Software Project Selection Methods

Selection of project

- Technical Assessment
  - Technical Assessment of a proposed system consists of evaluating the required functionality against the hardware/software available.
- Cost benefit analysis
  - Most common way of carrying out an economic assessment of a proposed system is by comparing the expected costs of development and operation of the system with the benefits of having it in place

Cost benefit analysis

- it is usually necessary to ask whether or not the project under consideration is the best of a number of options
  - There might be more candidate projects than can be undertaken at any one time and, in any case, projects will need to be prioritized so that any limited resources may be allocated effectively.
- Standard way of evaluating the economic benefits of any project is to carry out a cost benefit analysis, which consists of two steps.
  - Identifying and estimating all of the costs and benefits of carrying out the project and operating the system.
    - These include the **development** costs of the system, the **operating** costs and the **benefits** that are expected to accrue from the operation of the new system.
  - Expressing these costs and benefits in common units
    - We need to evaluate the net benefit, that is, the difference between the total benefit accruing from the system

CBA

- It is helpful to categorize costs according to where they originate in the life of the project.
  - Development costs:
    - Include the salaries and other employment costs of the staff involved in the development project and all associated costs.
  - Setup costs:
    - Include the costs of putting the system into place.
      - These consist mainly of the costs of any new hardware and additional equipment, but will also include costs of file conversion, and staff training.
  - Operational costs:
    - Consist of the costs of operating the system once it has been installed.

CBA Evaluation Techniques

- Consider proceeding with a project only where the benefits outweigh the costs.
- Decide on a consistent and standardized approach for measuring benefits for the criteria.
  - For instance, for **financial return** you could use one or more of the following:
    - Net Profit
    - Payback period
    - Net present value (NPV)
    - Return on investment (ROI)
    - Internal rate of return (IRR)
    - Other forms of cost/benefit analysis

Net Profit

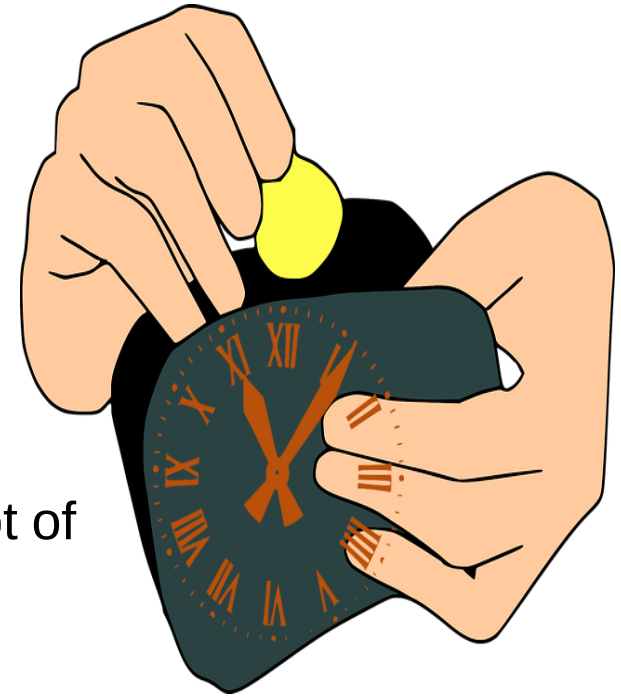
- Net profit
  - The net profit of a project is the difference between the total costs and the total income over the life of the project.
  - Net profit = Total income – Total costs
    - Advantage: simple to use
    - Disadvantage: ignores the timing of the cash flow

Financial Return methods

- **Payback period**
  - Payback period is the amount of time it takes a company to regain its initial investment in the cost of producing a product or service.
  - Payback period = Time taken to pay back the initial investment
    - Advantage: simple to calculate, not sensitive to small forecasting errors
    - Disadvantage: ignores any income (or expenditure) after the payback period

Time Value of Money

A Dollar sitting in your wallet is worth more today than the same dollar tomorrow.



Can you tell Why?

- Depreciation.
- Money grows over time when it earns interest.

So, the time value of money brings us to the concept of

- ✓ Future Value of Money
- ✓ Present Value of Money

Present Value

- Present value states that an amount of money today is worth more than the same amount in the future.
- In other words, present value shows that money received in the future is not worth as much as an equal amount received today.
- Receiving $1,000 today is worth more than $1,000 five years from now. Why?
  - An investor can invest the $1,000 today and presumably earn a rate of return over the next five years. Present value takes into account any interest rate an investment might earn.

Discount Rate for Finding Present Value

- The discount rate is the relevant interest rate that mathematically increases future value in nominal or absolute terms.

