TITLE: MAKE OR BUY DECISION

OBJECTIVE:	Decide the qualitative and quantitative of the product
APPLICATIONS:	DESK AND BENCH BUSHES

UNIVERSITY QUESTIONS:

1. What are the different approaches for make or buy decisions?
2. Explains the Criteria for Make or buy decision and its approach (10M) May-13
3. Write on Break Even Analysis, Engineering and Economic efficiency cost that go into the fixing of product cost. (16M) May-13.

NOTES

NOTES

INTRODUCTION:

Make or buy decision is a determination whether to produce a component part internally or to buy it from an outside. Each decision involves its own costs. So, in a given situation, the organisation should evaluate each of the above make or buy alternatives and then select the alternative which results in the lowest cost.

This is an important decision since it affects the productivity of the organisation. In long run, the make or buy decision is not static. The make option of a component may be economical today

but after sometime, it may turnout to be uneconomical to make the same.

Thus, the make or buy decision should be reviewed periodically, say, every 1 to 3 years. This is mainly to cope with the changes in the level of competition and various other environmental factors.

CRITERIA FOR MAKE OR BUY :

CRITERIA FOR MAKE: The following are the criteria for make:

1. The finished product can be made cheaper by the firm than by outside suppliers.
2. The part has an importance for the firm and requires extremely close quality control
3. The finished product is being manufactured only by a limited number of outside firms which are unable to meet the demand.
4. The part can be manufactured with the firm's existing facilities and similar to other items in which the company has manufacturing experience.

CRITERIA FOR BUY: The following are the criteria for buy:

1. Existing facilities of the company can be used more economically to make other parts
2. Requires high investments on facilities which are already available at suppliers plant.
3. The company doesnot have facilities to make it and there are more profitable opportunities for investing Company's capital.
4. The skill of personnel employed by the company is not readily adoptable to make the part.
5. Demand for the part is either temporary or seasonal
6. Patent or other legal barriers prevent the company for making the part.

Factors affecting Make or Buy decisions.

Quantitative Factors.

1. Opportunity costs
2. Incremental costs.
3. Idle Facilities.

Quantitative Factors

1. Product Quality
2. Patents
3. Skills and Materials.
4. Long Term Considerations.

Other Factors:

1. Number of outside suppliers
2. Reliability of outside sources
3. Seasonal or temporary demand
4. Size of investments.

APPROACHES FOR MAKE OR BUY DECISION

Types of analysis followed in make or buy decision are as follows:

1. Simple Cost Analysis
2. Economic Analysis
3. Break-Even Analysis

SIMPLE COST ANALYSIS: It is concerned with finding the actual expenditure incurred on a given thing. It is concerned with finding the total value of economic resources used as a result of producing a thing.

The concept is illustrated using an example.

12 (b) (16 M), May-08, May-12

Worked example 1: A firm has extra capacity that can be used to produce a fixture which it has been buying for Rs. 1,100/- each. If the Company makes the fixtures, it will incur material cost of Rs. 350/per unit, labour cost of Rs. 300/- per unit, and variable cost of Rs 150/- per unit. The annual fixed cost associated with the unused capacity is Rs 10,10,000/- Demand over the next year is estimated at 5,000 units. Should it be profitable for the Company to make the fixtures?

GIVEN: Fixed cost = Rs. 10,10,000/-

Material Cost = Rs 350/unit

Labour Cost = Rs 300/unit

Variable cost/overheads = Rs 150/unit

Purchase price = Rs 1,100/unit

Future Demand/unit = 5000 units

TO FIND: Make or Buy decision

SOLUTION: NOTE: We assume that the unused Capacity has alternative use.

COST OF MAKE:

Variable cost/unit = Material + Labour + Overheads

= 350 + 300 + 150

= Rs. 800/-

Total Variable cost = (5,000 units) x (Rs 800/unit)

= Rs 40,00,000/-

Add fixed cost associated with unused capacity } + Rs 10,10,000

Total Cost = Rs 50,10,000.

Cost to buy

Purchase cost = (5,000 units)(Rs. 1,100/units)

= Rs. 55,00,000 –

Add fixed cost associated with unused capacity } + Rs 10,10,000 –

Rs. 65,10,000 –

RESUCT:

The cost of making fixtures is less than that of cost of buying fixtures from supplies. So the firm should make the fixture in inhouse.

---

2. There are three alternatives available to meet the demand of a particular product. They are as follows.

(a) Manufacturing the product by using Process A

(b) Manufacturing the product by using Process B

(c) Buying the product.

The details are as given in the following table.

Description	Manufacturing the product by Process A	Manufacturing the product by Process B	Buy
fixed cost/year	Rs. 6,00,000	Rs. 7,00,000	
Variable cost/unit	Rs. 180	Rs. 160	
Purchase cost/unit			Rs. 130

The annual demand of the product is 8000 units. Should the company make the product using process A (or) Process B or buy it?

GIVEN:

Fixed cost/year for Manufacturing the product by Process A } Rs. 6,00,000

Fixed cost/year for manufacturing the product by Process B } Rs. 7,00,000

Variable cost/unit for Process A - Rs. 180/-

Purchase cost/unit - Rs. 130/-

Variable cost/unit for Process B - Rs. 160/-

Future demand - 8,000 units

TO FIND: MAKE OR BUY IN Three Alternatives

SOLUTION:

(a) ANNUAL COST OF PROCESS A

Variable cost = (8,000 units × 180/ unit) = 14,40,000

Fixed cost ⇒ = 6,00,000

Total cost = 20,40,000.

(b) Annual cost of Process B

Variable cost = (8000 units × 160/ unit) = 1,280,000

Fixed cost = 700,000

Total cost 19,80,000

(c) Annual cost to buy:

Annual cost to buy = Purchase price/unit x Volume

= Rs. 130 x 8000

= Rs. 10,40,000

RESUCT: It is clear that the annual cost of purchase is the minimum amongst all the alternatives. So the company should buy the product is the best alternative.

ECONOMIC ANALYSIS

The following inventory models are considered to illustrate economic analysis concept.

* Purchase Model
* Manufacturing Model.

The formulae for Economic order Quantity (EOQ) and Total Cost (TC) for each model are given in the following table below.

Purchase model	Manufacturing model
$Q_1 = \sqrt{\frac{2C_0D}{C_c}}$	$Q_2 = \sqrt{\frac{2C_0r}{C_c(1-r/k)}}$
$T.C = D \times P + \frac{DC_0}{Q_1} + \frac{Q_1 \times C_c}{2}$	$T_c = D \times P + \frac{DC_0}{Q_2} + C_c(k-r)\frac{Q_2}{2*k}$

where, D - Demand/year ; P - Purchase price/unit,

C_c - Carrying cost/unit/year ; C_0 - Ordering cost/order (or) Setup cost/setup

K - Production rate (No. of units/yr)

r - demand/year.

Q_1 - Economic order size,

Q_2 - Economic Production size

TC - Total cost/year.

EXAMPLE: A Machine part has a yearly demand of 2,000 units. The different costs in respect of make or buy are as follows. Determine the best option.

Description	Buy	Make.
Item cost/unit	Rs. 11.00	Rs. 9.00
Procurement cost/order	Rs. 140.00	—
Setup cost/Set-up	—	Rs. 70.00
Annual Carrying cost/item/yr	Rs. 1.80	Rs. 1.30
Production rate/year		8000 units

GIVEN DATA: Demand D = 2,000 units/yr

Item cost for buy/unit = Rs. 11.00

Item cost for make/unit = Rs. 9.00

procurement cost/order = Rs. 140.00

Setup cost/setup C_o = Rs. 70/- setup.

