

CFA[®] Level I

Volume 1, Quantitative Methods:

1. Formula:

$$P(\text{Event}|\text{Information}) = \frac{P(\text{Information}|\text{Event})P(\text{Event})}{P(\text{Information})}$$

Example:

A denotes the event that the person A comes too late to work. B denotes that it rains. The probability of rain is given by 0.1, the probability that the person comes too late to work is 0.3. He comes too late to work, given the fact that it rains has a probability of 0.6.

On a given day, the person comes to work too late. Compute the probability that it rains on this day.

2. Formula:

$$r_{TW} = [(1+r_1) \times (1+r_2) \times \dots \times (1+r_N)]^{1/N} - 1$$

Example:

Suppose the amount of money on your bank account is the following:

Year	Amount (€)
End of year 1	1000
End of year 2	1210
End of year 3	1310

a) Compute the interest rates per year.

b) Compute the annual interest rate that leads to the same value of \$ 1310, if compounded annually.

Volume 2, Economics:

3. Formula:

$$M = \left[\frac{(1+c)}{(r+c)} \right] \times B$$

Example:

People save 60%, the reserve ratio is 10%.

a) Compute the money-multiplier and

b) the money supply, if the central bank produces a monetary base of \$ 1,000,000.

4. Formula:

$$CPI = \frac{\text{Cost of CPI basket at current period prices}}{\text{Cost of CPI basket at base period prices}} \times 100$$

Example:

You are given the following information on the prices as well as the quantity demanded for milk and beer in the years 2008 and 2009, respectively.

2008	Quantity	Price
Beer	20	\$ 2
Milk	10	\$ 1
2009	Quantity	Price
Beer	30	\$ 1.5
Milk	8	\$ 1.1

Compute the consumer price index.

Formulas and their meaning

Volume 3, Financial Statement Analysis:

5. Formula:

$$\text{Basic EPS} = \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of shares outstanding}}$$

Example:

A company's net income for 2009 was \$ 3,200,000. The company declared and paid \$ 600,000 of dividends on preferred stock. Besides this, you have the following information on common stock:

shares outstanding on 1 January 2009	\$ 1,200,000
shares issued on 1 June 2009	\$ 300,000
shares repurchased (treasury shares) on 1 July 2009	(\$ 100,000)

- How many shares are outstanding on 31 December 2009?
- What is the company's weighted average number of shares outstanding?
- Calculate the company's basic EPS.

6. Formula:

$$\text{Basic EPS} = \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of shares outstanding}}$$

Example:

A company's net income for 2009 was \$ 3,200,000. The company declared and paid \$ 600,000 of dividends on preferred stock. There is a 3 for 1 stock split on 1 October 2009. Besides this, you have the following information on common stock:

shares outstanding on 1 January 2009	\$ 1,200,000
shares issued on 1 June 2009	\$ 300,000
shares repurchased (treasury shares) on 1 July 2009	(\$ 100,000)

Calculate the company's basic EPS.

Volume 4, Corporate Finance Portfolio Management:

7. Formula:

$$\text{Break Point} = \frac{\text{Amount of capital at which the source costs capital changes}}{\text{Proportion of new capital raised from the source}}$$

Example:

A company wants to have a capital structure of 70 percent equity and 30 percent debt.

Amount of new debt (in millions)	After-Tax Cost of Debt	Amount of new debt (in millions)	After-Tax Cost of Debt
new debt ≤ \$ 3	3 percent	new equity ≤ \$ 7.5	6 percent
\$ 3 < new debt ≤ \$ 6	4 percent	\$ 7.5 < new equity ≤ \$ 8	7 percent
\$ 6 < new debt	5 percent	\$ 8 < new equity	8 percent

Calculate the different break-points.

8. Formula:

$$r_e = \left(\frac{D_1}{P_0(1-f)} \right) + g$$

Example:

Suppose a company pays a dividend of 3 \$ per share. The share's current price is \$ 25, the company's expected growth rate equals 6 percent. There are flotation costs of 3 percent of the issuance.

