Reading1: Time Value of Money

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Key words: future value, present value, compound interest, financial
calculator, interest rate, risk, single sum, ordinary annuity, annuity due,
perpetuity, with multiple frequency of compounding
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1. EAY & Compounding Frequency

Financial Calulcator Operation

- use *TI BAII Plus*
- P/Y: periods/year originally set=12, which automatically convert annual interest rate (I/Y) to monthly rates, suitable for loan.
  - while we reset P/Y=1 by `[2ND] [P/Y] “1” [ENTER] [2ND] [QUIT]`
  - check the setting: `[2ND] [P/Y]`, it wil show P/Y=1.0, end checking `[2ND] [QUIT]`
- N: # of compounding period
- I/Y: interest rate per compounding period
- CPT: Compute

Time lines

- **Discounting**: Compute PV and move to the beginning of investment period
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- 0: at present; <0: past; >0: future

Interest Rate Interpretation

1. Required rate of return: equilibrium rate in market between savers and investors
2. Discount rate: should discount the payments to be made in the future for the purpose of getting equivalent value in present.
3. Opportunity cost/cost of capital： of current consumerption and alternative choice
4. Risk perspective:

- **Nominal rate of interest= nominal risk-free rate + default risk premium + liquidity premium + maturity risk premium**
  - Real risk-free rate: single-period loan which has no expectations of inflation in it.
  - **Nominal risk-free rate=real risk-free rate+expected inflation rate**
    - EG: Treasury-Bill rates contain an inflation premium
  - Default risk: The borrowers don't make the promised payments at time.
  - Liquidity risk: if sold an investment quickly for cash, the risk of receiving fair value
  - Maturity risk: The price of long-turn bonds with maturity risk premium, are more volatile than shorter-term bonds.

2. Calculating PV FV

Single Sum

Calculation	Function	FV/PV Factor
Future Value	`FV=PV(1+I/Y)^N`	`(1+I/Y)^N`
Present Value	`PV=FV/(1+I/Y)^N`	`1/(1+I/Y)^N`

Hence, PV< FV when discount rate>0.

Annuities

- Defintion: stream of equal cash flows that occurs at equal intervals over a given period.

Type	Calculation	Calculator
Ordinary Annuities(END)	Future Value	N,I/Y,PMT,CPT,**FV**
Ordinary Annuities(END)	Present Value	N,I/Y,PMT,FV,CPT,**PV**
Annuities Due(BEG)	Future Value	N,I/Y,PMT,CPT,**FV**
Annuities Due(BEG)	Present Value	N,I/Y,PMT,CPT,**PV**

- the PMT and FV must have the same sign, while the sign of PV is opposite.
- FVA_D,FVA_O,PVA_O,PVA_D
- FVA_D=FVA_O*(1+I/Y)，先计算ordinary的然后，计算PV的**转化**也是多乘一个factor, in this method, we can leave our calculator in END mode.
- Switch pattern: `[2nd] [BGN] [2nd] [SET] [2nd] [QUIT]`

Perpetuity

- Defintion: fixed amount of money at fixed time invertal over infinite period of time.
- Function: `PVperp=PMT/(I/Y)`, factor is `1/r`
- For deferred prepetuiry, we need first calculate the PV of prepetuity use the function above, then change the FV(the calculation result) to PV.

3. Uneven Cash Flows

- **Cash flow addivity principle**: FV of uneven cash flow= **Σ**FV_individual, PV of uneven cash flow= **Σ**PV_individual

Funding a Future Obligation

- Object: determine the size of the payment or deposit to meet a future goal.
- Solution procedure:分段，注意区别是END还是BEG的mode
  - determine the amount of money is available at the end of the first period to fulfill the second period payment requirement. `N,I/Y,PMT,CPT,PV`, N= the

numbers of payment period in the second period
    - Treat the result PV as at the end time point of the first period, if we want to get the PMT in the first period, we need to convert this value as the FV at that time point to the PV at time0. `N,I/Y,FV,CPT,PMT`, where N=the numbers of payment period in the first period

4. Compounding Frequencycies

TVM with Multiple Frequency of Compounding

- Rule: frequency of compounding(1,2,4,12,24,365)↑,effective rate of interest(EAR)↑,FV↑,PV↓
- Calculation with financial calculator:(2 ways)
    1. (Not recommended) change the `P/Y` value to the corresponding frequency of compounding
    2. Keep `P/Y`=1 unfixed看作时间单位, set （找4个变量）
        - `I/Y`:interest rate per compounding =the annual interest rate/m
        - `N`: numbers of compounding periods **in investment period** =number of years*m
        - `m`:numbers of compounding periods **per year**时间倍数
- **EAR(Effective Annual Rate)**
    - The annual rate of return actually being realized after adjustments have been made for different compounding periods.
    - Function: `EAR=(1+periodic rate)^m-1`
        - Periodic rate: *I/Y=stated annual interest rate/m*
        - EAR=stated rate, iff the interest is compounded annually
    - Calculator: `(1+periodic rate)[y^x]m[=]`