FinTree

JuiceNotes™

Quantitative Methods

CFA Level 1

2026

Index

Quantitative Methods

		Page No.
LM1	Rates and Returns	**5**
LM2	Time Value of money in Finance	**13**
LM3	Statistical Measures of Asset Returns	**20**
LM4	Probabilities Trees and Conditional Expectations	**29**
LM5	Portfolio Mathematics	**33**
LM6	Simulation Methods	**38**
LM7	Estimation and Inference	**42**
LM8	Hypothesis Testing	**47**
LM9	Parametric and Non-Parametric Test of Independence	**59**
LM10	Simple Linear Regression	**70**
LM11	Introduction to BIg Data Techniques	**82**

Quantitative Methods

Your CFA Journey with FinTree

A Guided Roadmap from Enrollment to Exam Day

At FinTree, we believe in smart preparation driven by structure, support, and consistency. Our unique LPR Methodology – Learn, Practice, Revise – is designed to guide you through each stage of your CFA prep journey with clarity and confidence.

Roadmap from Enrollment to Exam Day

1. Enrollment & Onboarding:

- Receive a welcome call from your dedicated Success Manager (RM)
- Added to a WhatsApp broadcast list for timely updates
- Join a peer group to engage in discussions, share queries, and stay motivated
- Get a personalized study plan and guidance on how to start your prep journey

2. Learning Phase (Initial Months)

- Watch Main Concept Videos and read the official CFA curriculum
- Focus on understanding foundational concepts topic-wise
- Attend live weekend classes to deepen understanding and clarify doubts

3. Practice Phase (Mid Journey)

- Watch EOC and Blue Box videos to apply concepts to CFA-style questions
- Attempt Learning Evaluation Sessions (LES) for topic-wise testing
- Give Weekly Tests based on a structured test calendar
- Weekly Test results are discussed in class on Sunday for deeper insight into common errors and personal improvement

4. Revision Phase (Final 60 Days)

- Revise thoroughly using Juice Notes and Crash Course videos
- Solve the LES twice –
- Vertically (topic by topic)
- Horizontally (across topics like in actual exams)
- Attempt mock exams as per our 60-day revision schedule
- Review mocks in detail, focusing on time management, accuracy, and weak areas

5. Final Phase - IPASS

Rates and Returns

FinTree Fruit 1: Interest Rate Interpretation

Interest rates can be thought of in three ways: 1. Required Rate of Return
2. Discount Rate
3. Opportunity Cost

(We use the terms "interest rate" and "discount rate" interchangeably)

FinTree Fruit 2: Interest Rate Components

- Interest rates are set by the forces of supply and demand, where investors supply funds and borrowers Demand their use
- Nominal Interest Rate = Real risk-free interest rate + Inflation premium + Default risk premium + Liquidity premium + Maturity premium.

Real risk-free interest rate

Reflects the time preferences Of individuals for Current versus future Real consumption.

+

Inflation premium

Compensates investors for expected inflation

+

Default risk premium

Compensates investors for Default risk

Liquidity Premium

Many bonds of small Issuers trade infrequently after they are issued;
the interest rate on such bonds includes a liquidity premium

+

Maturity Premium

Compensates investors for the increased sensitivity of the market value of debt to a change in market interest rates

YTM Long Term Debt (-) YTM Short Term Debt

FinTree Fruit 3: Nominal vs Real Interest Rates

(1 + Nominal risk-free rate) = (1 + real risk-free rate) * (1 + inflation premium)

Example 1: Inflation is 5%, Real RFR is 3% , Nominal Rate will be (1+ 5%)*(1+3%) -1 = 8.15%
(Close to 3% + 5% = 8%, however geometric chaining makes it 8.15%)

Example : Nominal RFR is 8.15%, Real RFR is 3% , Inflation will be (1+ 8.15 %) / (1+3%) -1 = 5%
(Again close to 8.15% - 3.15% = 5%)

FinTree Fruit 4 : Interest Rate Quote Convention

Interest rates are always quoted in annual terms, so the interest rate on a 90-day government debt security Quoted at 4 percent is the annualized rate and not the actual interest rate earned over the 90-day period

Interest earned on $100 investment will be $100 * 4% *90/360 = $100* 1% = $1

FinTree Fruit 5 : Holding Period Return (HPR)

Example 1 : $ 100 Investment becomes $ 105 in some time (time doesn't matter for HPR) and also gives you a Dividend of $ 3.

