Project Justification

- If cash flows are uniform, can use simple formulas; otherwise, need to use spreadsheet to discount each period's cash flows
- In practice, the payback period is used to evaluate most small projects:

$$\boxed{Payback\ period = \frac{IV_0}{OP}, \quad \text{for } OP > 0}$$

where

$$IV_0 = IV_{\text{new}} - SV_{\text{current}}, \quad \text{net intital investment expenditure at time 0 for project}$$

$$IV_{\text{new}} = \text{initial investment cost at time 0 for (new) project}$$

$$SV_{\text{current}} = \text{salvage value of current project (if any) at time 0}$$

$$OP = \begin{cases} OR - OC, & \text{uniform operating profit per period from project} \\ OC_{\text{current}} - OC_{\text{new}}, & \text{net uniform operating cost } \textit{savings} \text{ per period} \end{cases}$$

$$OR = \text{ uniform operating revenue per period from project}$$

$$OC = \text{ uniform operating cost per period of project}$$

Discounting

- NPV and NAV equivalent methods for evaluating projects
- Project accepted if NPV ≥ 0 or NAV ≥ 0

$$\textit{Weighted Average Cost of Capital:}\ \ i = (\%\ \text{debt})\, i_{\text{debt}} + (\%\ \text{equity})\, i_{\text{equity}}$$

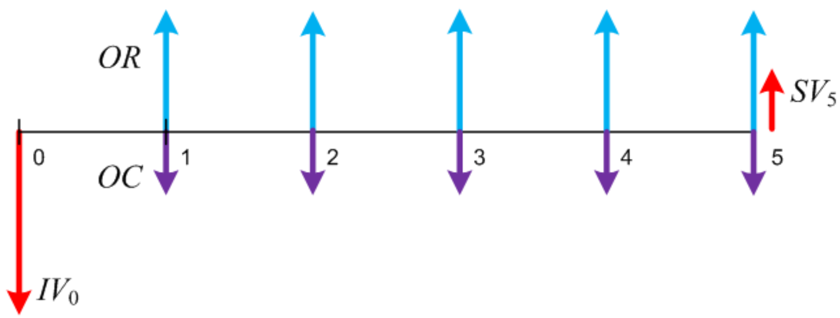
$$= (0.5)\, 0.06 + (0.5)\, 0.30 = 0.18$$

$$NPV = PV \text{ of } OP - IV^{\text{eff}}$$

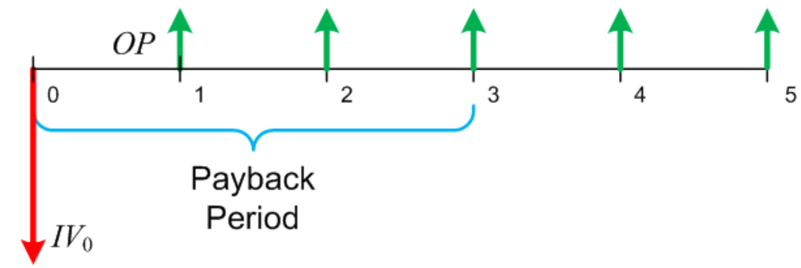
$$\textit{Net Present Value:}\quad = OP\left[\frac{1-(1+i)^{-N}}{i}\right] - IV^{\text{eff}}, \quad i \neq 0$$

$$\textit{Net Annual (Periodic) Value:}\ \ NAV = OP - K$$

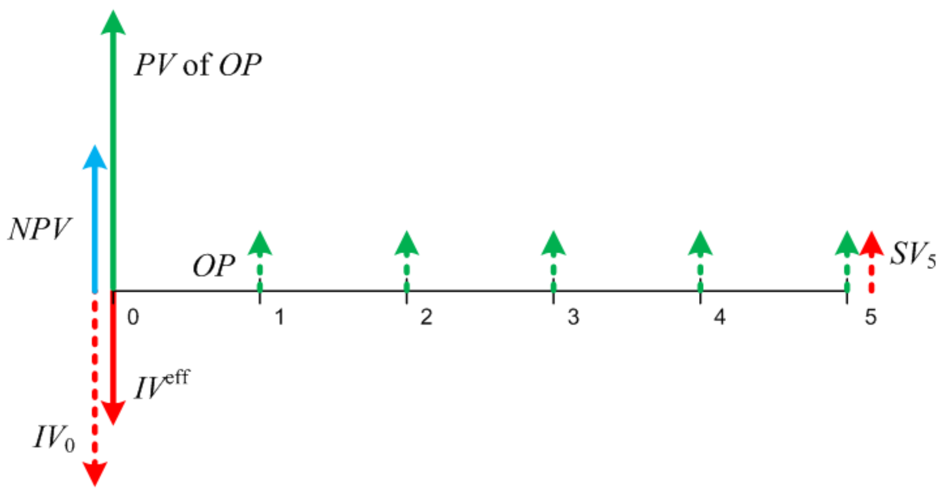
Project with Uniform Cash Flows



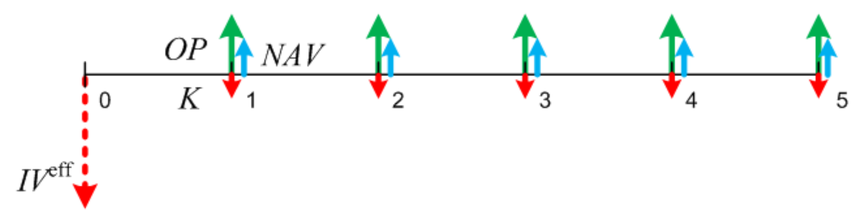
(a) Actual cash flows.



