

WOLLO UNIVERSITY (KIOT)

**DEPARTMENT OF CONSTRUCTION TECHNOLOGY
AND MANAGEMENT**

**FINANCIAL MANAGEMENT IN
CONSTRUCTION (HB)**

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CHAPTER TWO

FUNDAMENTALS OF INVESTMENT APPRAISAL

2.1. INVESTMENT

Investment may be defined as the commitment of resources to some economic activity in anticipation of greater returns or benefits in the future. Thus, investment clearly implies foregoing consumption now with the expectation of more consumption at a later time. In a strict economic sense, investment takes place only when natural resources are converted into real assets such as the plant and equipment. Thus, an investment occurs when a user of capital, such as a private corporation or a public agency, takes the savings resulting from foregoing present consumption out of the capital or financial market and spends them on the acquisition of new assets.

Investment in new real assets, whether in the private or public sector, is referred to as **capital investment**. An investment project of this nature requires a long-term commitment of resources with returns to be realized over the life of the real asset.

On the other hand, the commitment of savings into investment through various means provided by financial institutions is referred to as *financing*. Stocks, bonds, and bank notes representing claims on real assets which are financed by the issuance of these papers are called *financial assets* or *securities*. The purchase of such assets or securities for investment is referred to as **financial investment**.

Significance of investment

- Substantial expenditure,
- Long Time Periods,
- Implied sales forecasts.
- Investment appraisal
- Planning horizon/ decision regarding return on investments.

2.2. The Classification of Investment Projects

Before a new capital investment is undertaken, an extensive search is usually made to spot potential investment opportunities. It is important to recognize the characteristics of investment projects that appear to be attractive, particularly their interrelationships with other potential projects. An investment project may be economically independent of or dependent on other projects. An investment project is said to be *economically independent* if it is technically feasible to undertake this project alone and if its expected profit or net benefit will not be affected favorably or adversely by the acceptance or rejection of any other projects; otherwise an investment project is said to be *economically dependent*. For example, replacing a small, deteriorating bridge with a new one may be regarded as an economically independent project if no other alternative or supporting actions related to the replacement are anticipated. In reality, a project is seldom totally economically independent; however, if the

effects from other possibilities are small, then for all practical purposes the project is considered independent.

On the other hand, a proposed bridge for river crossing at a given site may be economically dependent on a network of access roads to the site which is not presently in existence, since without the network of access roads, the net benefit of the bridge cannot be realized. Alternatively, if an underwater tunnel instead of a bridge is proposed near the same site, then neither one is economically independent of the other since the construction of one will affect the expected net benefit of the other.

When two projects are dependent on each other, they may either *complement* each other or *substitute* for each other to some degree. For example, a proposed bridge and a proposed network of access roads complement each other. Suppose that the network of access roads can serve the community near the bridge site regardless of the acceptance or rejection of the bridge proposal, but the bridge will be inaccessible without the road network. Then the proposed network of access roads is said to be the *prerequisite* of the proposed bridge. On the other hand, a proposed bridge and a proposed underwater tunnel near the same site of the river crossing may have a substituting effect for each other for lack of sufficient traffic volume to justify the construction of both. In fact, if the construction of one makes it technically infeasible to construct the other or if the net benefit expected from one proposed project will be completely eliminated by the acceptance of the other, then they are said to be **mutually exclusive**.

In economic evaluation, we arrange the potential projects in the form of a set of investment proposals so that they are not economically interdependent. If the investment proposals are independent, we can analyze each proposal on its own merit since its net benefit will not be affected by the acceptance or rejection of other proposals. If all investment proposals are mutually exclusive, the acceptance of one investment will automatically lead to the rejection of all others. Hence, we can rank the merits of various investment proposals and select the best among them.

2.3. SIMPLE INTEREST & COMPOUND INTEREST

α. Interest and Interest rate

Interest is a fee that is charged for the use of someone else's money. The size of the fee will depend upon the total amount of money borrowed and the length of time over which it is borrowed.

