Comparing Alternatives

• Projects are acceptable if:
  - PW > 0 @ MARR
  - AW > 0 @ MARR
  - IRR > MARR

• What if you are considering multiple alternatives which meet these criteria?

• How do you select among alternative projects?
Ensuring Comparability

• Before comparing multiple options, consider whether they are truly equivalent

• Attempt to monetize those factors which differ

• What about Useful Life?
Tackling Alternatives with Different Useful Lives

• Study period (Planning Horizon) is the time period over which alternatives are to be compared
Tackling Alternatives with Different Useful Lives (cont)

• Decision Cases:
  - Useful life of all alternatives = Study Period
    • No adjustments required
  - Useful life of at least one alternative ≠ Study Period
Comparing Alternatives: Equivalent Worth

• If Useful Lives are equal to study period →
  *Alternative with greatest equivalent worth is preferred*

• Transitivity
  - If $PW_A > PW_B$, then $AW_A > AW_B$
Re-examining the Initial Example:
Where Should You Build? Far or Near

Where Should You Build?
Far or Near

Figure by MIT OCW.
Example: Comparing Alternatives  
MARR = 15%, Study Period = 120 Months

<table>
<thead>
<tr>
<th>Cost</th>
<th>Site A</th>
<th>Site B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost to build @ site</td>
<td>$250,000</td>
<td>$750,000</td>
</tr>
<tr>
<td>Monthly Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Hauling Distance</td>
<td>10</td>
<td>3 miles</td>
</tr>
<tr>
<td>Hauling Expense</td>
<td>$5</td>
<td>$5</td>
</tr>
<tr>
<td>Shipments</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Monthly Cost</td>
<td>$10,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Monthly Revenue</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
</tbody>
</table>

Present Worth                      | $679k   | $614k   |
Near vs Far Cash Flows

![Graph showing near and far cash flows over time.](image-url)
Comparing Alternatives: IRR

• As for all alternatives, lower investment is preferred, unless additional investment provides sufficient returns
  - Each increment of capital must produce a return > MARR
  - Select a higher investment only if the incremental investment provides returns > MARR
Comparing Alternatives IRR

• Do NOT compare the IRRs of alternatives

• Only compare IRRs against MARR
IRR Example 2 - Efficient Light Bulbs

• Are energy efficient light bulbs worth it?

• Bulb types

<table>
<thead>
<tr>
<th>Bulb Type</th>
<th>Expected Lifetime</th>
<th>Lumens</th>
<th>Wattage</th>
<th>Purchase Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent</td>
<td>750</td>
<td>585</td>
<td>60</td>
<td>$0.50</td>
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<tr>
<td>Halogen</td>
<td>3,750</td>
<td>570</td>
<td>50</td>
<td>$3.25</td>
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<tr>
<td>Compact Fluorescent</td>
<td>7,500</td>
<td>600</td>
<td>15</td>
<td>$13.50</td>
</tr>
<tr>
<td>Compact Fluor2</td>
<td>7,500</td>
<td>600</td>
<td>14</td>
<td>$14.00</td>
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</table>
### IRR Example 2 - Efficient Light Bulbs

<table>
<thead>
<tr>
<th>Year</th>
<th>Incandescent</th>
<th>Halogen</th>
<th>CF</th>
<th>CF2</th>
<th>Difference Hal-Incand</th>
<th>Difference CF-Incand</th>
<th>Difference CF2-Incand</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>$0.50</td>
<td>$3.25</td>
<td>$13.50</td>
<td>$15.00</td>
<td>-$2.75</td>
<td>-$13.00</td>
<td>-$14.50</td>
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<tr>
<td>1</td>
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<td>$1.88</td>
<td>$0.56</td>
<td>$0.53</td>
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<td>$2.23</td>
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<tr>
<td>2</td>
<td>$2.75</td>
<td>$1.88</td>
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<td>$2.23</td>
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<tr>
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<tr>
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<tr>
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<td>$2.23</td>
</tr>
<tr>
<td>10</td>
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<td>$0.56</td>
<td>$0.53</td>
<td>$0.38</td>
<td>$1.69</td>
<td>$1.73</td>
</tr>
</tbody>
</table>

**Assumptions:** Usage = 750 hrs / year; Electricity = $0.10 / kWh; Study Period = 10 years
IRR Example - Efficient Light Bulbs, MARR = 5%

Net Cash Flows for Compact Fluorescent

$2.19 $2.19 $2.19 $2.19 $2.19 $2.19 $2.19 $2.19 $1.69

Net Cash Flows for Compact Fluor2

$2.23 $2.23 $2.23 $2.23 $2.23 $2.23 $2.23 $2.23 $1.73
IRR Example 2 - Efficient Light Bulbs

We found that $PW_{CF} > PW_{CF2}$
Also, $IRR_{CF} > IRR_{CF2}$

Does this mean that we always prefer options with higher IRR?
IRR Ranking Does Not Always Match PW

- CF
- CF2
- Halogen

Discount Rate

Total Present Worth

IRR = 8%

10.5%  13.9%
IRR Ranking Procedure

1) Rank acceptable (IRR>MARR) alternatives based on investment

2) Find lowest investment acceptable (IRR>MARR) alternative (Base Alternative)

3) Develop Incremental Cash Flow for Next Alternative (i.e., in ranked list)
   a) Next Alternative Cash Flow - Base Alternative Cash Flow

4) Is Incremental Cash Flow acceptable (IRR>MARR)
   a) If yes, this is new Base Alternative
   b) If no, keep Base Alternative

5) Move to next alternative in ranked list and restart at 3