Notation :-

$r^{(m)}$: for interest rate quoted per annum that with frequency of m per annum.

r : normal interest rate quoted per annum.

$\left(1 + \frac{r^{(m)}}{m}\right)^m - 1 \longrightarrow$ Effective interest rate

$e^r - 1 \longrightarrow$ Effective interest rate for continuous compounding

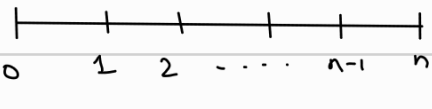
→ Nothing is risk free
  → Some instruments are very low risk.

→ Every random variable has a probability distribution function.
→ Returns = expectation of interest rate

Risk :-

→ Deviation from expectation.
→ Risk is very hard to compute.
→ Volitality.
→ Fluctuations can be controlled. (fixed Bandwidth)
→ S.D., Variance can be used
→ Semi-standard variance (to quantify the lower deviations)

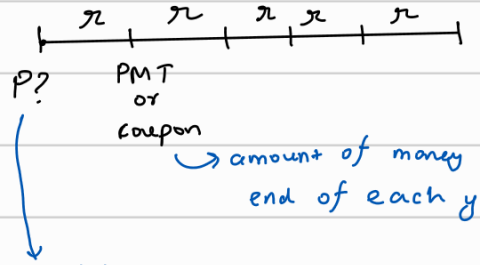
PV :- Present value of money
FV :- Future value of money



$$FV = PV\underbrace{(1+r)}_{\text{growth factor}}^{n} \qquad FV = PVe^{rn}$$

$$PV = FV\underbrace{(1+r)}_{\text{discount factor}}^{-n} \qquad PV = FVe^{-rn}$$

Annuity :-



→ amount of money received at end of each year

need to find this.

→ Annuity deferred :- Annuity will be given at the end of time period.

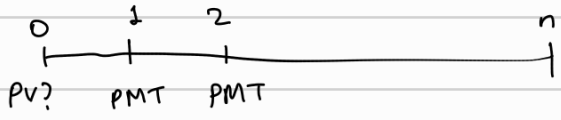
→ Annuity advanced :- Annuity will be given at begin of time period

Perpetuity :-

→ Same as Annuity but time period is infinite.

i.e., the scholarship will never stop.

Annuity deferred :-



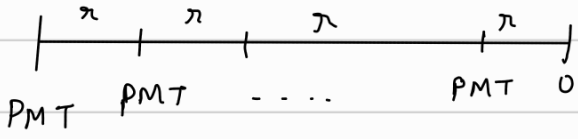
$$PV = \frac{PMT}{(1+r)} + \frac{PMT}{(1+r)^2} + \dots + \frac{PMT}{(1+r)^n}$$

$$= \frac{PMT}{(1+r)}\left[1 + \xi + \xi^2 + \dots + \xi^{n-1}\right] \qquad \left[\xi = \frac{1}{1+r}\right]$$

$$= \frac{PMT}{(1+r)}\left(\frac{1-\xi^n}{1-\xi}\right)$$

$$\boxed{PV = \frac{PMT\left(1-(1+r)^{-n}\right)}{r}}$$

Annuity advanced :-



$$PV = PMT + \frac{PMT}{1+r} + \dots + \frac{PMT}{(1+r)^{n-1}}$$

$$= \frac{PMT\,(1+r)\,(1-(1+r)^{-n})}{r}$$

Perpetuity :-

$$PV = \frac{PMT}{r}$$