Example 1.1 An engineer wishes to borrow \$20 000 in order to start his own business. A bank will lend him the money provided he agrees to repay \$920 per month for two years. How much interest is he being charged?

The total amount of money that will be paid to the bank is $24 \times \$920 = \$22\,080$. Since the original loan is only \$20 000, the amount of interest is $\$22\,080 - \$20\,000 = \$2080$.

Whenever money is borrowed or invested, one party acts as the lender and another party as the borrower. The lender is the owner of the money, and the borrower pays interest to the lender for the use of the lender's money. For example, when money is deposited in a savings account, the depositor is the lender and the bank is the borrower. The bank therefore pays interest for the use of the depositor's money. (The bank will then assume the role of the lender, by loaning this money to another borrower, at a higher interest rate.)

If a given amount of money is borrowed for a specified period of time (typically, one year), a certain percentage of the money is charged as interest. This percentage is called the **interest rate**.

Example 1.2 (a) A student deposits \$1000 in a savings account that pays interest at the rate of 6% per year. How much money will the student have after one year? (b) An investor makes a loan of \$5000, to be repaid in one lump sum at the end of one year. What annual interest rate corresponds to a lump-sum payment of \$5425?

- (a) The student will have his original \$1000, plus an interest payment of $0.06 \times \$1000 = \60 . Thus, the student will have accumulated a total of \$1060 after one year. (Notice that the interest rate is expressed as a decimal when carrying out the calculation.)
- (b) The total amount of interest paid is $\$5425 - \$5000 = \$425$. Hence the annual interest rate is

$$\frac{\$425}{\$5000} \times 100\% = 8.5\%$$

Interest rates are usually influenced by the prevailing economic conditions, as well as the degree of risk associated with each particular loan.

b. Simple Interest

Simple interest: is defined as a fixed percentage of the **principal** (the amount of money borrowed), multiplied by the life of the loan. Thus, $I = niP$

Where I = total amount of simple interest n = life of the loan

i = interest rate (expressed as a decimal)

P = Principal

It is understood that n and i refer to the same unit of time (e.g., the year).

Normally, when a simple interest loan is made, nothing is repaid until the end of the loan period; then, both the principal and the accumulated interest are repaid. The total amount due can be expressed as

$$F = P + I = P(1 + ni)$$

Example 1.3 A student borrows \$3000 from his friend in order to finish school. His friend agrees to charge him simple interest at the rate of 5% per year. Suppose the student waits two years and then repays the entire loan. How much will he have to repay?

$$F = \$3000 [1 + (2)(0.05)] = \$3300$$

c. Compound Interest

When interest is compounded, the total time period is subdivided into several interest periods (e.g., one year, three months, one month). Interest is credited at the end of each interest period, and is allowed to accumulate from one interest period to the next. During a given interest period, the current interest is determined as a percentage of the total amount owed (i.e., the principal plus the previously accumulated interest).

Thus, for the first interest period, the interest is determined as $I_1 = Pi$

and the total amount accumulated is $F_1 = P + I_1 = P + Pi = P(1 + i)$

For the second interest period, the interest is determined as $I_2 = iF_1 = i(1 + i)P$

and the total amount accumulated is $F_2 = P + I_1 + I_2 = P + Pi + i(1 + i)P = P(1 + i)^2$

For the second interest period, the interest is determined as $I_3 = iF_2 = i(1 + i)^2P$

and the total amount accumulated is $F_3 = P(1 + i)^3$

and so on. In general, if there are n interest periods, we have (dropping the subscript):

$$F_n = P(1 + i)^n$$

which is the so-called law of compound interest. Notice that F , the total amount of money accumulated, increases exponentially with n , the time measured in interest periods.