HPR = (105+ 3) / 100 = 8% ; Capital Gains = 5%, Income Yield = 3%

Example 2: Let's say returns earned in first 3 months is 4%, next 7 months is 3% and last 2 months of the year Is 6%, what will be one year holding period return ?

= (1+4%) * (1+3%) * (1+6%) - 1 = 13.55%

FinTree Fruit 6 : Geometric Mean Return (GM) & Arithmetic Mean Return (AM)

Example 1 : Calculate AM and GM Returns based on following data :

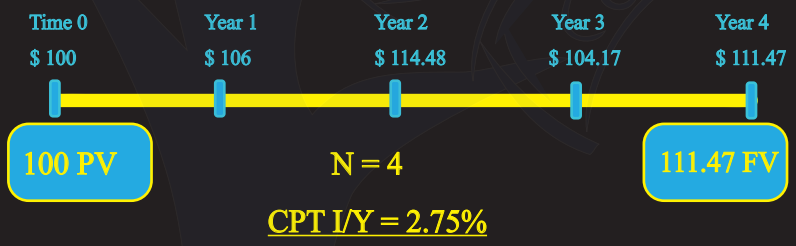
Year	Returns
1	6%
2	8%
3	-9%
4	7%

AM = (6% + 8% - 9% + 7%) / 4 = 3%

GM = $(1.06 * 1.08 * 0.91 * 1.07)^{(1/4)} - 1 = 2.75\%$

Another way to think of GM is , start with $ 100, grow @ 6% = 106, then $ 106 grows @ 8% = 114.48, then @ -9% = 104.17 and finally at 7% = 111.47 . So in four years, $ 100 are becoming $ 111.47. Using TVM row :

- HPR in previous example will be (1.06 * 1.08 * 0.91* 1.07) - 1 = 21.89%, notice how we are not taking the fourth root of the chained returns for HPR.



- AM is generally biased upwards (compared to GM), i.e. AM ≥ GM.
- Bias in AM returns is particularly higher if holding period returns are a mix of both positive and negative returns, as in this example.
- In general, the difference between the AM and GM increases with the variability within the sample; the more disperse the observations, the greater the difference .

FinTree Fruit 7 : Harmonic Mean

- Used when variable is a rate or a ratio, such as PE ratio.
- Useful measure when variables have outliers.
- Use AM if investments are made by purchasing constant quantity of stocks every month/year
- Use HM investment are made by purchasing constant amount every month/year (Dollar cost averaging)

- $AM * HM = GM^2$
- Unless all observations are same values, AM > GM > HM
- Harmonic Mean is calculated as:

$$\frac{n}{\frac{1}{X1} + \frac{1}{X2} + \ldots + \frac{1}{Xn}}$$

Example1: Calculate AM, GM and HM of PE Ratios

Stock	PE Ratio
A	3
B	4
C	5
D	20

- $AM = (3 + 4 + 5 + 20) / 4 = 8$
- $GM = (3 * 4 * 5 * 20)^{(1/4)} = 5.88$
- $HM = \frac{4}{\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{20}} = 4.8$
- Notice , AM > GM > HM
- Notice , HM is least affected by outlier value of 20

FinTree Fruit 8 : Trimmed Mean and Winsorized Mean

- Both are used to minimize the impact of outliers in a database
- Trimmed mean removes a small defined percentage of the largest and smallest values from a dataset before calculating the mean by averaging the remaining observations.
- Winsorized mean is calculated after replacing extreme values at both ends with the values of their Nearest observations, and then calculating the mean by averaging the remaining observations.
- In summary: HM, Winsorized and Trimmed mean are solutions to extreme outliers values
- GM is used when compounding is required
- HM is used while averaging ratios (like PE)

FinTree Fruit 9 : Time Weighted Rate of Return (TWRR) & Money Weighted Rate of Return (MWRR)

- MWRR is just the IRR when considering investment inflows and outflows
- MWRR is more accurate measure of what investor earned during the period , however it is not comparable across investors
- TWRR is GM of all the Holding Period Returns
- TWRR is not sensitive to investment inflows and outflows.
- Investment managers prefer TWRR as they do not control timing of inflows and outflows.

