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CHARTERED FINANCIAL ANALYST - LEVEL I

A PROFESSIONAL'S FIRST CHOICE IN EXAM TRAINING & PREPARATION

FORMULA BOOK

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STUDY SESSION 2 & 3

QUANTITATIVE METHODS

I TIME VALUE OF MONEY

Nominal Risk-Free Rate

$$\text{Nominal risk free rate} = \text{Real risk free rate} + \text{Expected inflation}$$

Required Rate of Return

$$\text{Required Return} = \underset{\text{Free Rate}}{\text{Nominal Risk}} + \underset{\text{Risk Premium}}{\text{Default}} + \underset{\text{Risk Premium}}{\text{Liquidity}} + \underset{\text{Risk Premium}}{\text{Maturity}}$$

Future Value of A Single Cash Flow

$$FV = PV\left(1 + \frac{r}{m}\right)^{m \times N}$$

Where: FV = Future value; PV = Present value; r = Annual interest rate; N = Number of years; m = compounding frequency per year.

Present Value of A Single Cash Flow (compounding frequency = 1)

$$PV = \frac{FV}{(1 + r)^{N}}$$

Present Value of A Single Cash Flow (compounding frequency ≠ 1)

$$PV = \frac{FV}{\left(1 + \frac{r}{m}\right)^{m \times N}}$$

Present Value of Ordinary Annuity

$$PV = A\left[\frac{1 - \frac{1}{(1 + r)^{N}}}{r}\right]$$

Future Value of Ordinary Annuity

$$FV = A\left[\frac{(1+r)^N - 1}{r}\right]$$

Present Value of Annuity Due

$$PV_{\text{Annuity Due}} = PV_{\text{Ordinary Annuity}} \times (1+r)$$

Note: The PV and FV of annuities can be done on the calculator using the TVM function. For Annuity Due (payments made at the start of a period), remember to use the BGN mode on your calculator.

Future Value of Annuity Due

$$FV_{\text{Annuity Due}} = FV_{\text{Ordinary Annuity}} \times (1+r)$$

Present Value Of Perpetuity

$$PV\ (\text{perpetuity}) = \frac{PMT}{I/Y}$$

Where: PMT = periodic payment I/Y = periodic interest rate

I/Y of an investment

$$I/Y = \left(\frac{FV}{PV}\right)^{1/N} - 1$$

Alternatively, to find the I/Y use the TVM function on the calculator. Don't forget to enter either FV or PV as a negative number, else you'll see an Error 5!

Continuous Compounding And Future Values

$$FV = PVe^{r_{cc} \times N}$$

Effective Annual Rates

$$EAR = (1 + \text{Periodic rate})^N - 1$$

$$EAR = e^{r_{cc} \times t} - 1$$

$$\text{Annual Percentage Rate (APR)} = \text{periodict rate} \times m$$

STUDY SESSION 4

ECONOMICS

I DEMAND AND SUPPLY ANALYSIS: INTRODUCTION

Demand Function

$$QD_x = f(P_x, I, P_y)$$

Where: QD_x= Quantity demanded of good X

Depends on: P_x = Price of good X, I = Average income per year P_y = Price of related good Y

Supply Function

$$QS_x = f(P_x, W, P_i)$$

Where: QS_x= Quantity supplied of good X

Depends on: P_x = Price of good X, W = Wage paid to labo P_i = Price of inputs

Price Elasticity of Demand

$$ED = \frac{\%\Delta QD}{\%\Delta P} = \left(\frac{P_o}{Q_o}\right) \times \left(\frac{\Delta QD}{\Delta P}\right)$$

Where: $\left(\frac{\Delta QD}{\Delta P}\right)$ is the slope of the demand function

$$ED = \frac{\%\Delta QD}{\%\Delta P} = \frac{\frac{(Q_1 - Q_0)}{(Q_0 + Q_1)/2} \times 100}{\frac{(P_1 - P_0)}{(P_0 + P_1)/2} \times 100}$$

$\%\Delta Q$ = new quantity change calculated against the average quantity.

ΔP = is the new price change calculated against the average price.

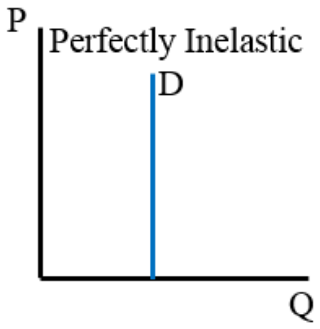
Note price elasticity of demand is always negative as price and quantity demanded move in opposite directions.