K = 8000 units/yr

C_c for buy = Rs. 1.80/unit/yr

C_c for Make = Rs. 1.30/unit/yr.

TO FIND: MAKE OR BUY

SOLUTION: BUY OPTION Formula

$$Q_1 = \sqrt{\frac{2C_o D}{C_c}} = \sqrt{\frac{2 \times 140 \times 2,000}{1.80}}$$

$Q_1 = 557.77 \simeq 558$ units

$$TC = DP + \frac{DC_o}{Q_1} + \frac{Q_1 C_c}{2}$$

$$= 2{,}000 \times 11 + \frac{2{,}000 \times 140}{558} + \frac{558 \times 1.80}{2}$$

T.C = Rs. 23,003.99

MAKE OPTION

$$Q_2 = \sqrt{\frac{2C_o r}{C_c\left[1-(r/k)\right]}}$$

$$= \sqrt{\frac{2 \times 70 \times 2{,}000}{1.3(1 - 2000/8000)}} = 537.87$$

$= 536$ units

$$TC = DP + \frac{D \times C_o}{Q_2} + C_c(k-r)\frac{Q_2}{2 \times K}$$

$$= 2{,}000 \times 9.000 + \frac{2000 \times 70}{536} + 1.30(8{,}000 - 2000)\frac{536}{2 \times 8{,}000}$$

Tc = Rs. 18,522.49

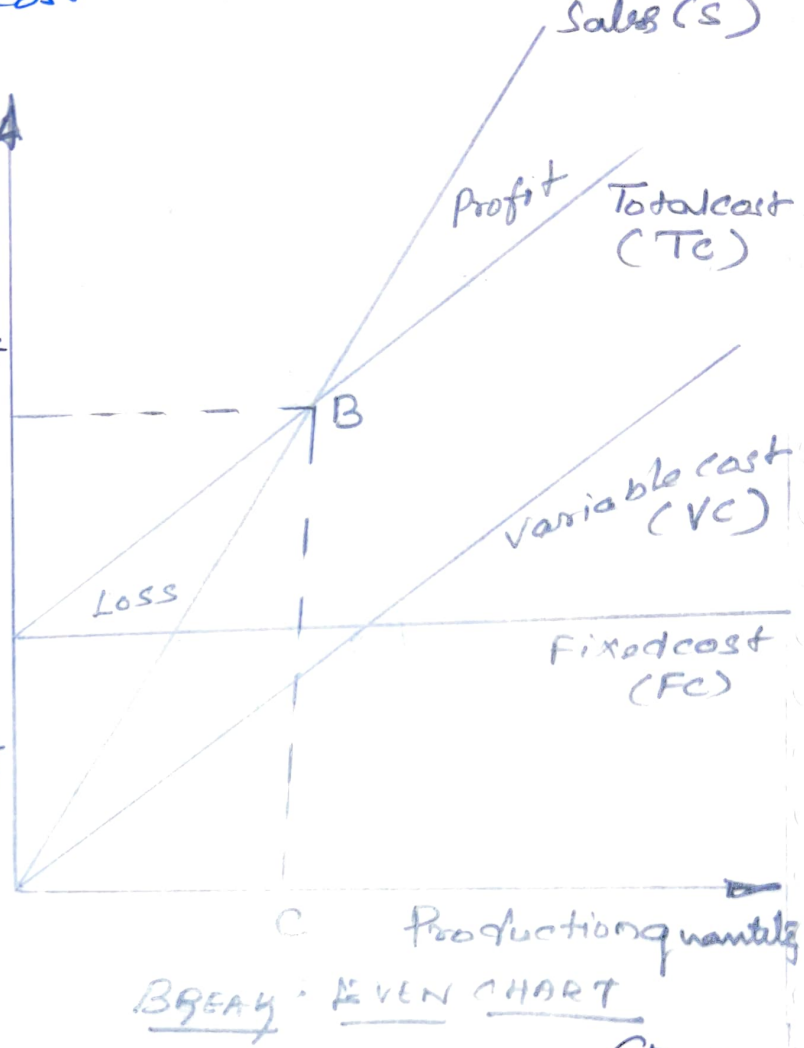
RESULT: The cost of making is less than the cost of buying. Therefore, the firm should go for making option is best.

BREAK-EVEN ANALYSIS:

It implies that the same point in the operations, where the total revenue equals total cost.

BREAK EVEN POINT: It is, the volume of output at which neither a profit is made nor a loss is incurred.

BREAK EVEN CHART: The Break Even Analysis Chart is a graphical representation of the relation ship b/w cost and revenue at a given time.



BREAK - EVEN CHART

Tc - Total cost

Fc - Fixed cost

Tc = Fc + Variable cost

B - The intersection of Tc and Sales [No loss or No gain situation]

A - Break - even Sales

C - Break - even quantity (B.E.P)

Formula for the Break even point (B.E.P)

$$B.E.P = \frac{FC}{\text{Selling price/unit} - \text{Variable cost/unit}}$$

Example: 1 A manufacturer of Car buys tail light at Rs. 220 each. In case it makes it themself, the fixed cost and Variable costs would be Rs. 25,00,000/- and Rs. 80 per tail light respectively Should the manufacturer make or buy the component if the demand is 2500 nos?

GIVEN

Selling price/unit (SP) = Rs. 220/-

Variable cost = Rs. 80/-

Fixed cost (FC) = Rs. 25,00,000/-

TO FIND: Break Even Point (B.E.P)

SOLUTION:

$$B.E.P = \frac{FC}{SP - VC} = \frac{25,00,000}{220 - 80}$$

$$= 17,857.14 \simeq 17,858 \text{ Nos.}$$

RESULT: Hence, the demand 2500 units is less than the break-even quantity, the company should buy the tail light.

---

2. There are three alternatives available to meet the demand of a particular product. They are as follows

(a) Manufacturing the product by using Process A

(b) Manufacturing the product by using Process B

(c) Buying the product.

The details are given in the following table below:

Descriptions	Manufacturing the product by Process A	Manufacturing the product by Process B	Buy
Fixed cost/year	Rs. 90,000	Rs. 2,50,000	
Variable cost/unit	Rs. 90	Rs. 80	
Purchase price/unit			Rs. 80

The annual demand of the product is 8,000 units, Should the Company make the product using process A or Process B or buy it?

GIVEN DATA:

Fixed cost/year for Manufacturing the product by Product A } = Rs. 90,000/-

Variable cost/unit for Manufacturing the product by Product A } = Rs. 90/-

fixed cost/year for Manufacturing the product by Product B } = Rs. 2,50,000

Variable cost/unit for Manufacturing the product by Product B } = Rs. 80/-

Buying the product = Rs. 80/-

TO FIND: which is Suitable Process A, B or buy

SOLUTION:

Annual cost of Process A = Fc + Vc x Volume.

= 90,000 + 90 x 8000

= Rs. 810,000/-

Annual cost of Process B = Fc + VC x Volume

= 2,50,000 + 80 x 8000

= Rs. 8,90,000/-

Annual Cost of buy = Purchase price/unit x Volume

= 80 x 8,000

= Rs. 6,40,000/-

RESULT: The Annual cost of buy option is the minimum among all the alternatives, the company should buy the product

Key points: * Make or buy decision - criteria, types of Economic Analysis * Worked examples * Alternatives.