TWRR can be computed in following steps :

1. Price the portfolio immediately prior to any significant addition or withdrawal of funds.
2. Break the overall evaluation period into sub periods based on the dates of cash inflows and outflows.
3. Calculate the holding period return for each sub period.
4. Calculate Geometric Mean of HPR of sub periods.

Example 1 : Calculate MWRR and TWRR

Time	Stock Price	Qty Purchased	Div Per Share
0	10	1	
1	20	4	1
2	25	10	1
3	50	15 (Sold)	2

MWRR can be computed by calculating IRR of Net Cash Flow (Last Column)

	A (Qty * Price pu)	B (Qty sold)	C (Div Received)	A+B+C
Time	Outflow	Inflow 1	Inflow 1	Net Cash Flow
0	-10			-10
1	-80		1*1 =1	-79
2	-250		5*1=5	-245
3		750	15*2=30	780

IRR = MWRR -> 83.91%

To compute TWRR, we will have to calculate HPR of each Period

Time (from - to)	Capital Gain	Div Yield	HPR
0 to 1	100% *(10 -->20)*	10% *1/10*	110%
1 to 2	25% *(20 -->25)*	5% *1/20*	30%
2 to 3	100% *(25 -->50)*	8% *2/25*	108%

TWRR will GM of 110%, 30% & 108%

$= \sqrt[3]{(1+110\%) * (1+30\%) * (1+108\%)} - 1 = 78.40\%$

FinTree Fruit 10 : Non-Annual Compounding Rate

Example 1 : Fill in the blanks of the following table

PV	Investment Period	Interest Rate	Compounding Frequency	FV
100	1 year	10%	Annually	?
100	3 months	10%	Annually	?
100	18 months	10%	Annually	?
100	1 year	10%	Semi-annual	?
100	3 months	10%	Semi-annual	?
100	18 months	10%	Semi-annual	?
100	1 year	10%	Quarterly	?
100	3 months	10%	Quarterly	?
100	18 months	10%	Quarterly	?

Solution with TVM row keys is as follows:

PV	N	I/Y	CPT FV
100	1	10%	110.00
100	0.25	10%	102.41
100	1.5	10%	115.37
100	2	10%	110.25
100	0.5	10%	102.47
100	3	10%	115.76
100	4	10%	110.38
100	1	10%	102.50
100	6	10%	115.97

FinTree Fruit 11 : Annualizing Rates

Example 1: Convert quoted rates to Annualized Rates using I-Conversion Function of the Table

To Access Interest Conversation Function, press 2nd and 2 on TI BA II Plus Calculator

Quoted Rate (Nominal Rate)	Quoted Compounding Frequency	Annualized Rate
10%	Annual	?
10%	Semi-annual	?
10%	Quarterly	?
10%	Weekly	?
10%	Daily	?

TVM Row Keys, Press 2nd , then 2 , 2nd then CLR WORK
Follow Sequence of the Column Headers.
Use Up and down arrows on the calculator to navigate

Enter NOM -->	Enter C/Y -->	Go to EFF (Press CPT)
10	1	10.000
10	2	10.250
10	4	10.380
10	52	10.507
10	365	10.516

FinTree Fruit 12 : Continuously Compounded Returns

Example 1: Fill in the blanks

Solution:

PV	CC Rate pa	Time Period	FV
100	10%	1 year	?
100	10%	3 Months	?
100	10%	18 Months	?

TI BA II Plus Keys	FV
10%* 1 --> 2nd e^x --> * 100	110.517092
10%* 0.25 --> 2nd e^x --> * 100	102.531512
10%* 1.5 --> 2nd e^x --> * 100	116.183424

PV	CC Rate pa	Time Period	FV
?	10%	1 year	100
?	10%	3 Months	100
?	10%	18 Months	100

TI BA II Plus Keys	PV
-10%* 1 --> 2nd eX --> * 100	90.4837418
-10%* 0.25 --> 2nd eX --> * 100	97.5309912
-10%* 1.5 --> 2nd eX --> * 100	86.0707976

PV	CC Rate pa	Time Period	FV
100	?	1 year	200
100	?	3 Months	200
100	?	18 Months	200