Example 1.4 A student deposits \$1000 in a savings account that pays interest at the rate of 6% per year, compounded annually. If all of the money is allowed to accumulate, how much will the student have after 12 years? Compare this with the amount that would have accumulated if simple interest had been paid.

$$F_n = 100(1 + 0.06)^{12} = \$2012.20$$

Thus, the student's original investment will have more than doubled over the 12-year period. If simple interest had been paid, the total amount that would have accumulated is determined as

$$F = \$1000[1 + (12)(0.06)] = \$1720.00$$

2.4. ECONOMIC EQUIVALENCE AND THE TIME VALUE OF MONEY

Money has time value. If one is given the choice to receive 100 birr today or 100 birr next year. The individual will definitely choose 100 birr today. This is because money has value.

- Individuals in general prefer current consumption to future,
- To account for opportunity cost and inflation of money through time. Opportunity cost is a cost foregone by not using resources at their best possible option.

Financial investments involve cash flows occurring at different points in the time series. These cash flows have to be brought to the same point of time for purposes of comparison and aggregation.

2.5. CASH FLOW

A cash flow is the difference between total cash receipts (inflows) and total cash disbursements (outflows) for a given period of time (typically, one year). Cash flows are very important in engineering economics because they form the basis for evaluating projects, equipment, and investment alternatives. The easiest way to visualize a cash flow is through a cash flow diagram, in which the individual cash flows are represented as vertical arrows along a horizontal time scale. Positive cash flows (net inflows) are represented by upward-pointing arrows, and negative cash flows (net outflows) by downward-pointing arrows; the length of an arrow is proportional to the magnitude of the corresponding cash flow. Each cash flow is assumed to occur at the end of the respective time period.

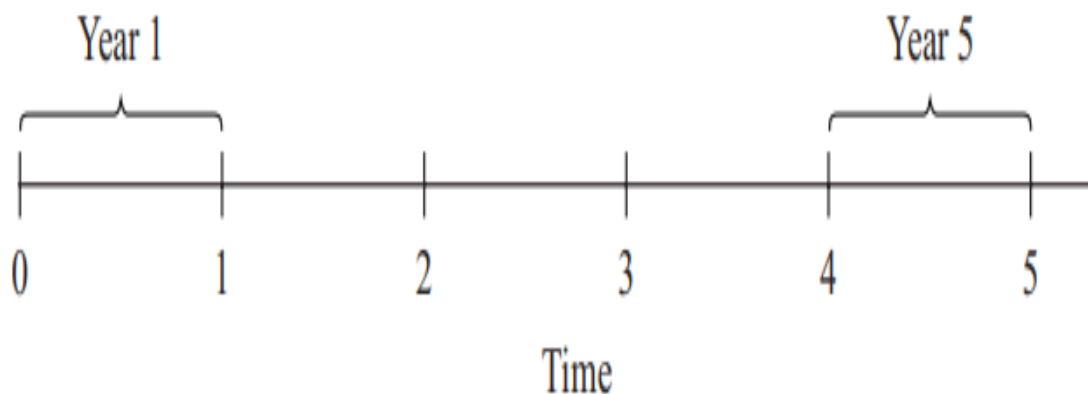


Figure- 2.1 Typical cash flow time scale for 5 years

CASH FLOW DIAGRAM

- A **Cash Flow Diagram** is a picture of a financial problem that shows **all cash inflows and outflows along a time line**.
- Each cash flow is assumed to occur at the **end of the respective time period**.
- **It is difficult to solve a problem if you cannot see it.**
- **The easiest way to approach problems in economic analysis is to draw a picture.**
- Cash flows can be positive or negative.
 - **Positive cash flows (cash inflows)** increase the funds available to the company; therefore, they include both **receipts and revenue**.
 - **Negative cash flows (cash outflows)** are deductions from the company's funds; hence, they include **first cost, annual expenses, and other cash disbursements**.
- Positive cash flows (net inflows) are represented by upward-pointing arrows, and
- Negative cash flows (net outflows) by downward-pointing arrows;
- The length of an arrow is proportional to the magnitude of the corresponding cash flow.
- The picture should show three things:
 - A time interval divided into an appropriate number of equal periods
 - All cash outflows (expenditure, etc.) in each period
 - All cash inflows (income, etc.) for each period
- Unless otherwise indicated, all such cash flows are considered to occur at the end of their respective periods