NPR College of Engineering & Technology
NPR Nagar, Natham, Dindigul - 624401, Tamil Nadu, India.
Phone No: 04544- 246 500, 246501 246502
Website : www.nprcolleges.org E-mail: nprgi@nprcolleges.org

TITLE: VALUE ENGINEERING - Function, aims, Procedure

OBJECTIVE:	How to select the one from various opportunities at lower cost.
APPLICATIONS:	Pen features
UNIVERSITY QUESTIONS:	1. Explain the concept of 'Value Engineering' (2M) May-11. 2. Differentiate between value analysis and Value Engineering. Explain Value Engineering procedures (8+8) May-11, May-12 3. Write any four aims of value Engineering. (2M) May 12 4. State aims two uses of value Engineering. (2M) (May 13)

NOTES

VALUE ENGINEERING / VALUE ANALYSIS:

INTRODUCTION:

Value analysis is one of the major techniques of cost reduction and cost prevention. It is a disciplined approach that ensures necessary functions for minimum cost without sacrificing quality, reliabil performance and appearance. According to the Societ of American Value Engineers (SAVE).

DEFINITION:

" Value Analysis is the Systematic application of recognized techniques which identify the function of a product or service, establish a monetary value for the function and provide the necessary function reliably at the lowest over all cost."

It may be concluded that Value
organised approach to the identification and elimination
of unnecessary cost wherever they occur.

When to apply Value Analysis:

One can definitely expect very good results by initiating a VA programme if one or more of the following symptoms are present:

* Company's products show decline in sales
* Company's prices are higher than those of its competitors
* Raw materials cost has grown disproportionate to the volume of production
* New designs are being introduced
* The cost of manufacture is rising disproportionate to the volume of production.
* Rate of return on investment has a falling trend.
* Inability of the firm to meet its delivery commitments

VALUE ANALYSIS Vs. VALUE ENGINEERING

Often the terms value analysis and value engineering are used synonymously. Though the philosophy underlying the two is same, i.e., identification of unnecessary cost. yet they are different. The difference lies in the time and the stage at which the techniques are applied.

Value Analysis is the application of a set of techniques to an existing product with a view to improve its value. It is thus a remedial process

Value engineering is the application of exactly the same set of techniques to a new product at the design stage, project concept or preliminary design when no hardware exists to ensure that bad features are not

added. It is a preventive process.

VALUE:

Value is used in different ways and consequently, has different meanings. Value differs from both price and cost in the sense that it is the cost proportionate to the function. We can express value mathematically as.

$$\text{Value} = \frac{\text{Function or Utility}}{\text{Cost}}$$

It can therefore be seen that the value of a product can be increased either by increasing its utility with the same cost or by decreasing its cost for the same function.

TYPES OF VALUE:

Everybody has one's own concepts of value depending upon requirement, situation and time. The designer equates the value with reliability, a purchase person with price paid for the item, a production person with cost of manufacture and a sales person with customer's willingness to pay.

It is only the economic value which can be measured and classified. Economic value can be sub-divided into four types. These are (i) Cost value (ii) Exchange value (iii) Use value (iv) Esteem value.

Cost Value: It is the summation of the labour, material overhead and all other elements of cost required to produce an item or provide a service compared to a base.

Exchange value: A product is said to posses exchange value if the same can be exchanged for another product or for money. Value derived from the product of two parts 'use value' and 'esteem value'

Use value: It is known as the function value. The use value is equal to the value of the functions performed. Therefore, it is the price paid by the buyer (buyer's view), or the cost incurred by the manufacturer (manufacturer's view) in order to ensure that the product performs its intended functions efficiently. The use value is the fundamental form of economic value. A part without "use value" can have neither "exchange value" nor "esteem value".

Esteem value: It involves the qualities and appearance of a product (like a Television set), which attract persons and create in them a desire to posses the product. Therefore, esteem value is the price paid by the buyer or the cost incurred by the manufacturer beyond the use value.

FUNCTION: It is the purpose for which the product is made. Identification of the basic functions and determination of the cost currently being spent on them are the two major considerations of value analysis.

Function identifies the characteristics which make the product/component/part/item/device to work or sell. "Work functions" lend performance value while 'Sell functions' provide esteem value. Verbs like "support", hold, 'transmit' 'prevent', 'protect', 'exhibit', 'control', etc., are used to describe work functions, while 'attract', 'enhance', 'improve' 'create', etc., are used to describe 'Sell' functions. For example, in a 'bus driver cabin' the functional analysis of some of the parts are given in Table below.

Functional Analysis of Some parts of a Bus drivel cabin.

Component of Study	Functional analysis	
	Verb	Noun
Steering wheel	Control	Direction
Gearbox	Change	Speed
Brake System	Stop	Vehicle
Wiper	Clear vision	Water
Horn	Make	Sound
Side mirror	Show	Side traffic

Classification of the functions:

Rarely do all functions assume equal importance. Usually, some functions are more important than others. Functions can be classified into the following three categories.

1. Primary 2. Secondary 3. Teetiary

1. Primary functions: These are the basic functions for which the product is specially designed to achieve primary functions, therefore, are the most essential functions whose non-performance would make the product worthless, e.g., a photo frame exhibits photographs, a chair supports weight, a fluorescent tube gives light.

2. Secondary functions are those which if not in built, would not prevent the device from performing its primary functions, e.g., arms of a chair provide support for hands. Secondary

functions are related to convenience. The product can still work and fulfill its intended objective even if these functions are not in-built and yet they may be necessary to sell the product.

Tertiary functions are usually related to esteem appearance For example, Sunmica top of a table gives esteem, appearence. for the table.

Let us consider a single example of painting a college bus to explain all the above three functions. Here, the primary function of painting is to avoid corrosion. The secondary function is to identify the bus to which the bus belongs by the colour of the paint. (e.g yellow colour for college bus for Institution bus in Tamil Nadu). The Tertiary function is to impart a very good appearance to the bus by using brilliant colours.

AIMS of VALUE ENGINEERING

1. Simplify the product.
2. Use (new) cheaper and better materials.
3. Modify and improve product design.
4. Use efficient processes.
5. Save money or increase the profits
6. Reduce the products cost
7. Increase the utility of the product by economic wise.

The value content of each piece of a product is assessed using the following questions.

1. Does it need all its features?
2. Does its use contribute to value?
3. Is its cost proportionate to its usefulness?

functions are related to convenience. The product can still work and fulfill its intended objective even if these functions are not in-built and yet they may be necessary to sell the product.

Tertiary functions are usually related to esteem appearance, For example, Sunmica top of a table gives esteem appearence. for the table.

Let us consider a single example of painting a college bus to explain all the above three functions. Here, the primary function of painting is to avoid corrosion. The secondary function is to identify the bus to which the bus belongs by the colour of the paint. (e.g yellow colour for college bus for Institution bus in Tamil Nadu). The Tertiary function is to impart a very good appearance to the bus by using brilliant colours.

AIMS of VALUE ENGINEERING

1. Simplify the product.
2. Use (new) cheaper and better materials.
3. Modify and improve product design.
4. Use efficient processes.
5. Save money or increase the profits
6. Reduce the product cost
7. Increase the utility of the product by economic wise.

The value content of each piece of a product is assessed using the following questions.

1. Does it need all its features?
2. Does its use contribute to value?
3. Is its cost proportionate to its usefulness?

* Complete cost data and marketing details
* Latest development in related product

Step 3: Define different functions: Identify and define the primary, secondary and tertiary functions of the product or parts of interest. Also, specify the value content of each function and identify the high cost areas.

Step 4: Different alternatives: Knowing the functions of each component part and its manufacturing details, generate the ideas and create different alternatives so as to increase the value of the product. Value engineering should be done after a brain storming session. All feasible or non-feasible suggestions are recorded without any criticism; rather, persons are encouraged to express their views freely.

BASIC PRINCIPLES OF BRAIN STORMING:

Some of the important principles of brain storming which are useful in value analysis are now listed.

