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Quantitative Methods and Economics



LEVEL I BOOK 1

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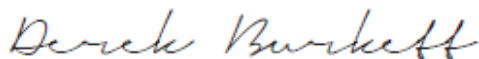
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Regards,



Derek Burkett, CFA, FRM, CAIA

Vice President (Advanced Designations)

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Book 1: Quantitative Methods and Economics

SchweserNotes™ 2023

Level I CFA®

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SCHWESERNOTES™ 2023 LEVEL I CFA® BOOK 1: QUANTITATIVE METHODS AND ECONOMICS

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LEARNING OUTCOME STATEMENTS (LOS)

1. The Time Value of Money

The candidate should be able to:

- a. interpret interest rates as required rates of return, discount rates, or opportunity costs.
- b. explain an interest rate as the sum of a real risk-free rate and premiums that compensate investors for bearing distinct types of risk.
- c. calculate and interpret the future value (FV) and present value (PV) of a single sum of money, an ordinary annuity, an annuity due, a perpetuity (PV only), and a series of unequal cash flows.
- d. demonstrate the use of a time line in modeling and solving time value of money problems.
- e. calculate the solution for time value of money problems with different frequencies of compounding.
- f. calculate and interpret the effective annual rate, given the stated annual interest rate and the frequency of compounding.

2. Organizing, Visualizing, and Describing Data

The candidate should be able to:

- a. identify and compare data types.
- b. describe how data are organized for quantitative analysis.
- c. interpret frequency and related distributions.
- d. interpret a contingency table.
- e. describe ways that data may be visualized and evaluate uses of specific visualizations.
- f. describe how to select among visualization types.
- g. calculate and interpret measures of central tendency.
- h. evaluate alternative definitions of mean to address an investment problem.
- i. calculate quantiles and interpret related visualizations.
- j. calculate and interpret measures of dispersion.
- k. calculate and interpret target downside deviation.
- l. interpret skewness.
- m. interpret kurtosis.
- n. interpret correlation between two variables.

3. Probability Concepts

The candidate should be able to:

- a. define a random variable, an outcome, and an event.
- b. identify the two defining properties of probability, including mutually exclusive and exhaustive events, and compare and contrast empirical, subjective, and a priori probabilities.
- c. describe the probability of an event in terms of odds for and against the event.
- d. calculate and interpret conditional probabilities.
- e. demonstrate the application of the multiplication and addition rules for probability.
- f. compare and contrast dependent and independent events.
- g. calculate and interpret an unconditional probability using the total probability rule.
- h. calculate and interpret the expected value, variance, and standard deviation of random variables.
- i. explain the use of conditional expectation in investment applications.
- j. interpret a probability tree and demonstrate its application to investment problems.
- k. calculate and interpret the expected value, variance, standard deviation, covariances, and correlations of portfolio returns.
- l. calculate and interpret the covariances of portfolio returns using the joint probability function.
- m. calculate and interpret an updated probability using Bayes' formula.
- n. identify the most appropriate method to solve a particular counting problem and analyze counting problems using factorial, combination, and permutation concepts.

4. Common Probability Distributions

The candidate should be able to:

- a. define a probability distribution and compare and contrast discrete and continuous random variables and their probability functions.
- b. calculate and interpret probabilities for a random variable given its cumulative distribution function.
- c. describe the properties of a discrete uniform random variable, and calculate and interpret probabilities given the discrete uniform distribution function.

- d. describe the properties of the continuous uniform distribution, and calculate and interpret probabilities given a continuous uniform distribution.
- e. describe the properties of a Bernoulli random variable and a binomial random variable, and calculate and interpret probabilities given the binomial distribution function.
- f. explain the key properties of the normal distribution.
- g. contrast a multivariate distribution and a univariate distribution, and explain the role of correlation in the multivariate normal distribution.
- h. calculate the probability that a normally distributed random variable lies inside a given interval.
- i. explain how to standardize a random variable.
- j. calculate and interpret probabilities using the standard normal distribution.
- k. define shortfall risk, calculate the safety-first ratio, and identify an optimal portfolio using Roy's safety-first criterion.
- l. explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices.
- m. calculate and interpret a continuously compounded rate of return, given a specific holding period return.
- n. describe the properties of the Student's t -distribution, and calculate and interpret its degrees of freedom.
- o. describe the properties of the chi-square distribution and the F -distribution, and calculate and interpret their degrees of freedom.
- p. describe Monte Carlo simulation.