CFDs are based on the following assumptions

- All cash flows occur at the end of the period.
- All periods are of the same length.
- The interest rate and the number of periods are of the same length.
- Negative cash flows are drawn downward from the time line.
- Positive cash flows are drawn upward from the time line.

Engineering economic analysis utilizes the following terms and symbols for CFDs:

- **P** - cash-flow value at a time designated as the present. This is usually at time 0. It may also be called the present value (PV) or the present worth (PW) dollars.
- **F** - cash-flow value at some time in the future. It is also called the future value (FV) or the future worth (FW) dollars.
- **A** - Series of equal, consecutive, end-of-period amounts of money. This is also called the annual worth (AW) or the equivalent uniform annual worth (EUAW) dollars per period.
- **G** - A uniform arithmetic gradient increase in period-by-period payments or disbursements.
- **n** - Number of interest periods (days, weeks, months, or years).
- **i** - Interest rate per time period expressed as a percentage.
- **t** - Time, stated in periods (years, months, days).
- **Cash inflows**, or receipts, may be comprised of the following, depending upon the nature of the proposed activity and the type of business involved.

- **Samples of Cash Inflow Estimates**
 - a. Revenues (from sales and contracts)
 - b. Operating cost reductions (resulting from an alternative)
 - c. Salvage value
 - d. Construction and facility cost savings
 - e. Receipt of loan principal
 - f. Income tax savings
 - g. Receipts from stock and bond sales
- Cash outflows, or disbursements, may be comprised of the following, again depending upon the nature of the activity and type of business.
- **Samples of Cash Outflow Estimates**
 - a. First cost of assets
 - b. Engineering design costs
 - c. Operating costs (annual and incremental)
 - d. Periodic maintenance and rebuild costs
 - e. Loan interest and principal payments
 - f. Major expected/unexpected upgrade costs
 - g. Income taxes

Example

A car leasing company buys a car from a wholesaler for \$24,000 and leases it to a customer for four years at \$5,000 per year. Since the maintenance is not included in the lease, the leasing company has to spend \$400 per year in servicing the car. At the end of the four years, the leasing company takes back the car and sells it to a secondhand car dealer for \$15,000. For the moment, in constructing the cash flow diagram, we will not consider tax, inflation, and depreciation

Solutions

Step 1:

- Draw the horizontal axis to represent 1,2,3, and 4 years.

Step 2:

- At time zero, i.e., the beginning of year 1, the leasing company spends \$24,000.
- Hence, at time zero, on the horizontal axis, a downward arrow represents this number.

Step 3:

- At the end of year 1, the company receives \$5,000 from his customer.
- This is represented by an upward arrow at the end of year 1.
- The customer also spends \$400 for maintaining the car; this is represented by a downward arrow.

- The situations at years 2 and 3 are exactly the same as year 1 and are the presentations on the cash flow diagram exactly as for the first year.

Step 4:

- At the end of the fourth year, in addition to the income and the expenditure as in the previous years, the leasing company receives \$15,000 by selling the car. This additional income is represented by an upward arrow.

