Economic Evaluation

- Objective of Analysis
- Criteria
  - Nature
  - Peculiarities
- Comparison of Criteria
- Recommended Approach

Objectives of Economic Evaluation Analysis

- Is individual project worthwhile? Above minimum standards?
  - This is a "choice", is it better or not?
  - This is easier
- Is it best? Is it at top of ranking list?
  - This is a "judgment" about details
  - This is more difficult

Principal Evaluation Criteria

- Net Present Value
- Benefit - Cost Ratio
- Internal Rate of Return
- Cost-Effectiveness Ratio
- Pay-Back Period

Net Present Value

- NPV = B - C (stated in present values)
- Objective: To Maximize
- Advantage: Focus on Result
- Disadvantage
  - Interpretation of NPV
  - No account for scale, thus difficult to use for ranking

Evaluation of Projects S and T

Project	Benefit $	Cost $	Net Value $	NPV as % of Cost
S	2,002,000	2,000,000	2,000	0.1
T	2,000	1,000	1,000	100

Benefit - Cost

- **Ratio = Σ B / Σ C (Present Values)**
- **Objective:**
  - **To Maximize**
- **Advantage:**
  - **Common Scale, Useful in Ranking**
- **Disadvantages:**
  - **Treatment of Recurring Costs**
    Σ B / Σ C or Net Benefits/Investment
    = > Bias against operating projects
  - **Ranking sensitive to r**
    low r = > higher rank for long-term projects

A Comparison of a Capital Intensive and Operations Project (Benefits in Present Values)

Project	K	R
Investment, C_K	$1,000,000	$1,000,000
Annual Cost, C_r	$50,000	$500,000
Annual Benefits	$200,000	$700,000
Annual Return	$150,000	$200,000
Useful Life	10 Years	10 Years
Total Benefits	$2,000,000	$7,000,000
Total Cost, $C_K + C_r$	$1,500,000	$6,000,000
Benefit/Cost Ratio	1.34 better than	1.17
Annual Return	15% worse than	20%
Net Value Present	$500,000 worse than	$1,000,000

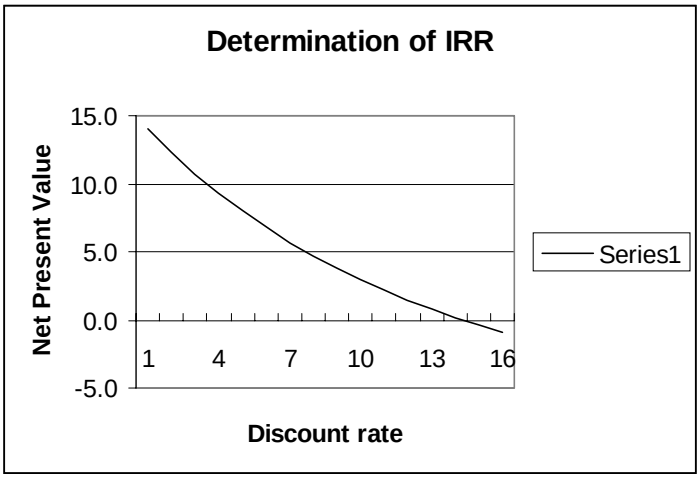
The Ranking of Projects by Benefit-Cost Criterion Can Depend on DR

Project	Investment C_K,$	Annual Benefits R, $	Project Life N Years	Benefit - cost at discount rate of 3%	10%
A	1000	200	10	1.73	1.23 (best)
B	1000	125	20	1.86 (best)	1.05

Internal Rate of Return

- **IRR = r such that NPB = 0**
- **Objective:**
  - **Maximize IRR**
- **Advantages:**
  - **No need to choose r**
  - **Manipulation by r impossible**
- **Disadvantages:**
  - **Calculations complex -- but easy in spreadsheet**
  - **Ambiguous**
- **Note: ranking by IRR and B/C ratio may differ**