Calculate the cost of externally generated equity.

Formulas and their meaning

Volume 5, Analysis of Equity Investments/ Analysis of Fixed Income Investments:

9. Formula:

$$\text{Price-Index} = \sum_{t=1}^n \frac{P_{ij}}{D_{\text{adj}}}$$

Example:

A stock-market index (price-weighted) consists of four stocks A, B, C, and D. There is a four-to-one split of stock A. Given the following prices about the four stocks, compute

- the new prices,
- the new divisor,
- the stock-market index (price-weighted) before the split.

Stock	Price before split
A	40
B	30
C	20
D	10

Volume 6, Analysis of Derivative Instruments/ Analysis of Alternative Instruments:

10. Formula:

$$\text{Notional principal} \left[\frac{(\text{Underlying rate at expiration} - \text{Forward contract rate}) \left(\frac{\text{Days in underlying rate}}{360} \right)}{1 + \text{Underlying rate at expiration} \left(\frac{\text{Days in underlying rate}}{360} \right)} \right]$$

Example:

A contract covers a given notional principal, namely \$ 5 million. Suppose that at expiration in 90 days, the rate on 180-day LIBOR is 8.5%. This interest will be paid 180 days later. Compute the payment from the dealer to the party going long on the Forward Rate Agreement.

11. Formula:

C_0, C_T = price of the call option at time 0 and time T

p_0, p_T = price of the pull option at time 0 and time T

X = exercise price

S_0, S_T = price of the underlying at time 0 and time T

$$C_t = \text{Max}(0, S_T - X)$$

$$C_T = \text{Max}(0, S_T - X)$$

$$p_T = \text{Max}(0, X - S_T)$$

$$P_T = \text{Max}(0, X - S_T)$$

Option price = Intrinsic value + Time value

Example:

Consider a European call with an exercise price of \$ 100. The price of the underlying at expiration in three months from now will be \$ 90. Calculate the call's intrinsic value.

Formulas and their meaning

Solutions Volume 1, Economics:

1. Solution:

$P(\text{Event}|\text{Information}) = \frac{P(\text{Information}|\text{Event})}{P(\text{Information})} P(\text{Event})$. So we have

$$P(B|A) = \frac{P(A|B)}{P(A)} P(B) = \frac{0.6}{0.3} * 0.1 = 0.2.$$

2. Solution:

We get $r_1 = 1,210 / 1,000 - 1 = 21\%$, $r_2 = 1,310 / 1,210 - 1 = 8.2644\%$.

b) Thus, we compute

$$r_{TW} = [(1+r_1) \times (1+r_2) \times \dots \times (1+r_N)]^{1/N} - 1 = (1.21 \cdot 1.082644)^{1/2} - 1 = 1.31^{0.5} - 1 = 14.456\%.$$

Solutions Volume 2, Quantitative Methods:

3. Solution:

We get

$$M = \left[\frac{(1+c)}{(r+c)} \right] \times B = \frac{1+0.6}{0.1+0.6} * 1,000,000 = 2.2857 * 1,000,000$$

$$= \$ 2,285,714.286.$$

Therefore, the money multiplier is 2.2857, the money supply itself \$ 2,285,714.286.

4. Solution:

First, compute the cost of CPI basket in 2008 and in 2009:

2008	Quantity	Price	Cost of CPI basket
Beer	20	\$ 2	\$ 40
Milk	10	\$ 1	\$ 10
			$\Sigma = \$ 50$

2009	Quantity	Price	Cost of CPI basket
Beer	30	\$ 1.5	\$ 45
Milk	8	\$ 1.1	\$ 8.8
			$\Sigma = \$ 53.8$

Then, we calculate the CPI as

$$\begin{aligned} \text{CPI} &= \text{Cost of CPI basket}_{2009} / \text{Cost of CPI basket}_{2008} \\ &= 53.8 / 50 - 1 \\ &= 0.076 \\ &= 7.6\% \end{aligned}$$