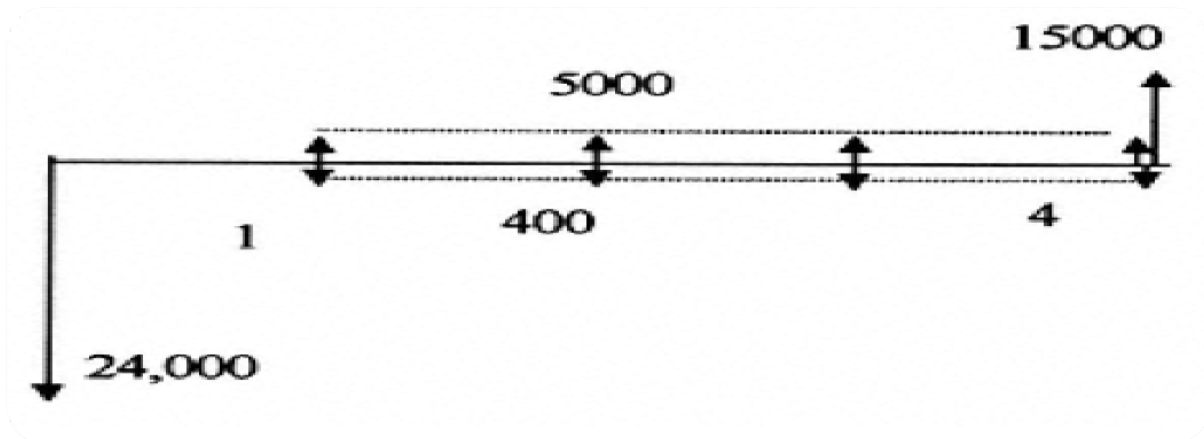


Figure- 2.2 Cash flow diagram of this project and is the financial model

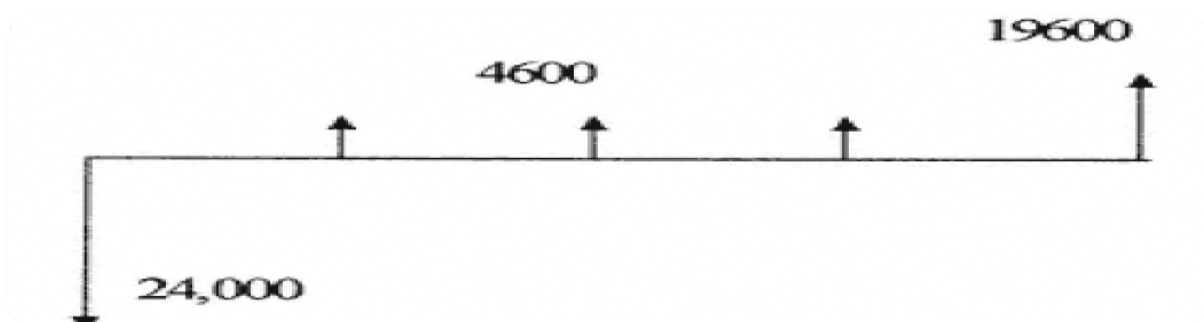


Figure- 2.3 The costs and benefits for each year can be deducted from each other to present a "netted" cash flow diagram as presented in

2.6. INTEREST FORMULAS FOR DISCRETE CASH FLOWS

1) Single Cash Flows / Payments

a. Finding F When Given P

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

The quantity $(1+i)^n$ is commonly called the *single payment compound amount factor*. The functional symbol of $(1+i)^n$ is $(F/P, i\%, N)$. Therefore the equation can be expressed as

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

Where the factor in parentheses is read “find F given P at i% interest per period for n interest periods.”

b. Finding P When Given F

$$P = F (1 / (1 + i))^n = F(1+i\%)^{-n}$$

The quantity $(1+i)^{-n}$ is called the *single payment present worth factor*. The functional symbol for this factor is $(P/F, i\%, n)$. Hence

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

Where the factor in parentheses is read “find P given F at i% interest per period for n interest periods.”

2) Uniform Series

Uniform series mean uniform amount of money, A, occurring at the end of each period for n periods with interest at i% per period. A uniform series is often called *annuity*.

Annuity - is a bunch of structured payments or equal payments made regularly, like every month or every week.

