UNIT 14 ISSUES IN CAPITAL BUDGETING

14.1 INTRODUCTION

Sometimes, a firm faces complex investment situations and has to choose among the available alternatives. In the previous unit, you have learned about the capital budgeting techniques, and so far we have assumed that the proposed investment do not involve any risk. But, in real world situation an investment project is exposed to various types of risk , uncertainty and constraints. Funds available for the projects may be limited and firm has to prioritize the project on the basis of the availability of funds and economic compulsion. In this unit you will be able to understand concept of capital rationing, selection of projects under different situations of capital rationing. You will also learn how to evaluate the project on the bases of sensitivity analysis, decision tree analysis and simulation technique. CAPM (capital asset pricing model) and the classification of risk into systematic and unsystematic risk have been discussed latter in this unit.

14.2 OBJECTIVES

After studying this unit, you will be able to understand the following;

- To make choices between investments under capital rationing.
- Focus on the technique of sensitivity analysis.

- Get familiar with the methodology of simulation analysis.
- Understand the decision tree approach in sequential investment decisions.
- Learn the concept of capital asset pricing model.

14.3 CONCEPT OF CAPITAL RATIONING

Capital allocation decisions are one of the most influential decisions in a firm's long-term financial health. Investment decisions presume vital significance since it determines the value of the firm by influencing its growth, profitability and risk. With a goal of maximizing its shareholders' value, a firm accepts all profitable projects and provide sufficient capital to utilize this opportunity. But, under capital rationing situation, a firm is unable to invest in all profitable projects as restrictions are placed on the amount of new investment to be undertaken by the firm when the supply of capital is limited. Theoretically speaking, a firm should aim to maximize shareholder's wealth by choosing profitable projects, but since the funds are made limited under capital rationing, all positive NPV projects may not be selected.

When evaluating capital investments, firm may often operate under capital constraint and faced with the possibility that the amount of capital it can devote to new investment is limited, also the cash flows of most investment project are uncertain and as such, availability of outside capital to fund these risky projects may be constrained. These capital constraints often lead to the phenomenon of capital rationing in the capital budgeting process of the firm.

Capital rationing is defined as a situation where a constraint or budgetary ceiling is placed on the total size of capital expenditures during a particular period. Capital budget is designed on the assumption that there are limited financial resources available within the firm. In capital rationing situation a company cannot undertake all positive NPV projects it has identified, because of shortage of capital. Therefore, sometimes managers are forced to let go some projects although they are viable and have positive net present value, simply because of lack of funds.

14.3.1FACTORS LEADING TO CAPITAL RATIONING

Sometimes due to imperfect capital market or because of some internal restrictions forced by the management, give rise to the situation of capital rationing. On this basis capital rationing can be of two types:

- ***External Capital Rationing(hard rationing)***: Imperfect capital market or sometimes due to deficiencies in market information for the availability of funds, leads to External capital rationing situations . Sometimes firm are unable to raise capital from external equity market to finance the new projects, thus leading to shortage of funds with the company. These constraints are due to imperfect equity market or can be due to restrictions imposed by government to supply the capital for investment even though the projects are profitable enough to produce the expected rate of return.

Therefore, because of these constraints by external means, firms are unable to carry out with all the projects even though they are viable or profitable.

Reasons for external capital rationing: There could be several reasons for this situation a) underperforming management team or bad track record of company b) new start –up firm c)restrictions imposed by lender : since most firm's rely on institutional investors and banks for its debt requirement, there can be limitations imposed by lenders upon borrowers, which affect the company's fund raising strategy. d) industry specific factors: there could be general downfall in the entire industry which could affect fund raising capacity of the individual firm .

- ***Internal Capital Rationing (soft rationing)*** :_when the management voluntarily "fixes" a certain budget at a predetermined levels and decides to restrict the use of total amount of capital by the firm , give rise to the situation of internal capital rationing. These self-imposed budgetary constraints by the managements are done to have financial control and manage the expenditure of the firm. Firm may opt for a conservative financial policy to manage the debt situations. Sometimes , the company may encourage only those investment which have lesser cost of capital , and thus by this way the restrictions imposed by the management through internal means forces firms to select only those project which will meet the managements expected rate of return and let go off some of the projects in spite being profitable and viable enough.

  Reasons for internal capital rationing:_They can be as follows: A) Promoter's Decision : sometimes top management are hesitant to expand their equity share base so as not to lose controlling power over the operations of the company. B) Increase in opportunity cost of capital: too much leverage in the capital structure makes the company a riskier investment and lead to an increase in opportunity cost of capital. C) Future scenario: management is cautious in conserving some capital for some future project which might yield a higher rate of return or a decline in cost of capital.