PV Formula and Calculation

- Present Value

- PV Formula and Calculation

$$\text{Present Value} = \frac{\text{FV}}{(1+r)^n}$$

where:

$\text{FV} = \text{Future Value}$

$r = \text{Rate of return}$

$n = \text{Number of periods}$

STEPS

- Input the future amount that you expect to receive in the numerator of the formula.
- Determine the interest rate that you expect to receive between now and the future and plug the rate as a decimal in place of "r" in the denominator.
- Input the time period as the exponent "n" in the denominator. So, if you want to calculate the present value of an amount you expect to receive in three years, you would plug the number three in for "n" in the denominator.

Future Value

- Future value (FV) is the value of a current asset at a specified date in the future based on an assumed rate of growth.
- Present value (PV) is the current value of a future sum of money or stream of cash flows given a specified rate of return. Present value takes the future value and applies a discount rate or the interest rate that could be earned if invested.
  - Future value tells you what an investment is worth in the future while the present value tells you how much you'd need in today's dollars to earn a specific amount in the future.

Present value intra-year discounting

- **Problem 1: Present value intra-year discounting**
- What is the present value of $1,000 received in two years if the interest rate is?
- **(a)** 12% per year discounted annually
- **Solution:**
- $1,000 / (1 + 0.12)^{2}$
- **Answer: $797.19**

- **b)** 12% per year discounted semi-annually
- **Solution:**
- $1{,}000 / (1 + 0.12/2)^{2*2}$
- **Answer: $792.09**
- **(c)** 12% per year discounted daily
- **Solution:**
- $1{,}000 / (1 + 0.12/365)^{2*365}$
- **Answer: $786.66**

Present value of a single amount

- **Problem 2: Present value of a single amount**
- You have just won a $1 million lottery. This new lottery, however, will pay out the award 60 years from today. What is the present value of your award based on a 16% p.a. interest rate?
- **Solution:**
- $1{,}000{,}000 / (1 + 0.16)^{60}$
- **Answer: $135.68**
-

Using present value formula

- **Problem 3: Using present value formula**
- $7,000 for 10 years from now at 7% is worth how much today?
-
- **Solution:**
- $7,000 / (1 + 0.07)^{10}$
- **Answer: $3,558.45**

Calculate the Future Value

Example: If $ 100 dollars is invested in a bank today may earn 8% per year. what is the future value of the $ 100 dollars for 1st, 5th and 15th year?

$$FV = PV\,(1 + r)^n$$

PV = 100
n = 1
n = 5
n = 15
K=r = 8%
FV = ? When n =1, n=5, n=15

K =	8%	=	8/100	=	0.08
(1+K)=	(1+0.08)	=	1.08	=	1.08

After 1 year(n=1): FV = 100 X $(1.08)^1$ = 100*1.08 = **$108**
After 5 years (n=5): FV = 100 X $(1.08)^5$ = 100*1.08*1.08*1.08*1.08*1.08 = **$146.93**
After 15 years (n=15): FV = 100 X $(1.08)^{15}$ = **$317.22**

Calculate the Present Value

Example

If $ 100 dollars is to be received after 1 year, what is the present value of $100 dollars today?

If $ 100 dollars is to be received after 5 years, what is the present value of $100 dollars today?

If $ 100 dollars is to be received after 15 years, what is the present value of $100 dollars today?

Note: Discounted rate is 8% per year.

$$PV = \frac{FV}{(1 + K)^n}$$

FV = 100
n = 1
n = 5
n = 15
K = 8%
PV = ? for n =1, n=5, n=15

Year	FV	PV
1	100	$\frac{100}{(1.08)^1}$
5	100	$\frac{100}{(1.08)^5}$
15	100	$\frac{100}{(1.08)^{15}}$

K =	8%	=	8/100	=	0.08
(1+K)=	(1+0.08)	=	1.08	=	1.08

The Present value of $ 100 to be received after 1 year is **$93** dollars today.
The Present value of $ 100 to be received after 5 years is **$68** dollars today.
The Present value of $ 100 to be received after 15 year is **$32** dollars today.

Net Present Value Analysis

Net Present Value (NPV) = “Present Value of all cash inflows – Present Value of all cash outflow”

Example: Salary Slip

Net Salary = Gross Salary – Deductions

Similarly, The **Present Value of all cash inflows** is the **Gross Present Value**

and if you **deduct cash outflows** it becomes your **Net Present Value.**

- Projects with a positive NPV should be considered if financial value is a key criterion. The higher the NPV, the better

If	It means	Then
NPV > 0	the investment would add value to the firm	the project should be accepted
NPV < 0	the investment would subtract value from the firm	the project should be rejected
NPV = 0	the investment would neither gain nor lose value for the firm	the project could be accepted as this project adds no monetary value. Decision should be based on other criteria, e.g. strategic positioning.