(i) A Quality idea comes from quantity of ideas: If the number of ideas created is more, the more good solutions do turn up.

(ii) Creative ideas emerge from unconventional thinking: This is possible when members of the group "talk off the top of their heads" and voice weird ideas as they flash through their minds, regardless of how stupid or impractical they may appear. Often, non-technical personnel can prove to be the greatest innovators in technical areas. Since their view points are objective and they do not know that some of their ideas are

technically not feasible at all. So it is preferable to include one or two non-technical persons in the study team. Members are to be told by the team leader in the beginning of the session itself, not to breathe a word of criticism of even the most wild idea

(iii) Spontaneous evaluation of ideas curbs imaginative thinking and retards the flow of creative ideas: The group should not evaluate the alternatives suggested by its member immediately since immediate evaluation may curb imaginative thinking and slow down the flow of creative ideas.

(iv) Hitch-hiking on the ideas often lead to better ideas: Participants have to improve upon ideas of other members either directly or by combining more ideas in addition to contributing ideas of their own. A brilliant idea may not be a practical one initially, or it may look to be silly or useless but discussions can convert it into a valuable one.

(v) When ideas ~~cease~~ of flow, short diversions enable the mind to rebound with new ideas after recuperation:

Members of the syndicate may reach a stage where new ideas do not come. At such a stage, short diversions - rest, favourite sport, hobby, lunch or tea break etc., - may be taken during which members are advised to sleep over the ideas and report fresh after the break. Such short diversions enable mind to recoup and rebound with new ideas.

iii) Creativity is a regenerative process and the recording of ideas as they emerge helps serve as a catalyst to generate more ideas.

Memory may not retain all ideas or recall them when they needed. So, a stenographer may be asked to record idea simultaneously. A tape recorder can also be used for this purpose or even ideas can be written on a black board. These recorded ideas can be reviewed at some late date.

Step 5: Critically evaluate the alternatives:

Different ideas recorded under step 4 are compared, evaluated and critically assessed for their virtues, validity and feasibility as regards their financial and technical requirements. The ideas technically found and involving lower costs are further developed.

Step 6: Develop the best alternative:

Detailed development plans are made for those ideas which emerged during Step 5 and appear most suitable and promising. Development plans comprise drawing the sketches, building of models, conducting discussions with the purchase section, finance section, marketing section etc.,

Step 7: Implement the alternative:

The best alternative is converted into a prototype manufacturing model which ultimately goes into operation and its results are recorded.

Eg: Pen features.

Advantages

1. It is much faster cost reduction techniques
2. It is a less expensive technique
3. It reduces production costs and add value to sales income of the product.

Applications:

* Machine tool industries
* Automobile industries
* Import substitutes
* Machine shop

Key points:

* Value Engineering - Introduction, Definition
* Value Engineering Vs value Analysis
* value - Types of value
* Function - classification
* Aims of value engineering
* Value Engineering procedure.
* Basic principle of brain storming
* Advantages
* Applications.

TITLE: Interest Formulae and their applications.

OBJECTIVE: To find out the future amount for their investment in financial companies &.

APPLICATIONS: Investments in Banks & other financial Sectors.

UNIVERSITY QUESTIONS: 1. What is time value of money? 2M May-13
2. What is effective interest rate? 2M (May-12)

NOTES

Introduction:

Interest rate is the rental value of money It represents the growth of capital per unit period The period may be month, a quarterly, half yearly or a annual. An interest rate 15% compounded annually means that for every hundred rupees invested now, an amount of Rs. 15/- will be added to the account at the end of the first year. So, the total amount of invested amount Rs. 100/- at the end of the year becomes Rs. 115/-. At the end of the second year, again 15% of Rs. 115/- i.e Rs. 17.25 will be added to the account. Hence the total amount at the end of the second year will be Rs. 132.25. The process will continue thus till the specified no. of years

TIME VALUE OF MONEY

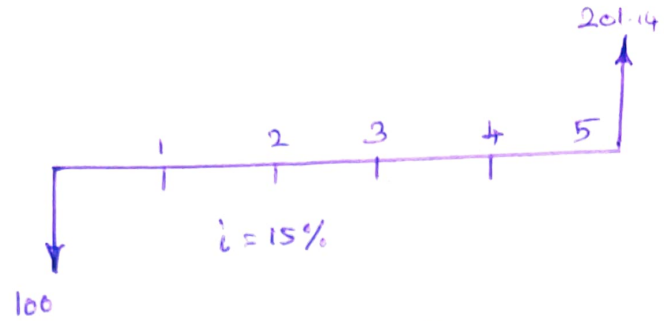
If an investor invests a sum of Rs. 100/- in a fixed deposit for five years with an interest rate of 15% compounded annually, the accumulated amount at the end of every year will be as shown in Table below.

Compound interest amount deposited : Rs. 100/-

Year end	Interest (15%) Rs.	Compound amount Rs.
0		100.00
1	15.00	115.00
2	17.25	132.25
3	19.84	152.09
4	22.81	174.90
5	26.24	201.14

The formula to find the future worth in the third column is $F = P \times (1+i)^n$ this the formula for calculate the compound interest where P - principle amount invested at time
F - Future amount
i - interest rate compounded annually
n - period of deposit.

The maturity value at the end of the fifth year is Rs. 201.14. This means that the amount Rs. 201.14 at the end of the fifth year is equivalent to Rs. 100 at time 0 (i.e., at present). This is diagrammatically shown in figure below. This explanation assumes that the inflation is at zero percentage



TIME VALUE OF MONEY

Alternatively, the above concept may be discussed as follows: If we want Rs. 100/- at the end of the n^{th} year, what is the amount that we should deposit now at a given interest rate, say 15%? A detailed working is shown in Table with the help of formula.

The formula to find the present worth in the second column is $P = \frac{F}{(1+i)^n}$

Present Worth Amounts Rate of interest 15%

End of year	Present worth	Compound amount after n years
0		
1	86.96	100
2	75.61	100
3	65.75	100
4	57.18	100
5	49.72	100
6	43.29	100
7	37.59	100
8	32.69	100
9	28.43	100
10	24.72	100

From table, it is clear that if we want Rs. 100/- at the end of the fifth year, we should now deposit an amount Rs. 49.72. Similarly, we want Rs. 100 at the end of 8th year, we should now deposit an amount of Rs. 32.69.

Also, this concept can be stated as follows:

A person has received a prize from a finance company during the recent festival contest. But the prize will be given in either of the following two modes:

1. Spot payment of Rs. 24.72 (or)
2. Rs. 100 after 10 years from now. (this is based on 15% interest rate compounded annually)

If the prize winner has no better choice that can yield more than 15% interest rate compounded annually, and if 15% compounded annually is the common interest rate paid in all the finance companies, then it makes no difference whether he receives Rs. 24.72 now or Rs. 100 after 10yrs.

On the other hand, let us assume that the prize winner has his own business wherein he can get a yield of 24% interest rate (more than 15%) compounded annually, it is better for him to receive the prize money of Rs. 24.72 at present and utilize it in his business. If this option is followed, the equivalent amount for Rs. 24.72 at the end of the 10th year is Rs. 212.45

This example clearly mentioned the time value of money.

INTEREST FORMULAS:

While making investment decisions, computations will be done in many ways. To simplify all these computations, it is extremely important to know how to use interest formulae more effectively. Before discussing the effective

applications of the interest formulae for investment decision making, the various interest formulae are presented first.

Interest rate can be classified into Simple rate of interest and Compound interest rate.

In Simple interest, the interest is calculated, based on the initial deposit for every interest period. In this case, calculation of interest on interest is not applicable.