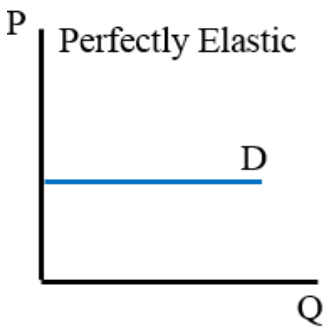
$|P_{ED}| > 1$ Elastic demand

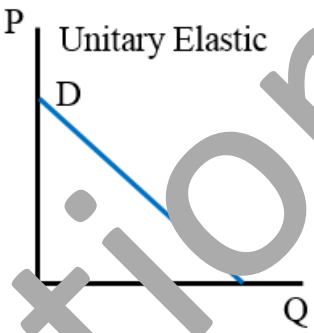
$|P_{ED}| < 1$ inelastic demand

$|P_{ED}| = 1$ Unitary elasticity.

Price elasticity of Demand







Income Elasticity of Demand

$$ED = \frac{\%\Delta QD}{\%\Delta I} = \left(\frac{I_o}{Q_o}\right) \times \left(\frac{\Delta QD}{\Delta I}\right)$$

Where: $\left(\frac{\Delta QD}{\Delta I}\right)$ is the slope term on the income variable

$\%\Delta Q$ = new quantity change calculated against the average quantity.

$\%\Delta I$ = is the new income change calculated against the average income.

Cross Price Elasticity of Demand (CPE)

$$CPE = \frac{\%\Delta QD_x}{\%\Delta P_y \text{ of substitute or complement}} = \left(\frac{P_{0\,Y}}{Q_{0\,X}}\right) \times \left(\frac{\Delta QD_x}{\Delta P_Y}\right)$$

Where: Q_x = Quantity demanded of good X P_Y = Price of good Y

STUDY SESSION 7

FINANCIAL STATEMENT ANALYSIS

I FINANCIAL REPORTING MECHANICS

Accounting Equation

$$\text{Assets} = \text{Liabilities} + \text{Equity}$$

Equity

$$\text{Equity} = \text{Owner contributed capital} + \text{Retained earnings}$$

Expanded Accounting Equation (1)

$$\text{Assets} = \text{Liabilities} + \text{Contributed Capital} + \text{Ending Retained Earnings}$$

Retained earnings at the end of the ye

$$\text{Ending Retained Earnings} = \text{Beg. ning Retained Earnings} + \text{Net income} - \text{Dividends}$$

Expanded Accounting Eq ation (2)

$$\text{Assets} = \text{Liabili s} + \text{Co buted Cap al} + \text{Begining Retained Earnings} + \text{Revenues} - \text{Expenses} - \text{Dividends}$$

Net Inc e

$$\text{Net come} = \text{evenue} - \text{Expenses}$$

II UNDERSTANDING THE INCOME STATEMENT

Net Income

$$\text{Net Income} = \text{Revenue} - \text{Operating Expenses} + \text{Other income} - \text{Other expenses} + \text{gains} - \text{losses}$$

Comparison of IFRS and U.S. GAAP BALANCE SHEET		
Component	**IFRS**	**U.S. GAAP**
Marketable Securities	Marketable securities should initially be recorded at fair value (generally the cost to acquire the security). Subsequent accounting for a marketable security depends on its classification: • Held-to-maturity securities are reported at amortized costs • Held-for-trading securities, including derivatives, are reported at fair value with unrealized gains and losses reported on the income statement • Available-for-sale securities are reported at fair value with unrealized gains and losses reported in equity as a component of other comprehensive income. Realized gains/losses and income (interest, dividends) are reported on the income statement for all marketable securities. For all financial instruments, including marketable securities, there must be disclosure of credit risk, liquidity risk, market risk, and risk management policies and procedures.	No significant differences from IFRS. Although not discussed in the source reading, under U.S. GAAP the unrealized gains and losses on derivative instruments are reported on the income statement or as a "direct-to-equity" adjustment in other comprehensive income.
Inventories	Inventory must be reported at the lower of cost or market. Inventory write-downs can be reversed. The method selected should reflect the order in which the products are sold, which calls for using specific identification whenever possible. Weighted average cost of FIFO (first in, first out) are both acceptable alternatives. The LIFO costing method is prohibited.	Inventory is reported at the lower of cost or market. The reversal of inventory write-downs is prohibited. The costing method is not required to reflect the actual flow of the inventory. The cost of inventory can be determined using specific identification, weighted average cost, FIFO or LIFO.