(b) Payback method.



(c) Net present value (NPV).

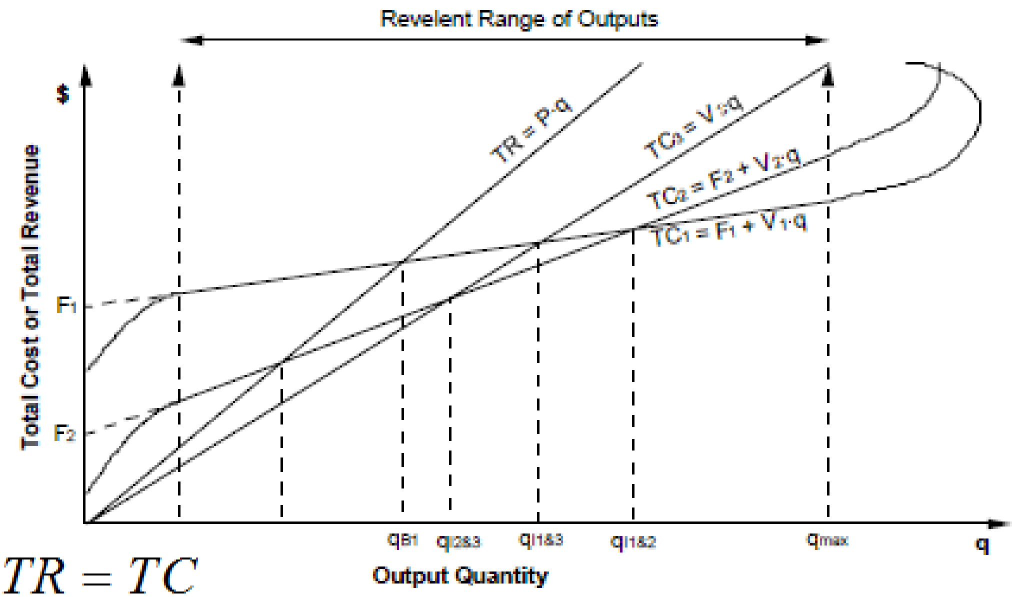


(d) Net annual value (NAV).

Cost Reduction Example

Common				
Cost of Capital	(*i*)	8%	8%	
Economic Life	(*N*, yr)	15	15	
Annual Demand	(*q*/yr)	500,000	500,000	
Sale Price	($/q)			
Project		**Current**	**New**	**Net**
Investment Cost	(*IV*, $)	2,000,000	5,000,000	3,000,000
Salvage Percentage		25%	25%	
Salvage Value	(*SV*, $)	500,000	1,250,000	750,000
Eff. Investment Cost	(IV^{eff}, $)	1,842,379	4,605,948	2,763,569
Cost Cap Recovery	(*K*, $/yr)	215,244	538,111	322,866
Oper Cost per Unit	($/q)	1.25	0.50	(0.75)
Operating Cost	(*OC*, $/yr)	625,000	250,000	(375,000)
Operating Revenue	(*OR*, $/yr)	0	0	0
Operating Profit (*OR* - *OC*)	(*OP*, $/yr)	(625,000)	(250,000)	375,000
Analysis				
Payback Period (*IV*/*OP*)	(yr)			8.00
PV of *OP*	($)	(5,349,674)	(2,139,870)	3,209,805
NPV (PV of *OP* - IV^{eff})	($)	(7,192,053)	(6,745,818)	446,236
NAV (*OP* - *K*)	($/yr)	(840,244)	(788,111)	52,134
Average Cost ((*K* + *OC*)/*q*)	($/*q*)	1.68	1.58	

(Linear) Break-Even and Cost Indifference Pts.



$$TR = TC$$

$$P \cdot q = F + V \cdot q$$

$$(P - V)q = F$$

$$\textit{Break-Even Point:} \quad q_B = \frac{F}{P - V}$$

$$TC_1 = TC_2$$

$$F_1 + V_1 \cdot q = F_2 + V_2 \cdot q$$

$$F_1 - F_2 = (V_2 - V_1)q$$

$$\textit{Cost Indifference Point:} \quad q_{I1\&2} = \frac{F_1 - F_2}{V_2 - V_1}$$

If output q is in units produced, then $F = K$ and $V = \dfrac{OC}{q}$.