In Compound interest, the interest for the current period is computed based on the amount. (principal plus interest up to the end of the previous period) at the beginning of the current period.

The notations which are used in various interest formulae are follows.

P = principal amount

n = No. of interest periods.

i = interest rate (It may be compounded monthly, quarterly, annually)

F = future amount at the end of year 'n'

A = equal amount deposited at the end of every interest period.

G – Uniform amount which will be added/Subtracted period after period to/from the amount of deposit A 1 at the end of period 1

Key Points

* Introduction
* Time value of money
* Formula with examples
  Compound interest
* Present worth calculations
* Interest formulae

TITLE: Single Payment compound amount factor, Single payment present worth factor.

OBJECTIVE:
How to invest their amount for future plan?

APPLICATIONS:
Fixed deposits. Future worth of investments

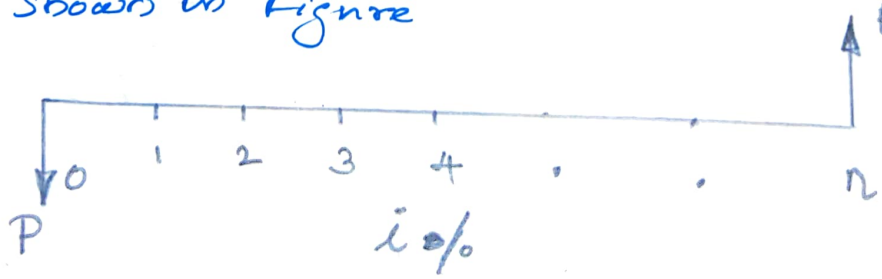
UNIVERSITY QUESTIONS:

1. Discuss about the different interest formula and their applications. (16M) Apr-14
2. Give the expression for Single Payment present worth factor. (2m) (May-12)
3. Discuss about Single Payment compound amount factor (16M) May-09

NOTES

SINGLE PAYMENT COMPOUND AMOUNT

The objective is to find the single future sum (F) of the initial payment (P) made at time '0' after 'n' periods at an interest rate 'i' compounded every period. The cash flow diagram of this situation is shown in Figure



Cash flow diagram of Single-payment Compound amount

The formula to obtain the future sum worth is

$$F = P(1+i)^n = P(F/P, i, n)$$

where $(F/P, i, n)$ is termed as Single-payment Compound amount factor.

Example.1 A person deposits a sum of Rs. 25,000 at the interest rate of 15% Compounded annually for 10 years. Find the maturity value after 10 years.

Given

Principal amount P = Rs. 25,000/-

Rate of interest i = 15%

No. of years n = 10 yrs.

To find: Maturity value. Future amount.

Solution:

Formula for future amount

$$F = P(1+i)^n = P(F/P, i, n)$$

$$= 25,000\ (F/P, 15\%, 10)$$

$$= 25,000\ (4.046)$$

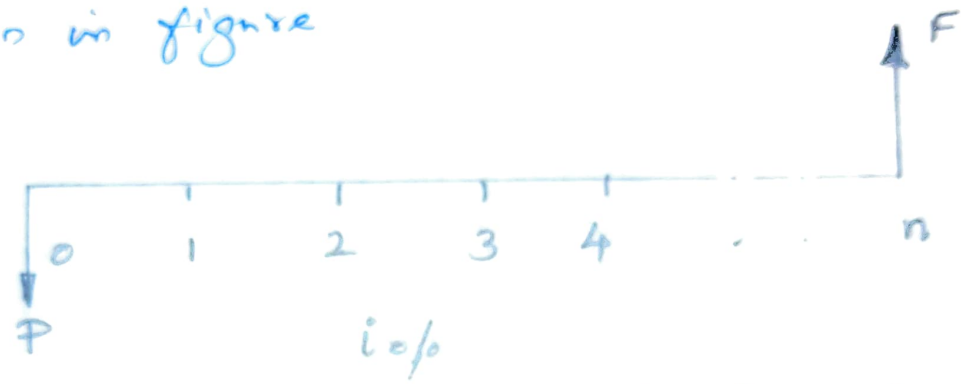
$$= Rs\ 1,01,150/-$$

RESULT: The maturity value of Rs. 25,000/- invested now at 15% Compounded yearly is equal to Rs. 1,01,150/- after 10 years.

SINGLE PAYMENT PRESENT WORTH AMOUNT

The objective is to find the present worth amount (P) of a single future sum (F) which will be received after 'n' periods at an interest rate of 'i' compounded at the end of every interest period.

The corresponding cash flow diagram is shown in figure



Cash flow diagram of single-payment present worth amount.

The formula to obtain the present worth is

$$P = \frac{F}{(1+i)^n} = F(P/F, i, n)$$

where $(P/F, i, n)$ is termed as single-payment present worth factor.

Ex:1: A person wishes to have a future sum of Rs. 2,00,000 for his son's education after 12 years from now. What is the single-payment that he should deposit now so that he gets the desired amount after 12 years? The bank gives 15% interest rate compounded annually.

GIVEN:

Future amount F = Rs. 2,00,000/-

Rate of interest i = 15%

No. of years n = 12

TO FIND: The family gives interest ? Principle amount.

Solution:

F = Rs. 2,00,000/-

Rate of interest i = 15%

n = 12

$$P = F/(1+i)^n$$

$$= F(P/F, i, n)$$

$$= 2,00,000\,(P/F, 15\%, 12)$$

$$= 2,00,000\,(0.1869)$$

$$P = \text{Rs. } 37,380/-$$

RESULT: The person has to invest Rs. 37,380/- now so that he will get a sum of Rs. 2,00,000/- after 12 years at 15% interest rate compounded annually.

Key points:

* Single Payment Compound amount - Definition, formulae, worked example.
* Single payment present worth amount - Definition, formulae, worked example.

TITLE: Equal-Payment Series Compound Amount
Equal-Payment Series Sinking Fund.

OBJECTIVE:
To find the future worth of n equal payments.

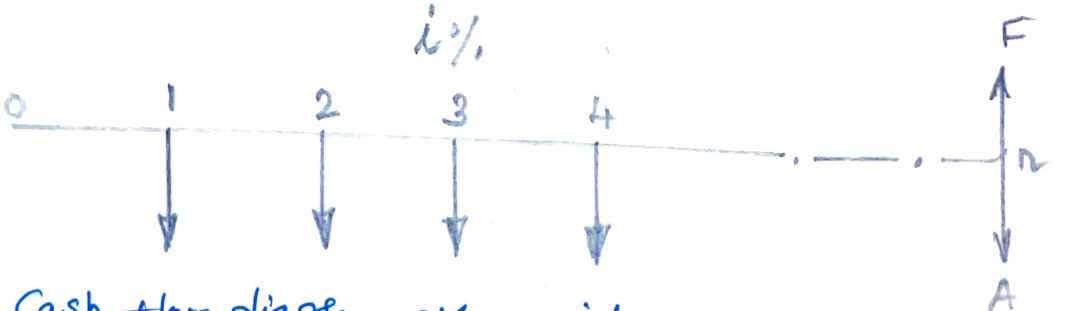
APPLICATIONS:
future worth of investment

UNIVERSITY QUESTIONS:
1. Discuss about the different interest formula and their applications (16m) Apr.-11
2. Explain in detail : Equal payment series sinking fund factor. (8m) May-2009.

NOTES

EQUAL-PAYMENT SERIES COMPOUND AMOUNT

In this type of investment mode, the objective is to find the future worth of n equal payments which are made at the end of every interest period till the end of the nth interest period at an interest rate of i compounded at the end of each interest period. The corresponding cash flow diagram is shown in figure below.