TI BA II Plus Keys	CC Rate pa
200/100 --> LN --> Divided by 1	69.3%
200/100 --> LN --> Divided by 0.25	277.3%
200/100 --> LN --> Divided by 1.5	46.2%

FinTree Fruit 13 : Return Measures

- **Gross Return** is the return earned by an asset manager prior to deductions for management expenses, Custodial fees, taxes etc.
- Trading expenses, such as commissions, are deducted from the computation of gross return.
- Gross Return is an appropriate measure for comparing the investment skill of asset managers.
- **Net return** accounts for all managerial and administrative expenses that reduce an investor's return.
- Because individual investors are most concerned about the net return, small mutual funds with a smaller asset base are at a disadvantage compared with larger funds that can spread their largely fixed administrative expenses over a larger asset base (economies of scale).
- **Post Tax Returns** = Pre tax Returns - Taxes Paid = Pre Tax Returns * (1- tax rate)
- **Risk Premium** can be calculated as ={ (1+ total return on an asset) / (1+ RFR) } - 1
- **Leveraged Return** = Returns earned on equity (own money) invested after accounting for interest paid on borrowed money to fund that investment

Example 1 : If you buy a stock worth $ 100, by borrowing $80 and investing $20 of equity (own). At the end of the year , the stock value is $ 120. Interest rate on borrowing is 12.5%. Calculate Asset Return (unlevered) and Leveraged Return.

Unlevered Return

= Profit / Total Value of Asset at the time of investment

$$\frac{20}{100} = 20\%$$

Leveraged Return

= Profit made after interest payment / Equity Invested

$$\frac{20 - 80*12.5\%}{20} = 50\%$$

Another way to calculate leveraged return:

Unlevered Return + Debt/Equity Ratio * (Unlevered Return - Interest Rate)

= 20 % (+) 80/20 * (20%- 12.5%)

= 20% (+) 4 * 7.5%

= 50%

The Time Value of Money in Finance

FinTree Fruit 1: Valuation of a Coupon Bond

- **A bond** is a fixed-income instrument that represents a loan made by an investor to a borrower
- **The face value of a bond** is the price that the issuer pays at the time of maturity, also referred to as "par value"
- **The coupon rate** is the interest rate paid on a bond by its issuer for the term of the security.
- It's calculated as Face Value * Par Rate
- **The term yield to maturity (YTM)** refers to the total return anticipated on a bond if the bond is held until it matures.
- **A bond's market value** is how much someone will pay for the bond on the free market. It is calculated as Present Value of future cash flows of the bond discounted at YTM.

Example 1: Calculate Value of the bond based on following data

Q NO	FV	Coupon Rate	Componding Frequency	Maturity	YTM	Market Value
1	1000	0%	Annual	10 Years	10%	?
2	1000	0%	Semi-annual	10 Years	10%	?
3	1000	0%	Quarterly	10 Years	10%	?
4	1000	5%	Annual	10 Years	10%	?
5	1000	5%	Semi-annual	10 Years	10%	?
6	1000	5%	Annual	10 Years	?	900
7	1000	5%	Semi-annual	10 Years	?	1100

Solution

Q NO	FV	PMT	I/Y	N	CPT PV
1	1000	0	10.0%	10	$385.54
2	1000	0	5.0%	20	$376.89
3	1000	0	2.5%	40	$372.43
4	1000	50	10%	10	$692.77
5	1000	25	5.0%	20	$688.44

Q NO	PV	PMT	N	FV	CPT I/Y	YTM
6	-900	50	10	1000	6.38%	6.38%
7	-1100	25	20	1000	1.89%	3.78%

FinTree Fruit 2 : PV of Perpetuity and Amortization Schedule

- A perpetual bond is a less common type of coupon bond with no stated maturity date.
- **PV(Perpetual Bond)** = PMT / Discount Rate
- **Amortization Schedule** = Schedule that displays how loan is repaid over a period of time.

Example 1: Build Amortization Scehdule for a Loan of $ 100, to be repaid over 5 years with level payments, at interest rate of 10%.

Use TVM row to calculate annual Installment to be paid.

2nd CLR TVM, 100 PV , 10 I/Y, 5 N , CPT PMT = 26.38

Now, press 2nd PV(AMORT), keep P1 = 1 - Enter & P2 = 1 - Enter, and press Down to see BAL, PRI, INT (for 1st Installment).

