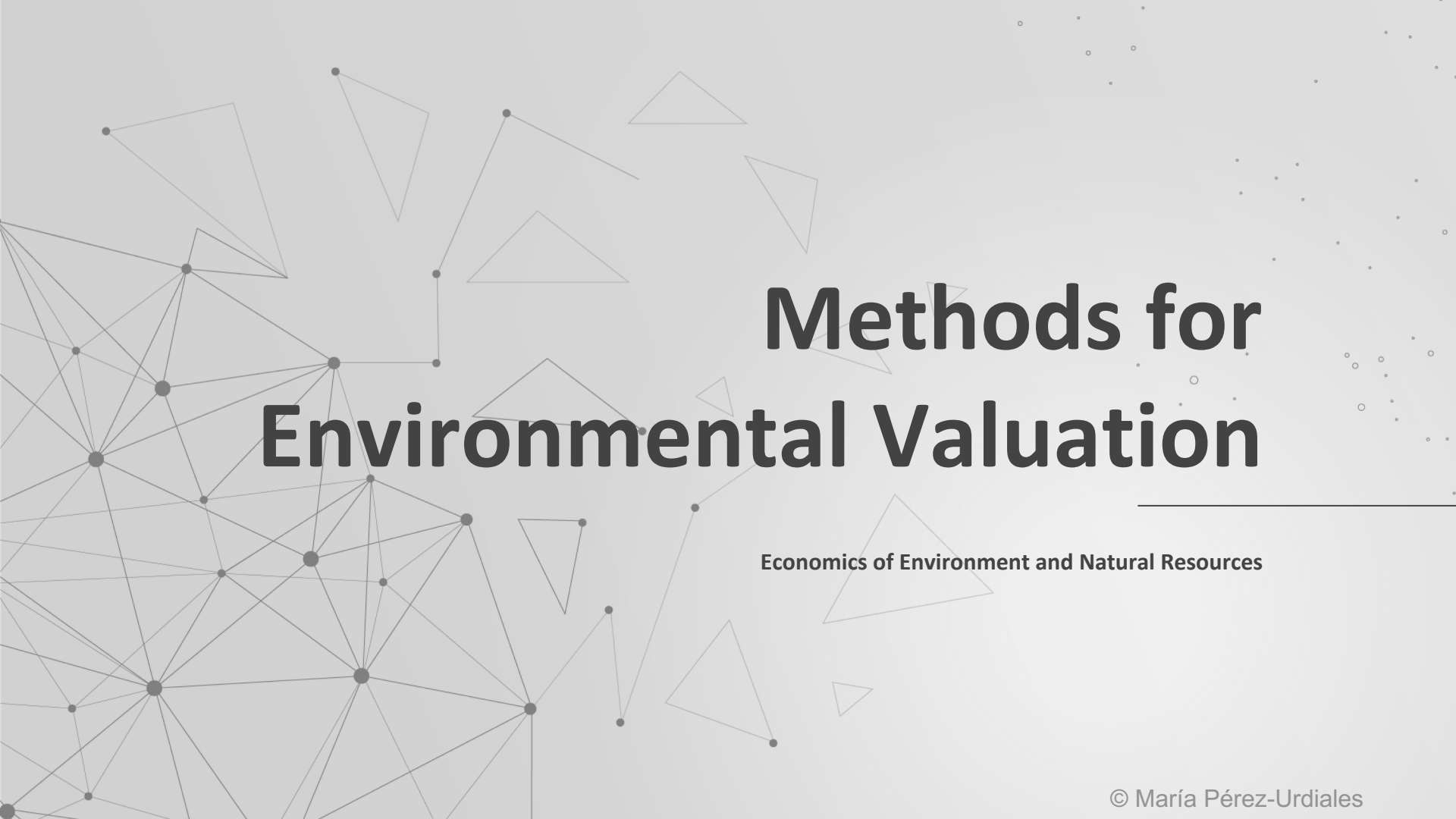
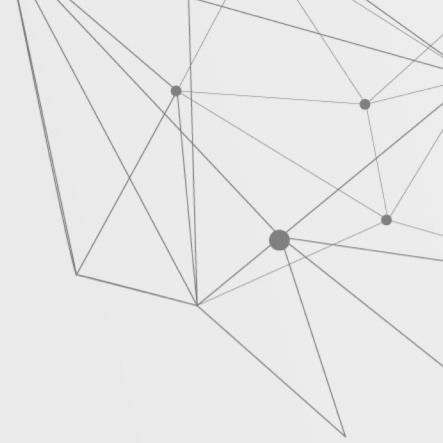


The background features a complex network of thin grey lines connecting various points, forming a web-like structure. Scattered throughout are several triangles of different sizes and orientations, some with solid black dots at their vertices. The overall aesthetic is modern and technical.