Cash flow diagram of equal-payment series compound amount

A - Equal amount deposited at the end of each interest period.

n - No. of interest periods

i - rate of interest

F - Single future amount

The formula to get F is $F = A \frac{(1+i)^n - 1}{i}$

$$F = A(F/A, i, n)$$

Where $(F/A, i, n)$ is termed as equal-payment Series compound amount factor.

Worked example:

A person who is now 25 years old is planning for his retired life. He plans to invest an equal sum of Rs. 10,000 at the end of every year for the next 35 years starting from the end of the next year. The bank gives 20% interest rate compound annually. Find the maturity value of his account when he is 60 years old.

GIVEN.

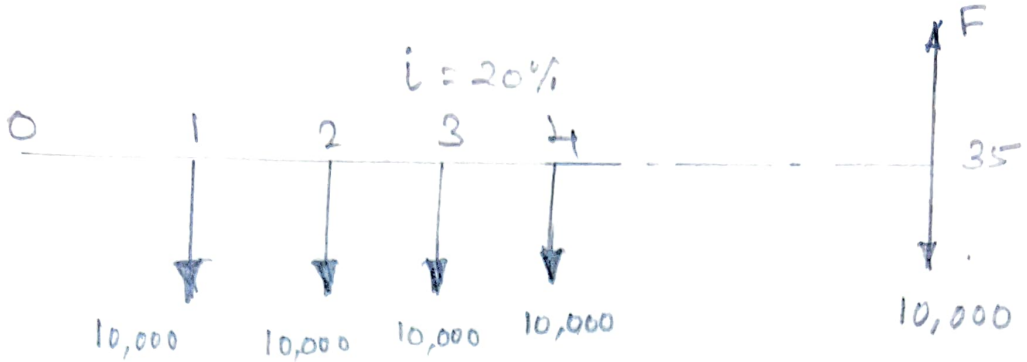
A - Rs. 10,000

No. of years n = 35 years

Rate of interest i = 20%

TO FIND Maturity value 'F'

SOLUTION The corresponding cash flow diagram is shown in figure below.



Cash flow diagram of equal-payment series Compound amount

$$F = A\,\frac{(1+i)^n - 1}{i}$$

$$= A\,(F/A, i, n)$$

$$= 10,000\,(F/A, 20\%, 35)$$

$$= 10,000\,(2,948.341)$$

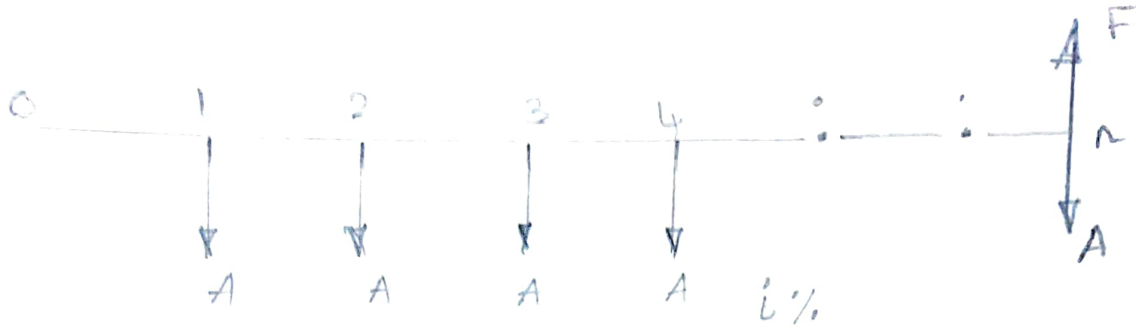
$$= ₹\,2,94,83,410/-$$

RESULT: The future sum of the annual equal payments after 35 years is equal to ₹ 2,94,83,410/-

EQUAL-PAYMENT SERIES SINKING FUND

In this type of investment mode, the objective is to find the equivalent amount (A) that should be deposited at the end of every interest period for 'n' interest periods to realize a future sum (F) at the end of the nth interest period at an interest rate of i

The corresponding cash flow diagram is shown in figure below.



Cash flow diagram of equal-payment Series Sinking fund

The formula to get A is $A = F \frac{i}{(1+i)^n - 1}$

$$A = F(A/F, i, n)$$

Where (A/F, i, n) is called as equal-payment Series Sinking fund factor.

Worked Example:

A Company has to replace a present facility after 25 years at an outlay of Rs. 3,00,000. It plans to deposit an equal amount at the end of every year for the next 25 years at an interest rate of 15% compounded annually. Find the equivalent amount that must be deposited at the end of every year for the next 25 years.

GIVEN DATA:

Future amount F = Rs. 3,00,000

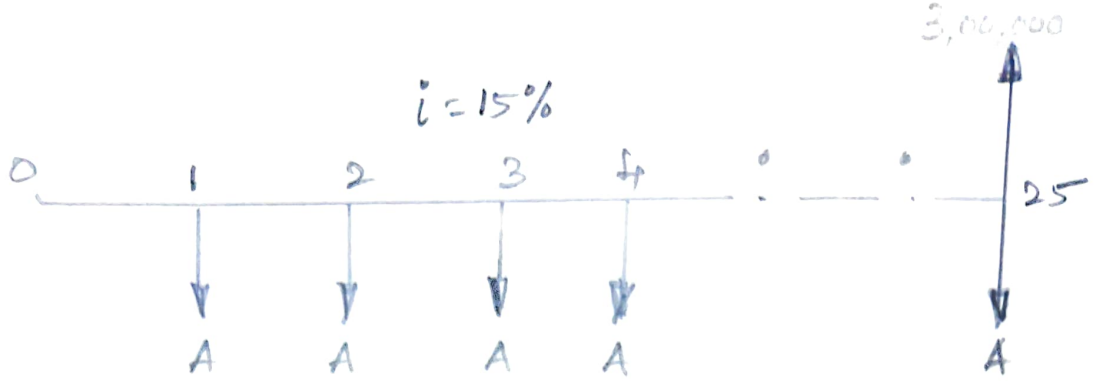
No. of years n = 25 years

Rate of interest i = 15%

TO FIND: Equivalent amount 'A'

SOLUTION:

The corresponding cash flow diagram is shown in figure below.



Cash flow diagram of equal-payment series Sinking fund.

Equal amount $A = F \dfrac{i}{(1+i)^n - 1} = F(A/F, i, n)$

$= 3,00,000\,(A/F, 15\%, 25)$

$= 3,00,000\,(0.0047)$

$= Rs.\ 1410/-$

RESULT: The annual equal amount which must be deposited for 25 years is Rs. 1410/-.

Key Points:

* Equal-payment series Compound amount
  - Definition, formulae
  Worked examples
* Equal-payment series Sinking fund
  - Definition, formulae.
  Worked example.

TITLE: Equal payment series payment present worth factor.

OBJECTIVE: To find the present worth of an equal payment

APPLICATIONS:

Money value.

UNIVERSITY QUESTIONS:

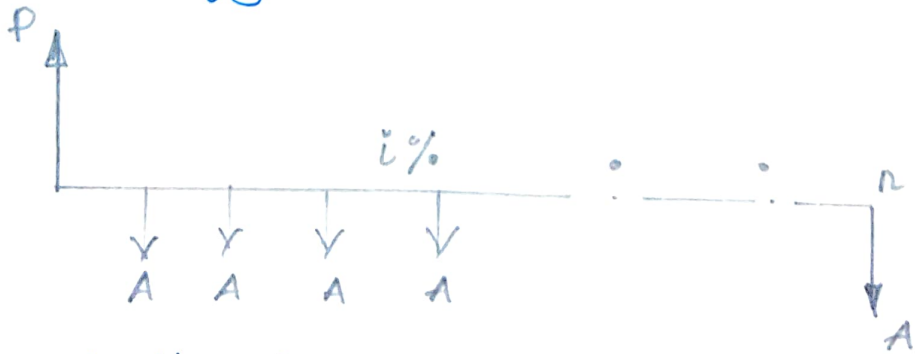
1. What is equal payment series payment present worth factor ? (2m)
2. Write an expression for equal payment series payment present worth factor. (4m)

NOTES

EQUAL PAYMENT SERIES PRESENT WORTH AMOUNT

The objective of this mode of investment is to find the present worth of an equal payment made at the end of every interest period for 'n' interest periods at an interest rate of 'i' compounded at the end of every interest period.

