Class 3

RECAP (STOCKS)

- The cash flow of a stock: uncertain dividends.

Q What is the price of a stock?

Dividend discount Model

- DDM $\leadsto$ $P_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \ldots$

EXPECTED

As a bond

If you sell it: $P_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \ldots + \frac{D_T + P_T}{(1+r)^T}$

```
def price_stock_DDM(D, F, r):
    #expected dividends D, final price F, discount rate r
    P = 0
    for i in range(1, len(D)):
        P += D[i-1]/((1+r)**(i))
    P += (D[-1]+F)/((1+r)**(len(D)))
    return round(P,2)
```

```
price_stock_DDM([50,52,55], 1100, 0.06)
```

```
1063.21
```

- GORDON GROWTH MODEL: $D_i = D_1 \cdot (1+g)^{i-1}$

So $P_0 = \sum_{i=1}^{\infty} \frac{D_i}{(1+r)^i} = \sum_{i=1}^{\infty} \frac{D_1 \cdot (1+g)^{i-1}}{(1+r)^i} = \frac{D_1}{r-g}$

```
def price_stock_GGM(D, r, g):
    #Gordon growth model, forever
    return round(D/(r-g), 2)
```

- ACCOUNTING QUANTITIES

- ASSETS: Sum of the owned stuff
- LIABILITIES: Debt
    - BOOK VALUE: Assets − Liabilities
    - BOOK VALUE per SHARE: BV / # shares
- EARNINGS: Profit over a year
    - EARNINGS per SHARE (EPS): Earnings / # shares
    - RETURN on EQUITY: Earnings / Book value $= EPS / BVPS$

SWITCH

FIXED

- PLOWBACK RATIO: $b = 1 -$ Dividends

$$\overline{\quad\quad EPS}$$

Rem ① In GGM, dividend growth rate

$g =$ growth rate of earning $= b \cdot ROE$

② In GGM, $P_0 = \dfrac{D}{r-g}$ ← $(1-b)\,(EPS)$ → Need to find

STOCK MARKET → Discount on the future ↗ r

↖ g: growth rate $= b \cdot ROE$

③ Return on a stock $R = \dfrac{D_1 + P_1 - P_0}{P_0}$

Should be constant in the market (given risk)

$$R = \frac{D_1 + P_1}{P_0} - 1 = \frac{(1+g)D_0 + (1+g)^2 D_0/(r-g)}{D_1/r-g} - 1 = \dots = r$$

r: discount for risk

↳ cousin vs stranger

Question 1
Respond briefly to the following statement: "You say stock price equals the present value of future dividends? That's crazy! All the investors I know are looking for capital gains."

Quick answer: By definition...

Even if $R = \dfrac{D_1 + P_1}{P_0} - 1$ we have $\underbrace{\dfrac{D_1}{P_0}}_{\text{dividend yield}}$

and $\underbrace{\dfrac{P_1}{P_0}}_{\text{capital gain}} = \dfrac{\frac{D_2}{1+r} + \frac{D_3}{1+r^2} + \dots}{P_0}$.

Question 2
Consider the following three stocks:
- Stock A is expected to provide a dividend of $10 a share forever.
- Stock B is expected to pay a dividend of $5 next year. Thereafter, dividend growth is expected to be 4% a year forever.
- Stock C is expected to pay a dividend of $5 next year. Thereafter, dividend growth is expected to be 20% a year for five years (i.e., until year 6) and zero thereafter.

If the required rate of return for each stock is 10%, which stock is the most valuable?

Calculations coming up.

Ⓐ perpetuity $P_A = \dfrac{C}{r} = \dfrac{10}{0.1} = 100$ ↖ coupon of perpetuity

Bc a perpet. starts at year

(B) Given with $D_1 = 5$, $g = 0.04$, $r = 0.1$ | (1), not 0

$\leadsto P_B = \frac{D_1}{r-g} = \frac{5}{0.1-0.04} = 83.33$

(C) Two RATES: $P_C = \frac{D_1}{1.1} + \frac{D_2}{1.1^2} + \frac{D_3}{1.1^3} + \dots + \frac{D_6}{1.1^6} + \frac{P_{Perpetuity}}{1.1^{6}}$

$$= \sum_{i=1}^{6} \frac{5 \cdot (1.2)^{i-1}}{(1.1)^i} + \frac{5 \cdot 1.2^5}{0.1} \cdot \frac{1}{1.1^6} \approx 104.5$$

→ price of perpetuity

Perpetuity

```
0   C   C   C ...
|---|---|---|--------- ....
0   1   2   3 ...
```

Question 3

Company Q's current return on equity (ROE) is 14%. It pays out one-half of earnings as cash dividends (payout ratio = .5). Current book value per share is $50. Book value per share will grow as Q reinvests earnings.

Assume that the ROE and payout ratio stay constant for the next four years. After that, competition forces ROE down to 11.5% and the payout ratio increases to 0.8. The cost of capital is 11.5%.

a. What are Q's EPS and dividends next year? How will EPS and dividends grow in years 2, 3, 4, 5, and subsequent years?

b. What is Q's stock worth per share? How does that value depend on the payout ratio and growth rate after year 4?

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EPS		$50*.14 = $7	$7.49	$8.014	$8.575	$7.537
Dividend		$7*.5 = $3.5	$3.75	$4.007	$4.288	$6.030
BVPS	$50	$50 + $3.5 = $53.5	$57.245	$61.252	$65.54	$67.05

```python
def all_accounting(BVPS_0: "Book_value_per_share_0", ROE: "Return_on_Equity", b: "Plowback ratio"):
    EPS = []
    DIV = []
    BVPS = [BVPS_0]
    if len(ROE)!=len(b):
        print("ERROR")
        return -1
    for i in range(1,len(ROE)+1):
        EPS_new = BVPS[-1]*ROE[i-1]
        DIV_new = EPS_new*(1-b[i-1])
        BVPS_new = BVPS[-1]+b[i-1]*EPS_new

        EPS.append(round(EPS_new,2))
        DIV.append(round(DIV_new,2))
        BVPS.append(round(BVPS_new,2))


    return EPS, DIV, BVPS
```

```python
E, D, B = all_accounting(50, [0.14, 0.14, 0.14, 0.14, 0.115, 0.115, 0.115], [0.5, 0.5, 0.5, 0.5, 0.2, 0.2, 0.2])
```

```python
print(tabulate ([["EPS"]+[""]+E, ["DIV"]+[""]+D,["BVPS"]+B], ["Year"]+["Year "+str(i) for i in range(8)]))
```

```
Year    Year 0      Year 1    Year 2    Year 3    Year 4    Year 5    Year 6    Year 7
------  --------  --------  --------  --------  --------  --------  --------  --------
EPS                      7      7.49      8.01      8.58      7.54      7.71      7.89
DIV                    3.5      3.75      4.01      4.29      6.03      6.17      6.31
BVPS    50            53.5     57.24     61.25     65.54     67.05     68.59     70.17
```

a) The growth rate is $0.5 \cdot 0.14$ for the first 4 years. Then it becomes $0.115 \cdot 0.2 = 0.023$

b) $P_0 = \frac{D_1}{1+r} + \dots + \frac{D_4}{(1+r)^4} + \frac{P_4}{(1+r)^4}$; $\frac{6.03}{0.115 - 0.023}$

↳ $g = 0.07$; $D_i = D_1 \cdot (1.07)^{i-1}$