  Whatever may be the type of restriction either (external or internal rationing) , the implications is that some of the viable and profitable projects will have to be foregone because of the shortage of funds.

14.3.2 SELECTION OF PROJECTS UNDER DIFFERENT SITUATION OF CAPITAL RATIONING

Needless to say, under capital rationing situation in spite of being a profitable and viable project, sometimes management has to forgo such projects and cannot accept them because of the lack of funds. Therefore, it is an important task of the management to identify not just the profitable projects but to obtain the best possible combination of profitable project with

highest NPV within the given available limit or constraint and then, they have to rank the projects in the order relative to their profitability.

Situations of capital rationing: some situations for which the capital rationing decisions need to be studied are as:

14.3.2.1(a) Case 1- When divisible projects are there, and restriction or constraint is for a single period. : (divisible projects are those projects which can be taken into parts example: construction of flats, whereas, single period rationing means, when there is capital constraints applied to the current period or for a single period only.)

Such problem can be solved by using the steps as follows:

(a) Firstly, we calculate the profitability index of each individual projects.
(b) Secondly, we will rank the projects in an order relative to their profitability index.
(c) Thirdly, choose the best possible combination of the projects.

ILLUSTRATION 1:

Project	**Required initial investment**	**NPV of cash inflows, at the appropriate cost of capital**
A	1,00,000	20,000
B	3,00,000	15,000
C	50,000	16,000
D	2,00,000	25,000
E	1,00,000	30,000

Total fund available is Rs 3,00,000. Determine the best possible combination of projects , when the given projects are divisible.

SOLUTION :

Projects	Required initial outlay(Rs) **'a'**	NPV of cash inflows, at the appropriate cost of capital(Rs)	Present value of cash inflow **'b'=(outflow 'a'+ NPV)**	**Profitability index**= **(b/a)**	Rank
A	1,00,000	20,000	1,20,000	1.20	3
B	3,00,000	15,000	3,15,000	1.05	5

C	50,000	16,000	66,000	1.32	1
D	2,00,000	25,000	2,25,000	1.125	4
E	1,00,000	30,000	1,30,000	1.30	2

Rank of Investment	**Project**	**Required initials (Rs)**
1	C	50,000
2	E	1,00,000
3	A	1,00,000
4	$1/4^{th}$ part of D	50,000*
Total		3,00,000

- Since, all the projects cannot be selected because they cannot be accommodated as the total funds available is 3,00,000. Therefore ,after the selection of project C,E,A the remaining funds with us are (3,00,000-(50,000+1,00,000+1,00,000))= 50,000. So, $1/4^{th}$ portion of D i.e (2,00,000X1/4) to be considered and we reject project B completely since no extra funds are remaining.
  Therefore, the best possible combination of projects is C,E,A and $1/4^{th}$ of D

14.3.2.1(b) Case II- when indivisible projects are there and constraint or restrictions is for a single period:

(Indivisible projects are those which cannot be taken up into parts example: construction of a ship)

Such problems can be solved by using the steps as follows:

(a) Firstly , we construct a table showing the feasible combinations of the project by choosing those combination whose aggregate of initial outlay does not exceed the fund available for investment.
(b) Secondly ,we choose the best possible combination of those projects whose aggregate NPV is maximum and those project is considered the optimal project mix .

ILLUSTRATION 2:

Using the data from Illustration 1 , find the best possible combination of project mix , when the projects are indivisible.

SOLUTION:

Feasible	**Total outlay**	**Aggregate of NPVs**

combinations		
A,C	1,50,000	36,000
A,D	3,00,000	45,000
A,E	2,00,000	50,000
C,D	2,50,000	41,000
D,E	3,00,000	55,000
A,C,E	2,50,000	66,000

By a careful examination of all the feasible combinations constructed in the above table, we will select those projects combination which have maximum or highest aggregate NPVs . Thus in the above table, the best possible combination of project mix is A,C and E because the aggregate of their NPV is maximum.

14.3.2.1(C) Situation III: When divisible projects are there , and constraint is Multi-period : (multi-period rationing means , when the constraints/or shortage is for more than one period.)

Under this situation , the problem of capital rationing can be solved with the help of linear programming . It is a mathematical programming approach .

14.4 SENSITIVITY ANALYSIS

Sensitivity analysis is a modelling procedure used in forecasting, to evaluate how sensitive the output variable is, to the change in one of the variables , while other input variables remains unchanged.

Sensitivity analysis is widely used in capital budgeting decisions to assess how the change in input variables such as sales, variable costs, fixed costs, cost of capital, initial investment , life of the project etc., will affect the output variable such as net present value (NPV) of a project, or internal rate of return (IRR). It help us to evaluate that how sensitive is the net present of a project is for a given change in one of the variables. The more sensitive the net present value of a project , the more critical is that particular variable .