The corresponding cash flow diagram is shown in figure below



Cash flow diagram of equal-payment series present worth amount

P = Present Worth

A = Annual equivalent payment

i = interest rate

n = No. of interest periods.

The formula to compute P is

$$P = A \frac{(1+i)^n - 1}{i(1+i)^n} = A(P/A, i, n)$$

Where (P/A, i, n) is called equal-payment series present worth factor.

Worked Example: ABC company wants to setup a reserve which will help the Company to have an annual equivalent amount of Rs. 5,00,000 for the next 25 years towards its employees welfare measures. The reserve is assumed to grow at the rate of 15% annually. Find the single-payment that must be made now as the reserve amount

Given data:

Annual equivalent amount A = Rs 5,00,000/-

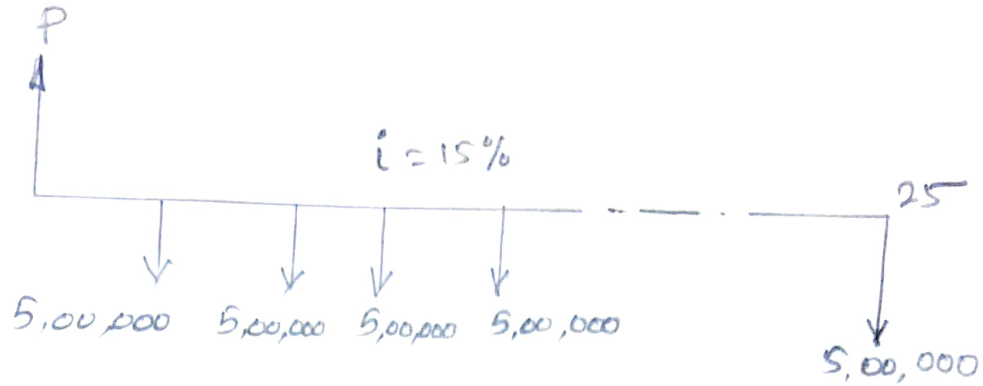
Rate of interest i = 15%

No. of years n = 25

To find:

Principal Single payment - P

Solution: The corresponding cash flow diagram is illustrated in figure below.



Cashflow diagram of equal-payment Series Payment worth amount

$$P = A \frac{(1+i)^n - 1}{i(1+i)^n} = A(P/A, i, n)$$

$$= 5,00,000 \times (P/A, 15\%, 25)$$

$$= 5,00,000 \times (6.4641)$$

$$= ₹\ 32,32,050/-$$

RESULT: The amount of reserve which must be setup now is equal to Rs. 32,32,050/-

Key points.

* Equal payment series payment present worth factor — Expressions, formulae
* Worked examples.

TITLE: Equal-payment Series Capital Recovery Amount

OBJECTIVE: This mode of investment is to find the annual equivalent amount

APPLICATIONS:

Loan from bank for business

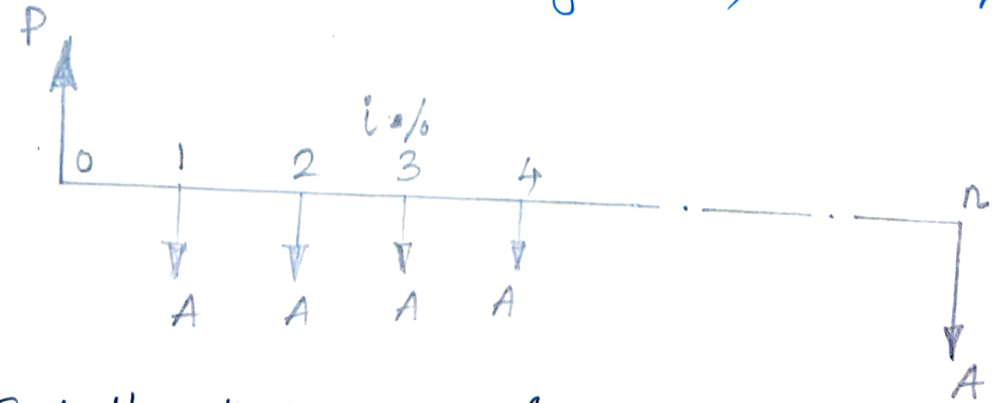
UNIVERSITY QUESTIONS:

Explain in detail: Equal-payment Series capital recovery factor (8M) May-2009.

NOTES

Equal-Payment Series Capital Recovery Amount

The objective of this mode of investment is to find the annual equivalent amount (A) which is to be recovered at the end of every interest period for 'n' interest periods for a loan (P) which is sanctioned now at an interest rate of 'i' compounded at the end of every interest period.



Cash flow diagram of equal-payment Series capital recovery amount

$$A = \frac{P\,i(1+i)^n}{(1+i)^n - 1}$$

$$A = P(A/P, i, n)$$

where $(A/P, i, n)$ is called equal-payment series capital recovery factor.

P - Present worth (loan amount)

A - Annual equivalent payment (recovery amount)

i - interest rate

n - no. of interest periods.

Worked Examples:

An economic concern gives a loan to a company to purchase an equipment worth Rs. 5,00,000/- at an interest rate of 20% compounded annually. This amount that the company has to pay to the concern. No of years - 18 equal installments. find the installments.

GIVEN DATA:

Principal amount P = Rs. 5,00,000/-

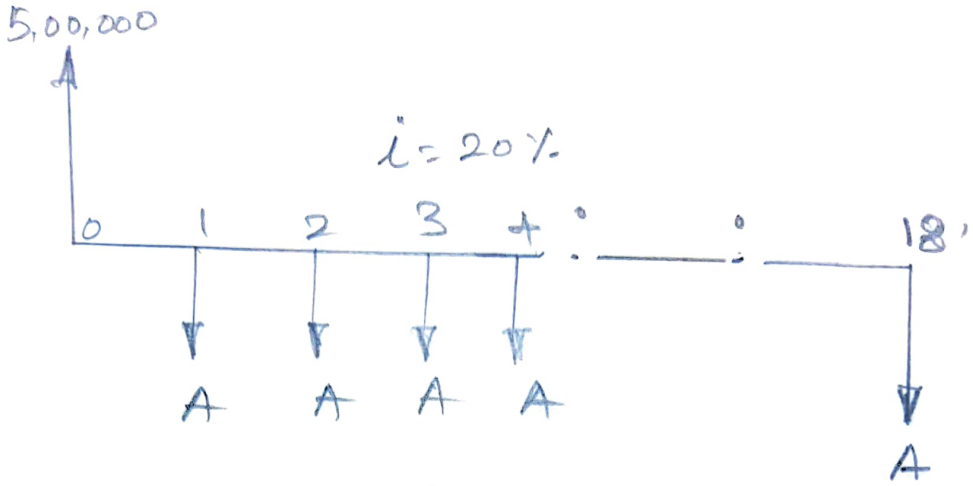
Interest rate i = 20%.

