REVIEW of Individual Assignment 2: Risk Assessment & Benefit Cost Analysis

Frameworks and Models in Engineering Systems (FAMES)

Spring 2006

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April, 6th 2006
Assignment IA2: Risk Assessment

• Application of Risk Assessment on a simplified case of transportation of SNF

Table 1: Network distances and Population Centers

<table>
<thead>
<tr>
<th>OD pair</th>
<th>Highway Distance (in miles)</th>
<th>Number of Cities</th>
<th>Population</th>
<th>Rail adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>300</td>
<td>1</td>
<td>300,000</td>
<td>x1.1</td>
</tr>
<tr>
<td>2A</td>
<td>150</td>
<td>3</td>
<td>100,000 each</td>
<td>x1.2</td>
</tr>
<tr>
<td>3A</td>
<td>350</td>
<td>1</td>
<td>50,000</td>
<td>x0.9</td>
</tr>
<tr>
<td>4B</td>
<td>150</td>
<td>3</td>
<td>75,000 each</td>
<td>x1</td>
</tr>
<tr>
<td>5B</td>
<td>200</td>
<td>1</td>
<td>50,000</td>
<td>x1.3</td>
</tr>
<tr>
<td>6B</td>
<td>300</td>
<td>1</td>
<td>1,000,000</td>
<td>x0.8</td>
</tr>
<tr>
<td>BA</td>
<td>1000</td>
<td>4</td>
<td>100,000 each</td>
<td>x1.1</td>
</tr>
<tr>
<td>AX</td>
<td>1500</td>
<td>5</td>
<td>50,000 each</td>
<td>x1.1</td>
</tr>
</tbody>
</table>

Note that for rail access multiply the distances by the given factor.
IA2: Risk Assessment

• Points to notice:
  – Creating alternatives (straight forward)
  – Calculating **Expected Value** of accidents from the given probabilities
    \[ EV(\ X) = P(X) \times V(X) \]
  – Probabilities
  – Error in 4 (given an accident happens)
  – This section does NOT consider transportation costs.
Mary’s question (+ a hint for P3?)

- [www.bts.gov](http://www.bts.gov) (useful site to keep in mind)

- The assignment’s data are made up. Nevertheless use them for this solution.
IA2: Risk Assessment

• Brief Probability Review
  – What is the probability of an unbiased die returning 2 for three consecutive throws?
  – $(1/6)^3$
  – What is the probability of an unbiased die returning 2 at least once in three consecutive throws?
  – $P(\text{not } 2) = (1-1/6)^3$
  – $P(\text{at least one } 2) = 1 - P(\text{not } 2)$
Questions on IA2 Risk Assessment?
Review of Benefit Cost Analysis 1

• What is BCA?
  – A way to compare alternatives

• Objective: normalizing benefits and costs in a way that are comparable internally and across projects.

• Key concept: value of money changes over time.

• Discount rate vs. interest rate and Opportunity costs.
Review of Benefit Cost Analysis 2

• Different ways to compare:

  – Net Present Value (NPV) → recommended for IA2
  – Benefit Cost Ratio
  – Internal rate of return (IRR)
  – Payback Period
  – Cost-effectiveness ratio
  – …
Review of Benefit Cost Analysis 3

• Calculate NPV for the different alternatives. The one with the higher NPV is chosen (absent politics).

• How to calculate NPV for discount rate r:
  – The value of a future sum (F) at N years:
    \[ P = F(1 + r)^N \]
  – The value of a RECURRING future sum (F) at N years:
    \[ P = F[1 - 1/(1+r)^N]/r \]
Review of Benefit Cost Analysis 3

• Some issues to notice:
  – **Net Present Value (NPV) →** does not account for scale
  – Does NPV equals profit?
  – **Benefit Cost Ratio →** favors capital intensive projects vs. those with high recurring costs
Questions on IA2 BCA ?
Issues with BCA

• Monetization and implicit monetization
• Difficulty to compute bc due to uncertainty
• Evaluative complexity on costs and benefits
• Discounting non discountable events
• Distributive equity
• Aggregation (non transparency) and a devilish devil
DR Discussion

- Choice of Discount rate depends on:
  - Opportunity cost of capital
- DR determines technology and choice preference.
  - Should state use different DR than business?