STUDY SESSION 11

CORPORATE FINANCE

I CAPITAL BUDGETING

Net Present Value

$$NPV = CFO_0 + \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

Where
CFO_0 = investment cash outflow
CF_t = after-tax cash flows from a project
r = discount rate

Internal Rate of Return

$$NPV = CF_0 + \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t} = 0$$

Average Accounting Rate of Return

$$ARR = \frac{\text{Average net income}}{\text{Average book value}}$$

Profitability Index

$$PI = \frac{\text{PV of future cash flows}}{CF_0} = 1 \frac{NPV}{CF_0}$$

II COST OF CAPITAL

Weighted average cost of capital

$$WACC = (w_d r_d[1-t]) + (w_{ps} r_{ps}) + (w_{ce} k_{ce})$$

Where:

w_d = % of debt in capital structure
w_{ps}= % of preferred stock in capital structure
w_{ce} = % of common stock in capital structure
r_{ce} = cost of common equity (required return on common stock)
t = marginal tax rate
r_d = before tax cost of debt
r_{ps}= cost of preferred stock

STUDY SESSION 12

PORTFOLIO MANAGEMENT

I PORTFOLIO MANAGEMENT AN OVERVIEW

Utility Function

$$\text{Utility} = E(R) - 1/2(A)(\sigma^2)$$

Where: U = utility of an investment E(R) = Expected return σ^2 = variance of returns
A = Risk aversion coefficient

II PORTFOLIO RISK AND RETURN: PART I

Leveraged Return

$$\text{Leveraged Return} = \frac{\text{Gain/Loss on investment}}{\text{Investor's funds}} = \frac{P_1 - \quad + \text{Dividends} - \text{Interest} - \text{Commissions}}{\text{Equity}}$$

III PORTFOLIO RISK AND RETURN: PART 2

Capital Market Line (CML) Slope

The CML has an intercept of risk free rate and a constant slope that equals Sharpe ratio:

$$\text{Slope} = \text{Sharpe ratio} = \frac{E(R_p) - r_f}{\sigma_p}$$

Where:
$E(R_p)$ is the return on portfolio 'p'
r_f is the risk free rate
σ_p is the standard deviation of portfolio 'p'

Capital Market Line (CML) Line Equation

$$R_p = R_f + \left(\frac{E(R_M) - r_f}{\sigma_M}\right)\sigma_p$$

OR

$$R_p = R_f + [E(R_M) - R_f]\left(\frac{\sigma_p}{\sigma_M}\right)$$

STUDY SESSION 13

EQUITY

I MARKET ORGANIZATION AND STRUCTURE

Leverage Ratio

$$\text{Leverage Ratio} = \frac{\text{Value of asset}}{\text{Equity position}}$$

Price that triggers Margin Call

$$\text{Margin call price} = P_0\left(\frac{1 - \text{initial margin}}{1 - \text{maintenance margin}}\right)$$

Variation Margin

$$\text{Variation Margin} = \text{Maintenance Margin} - \text{Current Margin Balance}$$

Note: In the equity market, if margin balance falls below maintenance margin, the investor must provide variation margin (funds) sufficient to bring the account back to **maintenance margin**.

Market Quote

$$\text{Market Quote} = (\text{Bid}_{high}, \text{Ask}_{low})$$

Where :
Bid_{high} = Highest bid amongst all dealers
Ask_{low} = Lowest ask amongst all dealers

Order Type	Description
Market Order	Will execute immediately at the best available price
Limit Buy Order	Limit price is set BELOW current market price
Limit Sell Order	Limit price is set ABOVE current market price
Stop-Loss Buy Order	Stop price is set ABOVE current market price
Stop Loss Sell Order	Stop price is set BELOW current market price

STUDY SESSION 15

FIXED INCOME

I FIXED INCOME SECURITIES: DEFINING ELEMENTS

Fixed Coupon Bond

$$\text{Coupon} = \text{Coupon Rate} \times \text{Bond Par Value}$$

Floating Coupon Bond

$$\text{Coupon Rate} = \text{Reference Rate} \pm \text{Quoted Margin}$$

Inverse Floaters Bond

$$\text{Coupon Rate} = \text{Qouted Margin} - \text{Reference Rate}$$

Inflation – Indexed Treasury Securities

$$\text{TIPS Coupon} = \text{Inflation adjusted par value} \times \left(\frac{\text{Stated coupon rate}}{2}\right)$$

Convertible bonds – Conversion Price

$$\text{Conversion price} = \frac{\text{Par value}}{\text{Conversion ratio}}$$

II INTRODUCTION TO FIXED INCOME VALUATION

Annual Pay Bond Value

$$P_{annual} = \frac{\text{Coupon}}{(1+\text{YTM})} + \frac{\text{Coupon}}{(1+\text{YTM})^2} + \cdots + \frac{\text{Coupon} + \text{Principal}}{(1+\text{YTM})^N}$$