No. of interest periods n = 18

TO FIND: installment amount 'A' - ?

SOLUTION:

The corresponding cash flow diagram is shown in figure below.



Cash flow diagram of equal-payment series Capital recovery amount.

$$A = P \frac{i(1+i)^n}{(1+i)^n - 1}$$

$$A = P(A/P, i, n)$$

$$A = 5,00,000\ (A/P, 20\%, 18)$$

$$A = 5,00,000\ (0.2078)$$

$$A = Rs.\ 1,03,900/-$$

RESULT: The annual equivalent installment to be paid by the company to the economic Concern is Rs. 1,03,900/-

TITLE: Uniform gradient series annual equivalent factor

OBJECTIVE: This mode of investment is to find the annual equivalent amount of a series.

APPLICATIONS:

planning for Retirement benefits

UNIVERSITY QUESTIONS:

12(b) Problem - Apr 2011 (16m), May 2012 (16m), in worked example

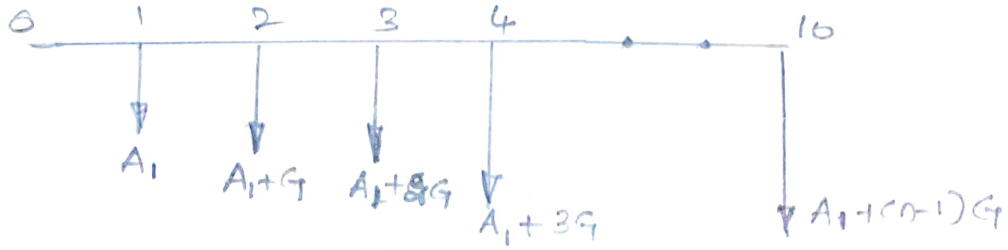
1. What is uniform gradient conversion? Illustrate with an example. (8M) (May-08)

NOTES

UNIFORM GRADIENT SERIES ANNUAL EQUIVALENT AMOUNT

The objective of this mode of investment is to find the annual equivalent amount of a series with an amount A_1 at the end of the first year and with an equal increment (G) at the end of each of the following (n-1) years with an interest rate 'i' compounded annually.

The corresponding cash flow diagram is shown in figure below.



The formula to compute A under this situation

$$A = A_1 + G\,\frac{(1+i)^n - in - 1}{i(1+i)^n - i}$$

$$A = A_1 + G(A/G, i, n)$$

where $(A/G, i, n)$ is called uniform gradient series factor

A_1 - end of first year deposit.

A - Annual equivalent payment

G - equal increment.

✓ Worked Example:

May. 11 (16M) 1. Kumar is planning for his retired life he has 10 more years of service. He would like to deposit 25% of his salary, which is Rs. 5,000 at the end of the first year. and there after he wishes to deposit the amount with an annual increase of Rs. 500/- for the next 9 years with an interest rate of 18%. Find the total amount at the end of the 10th year of the above series.

GIVEN DATA:

End of first year deposit A_1 = Rs. 5000/-

Equal increment G = Rs. 500/-

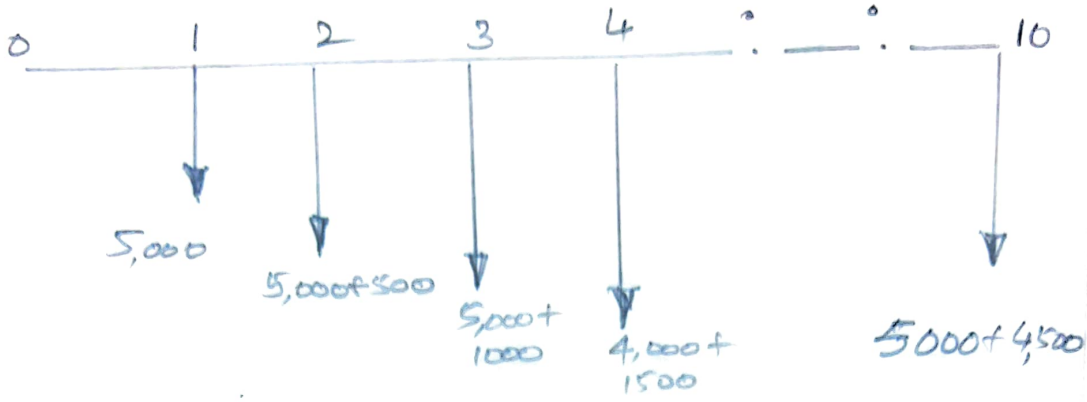
Rate of interest i = 18%

No. of years n = 10

TO FIND: A - Annual equivalent payment ?

F - Future worth Sum

The cash flow diagram is shown below



Cash flow diagram of uniform gradient series annual equivalent amount

Formula $A = A_1 + G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right]$

$= A_1 + G(A/G, i, n)$

$= 5000 + 500(A/G, 18\%, 10)$

$= 5000 + 500(3.1936)$

$= Rs.\ 6,596.80$

This is equivalent to paying an equivalent amount of Rs. 6,596.80 at the end of every year for next 10 years. The future worth sum of this revised series at the end of the 10th year is obtained as follows.

Future amount $F = A(F/A, i, n)$

$= 6,596.80(F/A, 18\%, 10)$

$= 6,596.80(23.521)$

$= Rs.\ 155163.33$

RESULT: At the end of the 10th year, the Compound amount of all this payments will be ₹1,55,163.33

KEY POINTS:

* UNIFORM gradient Series annual equivalent method
  - Expression
  - worked example.

TITLE: EFFECTIVE INTEREST RATE

OBJECTIVE: To find the interest rate as per the given periods
APPLICATIONS: Calculate the future amount.
UNIVERSITY QUESTIONS: 1. What is effective interest rate ? (2m) Apr-14 2. Write the equation for interest Compounding of a Capital (yearly, half yearly and @quarterly Compounding. (6M) May-13

NOTES

EFFECTIVE INTEREST RATE:

Generally nominal interest rates are Compounded annually. But in practice, the compounding may occur less than a year. For example, Compounding may be monthly, quarterly, and half yearly. Compounding monthly means that the interest is computed at the end of every month. There are 12 interest periods in a year if the interest is Compounded monthly under such situations, the formula to compute the effective interest rate, which is Compounded annually, is

Effective interest rate $R = (1 + i/c)^c - 1$

Where i – the nominal interest rate

c – the number of interest period in a year.

Worked Example: A person invests a sum of Rs. 6,000 in a bank at a nominal interest rate of 13% for 10 years. The compounding is half yearly. Find the maturity amount of the deposit after 10 years.

GIVEN DATA:

Principal amount P = Rs. 6,000/-

No. of years n = 10 years

Rate of interest i = 13%

TO FIND: Future amount 'F'

SOLUTION: Method. 1

No. of interest periods per year = 2.

No. of interest periods in 10 years

$= 10 \times 2 = 20$

Revised no. of periods. $N = 20$ (half yearly)

Interest rate per half yearly

$r = 13\%/2$

$= 6.5\%$ Compounded half yearly

$$F = P(1+r)^N$$

$$= 6000(1 + 0.065)^{20}$$

$$F = 21,141.87$$

METHOD : 2

No. of interest periods per year $C = 2$

Effective interest rate $R = (1 + i/c)^c - 1$

$$= (1 + 13\%./2)^2 - 1$$

$$= 13.42\%.$$ Compounded annually

$$F = P(1+R)^n = 6,000(1 + 0.1342)^{10}$$

$$= Rs.\ 21,137.21$$

RESULT:

Future amount $F = Rs.\ 21,141.87$.

KEY POINTS:

* Effective interest rate - Expression, formulae
* worked examples.