Assumptions:

- P (present worth) occurs at one interest period before the first A.
- F (future worth) occurs at the same time as the last and n interest periods after P.
- A (annual worth) occurs at the end of periods 1 through N, inclusive.

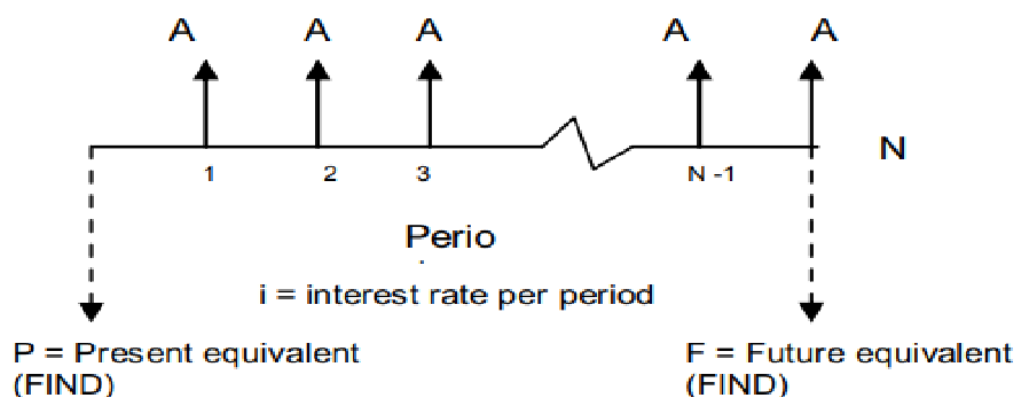


Figure – 2.4 A general cash flow diagram relating uniform series to the present equivalent and future equivalent values

a. Finding F When Given A

$$F = A [(1+i)^n - 1] / i$$

The Equation in the bracket is called the *uniform series compound amount factor*. The functional symbol for this factor is (F/A, i%, n). Hence

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

Where the factor in parentheses is read “find F given A at i% interest per period for n interest periods.”

Example: If you deposit \$10,000 in a bank every year for 18 years at interest rate 8%. Then this amount becomes:

$$F = 10,000 \times \{[(1 + 0.08)^{18} - 1] / 0.08\} = \$374, 502.43$$

What this amount will be if the interest rate is 10%? What if N = 20?

b. Finding P When Given A

$$P = A [(1+i)^n - 1] / i(1+i)^n$$

The equation in bracket is called the *uniform series present worth factor*. And the functional symbol for this factor is (P/A, i%, N). Hence

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

Where the factor in parentheses is read “find P given A at i% interest per period for n interest periods.”

Example: If a certain machine undergoes a major overhaul now, its output can be increased by 20% - which translates into additional cash flow of \$20,000 at the end of each year for five years. If i = 15% per year, how much can we afford to invest to overhaul this machine?

$$P = 20,000 \times \{[(1 + 0.15)^5 - 1] / 0.15 (1 + 0.15)^5\} = \$20,000 (3.3522) = \$67,044$$

c. Finding A When Given F

$$A = F [i / (1+i)^n - 1]$$

The Equation in the bracket is called the *sinking fund factor*. The functional symbol for this factor is (A/F, i%, n). Hence

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

Where the factor in parentheses is read “find A given F at i% interest per period for n interest periods.”

Example: How much do you need to invest every year in a bank with an interest rate of 8% in order to yield \$1 million in 30 year? $A = 1,000,000 \times (A/F, 8\%; 30) = \$8,827$ How much this will be if the interest rate is 10%?

d. Finding A When Given P

$$A = P [i(1+i)^n / (1+i)^n - 1]$$

The equation in bracket is called the *capital recovery factor*. And the functional symbol for this factor is $(A/P, i\%, N)$. Hence

$$A = P (A/P, i\%, n).$$

Where the factor in parentheses is read “find A given P at $i\%$ interest per period for n interest periods.”