Formula :

$$\text{Sensitivity analysis} = \frac{\text{Percentage change in output or one variable}}{\text{Percentage change in input or another variable}}$$

It helps us to understand the degree of uncertainty associated with a project , and to identify the critical factors so that further research can be carried out about such factors before accepting the project.

Let us understand the steps involved in sensitivity analysis:

- Firstly , identify all the input variables , which can have an influence on the project's NPV .
- Secondly, define the underlying relationship between the identified variables.
- Lastly, analyse the effect of the change in each of the variables it has on the net present value of the project.

Now, In order to start with this analysis , the decision maker will have to calculate the NPV of the project for each forecast under three assumptions (a) pessimistic (b) expected (c)optimistic. An "optimistic decision maker" considers the most favourable outcome in the project , whereas the "pessimistic decision maker" is very conservative in his approach.

This analysis is also known as "**what if**" analysis as it allows him to ask "what if" question. For example : **what** (is going to be the NPV) **if** volume increases or decreases ?**What** (will be the change in NPV) **if** the project cost (fixed or variable) increases or decreases?

Let us consider an example:

ILLUSTRATION 3:

Cash flow forecast for 'XYZ' flour mill project :

Table 1:

	Year 0	Year 1-12
Investment	-5400	
Sales		16,000
Variable cost		12,800
Fixed cost		2000
Depreciation		450
Pre tax profit		750
Taxes		300
Profit after tax		450
Operating cash flow		900
Net cash flow	-5400	900

Finance manager is considering to setup a new project costing 5,40,0000 as Initial Investment . The expected values of all the variables are given in the table above.

Expected cash flow from a new project (with 8% cost of capital) and 40% Average tax rate, variable cost are 80% of sales and all numbers in (Rs'000).

Table 2. Forecast under different Assumptions :

Range			
Variables	Pessimistic	Expected	Optimistic
Sales	14,000	16,000	18,000
Fixed cost	2500	2000	1500

SOLUTION:

Since the cash flow from operation is an annuity, the NPV of the flour mill project is :

NPV = Present value of cash inflows(PVCIF) – Present value of cash outflow(PVCOF).

= 900,000 X PVFA(8%,12yrs) – 5400,000

= (900,000x7.536)-5400000 = 1382400.

Since, the NPV of the project looks positive. The underlying variables can vary widely and hence we would like to explore the effects of such variations on NPV. We will define the optimistic and pessimistic estimates for the underlying variables. The following data for the pessimistic and optimistic values for sale and fixed cost are given in Table 2 in the question itself.

We will calculate the optimistic and pessimistic values of each variables as:

1. ***Calculation of Sensitivity Analysis: 'when change in sales is taken'***
   a) Pessimistic case: Given sales 14,000, (cost of capital = 8%, average tax rate 40%, Variable Cost are a constant 80% of sales, all numbers in '000).

Pessimistic case	Year 0	Year 1-12
Investment	-5400	
Sales		14,000
Variable cost		11,200*
Fixed cost		2000
Depreciation		450
Pre – tax profit		350
Taxes		140**

PAT		210
Operating cash flow		660
Net Cash Flow	-5400	660

*Variable cost = 80% of 14,000 = 11,200.

** Tax= 40%of Pretax profit = 40/100x350=140

NPV= PVOCI-PVCOF = 660XPVFA(8%,12yrs) – 5400

=660X7.536 – 5400 = -426.

b) **Optimistic case:** Given sales 18,000, (cost of capital = 8%, average tax rate 40%, Variable Cost are a constant 80% of sales, all numbers in '000).

Optimistic case	Year 0	Year 1-12
Investment	-5400	
Sales		18000
Variable cost		(14,400)*
Fixed cost		(2000)
Depreciation		(450)
Pretax profit		1,150
Taxes		(460)**
Profit after tax		690
Operating cash flow		1,140
Net cash flow	-5400	1,140

*****V.c = 80% of 18,000= 14,400. **Tax= 40%of 1150 = 460.

NPV = (1140X7.536)-5400 = 3191.04

2. Calculation of Sensitivity analysis : For changing fixed cost :

a) Pessimistic Case : Fixed cost = 2500

Pessimistic Case	Year 0	Year 1-12
Investment	-5400	
Sales		16000

Variable costs		(12,800)
Fixed cost		(2500)
Depreciation		(450)
Pretax profit		250
Taxes		(100)*
Profit after tax		150
Operating cash flow		600
Net cash flow	-5400	600

- Tax = 40%of 250= 100.
  NPV = 600X PVFA (8%,12) – 5400 = -878.

b) Optimistic case : fixed cost = 1500

Optimistic case	Year 0	Year 1-12
Investment	-5400	
Sales		16000
Variables cost		(12800)
Fixed cost		(1500)
Depreciation		(450)
Pretax profit		1250
Taxes		(500)*
Profit after tax		750
Operating cash flow		1200
Net cash flow	-5400	1200

*tax= 40%of 1250= 500
NPV = 1200x PVFA (8%,12) -5400= +3643.