Methods for Environmental Valuation

Economics of Environment and Natural Resources



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01

INTRODUCTION

INTRODUCTION

In this chapter, we study several methods to value the Environment. In particular:

- Understand the complexities associated with Cost-Benefit Analysis due to the monetization of benefits and costs.
- Classify different nonmarket valuation methods depending on whether they are based on a hypothetical market or on observed behavior.
- Compare these methods and identify strengths and weaknesses.

INTRODUCTION

EXAMPLE:

Exxon Valdez oil spill in the coast of Alaska (1989):

- 11 million gallons of spilled oil
- Cost of cleaning the oil -> \$2.1 billion
- Cost to the local fishermen, economy and wildlife

Prestige oil spill in Spain (2002):

- 17.8 million gallons of heavy fuel oil
- Cost of cleaning the oil -> 2.5€ billion
- Cost to the local fishermen, economy and wildlife

[The BP oil spill \(2010\)](#)



INTRODUCTION

EXAMPLE:

- How can we estimate the damages caused by the oil spill?
- Different values for the damages:
 - Use value
 - Option value
 - Passive-use value



02

VALUING THE ENVIRONMENT

VALUING THE ENVIRONMENT

Humans valuing the Environment:

- Environmental Philosophy: Deep Ecology
 - The Environment has an intrinsic value, independent of human interests.
 - The Environment also has an instrumental value, derived from its usefulness satisfying human needs.
- Two issues to consider:
 - What is the basis for Environmental valuation? -> The Environment has a value beyond its direct usefulness to humans.
 - How can we determine the valuation? -> Complex issue.

VALUING THE ENVIRONMENT

How can we determine the Environmental valuation?

- Based on human preferences (For Environmental Economics).
- No moral basis allows humans to determine the value of other species (Deep Ecology).
 - Humans should only value resources when necessary for survival.
 - Otherwise, Nature should not be valued by humans.

BUT:

- If humans do not value the Environment, it would be assigned ZERO value in policy design.
- Assigning zero value will lead to Environmental Degradation that cannot be valued.

VALUING THE ENVIRONMENT

VALUING THE ENVIRONMENT:

- POLLUTION from Oil Spill as an example:
 - Multiple damages due to the Oil Spill (Costs):
 - Polluted water can cause illness or death when ingested/exposed to. (Direct impact)
 - Loss of Economic activity. (Direct impact)
 - Damage to wildlife and vegetation. (nonmarket impact)
 - Loss of enjoyment from outdoor water activities. (nonmarket impact)
- Need to find the tools to measure these damages.

VALUING THE ENVIRONMENT

MEASURE ENVIRONMENTAL DAMAGE REQUIRES:

- Identifying all the affected categories.
- Analyzing the relationship between the oil spill and the damages caused to the categories.
- Analyzing the responses by the affected parties in terms of averting part of the damage.
- Assigning a monetary value on the physical change.



VALUING THE ENVIRONMENT

Types of Economic Values

- Use Value
 - The willingness to pay for direct use of the environmental resource.
 - Example: fish harvested from the sea, water used for irrigation in the agricultural sector, etc.
- Option Value
 - The willingness to pay for the future ability to use the environment.
 - Example: National Park, clean lake, forest, etc.



VALUING THE ENVIRONMENT

- Passive-use Value (Non-consumptive Use Value)
 - Individuals' willingness to pay to preserve a resource that he or she will never use.
 - Example: preserving a resource for your children.

Economic value/ Total Willingness to Pay (TWTP)= Use value + Option value + Passive-use value

- Market goods-> easy to measure, straightforward TWTP
- Non-market goods-> not directly quantifiable, need to estimate through survey responses or examining observed behavior

VALUING THE ENVIRONMENT

VALUATION METHODS

- Revealed preference method
 - Methods which are based on actual observable choices and from which actual resource values can be directly inferred
 - Example: declined in fish catch after oil spill and the value of the declined catch
- Stated preference method
 - Methods to elicit respondents' willingness to pay when the value is not directly observable
 - Example: What is your willingness to pay to protect the Long Island sound?



VALUING THE ENVIRONMENT

Methods	Revealed Preference	Stated Preference
Direct	Market Price	Contingent Valuation
	Simulated Markets	
Indirect	Travel Cost	Attribute-Based Models
	Hedonic Property Values	Conjoint Analysis
	Hedonic Wage Values	Choice Experiments
	Avoidance Expenditures	Contingent Ranking

Source: Modified by the author from Mitchell and Carson, 1989.

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03

STATED PREFERENCE METHODS

STATED PREFERENCE METHODS

CONTINGENT VALUATION (Direct Method)

- Designed to elicit people's willingness-to-pay (WTP) in a hypothetical market.
- It provides a way to identify values that cannot be obtained otherwise.
 - Example:
 - Survey participants are asked about their willingness to pay for some environmental change
 - Would you be willing to pay for reducing the risk of Moose-vehicle collisions?