Example1: Calculating NPV

A sum of **$ 400,000** dollars invested today in an IT project may give a series of below cash inflows in future:

$ 70,000 in year 1
$ 120,000 in year 2
$ 140,000 in year 3
$ 140,000 in year 4
$ 40,000 in year 5

If Opportunity cost of capital is 8% per annum, then should we accept or reject the project?

$$PV = FV \times \frac{1}{(1+k)^n}$$

Solution:
Step 1: Calculate the PV value of year 1, year2, year3, year4, and year5
Step 2: Sum up the PV of all years
Step3: NPV = Present value of all cash inflows – Present value of all cash outflow.
Step 4: If NPV is positive, Accept the project, if not Reject the project.

Example1: Calculating NPV

Formula for calculating Present value = $PV = FV \times \frac{1}{(1+k)^n}$

Step 1: Calculating Present Value of all the Years						
PV for Year 1	=	$70000/(1.08)^1$	=	70000/1.08	=	64814.8
PV for Year 2	=	$120000/(1.08)^2$	=	120000/1.17	=	102880.7
PV for Year 3	=	$140000/(1.08)^3$	=	140000/1.26	=	111136.5
PV for Year 4	=	$140000/(1.08)^4$	=	140000/1.47	=	102904.2
PV for Year 5	=	$40000/(1.08)^5$	=	40000/1.59	=	27223.3
Cash inflow for all the Present Values					=	408959.5

Cash Inflow of all Present Values is : $ 408,959
Present value of Cash outflow is : $400,000

Net Present Value = PV of Cash inflows – PV of Cash Outflows
= ($408959 – $400000) = $8959 dollars.

Since NPV is positive, (i.e., $8959, This project can be accepted)

Example2: Calculating NPV

Same example: Calculating NPV however with Discount rate or Opportunity cost of capital at 15%
A sum of $ 400,000 dollars invested today in an IT project may give a series of below cash inflows in future:

$ 70,000 in year 1
$ 120,000 in year 2
$ 140,000 in year 3
$ 140,000 in year 4
$ 40,000 in year 5

If Opportunity cost of capital is 15% per annum, then should we accept or reject the project?

Solution: Calculating NPV
Step 1: Calculate the PV value of year 1, year2, year3, year4, and year5
Step 2: Sum up the PV of all years
Step3: NPV = Present value of all cash inflows – Present value of all cash outflow.
Step 4: If NPV is positive, Accept the project, if not Reject the project.

Example2: Calculating NPV

Formula for calculating Present value = $PV = FV \times \frac{1}{(1+k)^n}$

Step 1: Calculating Present Value of all the Years						
PV for Year 1	=	$70000/(1.15)^1$	=	70000/1.15	=	60869.6
PV for Year 2	=	$120000/(1.15)^2$	=	120000/1.32	=	90737.2
PV for Year 3	=	$140000/(1.15)^3$	=	140000/1.52	=	92052.3
PV for Year 4	=	$140000/(1.15)^4$	=	140000/1.75	=	80045.5
PV for Year 5	=	$40000/(1.15)^5$	=	40000/2.01	=	19887.1
Cash inflow for all the Present Values					=	343591.6

N.B: Though we have the same inflow & outflow of cash as in the previous example, the NPV value changed with the change in the Discount rate of interest.
Therefore, NPV is very much dependent on the Discount rate.

Cash Inflow of all Present Values is : $ 343591
Present value of Cash outflow is : $400,000

Net Present Value = PV of Cash inflows – PV of Cash Outflows
=($343591 – $400000) = $ -56408 dollars.
(negative 56408 dollars)

Since NPV is Negative, (i.e., - $56408, This project should be rejected)

Financial Return methods

- NPV

  Advantage:

  It considers time value of money.

  Considers the profitability of a project and the timing of the cash flows that are produced.

  Disadvantage:

  – 1. hard to select an appropriate discount rate

  – 2. NPV only takes into account the cash inflows and outflows of a particular project. It does not consider any hidden costs, sunk costs, or other preliminary costs incurred about the specific project. Therefore, the profitability of the project may not be highly accurate.