Table above shows project NPV when each variables is set to its pessimistic, expected and optimistic value. If the sales is decreased by 12.5%(i.e to 14,000), then NPV of the project becomes negative (-426) , similarly , if fixed cost is increased by 25% , NPV is negative (-878). Therefore the effect of variations in values can be analysed.

14.5 DECISION TREE ANALYSIS

So far we have discussed about the simple accept or reject decisions for a particular current investments. But in practice, the present decision may have an implications for future investment decisions and can also affect future events and decision making . Such complicated investment decisions requires a sequence of decision making over the time period . An analytical technique to handle the sequential decision is to use decision trees.

Decision tree is a graphical presentation of a decision making situation. It represents the relationship between a present decision and the future events, future decisions and their consequences. The events are plotted over time in an arrangement similar to the branches of a tree. The decision tree is constructed from left to right. The branches represent the possible alternative decisions which could be made.

- The "decision points" also called "decision nodes" (typically represented by 'square')

  = 

  From which the alternatives options will come out.

- The "chance point" also called "chance events" (typically represented by 'circles')

  = 

From which certain outcome like high demand , low demand or success or failure will come out.

14.5.1 STEPS IN DECISION TREE APPROACH:

While constructing and using decision tree, some important steps should be considered:

- Define investments: The investment proposal should be well defined. The proposal may be to enter into a new market or it can be for a new product development.
- Identify all the decision alternatives available: The decision alternatives should be clearly identified. For example , if the company is building a new plant then , it may construct a large plant, medium – size plant or a small plant, or and it may go for expansion later on or it might construct no plant at all.
- Draw a decision tree: the decision tree should display the decision points, chance events and other data.
- Analyse data: The results should be analysed and the best alternative should be selected.

ILLUSTRATION 4:

A Garment factory that specialized in handwoven sarees , is having a substantial backlog and for this, the firm's management is considering three courses of action , the correct choice depends largely upon the demand in future , which due to uncertainty can be low, medium or high.

Show this decision situation in the form of decision tree and indicate the most preferred decision and its corresponding expected value.

Where, S1= sub-contracting, S2= Begin-overtime, S3= construct new facility.

Demand	**Probability**	**Course of Action**		
		S1	**S2**	**S3**
Low	0.10	10	-20	-150
Medium	0.50	50	60	20
High	0.40	50	100	200

SOLUTION :

Steps involved: 1) Calculate the Expected Monetary Value using probability.

2) Draw the Decision Tree Diagram.

3) Select the best alternative among the following.

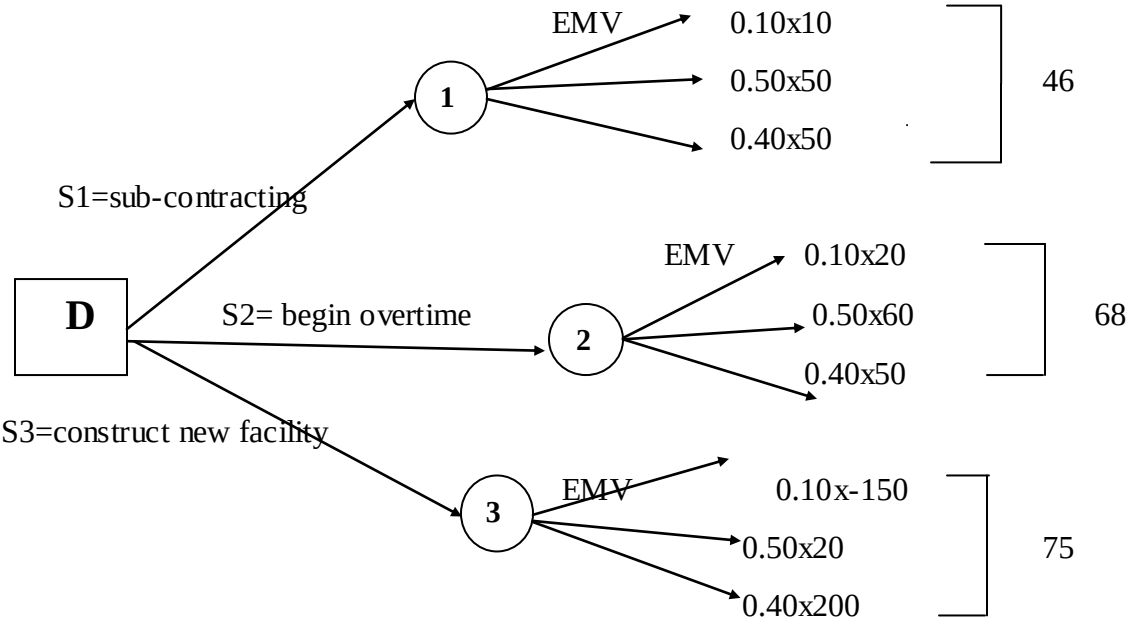
1) EMV(S1) = 0.10(10)+ 0.50(50)+0.40(50)= 46.

