



Module 6: Impact Assessment


6.1 Impact Assessment




Impact Assessment

- ◆ Sometimes, the question of interest is:
 - Did an event or intervention have an effect on the environment?
- ◆ The effect might be natural (fire or flood), accidental (spill or release of contaminants), or purposeful (treatment or remediation)


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Impact Assessment


- ◆ The impacted areas are studied to see if changes occurred as a result of the event.
- ◆ Control sites are often used to control for changes that may have occurred unrelated to the event and to get a feel for natural variation between different sites.
- ◆ Ideally, there would be multiple impact and control sites.

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Impact Assessment

- ◆ Sampling designs:
 - BACI = Before-After-Control-Impact
 - BACIP = Before-After-Control-Impact-Pairs
 - Impact-Control
 - Before-After
 - Impact-Gradient

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Impact Assessment

- ◆ Methods that can be used to analyze the data
 - t tests
 - ANOVA
 - Repeated Measures ANOVA
 - Regression Analysis
 - General Linear Models
 - Methods for data correlated in time or space
 - Time series analysis
 - Spatial data methods

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Sampling designs

- ◆ BACI = Before-After-Control-Impact
 - Use when the event is controlled by humans. One or more Impact sites and one or more Control sites are identified. Before and After observations are taken at the Control and Impact sites.
 - Advantages
 - Powerful to detect small changes
 - Disadvantages
 - Requires the identification of one or more Control sites that are similar in characteristics to the Impact sites. This can be difficult and is open to debate.
 - May involve multiple samples Before and After at multiple locations, may be expensive.
 - May require Repeated Measures ANOVA

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Sampling designs

- ◆ BACIP = Before-After-Control-Impact-Pairs
 - Use when the event is controlled by humans. Each Impact site is paired with a Control site. Before and After observations are taken at the Control and Impact sites.
 - Advantages
 - Powerful to detect small changes
 - Disadvantages
 - Requires the identification of paired Impact and Control sites. This can be difficult and is open to debate.
 - May involve multiple samples Before and After at multiple locations, may be expensive.

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Sampling designs

- ◆ Impact-Control
 - Use when there is no chance of getting Before data due to the unexpected nature of the event. Identify one or more Impacted sites and one or more Control sites. Sample After the impact has occurred.
 - Advantages
 - Even though Before data is not available, you can still analyze the data rigorously
 - Disadvantages
 - Again, selection of control sites is problematic


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Sampling designs


- ◆ **Before-After**
 - Use when you can collect baseline data before an event occurs and no appropriate control site exists or can be measured
 - Advantages
 - The site acts as its own control. Compare the Before and After data at one site.
 - Disadvantages
 - No information on the changes that may have happened naturally unrelated to the Impact
 - Generally data are correlated so analysis must use time series analysis or other more complex methods

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Sampling designs

- ◆ **Impact-Gradient**
 - Use when the impact originated at a point and is expected to decrease with distance
 - Advantages
 - Gives impact as a function of distance from the source
 - Disadvantages
 - May require more complex data analysis methods such as spatial methods

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Data Analysis Methods

◆ T tests

- Use when you have independent observations from two locations (two-sample t test) or Before-After at same location (paired t test)
- Advantages
 - Simple, well understood technique
- Disadvantages
 - The assumption of independent observations may be violated and create the problem of pseudo-replication

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Data Analysis Methods

◆ ANOVA

- Use when you have multiple Impact and Control sites and each site was measured just once (Impact/Control) or when Impact and Control sites are paired (CTP/BACIP)
- Advantages
 - Well known technique
- Disadvantages
 - Requires data points to be independent. This comes from measuring each site once or from taking differences of pairs.


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Data Analysis Methods


- ◆ Repeated Measures ANOVA
 - Use when you have multiple Impact and Control sites and each site was measured at several times (BACI and Impact-Control Designs)
 - Advantages
 - Takes into account serial correlation
 - Disadvantages
 - Complexity of analysis


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Data Analysis Methods


- ◆ Regression Analysis
 - Use when trends are sought and the data can be expected to be independent (uncorrelated).
 - Example: Points taken far apart in time or space
 - Advantages
 - Easy to understand and carry out
 - Disadvantages
 - Assumes independence and normality


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Data Analysis Methods

- ◆ Time Series Analysis
 - Use when the data points are taken in time at one location (Before-After design). In this situation, they are probably correlated with each other in time.
 - Example: Points taken close together in time
 - Advantages
 - Gives rigorously correct results
 - Disadvantages
 - Complexity of analysis

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Data Analysis Methods

- ◆ Methods for Spatial Data
 - Use when the data points are taken at different locations in the area of interest (Impact-Gradient design). In this situation, they are probably correlated with each other in space.
 - Example: Points taken close together in space
 - Advantages
 - Gives rigorously correct results
 - Disadvantages
 - Complexity of analysis

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