Example: You want to buy an apartment at the price of 4 million dollars. You will do this with a mortgage from a bank at the annual interest rate 8% for 30 years. What is your annual payment?

$$A = 4,000,000 (A/P, 8\%, 30) = \$355,200$$

3) Gradient Series Factor

A **gradient series** is a series of annual payments in which each payment is greater than the previous one by a constant amount, G .

a. The gradient series factor, $(A/G, i\%, n)$. $A/G = \frac{1}{i} - \frac{n}{(1+i)^n - 1}$

Example: An engineer is planning for a 15-year retirement. In order to supplement his pension and offset the anticipated effects of inflation, he intends to withdraw \$5000 at the end of the first year, and to increase the withdrawal by \$1000 at the end of each successive year (Figure. 1.4). How much money must the engineer have in his savings account at the start of his retirement, if money earns 6% per year, compounded annually?

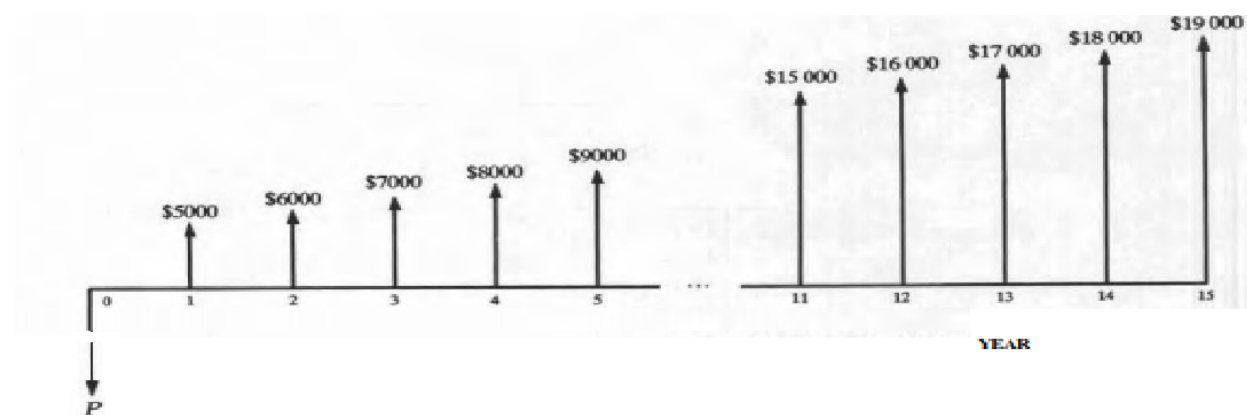


Figure 1.4

We want to obtain the value of P , given the values of A_0, G, i , and n . We first obtain a series of uniform withdrawals A' equivalent to the series of gradients.

$$A = G \times (A/G, i\%, n) = \$1000(A/G, 6\%, 15) = \$1000(5.9260) = \$5926$$

$$A' = A_0 + A = \$5000 + \$5926 = \$10,926$$

We can now calculate P as follows:

$$P = A' \times (P/A', i\%, n) = \$10,926(P/A', 6\%, 15) = \$10,926(9.7123) = \$106,116.59$$

A more concise, and the preferable, way to solve this problem is to write

$$\begin{aligned}
 P &= A_0 \times (P/A, 6\%, 15) + G \times (A/G, 6\%, 15) \times (P/A, 6\%, 15) \\
 &= \$5000(9.7123) + \$1000(5.9260)(9.7123) = \mathbf{\$106,116.59}
 \end{aligned}$$

b. The present worth of the gradient series:
$$P = \frac{G}{i} \left[\frac{(1+i)^n - 1}{i(1+i)^n} - \frac{n}{(1+i)^n} \right]$$

c. The Future worth of gradient series:
$$F = G \left[\left(\frac{1}{i} \right) \left(\frac{(1+i)^n - 1}{i} \right) - 1 \right]$$