When net cash flows are even, i.e. when all net cash flows are equal:

When net cash flows are even, i.e. when all net cash flows are equal:

$$\text{NPV} = \text{R} \times \frac{1-(1+\text{i})^{-\text{n}}}{\text{i}} - \text{Initital Investment}$$

Where:

R is the estimated periodic net cash flow,

i is the required rate of return per period, and

n is the life of the project in months, years etc.

UNEVEN Cash Flows

When net cash flows are uneven, i.e. when net cash flows vary from period to period:

$$NPV = \sum_{i=1}^{n} \frac{R_i}{(1+r)^i} - \text{Initital Investment}$$

Where:

R_i is the estimated net cash flow for i^{th} period,

r is the required rate of return per period, and

n is the life of the project in months, years etc.

Even net cash flows

- Example 1: Even net cash flows
- Calculate the net present value of a project which requires an initial investment of $243,000 and it is expected to generate a net cash flow of $50,000 each month for 12 months. Assume that the salvage value of the project is zero. The target rate of return is 12% per annum.

Solution

- We have,
  Initial Investment = $243,000
  Net Cash Inflow per Period = $50,000
  Number of Periods = 12
  Discount Rate per Period = 12% ÷ 12 = 1%
- Net Present Value
  $= \$50{,}000 \times (1 - (1 + 1\%)^{-12}) \div 1\% - \$243{,}000$
  $= \$50{,}000 \times (1 - 1.01^{-12}) \div 0.01 - \$243{,}000$
  $\approx \$50{,}000 \times (1 - 0.887449) \div 0.01 - \$243{,}000$
  $\approx \$50{,}000 \times 0.112551 \div 0.01 - \$243{,}000$
  $\approx \$50{,}000 \times 11.2551 - \$243{,}000$
  $\approx \$562{,}754 - \$243{,}000$
  $\approx \$319{,}754$

Example 2: Uneven net cash flows

- An initial investment of $8,320 thousand on plant and machinery is expected to generate net cash flows of $3,411 thousand, $4,070 thousand, $5,824 thousand and $2,065 thousand at the end of first, second, third and fourth year respectively. At the end of the fourth year, the machinery will be sold for $900 thousand. Calculate the net present value of the investment if the discount rate is 18%. Round your answer to nearest thousand dollars.

Solution

Solution

PV Factors:

Year 1 = $1 \div (1 + 18\%)^1 \approx 0.8475$

Year 2 = $1 \div (1 + 18\%)^2 \approx 0.7182$

Year 3 = $1 \div (1 + 18\%)^3 \approx 0.6086$

Year 4 = $1 \div (1 + 18\%)^4 \approx 0.5158$

The rest of the calculation is summarized below:

Year	1	2	3	4
Net Cash Inflow	$3,411	$4,070	$5,824	$2,065
Salvage Value				900
Total Cash Inflow	$3,411	$4,070	$5,824	$2,965
× Present Value Factor	0.8475	0.7182	0.6086	0.5158
Present Value of Cash Flows	$2,890.68	$2,923.01	$3,544.67	$1,529.31
Total PV of Cash Inflows	$10,888			
− Initial Investment	− 8,320			
Net Present Value	$2,568	thousand		

Internal Rate of Return (IRR)

- IRR % of Return on investment.
- To put it simple: It is the percentage of Return of your investment.
- How do we calculate IRR?
  - If you remember from NPV example, we mentioned that the NPV is dependent on Discounted rate
    - If we increase the discount rate the NPV value decreases and vice versa
  - We need to increase /decrease the discount rate to a level where NPV becomes zero
  - The discount rate at which NPV becomes zero is the **Internal rate of return**

IRR

Discount Rate

Net Present Value

Let's say at 8%, Discount rate, the NPV is 5000
And
Let's say at 12%, Discount rate, the NPV is 0

Then 12% is the return, we are getting from the project And
This 12% is called the IRR.

Internal Rate of Return (IRR)

- Accept the project when Internal rate of return > Discount rate
- Reject the project when Internal rate of return < Discount rate
- May accept the project when Internal rate of return = Discount rate

Relationship between IRR, Discount rate and NPV

If IRR > Discount rate ------ The NPV is always Positive.

If IRR < Discount rate --------The NPV is always Negative.

If IRR = Discount rate -------The NPV is Zero.

Note: As long as the NPV is Positive, the project is financially viable.
The moment that NPV becomes Negative, the Project is NOT financially viable.

Calculating Internal Rate of Return

Example:

The cost of a project is $1000. It has a time horizon of 5 years and the expected year wise incremental cash flows are:

Year 1 : $200
Year 2 : $300
Year 3 : $300
Year 4 : $400
Year 5 : $500

Compute IRR of the project. If opportunity cost of Capital is 12%, And tell us, should we accept the project?