STATED PREFERENCE METHODS

CONTINGENT VALUATION

Potential issues:

- Strategic bias
- Information bias
- Starting-point bias
- Hypothetical bias
- Discrepancy between WTP and willingness-to-accept (WTA)

STATED PREFERENCE METHODS

STRATEGIC BIAS

- Survey respondent “deliberately misrepresents their preferences in order to influence the decision-making process” (Bennett and Blamey, 2001).
- Example: Contingent valuation study to reduce the risk of Moose-vehicle collisions by constructing highway wildlife crossings. The actual decision depends on whether the survey provides a sufficiently high value. A respondent that enjoys wildlife watching may be tempted to overstate the WTP to ensure the decision.

STATED PREFERENCE METHODS

INFORMATION BIAS

- Survey respondent has little or no experience with the attribute to value.
- Example: Contingent valuation study to reduce the risk of Moose-vehicle collisions by constructing highway wildlife crossings. If the survey is conducted in Long Island, residents may not have enough experience to provide a value.

STATED PREFERENCE METHODS

STARTING-POINT BIAS

- Survey respondent may provide a different answer depending on the context in which a question is put.
- Example: Anchoring effect in a restaurant.

STATED PREFERENCE METHODS

HYPOTHETICAL BIAS

- Survey respondent may not provide a serious answer because he/she is confronted by hypothetical scenarios, that is, he/she will not actually pay.
- Example: Landry et al. (2006) conducted a door-to-door survey in which the interviewer was increasingly attractive. It led to significant increase in the value provided by the respondent, particularly by the male households.

STATED PREFERENCE METHODS

DISCREPANCY BETWEEN WTP AND WTA

- Survey respondent may understate their WTP to avoid some loss.
- Survey respondent may overstate their WTA to compensate for the same loss.

STATED PREFERENCE METHODS

ATTRIBUTE-BASED METHODS (INDIRECT)

- Choice-based, conjoint analysis, choice experiments
- Contingent ranking
 - These methods are based on surveys, but respondents are asked to choose among alternate bundles of goods. That is, they do not directly state their WTP. Each bundle has a set of attributes and the levels of each attribute vary across bundles. Since one of the attributes in each bundle is a price measure, willingness to pay can be identified.

Choice-based, conjoint analysis, choice experiments

Consider an example (Landry and Mires, 2017 working paper) that surveyed North Carolina residents on their preferences and willingness to pay for marine cultural heritage sites (e.g. shipwrecks). The choice experiment included 5 attributes including the preservation zone, the availability of public programs and whether or not there was a walking, virtual or driving trail. Table 4.2 reproduces the attributes and levels. With three attributes with three levels and two with two levels, there is a possibility of 216 different profiles. Best practices suggests the use of a fractional factorial design and the authors chose 8 versions with 3 choice sets per version of the survey, resulting in 24 choice sets.

Attributes	Levels
Preservation Zone	• Status Quo; 30 shipwrecks protected • 38 more shipwrecks (68 total; 127% increase); 2,192 m² of bottomland • 56 more shipwrecks (124 total; 313% increase); 13,498 m² of bottomland
Public Programs	• No change • Increase museum exhibits and provide educational workshops • Increase museum exhibits and provide educational workshops, plus public television series about shipwrecks and creation of boating tours to shipwrecks
Walking Trail	• Yes/ No
Virtual Trail	• Yes/ No
Diving Trail	• Yes/ No

I: Here is the first voting opportunity
(Please choose one of the four options below by putting an "X" in one of the empty boxes)

26.	Program 1	Program 2	Program 3	Status Quo
Preservation Zone	Yellow Zone	Yellow Zone	Red Zone	Red Zone
Public Programs	Large Investment	No Investment	Large Investment	No Investment
Walking Trails	Yes	No	No	No
Virtual Trails	No	Yes	Yes	No
SCUBA Diving Trails	Yes	No	No	No
One-time Tax	\$12	\$55	\$145	\$0
put an "X" in one of the boxes to the right	☐	☐	☐	☐

27. How confident are you about this choice from these options? (Please select one)

☐ Very Certain ☐ Somewhat Certain ☐ Somewhat Uncertain ☐ Very Uncertain ☐ Don't Know

II: Now consider another voting opportunity with different choices
(Please choose one of the four options below by putting an "X" in one of the empty boxes)

28.	Program 4	Program 5	Program 6	Status Quo
Preservation Zone	Orange Zone	Orange Zone	Yellow Zone	Red Zone
Public Programs	Large Investment	No Investment	No Investment	No Investment
Walking Trails	No	Yes	No	No
Virtual Trails	No	Yes	No	No
SCUBA Diving Trails	Yes	No	Yes	No
One-time Tax	\$145	\$12	\$55	\$0
put an "X" in one of the boxes to the right	☐	☐	☐	☐