STUDY SESSION 16

FIXED INCOME

I UNDERSTANDING FIXED INCOME RISK AND RETURN

Bond income (sources of return)

$$\text{Bond return} = \text{Coupons} + \text{Coupon reinvestment income} + \text{Capital gains/loss}$$

Macaulay Duration

$$\text{Macaulay Duration} = \sum_{t=1}^{n}\left[t \times \frac{\left[\frac{CF_t}{(1+r)^t}\right]}{\text{Bond price}}\right]$$

Modified Duration

$$\text{Modified duration} = \frac{\text{Macaulay d}\ldots\text{ation}}{(1 + \text{periodi}\ldots\text{YTM})}$$

Approximate Modified D…atio…

$$\text{Approx. Modi…d Duration} = \frac{V_- - V_+}{\ldots \times V_0 \times \Delta\text{YTM}}$$

Effe…e Duratio…

$$\text{Effective …ation} = \frac{V_- - V_+}{2 \times V_0 \times \Delta\text{benchmark yield curve}}$$

Portfolio Duration

$$\text{Portfolio Duration} = w_1D_1 + w_2D_2 + \cdots + w_ND_N$$

Where : N = number of bonds in portfolio
D_i = Duration of bond *i*
w_i = Market value of bond *i* divided by the total market value of portfolio

STUDY SESSION 15

DERIVATIVES

I DERIVATIVE MARKETS AND INSTRUMENTS

Derivative Contract Pricing

$$\text{Risky asset} + \text{Derivative} = \text{Risk free asset}$$

$$\text{Long underlying asset}_{t=0} + \text{Short derivative}_{t=0} = \frac{\text{Certain payoff}_T}{(1+r_f)^T}$$

$$\text{Risky asset} - \text{risk free asset} = -\text{derivative}$$

Where: '–' for risk free asset implies borrowing of funds
'–' on derivatives implies short position.

General Payoff on Futures contract

$$\text{Gain / Loss} = \#\text{ of Contracts} \times \text{Contract size} \times (F_T - F_0)$$

Where: F_T= Futures price when contract is closed at maturity time = T
F_0 = Futures price agreed at inception at time t = 0
$(F_T - F_0)$ = Change in futures price
# of Contracts × Contract size = Size of trade

Initial Margin

$$\text{Initial Margin} = \text{Initial Margin per Contract} \times \#\text{ No. of contracts}$$

Maintenance Margin

$$\text{Maintenance Margin} = \text{Maintenance Margin per Contract} \times \#\text{ No. of contracts}$$

Variation Margin

$$\text{Variation Margin} = \text{Initial Margin} - \text{Current margin balance}$$

Note: In the futures market, if margin balance falls below maintenance margin, the investor must provide variation margin (funds) sufficient to bring the account back to **initial margin**.

STUDY SESSION 18

ALTERNATIVE INVESTMENTS

I INTRODUCTION TO ALTERNATIVE INVESTMENTS

Total Return

Total Return = Alpha Return + Beta Return

Where: Alpha return = excess return on the asset
Beta return = expected return given asset's systematic risk

Pricing futures contract

Futures price ≈ Spot price (1 + risk free rate) + Storage cost – convenience yield

Real Estate Valuation:

A. Income Approach

$$\text{Value} = \text{PV}(\text{Cash flows})$$

Where: Cash flows = Net Operating Income (NOI)

$$\text{Value (perpetuity)} = \frac{\text{Net operating income}}{\text{Cap Rate}}$$

$$\text{Value} = \frac{\text{NOI}_1}{(1+\text{cap rate})^1} + \frac{\text{NOI}_2}{(1+\text{cap rate})^2} + \cdots + \frac{\text{NOI}_n + V_n}{(1+\text{cap rate})^n}$$

Where:
V_n= terminal value of property

Net Operating Income = EBIT + Depreciation

Net Operating Income = Net revenue – collection and vacancy losses – utilities – maintenance and repair expenses – insurance – property taxes (do not deduct investor's *income tax*)

Note: Do not deduct interest expense or depreciation when calculating NOI

B. Comparable Sales Approach (Regression Approach or Hedonic Approach)

$$\text{Value} = \alpha + \beta_1(\#\text{ of rooms}) + \beta_2(\text{distance from city}) + \cdots + \beta_n(\text{age of property})$$

Note: regression equation and α and β_i will be provided in the question. Simply plug all variables into the equation and solve for the value of the property.