EMV(S2)= 0.10(-20)+0.5(60)+0.4(100)= 68.

EMV(S3)= 0.10(-150)+0.5 (20)+0.4(200) = 75.

Therefore , alternative S3 which has highest EMV is selected.

2) **Graphical Representation of decision tree:**



As per the decision tree analysis, alternative S3, which means 'construct the new facility' is selected as it has the highest NPV.

14.5.2 USEFULNESS OF DECISION TREE APPROACH:

This method of analysis is very useful in handling the sequential investments. With the help of this method we are able to eliminate unprofitable branches and can determine the optimum decision at various decision points. Following are the merit of this method:

- Decisions on whether to continue the project or not can be made in a well defined stages.
- Clarity: it brings out the implicit assumptions and calculations for all to see, question and revise back the decisions.
- Graphic visualization: it allows a decision maker to visualize assumptions and alternatives in a graphic form, which is usually much easier to understand than te more abstract, analytical form.
- The probabilities and the cash flow associated with the outcomes are specified at the beginning of the project, which means that the firm has experience of doing similar projects in the past.

However , in this analysis decision maker requires huge amount of information which sometimes becomes quite difficult to gather if the company has introduced something new (product or services) in market because when something new is launched in the market the available information for it is quite less for the analysis . It suffers from another limitation that sometimes, decision tree becomes complicated when more and more alternatives and variables are included in order to have wider future perspectives.

14.6 SIMULATION

Simulation means 'Imitation of the reality'. In simulation, a model is developed which has a well defined description or characteristics of a real system, and experiments are conducted with the model as the model represents the system itself. It is done for the purpose of understanding the behavior for the operation of the system.

Till now we have discussed about the sensitivity analysis, which indicate the sensitivity of the criterion (NPV, IRR etc) to the variations made in the basic factors example: if the quantity sold is decreased by 1%, other things being equal, then NPV falls by 6%. Such information is not adequate for the decision making, as the decision maker would like to know the likelihood of such occurrences, since this method does not reflect the probability by which the change in the variables occur, therefore we use the simulation technique.

Simulation is the representation of a model which will react to change in a similar way to that which is being simulated. Simulation technique is used to solve problem involving 'uncertainty'.

There are several technique of simulation, out of which 'Monte Carlo' technique is considered the very popular and easy to use technique.

This method uses 'random numbers' to solve problem which involve conditions of 'uncertainty'. It is an experiment on chance (use of probability). A computer would normally be used to build and run the model; meaningful information can be extracted only after a number of runs are done using different random numbers.

Some problems are very complex to solve with pure mathematics, so they involve random elements or risk situations that defy a practical mathematical solution. Therefore, we construct a model of a real world problem and use the trial –error approach to arrive at a reasonable solution to the problem.

Uses:

Simulation is basically the duplication of the original system. It can be use for a) inventory control b) financial decisions c) production scheduling d) investment analysis e) queueing problems etc.

14.6.1 ADVANTAGE OF SIMULATION

1. Problems that are too complex to be modelled mathematically can be solved using simulation.
2. It is microanalysis of big and complicated system by breaking it into various sub – system and studying the interface of various sub- system.
3. It forces the decision maker to clearly consider the interdependencies and the uncertainties characterizing the project.
4. A powerful technique which uses large amount of information, which would otherwise be lost.
5. It helps to identify the interactive effect of each single variables / components in order to determine which are important.

14.6.2 DISADVANTAGE OF SIMULATION

1. Simulation works on voluminous data, and is a costly process as well. Each simulation method is unique and the solution retrieved cannot be applied to other problems, even if the problems are similar in nature.
2. It is a complicated model, as the variables used in it are interrelated to each other and the values of the variables depend on previous time periods as well, therefore estimation of a possible relationship and the estimation of probability distribution is a difficult , expensive and time consuming task .
3. This method gives a rough approximation of the probability distribution of (NPV, IRR etc) . There is a lack of accuracy in the method, as the simulated probability distribution may be misleading when a tail of distribution is critical.

