soleadea

LEVEL 1: QUANTITATIVE METHODS

Module 01 (1st out of 11): RATES & RETURNS

Difficulty: **easy**

Benchmark Study Time: **2h**

2024

https://soleadea.org/

INTENTIONALLY EMPTY

THIS E-BOOK:

- ❖ is a selective summary of the corresponding Module in your CFA® Program Curriculum,
- ❖ provides place for your own notes,
- ❖ helps you structure your study and revision time!

How to use this e-book to maximize your knowledge retention:

1. **Print** the e-book in duplex and bind it to keep **all** important info for this Module **in one place.**
2. **Read** this e-book, best twice, to grasp the idea of what this Module is about.
3. **Study** the Module from your curriculum. **Here add** your notes, examples, formulas, definitions, etc.
4. **Review** the Module using this e-book, e.g. write your summary of key concepts or revise the formulas at the end of this e-book (if applicable).
5. **Done?** Go to your study plan and change the Module's status to **green** : (it will make your Chance-to-Pass-Score™ grow ☺).
6. **Come back** to this e-book from time to time to **regularly review for knowledge retention!**

NOTE: While studying or reviewing this Module, you can use the tables at the end of this e-book and mark your study/review sessions to hold yourself accountable.

INTEREST RATE

Definitions

An interest rate is:

- a measure that helps us compare cash flows occurring on different dates,
- the price of money.

Interest rates can be perceived as:

- required rates of return,
- discount rates,
- opportunity costs.

The required rate of return can help us answer the following question:

What are the expected future profits from an investment?

A discount rate can help us answer the following question:

What is the present value of a certain future amount?

An opportunity cost can help us answer the following question:

What future profits do we forego in favor of current consumption?

Components of interest rates

$$\text{interest rate} = (\text{real risk-free interest rate}) + (\text{inflation premium}) +$$
$$+ (\text{default risk premium}) + (\text{liquidity premium}) + (\text{maturity premium})$$

real risk-free interest rate = an interest rate expected for postponing consumption,

inflation premium = a premium connected with expected inflation = a price of the expected inflation rate,

nominal risk-free interest rate = real risk-free interest rate + inflation premium,

default risk premium = a premium for the possibility that the entity concerned may fail to meet its financial obligation,

liquidity premium = a premium for reduced or no liquidity,

maturity premium = a premium connected with the increased price sensitivity of a financial instrument with a longer time to maturity with respect to changes in market interest rates,

HERE KNOWLEDGE RETENTION HAPPENS | WRITE: notes, examples, formulas, definitions, relations, etc.

RATE OF RETURN AND ITS MEASURES

Sources of return:

- income (e.g. dividends),
- capital gain (increase in the price).

Holding period return (HPR)

HPR measures return over a single period.

$$\mathrm{HPR} = \frac{P_1 + D_1}{P_0} - 1$$

Where:

- HPR – holding period return,
- P_1 – value of the investment at the end of the period,
- D_1 – value of dividend,
- P_0 – value of the investment at the beginning of the period.

Arithmetic return (mean return)

$$\overline{R}_A = \frac{1}{T}\sum_{t=1}^{T} R_t$$

Where:

- $\overline{R}_A$ – arithmetic return,
- T – number of holding periods during the lifetime of the investment,
- R_t – rate of return over a single period t.

The arithmetic mean is a commonly used measure of central tendency, but it can be distorted by **outliers, which are observations that differ extremely from most data points**. Outliers skew the mean by shifting it toward very high or low values. Before removing outliers, we should check for errors.

To reduce the influence of outliers, we can use the **trimmed mean**, which excludes a percentage of the highest and lowest values, or the **winsorized mean**, which caps extreme values at specified percentiles.

Ultimately, the treatment of outliers depends on the goals of the analysis and the nature of the data. Care should be taken to avoid eliminating useful information just because it differs from the majority.

HERE KNOWLEDGE RETENTION HAPPENS | WRITE: notes, examples, formulas, definitions, relations, etc.

Geometric mean return

$$\overline{R}_G = \sqrt[T]{\prod_{t=1}^{T}(1 + R_t)} - 1$$

Where:

- $\overline{R}_G$ – geometric mean return,
- T – number of holding periods during the lifetime of the investment,
- R_t – rate of return over a single period t.

Harmonic mean

The **harmonic mean** can be used to determine the average purchase price paid for stocks if we bought them in several periods for the same amount or to calculate the average time necessary for the production of a given product.

$$\overline{X}_H = \frac{n}{\sum_{t=1}^{n} \frac{1}{X_i}}$$

Where:

- $\overline{X}_H$ – harmonic mean,
- n – number of observations,
- X_i – value of observation i.

Continuously compounded returns

$$r_{t,t+1} = \ln\left(\frac{S_{t+1}}{S_t}\right) = \ln(1 + R_{t,t+1})$$

Where:

- $r_{t,t+1}$ – continuously compounded return for "t" to "t+1" period,
- S_{t+1} – stock price at time "t+1",
- S_t – stock price at time "t",
- $R_{t,t+1}$ – holding period return for "t" to "t+1" period.

HERE KNOWLEDGE RETENTION HAPPENS | WRITE: notes, examples, formulas, definitions, relations, etc.