Solutions Volume 3, Financial Statement Analysis:

5. Solution:

a) We get

shares outstanding

$$\begin{aligned} \text{on 31 December 2009} &= \text{shares outstanding on 1 January 2009} + \text{shares} \\ &\quad \text{issued on 1 June 2009} - \text{shares repurchased (treasury shares) on 1 July 2009} \\ &= 1,200,000 + 300,000 - 100,000 \\ &= 1,400,000. \end{aligned}$$

b) We calculate

$$\begin{aligned} \text{weighted average number of shares outstanding} &= 1,200,000 * (5/12) + 1,500,000 * (1/12) + 1,600,000 * (6/12) \\ &= 500,000 + 125,000 + 800,000 \\ &= 1,425,000. \end{aligned}$$

Formulas and their meaning

c) We compute

$$\begin{aligned} \text{Basic EPS} &= \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of shares outstanding}} \\ &= \frac{3,200,000 - 600,000}{1,425,000} \\ &= 1.8246. \end{aligned}$$

6. Solution:

We get

$$\begin{aligned} \text{Basic EPS} &= \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of shares outstanding}} \\ &= \frac{3,200,000 - 600,000}{3 * 1,425,000} \\ &= 0.61. \end{aligned}$$

Solutions Volume 4, Corporate Finance Portfolio Management:

7. Solution:

Using $\text{Break Point} = \frac{\text{Amount of capital at which the source costs capital changes}}{\text{Proportion of new capital raised from the source}}$, we calculate

$$\text{first break-point} = 3/0.3 = 10,$$

$$\text{second break-point} = 6/0.3 = 20,$$

$$\text{third break-point} = 7.5/0.7 = 10.714, \text{ and}$$

$$\text{fourth break-point} = 8/0.7 = 11.43.$$

Put in line, the break-points are (in millions) \$ 10, \$ 10.714, \$ 11.43, and \$ 20.

8. Solution:

Using $r_e = \left(\frac{D_1}{P_0(1-f)} \right) + g$, we get

$$r_e = \frac{3 * (1 + 0.06)}{25 * (1 - 0.03)} + 0.06 = 0.1911 = 19.11 \text{ percent.}$$

Solutions Volume 5, Analysis of Equity Investments/ Analysis of Fixed Income Investments:

9. Solution:

a) Confer the table, last row.

Stock	Price before split	a) Price after split
A	40	10
B	30	30
C	20	20
D	10	10
	Sum of prices : divisor = pre-split index-value <=> 100:4 = 25	Sum of prices:new divisor = after split index-value <=> 70:X = 25

b) The adjusted divisor ensures that the new value for the index is the same as it would have been without the split. We get $X = 70/25 = 2.8$

c) The index computes to

$$\text{Price-Index} = \sum_{t=1}^n \frac{P_{ij}}{D_{adj}} = (40 + 30 + 20 + 10)/4 = 25.$$

Formulas and their meaning

Solutions Volume 6, Analysis of Derivative Instruments/ Analysis of Alternative Instruments:

10. Solution:

$$C_3 = \text{Max}(0, S_T - X) = \text{Max}(0, 90 - 100) = \text{Max}(0, -10) = 0.$$

11. Solution:

$$\text{Notional principal} \left[\frac{(\text{Underlying rate at expiration} - \text{Forward contract rate}) \left(\frac{\text{Days in underlying rate}}{360} \right)}{1 + \text{Underlying rate at expiration} \left(\frac{\text{Days in underlying rate}}{360} \right)} \right]$$
$$= 5,000,000 \left[\frac{(0.085 - 0.07) \left(\frac{180}{360} \right)}{1 + 0.085 \left(\frac{180}{360} \right)} \right] = 35,971.22.$$