ILLUSTRATION 5. The financial controller of XYZ Ltd. Has drawn the following projections with probability distributions :

Wages and salaries (Rs '000)	Probability	Raw material	Probability	Sales revenue (Rs '000)	Probability
10-12	0.3	6-8	0.2	30-34	0.1
12-14	0.5	8-10	0.3	34-38	0.3
14-16	0.2	10-12	0.3	38-42	0.4
		12-14	0.2	42-46	0.6

You are required to simulate the cashflow projection and expected cash balance at the end of the sixth month. Use the following random numbers:

Wages and salaries	2	7	9	2	9	8
Raw materials	4	4	1	0	3	4
Sales revenue	0	6	6	8	0	2

SOLUTION:

Steps to solve :

- Estimate the probability distribution (in this case, it is already provided in question)
- Calculate the cumulative probability distribution.
- Setting random number Intervals .
- Generating random numbers (in this case, it is already provided in question)
- Interpret the result.

(a) Simulation of Cash flow Projection

Random Number Allocation:

Wages and salaries		
Mid point (Rs'000)	Cumulative probability	Random numbers intervals
11	0.3	0-2
13	0.8	3-7

15	1.0	8-9

Raw Materials		
Mid point	Cumulative probability	Random number intervals
7	0.2	0-1
9	0.5	2-4
11	0.8	5-7
13	1.0	8-9

Sale Revenue		
Mid point	Cumulative probability	Random number intervals
32	0.1	0
36	0.4	1-3
40	0.8	4-7
44	1.0	8-9

Simulation of cash flow :
(Rs'000)

Month	Wages and salaries (a)	Raw materials (b)	Sales revenues (c)	Fixed cost (d)	Net cash flow (opening bal =Rs 50) (e)= c-(a+b+d)	Cash balance
1	11	9	32	14	-2	48
2	13	9	40	14	+4	52
3	15	7	40	14	+4	56
4	11	7	44	14	+12	68
5	15	9	32	14	-6	62
6	15	9	36	14	-2	60

From the above simulation it will be observed that there are 3 months (2^{nd},3^{rd},4^{th}) which have net cash outflows, the probability of net cash outflow can therefore be estimated as 3/6 = 0.5. From the above table estimated total cash balance at the end of sixth month is Rs 60,000.

(b) Expected Value Method of Cash flow Projection

EV of salaries and wages = (11x0.3)+(13x0.5)+(15x0.2) = 12,800.

EV of raw materials = (7x0.2)+(9x0.3)+(11x0.3)+(13x0.2)=10,000.

EV of sales revenue = (32x0.1)+(36x0.3)+(40x0.3)+(44x0.2)=34,800

Expected Net cash inflow per month = 34,800-12,800-10,000-14,000 = Rs 2000.

Expected cash balance after six month = 50,000+(2000x6) = Rs 62,000.

The difference between the two values Rs 60,000 and Rs 62,000 is due to sample errors . If more number of times the simulation process will be repeated then the mean of the balances predicted should approach the expected value more closely and more similar to each other as the number of repetition of process was increased.

14.7 CAPITAL ASSET PRICING MODEL (CAPM)

CAPM model was introduced by William Sharpe and John Linter , which is build upon the earlier work of Harry Markowitz on diversification and modern portfolio theory.

This model provides a framework to determine the required rate of return on an asset and describes the relationship between expected rate of return and the risk of the asset.

The model draws the attention that the risk factor in a portfolio theory is a combination of two risk i.e systematic risk and unsystematic risk (Table). The combination of both types of risk give us the total risk .

Total risk = Systematic risk + Unsystematic risk

CAPM suggest that the required rate of return on security 'Ri' or 'Ke' is directly related to 'systematic risk', since it cannot be neutralized through diversification , whereas unsystematic risk can be reduced through a diversified and a balanced portfolio.

The required rate of return ('Ke' or 'Ri')as estimated by CAPM help in valuing an asset or securities , as we can compare the expected rate of return on an asset with the required rate of return and we can determine whether the assets is fairly valued, over-valued, or under-valued.

It also helps us to make an informed guess about the returns we can expect from an assets which has not yet been traded in the market.

Before moving forward, first we should understand how the risk is classified:

- ***Systematic Risk***: This risk arises out of external and uncontrollable factors. The effect in systematic risk causes the price of individual shares to move in the same direction, which is generally due to the response to economic, social and political change . Systematic risk is difficult to reduce through diversification of portfolio.

Example :

- Government changes the interest rate policy, deficit financing,
- Increase in inflation rate.
- Government relaxes the forex exchange control.

- ***Unsystematic risk :*** This risk arises out of known and controllable factors. These factors are unique and related to a firm or Industry. Unsystematic risk is the change in the price of the stock due to the factors which are particular to the stock. Unsystematic risk can be reduced or eliminated through diversification of portfolio.

