By: CS REENA KUMARI

Assistant Professor

Department of Commerce

PATNA WOMEN'S COLLEGE
(Autonomous)

Email id:
reenakumari19jan@gmail.com

ANNUITY AND ITS TYPES

B.COM CC204 SEMESTER 2
UNIT 3 (Mathematics of finance)

BUSINESS MATHEMATICS AND STATISTICS

MEANING OF ANNUITY

- **An annuity is a series of payments required to be made or received over time at regular intervals. The most common payment intervals are yearly (once a year), semi-annually (twice a year), quarterly (four times a year), and monthly (once a month). Some examples of annuities: Mortgages, Car payments, Rent, Pension fund payments, Insurance premiums.**

TYPES OF ANNUITY

1) Ordinary Annuity or Annuity Regular
2) Annuity Due or Annuity Immediate
3) Perpetuity
4) Continuous Annuity
5) Deferred Annuity

BY CS REENA KUMARI

ORDINARY ANNUITY OR ANNUITY REGULAR

- An ordinary annuity is a series of equal payments made at the end of consecutive periods over a fixed length of time.
- **Key takeaway : An ordinary annuity is a series of regular payments made at the end of each period, such as monthly or quarterly. Example : Stock dividends.**

ANNUITY DUE OR ANNUITY IMMEDIATE

- In this type of annuity, the first payment is usually made in the start i.e. start of the annuity. This is called annuity immediate or annuity due.
- **Key takeaway : Payment/Receipt at the beginning of the period. Example –Monthly Rent.**

Formulas Captured (Future value of Annuity Regular)

1)**FV of Annuity Regular** - If A be the periodic payments ,the future value of A(n,i) of annuity-

$$A(n,i) = A\left[\frac{(1+i)^n - 1}{i}\right]$$

Where, n = time

i =Interest rate

Formulas Captured (Future value of Annuity Due)

1)**FV of Annuity Due** - If A be the periodic payments ,the future value of A(n,i) of annuity-

$$A(n,i) = A\left[\frac{(1+i)^n - 1}{i}\right] \times (1+i)$$

Where, n = time

i =Interest rate

Formulas Captured (Present value of Annuity Regular)

1)**PV of Annuity Regular** – The present value (V) of annuity (A) is the sum of the present values of the payments.

$$V = \frac{A}{(1+i)^1} + \frac{A}{(1+i)^2} + \frac{A}{(1+i)^3} \quad \text{..... So on}$$

Hence , **A (Annuity) = $\frac{\text{Present Value (V)}}{\text{P (n, i)}}$**

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

Formulas Captured (Present value of Annuity Due)

Present value of annuity due for n years is the same as annuity regular for (n-1) years plus an initial receipt or payment at the beginning of the period.

Calculating PV of annuity due involves 2 steps.

Step 1 : Compute the PV of annuity as if it was annuity regular for one period short i.e. (n -1).

Step 2 : Add initial cash payment/receipt to step 1 value.

PERPETUITY

- A perpetuity is a security that pays for an infinite amount of time. In finance, perpetuity is a constant stream of identical cash flows with no end. Example is UK Government Bond called consol. The formula to calculate the present value of a perpetuity, or security with perpetual cash flows, is as follows:

$$PV = \frac{C}{(1+r)1} + \frac{C}{(1+r)2} + \frac{C}{(1+r)3} = \frac{C}{r}$$

- **where:**

  PV= present value

  C= cash flow

  r = discount rate

CONTINUOUS ANNUITY

- Continuous annuities are a type of guaranteed annuity where the annuity issuer is required to make payments for at least a specified number of years.
- It is also known as certain annuity.
- **Two Types of Certain and Continuous Annuities**

Certain and Continuous Only

- An annuitant doesn't have to attach a life contingency when they annuitize. Instead, they can choose a specific period of time for the payments to occur. For example, a 20-year certain and continuous annuity will pay for 20 years, and then payments will stop. The shortest certain and continuous annuity is typically five years.

Life with Certain and Continuous

- This type of annuity still provides a lifetime income stream, but the annuitant can choose the minimum amount of years that they or their beneficiaries will receive payments. For example, life with 10-year certain and continuous means that you will be paid for as long as you live. However, if you die in year three, your beneficiaries will receive seven more years of payments. If you live past 10 years, then there will be nothing left for your beneficiaries when you die.

BY CS REENA KUMARI

DEFERRED ANNUITY

- In a deferred annuity, you can contribute one or more cash payments up to a future date, called the annuity date, when you stop contributing and begin receiving your payments. OR
- A deferred annuity is a type of annuity contract that allows for periodic contributions to the plan, but does not allow any withdrawals from the plan until either an appointed time is reached or a specific event takes place.
- Example : Retirement benefits plan, LIC Term plans etc

BY CS REENA KUMARI

USE OF ANNUITY IN DEPRECIATION

- Under **annuity method** of depreciation the cost of asset is regarded as investment and interest at fixed rate is calculated thereon. Had the proprietor invested outside the business, an amount equal to the cost of asset, he would have earned some interest. So as a result of buying the asset the proprietor loses not only cost of asset by using it, but also the above mentioned interest . The loss by the proprietor known as **opportunity cost**. Annuity method is particularly applicable to those assets whose cost is heavy and life is long and fixed, e.g. leasehold property, land and building etc.

Practical sum on depreciation

1) A machine can be purchased for ` 50000. Machine will contribute ` 12000 per year for the next five years. Assume borrowing cost is 10% per annum compounded annually. Determine whether machine should be purchased or not.

Solution : The present value of annual contribution V = A.P(n, i)

= 12,000 × P(5, 0.10)

= 12,000 × 3.79079

= ` 45,489.48

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

You can calculate using the formula I have explained earlier or you can calculate the sum of present value of Re.1 at 10 % for 5 years.(0.909+0.826+0.751+0.683+0.621)=3.79

Annuity here basically sum of the present values.

Practical sums on depreciation

A machine with useful life of seven years costs ` 10,000 while another machine with useful life of five years costs ` 8,000. The first machine saves labour expenses of ` 1,900 annually and the second one saves labour expenses of ` 2,200 annually. Determine the preferred course of action. Assume cost of borrowing as 10% compounded per annum.

Solution: The present value of annual cost savings for the first machine

= ` 1,900 × P (7, 0.10)

= ` 1,900 × 4.86842 =9,249.99 or Rs.9250

Cost of machine being ` 10,000 it costs more by ` 750 than it saves in terms of labour cost. The present value of annual cost savings of the second machine

= ` 2,200 × P(5, 0.10)

= ` 2,200 × 3.79079 = ` 8,339.74

Cost of the second machine being ` 8,000 effective savings in labour cost is ` 339.74. Hence the second machine is preferable.

THANK YOU AND HAPPY LEARNING

BY CS REENA KUMARI