Money-weighted return

To measure the return on investment over multiple periods, we can also use the money-weighted return. The money-weighted return is an internal rate of return. We use it when the investment amount changes from period to period.

$$\sum_{t=0}^{T} \frac{CF_t}{(1+IRR)^t} = 0$$

Where:

- CF_t – cash flow in period t,
- IRR – money-weighted return,
- T – number of periods during the lifetime of the investment.

Time-weighted return

For practical reasons, we often apply the time-weighted rate of return. The time-weighted rate of return differs from the money-weighted rate of return as it does not depend on the value of particular cash flows. The time-weighted rate of return is a **geometric return** over the whole investment period.

Money-weighted rate of return vs Time-weighted rate of return

- The money-weighted rate of return gives different weights to different periods, while the time-weighted rate of return gives the same weights to different periods.
- If the portfolio manager has **full control** of the timing and amounts of cash inflows and outflows, the **money-weighted rate of return** should be used.
- When the portfolio manager has **little influence** on the timing and invested amounts, the **time-weighted rate of return** should be applied.

HERE KNOWLEDGE RETENTION HAPPENS | WRITE: notes, examples, formulas, definitions, relations, etc.

Annualized rate of return

As far as both the computation and the comparison of returns on different investments are concerned, it is important for you to be able to convert rates of return to a single period. The annualized rate of return helps compare returns on different investments.

$$R = (1 + r)^{t} - 1$$

Where:

- R – annualized rate of return,
- r – rate of return over the analyzed holding period,
- t – number of holding periods during one year.

Important: For calculation purposes assume that 1 year = 52 weeks and 1 week = 5 days.

Leveraged return

Leveraged return involves using borrowed money to amplify the potential gains of an investment.

$$R_l = R_p + \left(R_p - R_d\right) \times \frac{V_d}{V_e}$$

Where:

- R_l – leveraged return,
- R_p – portfolio return,
- R_d – cost of debt,
- R_e – proportion of investment financed using equity,
- R_d – proportion of investment financed using debt.

Nominal return VS Real return

Real return is nominal return adjusted for inflation.

$$(1 + R_{real}) = \frac{(1 + R_{nom})}{(1 + R_i)}$$

Where:

- R_{real} – real return,
- R_{nom} – nominal return,
- R_i – inflation rate.

HERE KNOWLEDGE RETENTION HAPPENS | WRITE: notes, examples, formulas, definitions, relations, etc.

Summarizing key concepts:

☐ Interest rates: 3 interpretations

My summary:

☐ Components of interest rates

My summary:

☐ Holding period return (HPR)

My summary:

☐ Arithmetic return (mean return)

My summary:

☐ Geometric mean return

My summary:

☐ Harmonic mean

My summary:

☐ Continuously compounded returns

My summary:

☐ Money-weighted return

My summary:

☐ Time-weighted return

My summary:

☐ Annualized rate of return

My summary:

☐ Leveraged return

My summary:

☐ Nominal return VS Real return

My summary:

Reviewing formulas:

$$HPR = \frac{P_1 + D_1}{P_0} - 1$$

Write down the formula:

$$\bar{R}_A = \frac{1}{T}\sum_{t=1}^{T} R_t$$

Write down the formula:

$$\bar{R}_G = \sqrt[T]{\prod_{t=1}^{T}(1 + R_t)} - 1$$

Write down the formula:

$$\bar{X}_H = \frac{n}{\sum_{t=1}^{n}\frac{1}{X_i}}$$

Write down the formula:

$$r_{t,t+1} = \ln\left(\frac{S_{t+1}}{S_t}\right) = \ln(1 + R_{t,t+1})$$

Write down the formula:

$$\sum_{t=0}^{T} \frac{CF_t}{(1 + IRR)^t} = 0$$

Write down the formula:

$$R = (1 + r)^t - 1$$

Write down the formula:

$$R_l = R_p + (R_p - R_d) \times \frac{V_d}{V_e}$$

Write down the formula:

$$(1 + R_{real}) = \frac{(1 + R_{nom})}{(1 + R_i)}$$

Write down the formula:

Keeping myself accountable:

TABLE 1 | STUDY

When you sit down to study, you may want to **try the Pomodoro Technique** to handle your study sessions: study for 25 minutes, then take a 5-minute break. Repeat this 25+5 study-break sequence all throughout your daily study session.

✔ Tick off as you proceed.

POMODORO TIMETABLE: study-break sequences (25′ + 5′)													
date		date		date		date		date		date		date	
25′		25′		25′		25′		25′		25′		25′	
5′		5′		5′		5′		5′		5′		5′	
25′		25′		25′		25′		25′		25′		25′	
5′		5′		5′		5′		5′		5′		5′	
25′		25′		25′		25′		25′		25′		25′	
5′		5′		5′		5′		5′		5′		5′	
25′		25′		25′		25′		25′		25′		25′	
5′		5′		5′		5′		5′		5′		5′	

TABLE 2 | REVIEW

Never ever neglect revision! Though it's not the most popular thing among CFA candidates, regular revision is what makes the difference. If you want to pass your exam, **schedule & do your review sessions.**

REVIEW TIMETABLE: When did I review this Module?													
date		date		date		date		date		date		date	
date		date		date		date		date		date		date	