29. How confident are you about this choice from these options? (Please select one)

☐ Very Certain ☐ Somewhat Certain ☐ Somewhat Uncertain ☐ Very Uncertain ☐ Don't Know

III: Finally, consider this third opportunity with different choices
(Please choose one of the four options below by putting an "X" in one of the empty boxes)

30.	Program 7	Program 8	Program 9	Status Quo
Preservation Zone	Red Zone	Red Zone	Yellow Zone	Red Zone
Public Programs	No Investment	Moderate Investment	Moderate Investment	No Investment
Walking Trails	Yes	No	Yes	No
Virtual Trails	Yes	No	Yes	No
SCUBA Diving Trails	No	Yes	No	No
One-time Tax	\$12	\$145	\$55	\$0
put an "X" in one of the boxes to the right	☐	☐	☐	☐

31. How confident are you about this choice from these options? (Please select one)

☐ Very Certain ☐ Somewhat Certain ☐ Somewhat Uncertain ☐ Very Uncertain ☐ Don't Know

STATED PREFERENCE METHODS

Contingent ranking method

- Survey respondents are presented with a set of hypothetical situations that differ in terms of the environmental amenity available (instead of a bundle of attributes).
- Respondents are asked to rank-order the hypothetical situations.
- WTP can be inferred from the responses.

04

REVEALED PREFERENCE METHODS

REVEALED PREFERENCE METHODS

Two main characteristics:

- These methods are based on observables: behaviour and expenditures.
- They are categorized as indirect as they infer a value rather than compute it directly.

REVEALED PREFERENCE METHODS

TRAVEL COST METHOD:

- This method is commonly used to value parks, fisheries, wildlife preserves, etc.
- Values are inferred by analyzing how much visitors spent getting to the recreational resource.
- Using the values, a demand curve is estimated and therefore, the WTP.
- BUT: It only identifies Use Value.

REVEALED PREFERENCE METHODS

TRAVEL COST METHOD:

- Two possible analysis:
 1. Measure the number of visitors to a recreational resource.
 2. Identify whether the population decides to visit a recreational resource and if so, which one.

Therefore, this method identifies:

- The travel expenses
- The opportunity cost of time to visit a specific recreational resource

REVEALED PREFERENCE METHODS

HEDONIC WAGE AND PROPERTY VALUE METHODS:

- Regression Analysis is used to infer environmental values in a related market.
- We can distinguish two main categories:
 1. Hedonic property value models: they use market data on house sale prices. Prices are regressed on the house characteristics, the neighborhood characteristics, and environmental characteristics.
 2. Hedonic wage models: similarly, these models attempt to identify the effect of the environmental risk on wages. This effect serves to isolate the amount of compensation workers require in order to work in risky occupations.

05

OTHER METHODS AND CONSIDERATIONS

OTHER METHODS AND CONSIDERATIONS

BENEFIT TRANSFER AND META ANALYSIS:

- Survey analysis can be extremely costly and risky.
- An alternative solution would be conducting a meta-analysis: this method uses empirical estimates from a sample of related studies, statistically relates them to the characteristics of the studies, and analyses whether the differences can be due to differences in location, subject matter, or methodology.
- Benefits transfers are another solution: this method uses estimates from other times and places that were conducted for a similar purpose.

OTHER METHODS AND CONSIDERATIONS

GEOGRAPHIC INFORMATION SYSTEMS (GIS):

- GIS are computerized mapping models and analysis tools.
- A GIS map is made up of layers such that many variables and characteristics can be plotted simultaneously.
- GIS provides a powerful collection of tools and data that can be used together with other data to get new insights into the analysis.

OTHER METHODS AND CONSIDERATIONS

VALUE OF HUMAN LIFE:

- Controversial topic, but necessary in many circumstances.
- Misleading name-> life is not valued, but a (small) reduction in mortality risk, that is, the probability that a segment of the population dies earlier than otherwise.
- In this class, we focus on mortality risks related to some environmental problem.

OTHER METHODS AND CONSIDERATIONS

VALUE OF HUMAN LIFE:

- Value of Statistical Life (VSL): Individuals' WTP for mortality risk reductions.
- Contingent Valuation is often used to obtain VSL.
- The literature shows that most VSL range between \$3 million and \$7 million.
- Aldy and Viscusi (2008) show an inverted U-shaped relationship between age and VSL:
 - Population aged 18-24 → VSL = \$3.7 million.
 - Population aged 35-44 → VSL = \$9.7 million.
 - Population aged 55-62 → VSL = \$3.4 million.