Example :

- Company workers have declared strike.
- Government increases the taxes on certain raw materials
- New competitors enter the market or the company has old and obsolete technology.

Table 14.1 : Showing systematic and unsystematic risk.

Assumptions of CAPM :

1. Capital market are in equilibrium
2. There is no market imperfection. All the investment are infinitely divisible.
3. There are no taxes ,no interest changes , information is cost less, there is no inflation
4. Investment goals of investors are rational.
5. No transaction costs involved.
6. All investors have the same expectations about the risk and returns.
7. Investors base their portfolio investment decisions on security, its expected returns and standard deviation criteria.

Limitations of CAPM :

1. In real world assumptions made under CAPM does not hold good.
2. It is difficult to estimate the risk free return, market rate of return and risk premium.
3. CAPM is a single period model and most project available as large indivisible projects.

14.7.1 SML (SECURITY MARKET LINE)

In this section ,we will discuss about SML under CAPM, it demonstrate the relationship between an asset's risk and its required rate of return .SML expresses the basic theme of CAPM i.e the expected return of a security increases linearly with the risk as measured by β 'beta', which is explained latter in this section.

SML is straight line sloping upwards with an intercept at the risk-free return securities and passes through the market portfolio.

The upward slope of line indicate that greater expected return follows the higher levels of beta. i.e(more risk, more return).

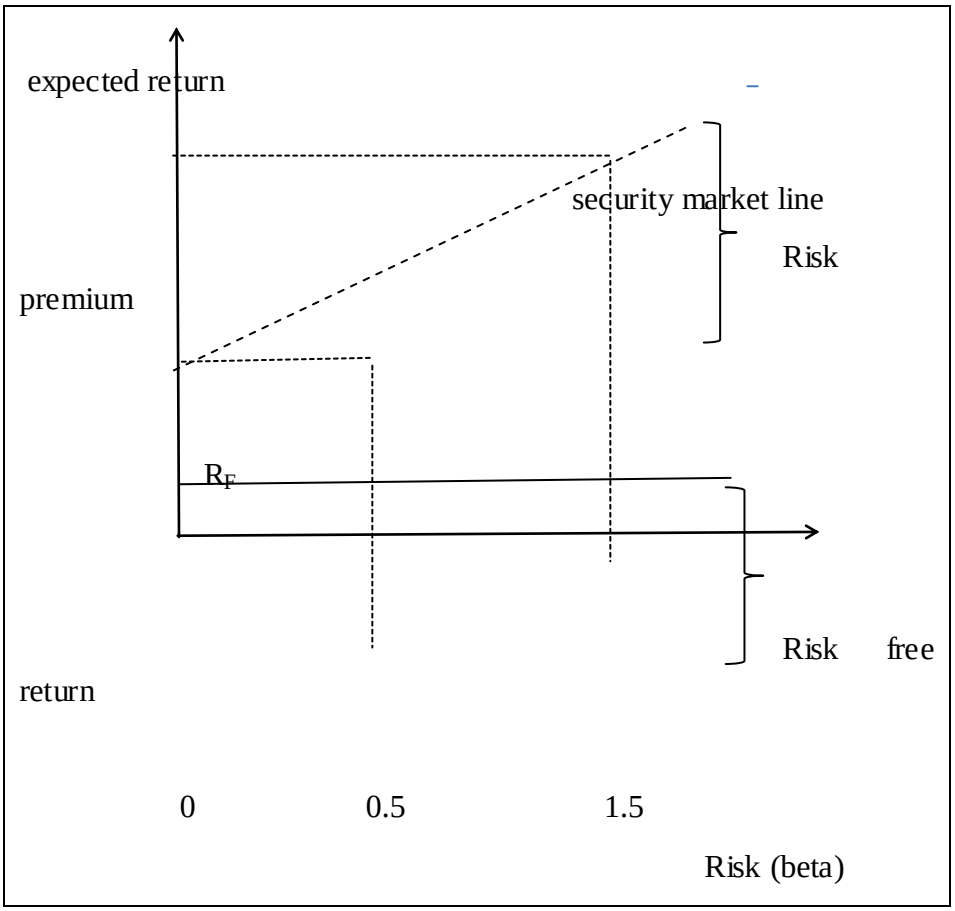


Figure 14.2: Security Market Line Chart. Reprinted from Financial Management (p1046),by Ravi.Kishore,2009,NewDelhi,Taxmann Publication.

The above diagram shows that the return expected from the investment made is a combination of risk free return plus risk premium.

The investors will only be interested in taking risk only if the return on investment will also include the risk premium also.

