Cost-Benefit Analysis: The Basics with an Example

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Purpose of Presentation

• Introduce you to the basics of Cost-Benefit Analysis;

• Provide an example based on benefits and costs associated with providing high quality early childhood education (ECE) to at-risk children in Nebraska;
Basic Idea

• Cost benefit analysis compares the flow over time of costs and benefits accruing from a project.
• Used to evaluate the “return” on a project.
• One way to compare and prioritize various project alternatives.
• As a simple example, think about putting a fire detection system in your home.
Benefits

• Identify benefits
  • Reducing loss of property
  • Reducing loss of life
Benefits

• Identify benefits
  • Reducing loss of property
  • Reducing loss of life

• Bring benefits to a common unit - $$$
  • Dollar value of property saved * probable reduction in fire loss
  • Dollar value of lives saved * probable reduction in loss of life
Benefits

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• Bring benefits to a common unit - $$$
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  • Dollar value of lives saved * probable reduction in loss of life

• **Measure stream of benefits over time**
Example

Benefits Over Time

<table>
<thead>
<tr>
<th>TIME IN FUTURE</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Benefits

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  • Reducing loss of life

• Bring benefits to a common unit - $$$
  • Dollar value of property saved * probable reduction in fire loss
  • Dollar value of lives saved * probable reduction in loss of life

• Measure stream of benefits over time

• **Bring future benefits to a present value**
Digression on present value

How much money would you have to put in the bank right now, so that if it stayed there and earned interest, it would be worth the amount you need in the future?

$$PV = \frac{FV}{(1+r)^t}$$

$t = \text{years into future when benefit will occur} = 10$

$r = \text{interest rate} = 2\%$

$FV = \text{Future value} = \$1,000$

$PV = \text{Present value} = \$820.35$
Example

Benefits Over Time

TIME IN FUTURE

Benefit

Present Value
Benefits

• Identify benefits
  • Reducing loss of property
  • Reducing loss of life
• Bring benefits to a common unit - $$$
  • Dollar value of property saved * probable reduction in fire loss
  • Dollar value of lives saved * probable reduction in loss of life
• Measure stream of benefits over time
• Bring future benefits to a present value
• Aggregate present values
Costs – Same Idea

• Identify Costs
  • Installation fee
  • Annual Monitoring fee
Costs – Same Idea

- Identify Costs
  - Installation fee
  - Annual Monitoring fee

- Bring costs to a common unit - $$$
  - Cost to Install
  - Annual cost to monitor
Costs – Same Idea

• Identify Costs
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• Bring costs to a common unit - $$$
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• Measure stream of costs over time
Costs – Same Idea

- Identify Costs
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  - Annual Monitoring fee
- Bring costs to a common unit - $$$
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  - Annual cost to monitor
- Measure stream of costs over time
- **Bring future costs to a present value**
Costs – Same Idea

- Identify Costs
  - Installation fee
  - Annual Monitoring fee
- Bring costs to a common unit - $$$
  - Cost to Install
  - Annual cost to monitor
- Measure stream of costs over time
- Bring future costs to a present value
- **Aggregate present values**
Compare Present value of stream of benefits to present value of stream of costs

- Cost-Benefit Ratio
- Internal rate of return
- Payback Period
Example:
The Economic Impact of Early Childhood Education and Programming in Nebraska
Estimated Costs

- ECE cost per year over three years
- Travel costs for parents
<table>
<thead>
<tr>
<th>Age</th>
<th>Increase in Income</th>
<th>Grade Retention</th>
<th>Special Education</th>
<th>Crime Reduction</th>
<th>Increased Parent Earning</th>
<th>Total</th>
<th>PDV Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$4,594</td>
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<td>-$1,024</td>
<td>-$571</td>
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<td></td>
<td>$2,951</td>
<td>$5,465</td>
<td>$2,564</td>
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<tr>
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<td>$2,514</td>
<td></td>
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<td>$822</td>
<td>$3,336</td>
<td>$1,318</td>
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<tr>
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<td>$231</td>
<td>$4,346</td>
<td>$1,446</td>
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<tr>
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<td>$4,115</td>
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<td></td>
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<td>$4,198</td>
<td>$1,175</td>
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<tr>
<td>50</td>
<td>$4,352</td>
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<td>$11</td>
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<td>$4,363</td>
<td>$866</td>
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<tr>
<td>60</td>
<td>$3,819</td>
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<td>$1</td>
<td></td>
<td>$3,820</td>
<td>$538</td>
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<td>Aggregate</td>
<td>$135,189</td>
<td>$9,187</td>
<td>$191,899</td>
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</tbody>
</table>
Examining the total costs and benefits of providing ECE in Nebraska shows significant long-term economic benefits.
Providing a child with early childhood education produces outcomes over their lifetime with a current net value of almost $40,000.
Impacts of High Quality ECE

Three measures of impact were developed:
• The benefit/cost ratio which shows the benefit associated with each dollar of cost;
• The internal rate of return which measures the return associated with the initial investment in ECE;
• The payback period which shows how long it takes to gain back the initial investment in ECE.

<table>
<thead>
<tr>
<th></th>
<th>Full-Time</th>
<th>Part-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit/Cost Ratio⁺</td>
<td>2.50</td>
<td>3.23</td>
</tr>
<tr>
<td>Internal Rate of Return (IRR)</td>
<td>9.63%</td>
<td>8.54%</td>
</tr>
<tr>
<td>Payback Period</td>
<td>22 years</td>
<td>24 years</td>
</tr>
</tbody>
</table>

⁺ Comparable to other available estimates
(Major EC programs = 2.5 to 12.9; other state programs = .68 to 3.5)