Solution:
Step 1: Take “K” as 12% and calculate NPV value.
Step 2: If NPV < 0 then Project is NOT financially viable at 12% discount rate.
Step 3: If NPV > 0 then Project is financially viable at 12% however we need to know the actual IRR value, so we need to increase the K value to and calculate the NPV, continue it till you reach a point where the NPV becomes zero or close to zero.

Step 4: The “K” value at which NPV becomes Zero or “Near Zero” is the actual IRR (Internal Rate of Return)

Calculating Internal Rate of Return

K (Discount rate)	12
K%	0.12
(1+K)	1.12

IRR using Variable Discount Rate				
Year (n)	FV	$(1+K)^n$		$PV = FV \times \frac{1}{(1+k)^n}$
1	200	$(1+K)^1$	1.12	**178.57**
2	300	$(1+K)^2$	1.254	**239.16**
3	300	$(1+K)^3$	1.4049	**213.53**
4	400	$(1+K)^4$	1.57352	**254.21**
5	500	$(1+K)^5$	1.762342	**283.71**
Total Cash Inflow				**1169.18**

NPV = Cash Inflow - Cash Outflow		
Cash Inflow	=	**1169.18**
Cash Outflow	=	**1000**
NPV	=	169.18

IRR

Example:

The cost of a project is **$1000**.
It has a time horizon of 5 years and the expected year wise incremental cash flows are:

Year 1 : $200
Year 2 : $300
Year 3 : $300
Year 4 : $400
Year 5 : $500

Compute IRR of the project.
If opportunity cost of Capital is 12%,
And tell us, should we accept the project?

At Discount Rate of 12%, the NPV is 169 (positive)

At Discount Rate of 17.7%, the NPV is 0 (Zero), therefore the IRR is 17.7%

Since IRR > Discount rate, Project can be accepted

Return on Investment

- Return on investment (ROI) is a financial metric that is widely used to measure the probability of gaining a return from an investment. It is a ratio that compares the gain or loss from an investment relative to its cost.
- It is as useful in evaluating the potential return from a stand-alone investment as it is in comparing returns from several investments.

Steps

- ROI is calculated by subtracting the initial value of the investment from the final value of the investment (which equals the net return), then dividing this new number (the net return) by the cost of the investment, and, finally, multiplying it by 100.
- ROI is relatively easy to calculate and understand, and its simplicity means that it is a standardized, universal measure of profitability.

How to Calculate Return on Investment (ROI)

ROI = Net Income / Cost of Investment

EXAMPLE

- An investor purchases property A, which is valued at $500,000. Two years later, the investor sells the property for $1,000,000.
- We use the investment gain formula in this case.
- ROI = (1,000,000 – 500,000) / (500,000) = 1 or 100%

Important: Few tips to Remember

- ✓ Always choose projects with highest NPV.
- ✓ If NPV is same for the given projects, choose the project with highest IRR.
- ✓ If NPV, IRR remains the same for the given projects, choose the projects with early pay back period.
- ✓ NPV = All Cash Inflows – Cash Outflows
- ✓ IRR = Discount rate at which the NPV becomes zero, this tell us what is the percent of return for the project.
- ✓ Payback period is a major consideration for every project, business or organization, it tells us how soon we can recover our investment and this investment can be utilized for other business needs/projects later on.

Cash Benefit Analysis-CBA

Year	Project 1	Project 2	Project 3	Project 4
0	100,000	1000000	100000	120000
1	10,000	200000	30,000	30,000
2	10,000	200000	30,000	30,000
3	10,000	200000	30,000	30,000
4	20,000	200000	30,000	30,000
5	100,000	300,000	30,000	75,000
Cash Flow	150,000	1,100,000	150,000	195,000

Financial Return methods

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
0	-100,000	-1,000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net Profit	50,000	100,000	50,000	75,000
Payback	5	5	4	4

Project 2 in Table shows the greatest Net Profit but this is at the

Payback favor Project 3 or 4

But Project 3 has shorter payback period

(r

in

start of the project.

CBA - Payback

Year	Project 1	Project 2	Project 3	Project 4
	100,000	1000000	100000	120000
Cash Flow	150,000	1,100,000	150,000	195,000
Net Profit	50,000	100,000	50,000	75,000
Payback	5yrs	5yrs	4yrs	4yrs
Avg Annual Profit	10000	20000	10000	15000

Net Profit = cash flow – investment

Payback = invested money start profit

Avg Annual Profit = net profit / payback pd