CAPM shows the risk-return relationship of an investment is given by the formula :

$E(R_i) = R_f + \beta i\ (R_m - R_f)$
Expected return on security = Risk-free return + Beta of security X Market risk premium

Where, $E(R_i)$ = Expected rate of return on security or (portfolio of security)

$R_{f=}$ risk free rate of return.

$R_{m=}$ expected rate of return.

R_m-R_f = Risk premium or Equity market premium.

B_i = 'beta' of the security, or market sensitivity of the individual security or (portfolio of security).

Beta 'β' is a measure of a security's systematic risk. The market related risk is also called 'systematic risk' and it is an unavoidable risk even after diversification, whereas unsystematic risk can be avoided by diversification of portfolio.

'Beta' factor is a measure of volatility of a systematic risk of a security. 'β' of a market as a whole is 1. A zero β means no risk.

a) A 'β = 1' indicate that the systematic risk is equal to the aggregate market risk, and the required rate of return on security will be equal to market rate of return.
b) A 'β greater than 1' means the systematic risk is greater than the aggregate market risk and the security's return are more sensitive and fluctuate more than the market return, which implies that the security's required rate of return will be more than the market rate of return.
c) A 'β less than 1' indicate that the systematic risk is lower than the aggregate market risk , and the security's return are less sensitive to the changes in the market return, which implies that security's required rate of return will be less than the market rate of return.

ILLUSTRATION 6:

ABC Ltd , an investment company has invested in equity share of a blue chip company, it's risk- free return (R_f) = 8%, expected total return (R_m) = 15%, market sensitivity index(β) = 1.5. Calculate expected return on security.

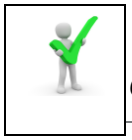
SOLUTION :

Total expected return (R_m) = 15%

Risk free return (R_f)= 8%

Risk premium ($R_m - R_f$) = 7%

$E(R_i) = R_f + \beta (R_m - R_f) = 8+1.5 (15-8) = 18.5$ %.



Check Your Progress-A

Fill in the blanks :

1. The required rate of return of the project can be calculated as_____.
2. Two steps involved in capital rationing are _____and_____
3. In sensitivity analysis , the emphasis is on assessment of sensitivity of _____
4. When a firm imposes constraint on the total size of its capital budget , it is know as _____
5. Decision tree approach is used in _____decision making.
6. A risk free security has a beta equal to ____, while the market portfolio's beta is equal to _____.
7. According to CAPM , overpriced securities has a _____beta.
8. Beta is a measure of volatility of _____risk, if the beta is _____means the stock is more sensitive .
9. SML line slopes_____ and passes through___ and expected return.
10. Rigidity that affects the free flow of capital between firms causes_____.

14.8 SUMMARY

In this unit we have discussed about, how the firms prioritize the projects in the basis of limited availability of funds and the economic compulsion to do so. When capital is rationed there is a need to develop a method of selecting the best project with its highest possible NPV. We also learnt about the forecasting method by sensitivity analysis when the change in one input variable leads to the change in other output variables. Further, we also learnt about the steps involved in Decision Tree approach and the concept of simulation. Lastly , we discussed about the CAPM which helps us to identify the relationship between expected rate of return and the risk of an asset . Classification of risk into systematic and unsystematic risk is also discussed at the end.

14.9 GLOSSARY

Expected return: expected return of an investment or portfolio is a combination of risk free return plus a risk premium.

Beta factor: it is a measure of the volatility of the systematic risk of an investment in the portfolio. Beta more than 1 means stock is more sensitive than average investment.

CAPM: Capital asset pricing model

Expected value: the probability of occurrence of cash flow will help estimating the expected value.

Decision tree: a branching diagram with probabilities of different activities and the payoffs of different decisions.

14. 10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress –A

1. $E(R_i) = R_f + \beta i\ (R_m - R_f)$
2. Ranking the project, selection of the most profitable investment proposal
3. NPV
4. Capital Rationing
5. sequential
6. Zero,one
7. Negative
8. systematic risk, more than 1
9. Upwards, risk free return
10. External capital rationing.

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14.13 TERMINAL QUESTIONS

Q1. What is capital rationing? What are the factors leading to capital rationing?

Q2. Write a short note on 'Monte –Carlo simulation'. State its advantages and disadvantages .

Q3. 'Decision tree analysis is helpful in managerial decisions' . Explain with an example.

Q4. What is sensitivity analysis in capital budgeting .

Q5 . Briefly explain capital asset pricing model and state its assumptions.

Q6. The following information is given

Risk free rate of return 8%

Expected rate of return on market portfolio 16%

Beta of security = 0.7

i) Find out the expected rate of return of the security.
ii) If another security has an expected return of 20%, what must be its beta?