Graphical Determination of IRR (Data from example in Session 4)

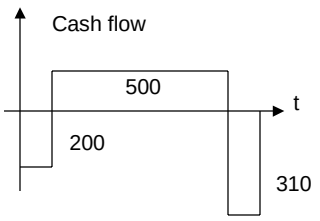


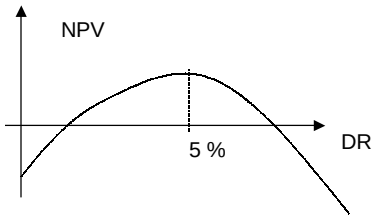
Spreadsheet Determination of IRR (Data from Example in Session 4)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Investment	15			3			5			
Net Income		2	3	4	5	5	3	4	5	6
Cash Flow	-15	2	3	1	5	5	-2	4	5	6
IRR	13.33%			Formula: IRR(b9:k9)						

Projects can Lead to Ambiguous Solutions for the Internal Rate of Return

Project	Investment, $	Annual Benefits $	Project Life Years	Closure cost at Year N-1 $
P	C_k	R	N	$C_c > RN - C_k$
Q	200	100	5	310





Ranking of Projects by Internal Rate of Return and Benefit-Cost Ratio Can Differ

Project	Investment, C_K, $	Annual Benefits R, $	Project Life N Years	Benefit - Cost r = 3%	Internal Rate of Return, 0%
A	1000	200	10	1.71	15.10 (best)
B	1000	125	20	1.86 (best)	10.93

Pay-Back Period

- **PBP = Cost/Annual Benefits**
  - Note: undiscounted
- **Objective:**
  - To minimize
- **Advantages:**
  - Really simple
  - No choice of r
- **Disadvantages**
  - Difficult to rank correctly projects with different useful lives or uneven cash flows

Evaluation of Projects V and W

Project	Investment, C_k, $	1	2	3	4	5	6	Payback Period Years	NPV at 10%	IRR
V	2000	1000	1000	1000				2	487	23.4%
W	2000	800	800	800	800	800	800	2.5	1484	32.7%

Cost- Effectiveness Ratio

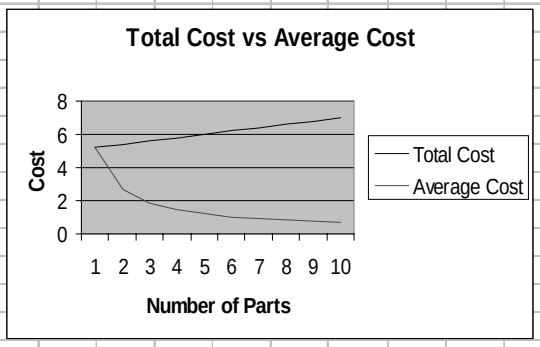
- Ratio = (Units of Benefit) / Cost
  - example: "lives saved/million dollars"
- Objective: To Maximize
- Advantage: Avoids problem of trying to assign $ values to "intangibles" such as a "life", "ton of pollution", etc.
- Disadvantage: No sense for minimum standard or limits

Recommended Procedure (if you have discretion to choose)

- **Examine Nature of projects**
  - **Easy to put into $ terms? Steady cash flows? or with closure costs? Or various project lifetimes?**
  - **An operating or a straight capital investment?**
- **Choose Method Accordingly**
- **No method is perfect -- ultimately a judgment**
- **Current "best practice" uses several criteria; uses judgment to decide on project**

A Note for Exercise 1:
Average Costs of Production vary

	1	2	3	4	5	6	7	8	9	10
Total Cost	5.2	5.4	5.6	5.8	6	6.2	6.4	6.6	6.8	7
Average Cost	5.2	2.7	1.867	1.45	1.2	1.03	0.914	0.825	0.756	0.7



Capital cost =5
Labor and Materials =0.2/part
Maximum Capacity= 10