ESM 245
Homework #4: Benefit transfer

Introduction

Coastal wetlands provide a natural defense against storm surges and the effects of sea-level rise. They act like a sponge that dissipates wave impacts and reduces flood risk. In this homework, you will help derive the value of wetlands for a study in Huntington Beach, California.

Valuing wetland restoration

You will contribute to a study on wetlands restoration in **Huntington Beach, California**, which has an area of **60 hectares of salt marsh** to restore. You will conduct a benefits transfer analysis, drawing on several other studies.

After some work, you identified the following:

- Bayraktov et al. (2015): a meta-analysis of coastal wetland restoration costs. Specifically, you have access to the mangrove and salt marsh databases.
- Costanza et al. (2021): estimate the storm protection benefits (avoided damage).

Data

You have part of the dataset of Bayraktov et al. (2015). We called this database cost_df, and it has the following information:

1) study_cluster: research belonging to a specific year
2) wetland_type: mangrove or saltmarsh
3) observation: research ID
4) reference: authors
5) ref_year: publication year
6) country: country where the restoration project took place
7) area_ha: restoration area
8) total_cost_2010: total restoration cost in USD2010

Part 1: Restoration costs

You will employ a benefit transfer to find the costs of restoring 60 hectares of wetland.

1) Inspect the dataset. What wetland type is most appropriate for your analysis? Filter the dataset for that wetland type.
2) Create a new variable with the restoration costs per hectare. Then, choose one of the research studies and estimate the total costs of restoring 60 hectares in Huntington Beach. Explain your choice.

3) We are interested in the marginal cost of each additional hectare restored. Make a scatter plot of hectares on the y-axis and total restoration costs on the x-axis. Describe the relationship between total costs and wetland area restored.
4) Run the following regression: total_cost_2010 = a + b*area_ha + error. Using the outcome of this regression, recalculate the total cost of restoring 60 hectares of wetland.
5) Describe one way you could improve your cost analysis and valuation.

Part 2: Storm protection benefits

Costanza et al. (2021) analyzed 1288 coastal storms globally to calculate the storm protection benefits from wetlands. The authors obtained the following regression estimates:

$$ln\left(\frac{damages}{GDP}\right) = -7.992 - 0.236ln\,(wetlands) + 3.298ln\,(windspeed) - 0.55ln\,(speed) + 0.137(volume) - 0.058(time)$$

They have the following variables: damages/GDP, wind speed of the storm (windspeed), the forward speed of the storm (speed), wetland area in the swath of the storm (wetlands), the volume of water in the ocean proximal to the storm landfall (volume), and the year of the storm minus 1900 (time) as a (non-transformed) linear variable.

6) Interpret the coefficient on ln(wetlands). (Hint: notice that the dependent variable is also log-transformed)

7) Calculate the avoided damage of 60 additional hectares of wetlands in case of a storm like Hurricane Hilary. You have the following information: damages = $18 million, and the available wetland area today is 72 hectares. Assume the GDP doesn't change (only damage moves), and all the remaining variables remain constant.