			(a) * 10%	(b) - (c)	(a) - (d)
	(a)	(b)	(c)	(d)	(e)
Year	Op Loan	Installment Paid	Interest Component	Principal Repaid	Cl. Loan
1	100.00	26.38	10.00	16.38	83.62
2	83.62	26.38	8.36	18.02	65.60
3	65.60	26.38	6.56	19.82	45.78
4	45.78	26.38	4.58	21.80	23.98
5	23.98	26.38	2.40	23.98	0.00

FinTree Fruit 3 : Valuation of Equity (Dividend Discount Model)

- Value of Equity Share is PV of all Future Cash Flows.
- Future Cash Flows include dividends and Terminal Value
- Terminal Value is the estimated value of the stock at the end of the forecast horizon.
- Estimated dividend payments could be:
  1. **Constant Payment** in perpetuity = **Dividend Pmt / Disc Rate**
  2. **Constant Growth** in Perpetuity (Gordon Growth Model) = **D1 / (Disc Rate - growth rate)**
  3. Different Growth rates (2 Stage and 3 Stage models) - Look example below

Example 1 : A stock is expected to pay a dividend of $ 10 in perpetuity. Expected return on the stock is 5% (Discount rate). Determine Value of the stock

$Value_0$ = $Dividend_1$ / Discount Rate

V_0 = $10 / 5% = $ 200

Example 2 : A stock is expected to pay a dividend of $ 10 next year. Expected return on the stock is 10% (Discount rate). Dividends are expected to grow at 4%.

$Value_0 = Dividend_1 / (Discount\ Rate - growth\ rate)$

$V_0 = \$10 / (10\% - 4\%) = \$\ 166.67$

Example 3 : A stock paid a dividend of $ 10 last year. Expected return on the stock is 10% (Discount rate). Dividends are expected to grow at 4%.

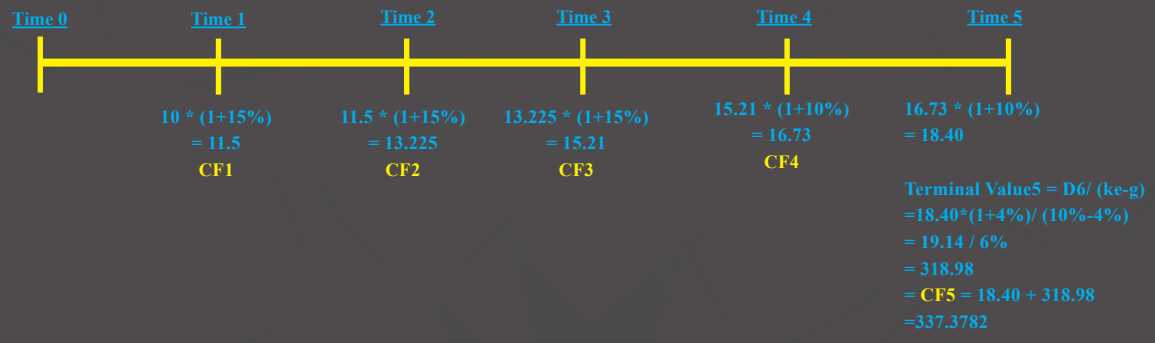
$Value_0 = Dividend_1 / (Discount\ Rate - growth\ rate)$

$Value_0 = Dividend_0 * (1 + growth\ rate) / (Discount\ Rate - growth\ rate)$

$V_0 = \$10 * (1 + 4\%) / (10\% - 4\%)$

$V_0 = \$10.4 / (10\% - 4\%) = 173.33$

Example 4 : A stock paid a dividend of $ 10 last year. Dividends are expected to grow at 15% for first 3 years, then at 10% for next two years and 4% therefter in perpetuity. Discount rate is 10%.



Compute NPV, by using NPV function by inserting on TI BA II Plus Calculator.

Keep I = 10%. NPV = 253.72

FinTree Fruit 4 : Implied Growth and Discount Rates

- Gordon Growth Model = $V_0 = D_1 / (ke - g)$
- Rearranging the equation, $ke - g = D_1 / V_0$; $ke = D_1 / V_0 + g$
- $g = ke\ (-)\ D_1 / V_0$