5. Sampling and Estimation

The candidate should be able to:

- a. compare and contrast probability samples with non-probability samples and discuss applications of each to an investment problem.
- b. explain sampling error.
- c. compare and contrast simple random, stratified random, cluster, convenience, and judgmental sampling.
- d. explain the central limit theorem and its importance.
- e. calculate and interpret the standard error of the sample mean.
- f. identify and describe desirable properties of an estimator.
- g. contrast a point estimate and a confidence interval estimate of a population parameter.
- h. calculate and interpret a confidence interval for a population mean, given a normal distribution with 1) a known population variance, 2) an unknown population variance, or 3) an unknown population variance and a large sample size.
- i. describe the use of resampling (bootstrap, jackknife) to estimate the sampling distribution of a statistic.
- j. describe the issues regarding selection of the appropriate sample size, data snooping bias, sample selection bias, survivorship bias, look-ahead bias, and time-period bias.

6. Hypothesis Testing

The candidate should be able to:

- a. define a hypothesis, describe the steps of hypothesis testing, and describe and interpret the choice of the null and alternative hypotheses.
- b. compare and contrast one-tailed and two-tailed tests of hypotheses.
- c. explain a test statistic, Type I and Type II errors, a significance level, how significance levels are used in hypothesis testing, and the power of a test.
- d. explain a decision rule and the relation between confidence intervals and hypothesis tests, and determine whether a statistically significant result is also economically meaningful.
- e. explain and interpret the p -value as it relates to hypothesis testing.
- f. describe how to interpret the significance of a test in the context of multiple tests.
- g. identify the appropriate test statistic and interpret the results for a hypothesis test concerning the population mean of both large and small samples when the population is normally or approximately normally distributed and the variance is (1) known or (2) unknown.
- h. identify the appropriate test statistic and interpret the results for a hypothesis test concerning the equality of the population means of two at least approximately normally distributed populations based on independent random samples with equal assumed variances.
- i. identify the appropriate test statistic and interpret the results for a hypothesis test concerning the mean difference of two normally distributed populations.
- j. identify the appropriate test statistic and interpret the results for a hypothesis test concerning (1) the variance of a normally distributed population and (2) the equality of the variances of two normally distributed populations based on two independent random samples.

- k. compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.
- l. explain parametric and nonparametric tests of the hypothesis that the population correlation coefficient equals zero, and determine whether the hypothesis is rejected at a given level of significance.
- m. explain tests of independence based on contingency table data.

7. Introduction to Linear Regression

The candidate should be able to:

- a. describe a simple linear regression model and the roles of the dependent and independent variables in the model.
- b. describe the least squares criterion, how it is used to estimate regression coefficients, and their interpretation.
- c. explain the assumptions underlying the simple linear regression model, and describe how residuals and residual plots indicate if these assumptions may have been violated.
- d. calculate and interpret the coefficient of determination and the F -statistic in a simple linear regression.
- e. describe the use of analysis of variance (ANOVA) in regression analysis, interpret ANOVA results, and calculate and interpret the standard error of estimate in a simple linear regression.
- f. formulate a null and an alternative hypothesis about a population value of a regression coefficient, and determine whether the null hypothesis is rejected at a given level of significance.
- g. calculate and interpret the predicted value for the dependent variable, and a prediction interval for it, given an estimated linear regression model and a value for the independent variable.
- h. describe different functional forms of simple linear regressions.

8. Topics in Demand and Supply Analysis

The candidate should be able to:

- a. calculate and interpret price, income, and cross-price elasticities of demand and describe factors that affect each measure.
- b. compare substitution and income effects.
- c. contrast normal goods with inferior goods.
- d. describe the phenomenon of diminishing marginal returns.
- e. determine and interpret breakeven and shutdown points of production.
- f. describe how economies of scale and diseconomies of scale affect costs.

9. The Firm and Market Structures

The candidate should be able to:

- a. describe characteristics of perfect competition, monopolistic competition, oligopoly, and pure monopoly.
- b. explain relationships between price, marginal revenue, marginal cost, economic profit, and the elasticity of demand under each market structure.
- c. describe a firm's supply function under each market structure.
- d. describe and determine the optimal price and output for firms under each market structure.
- e. describe pricing strategy under each market structure.
- f. explain factors affecting long-run equilibrium under each market structure.
- g. describe the use and limitations of concentration measures in identifying market structure.
- h. identify the type of market structure within which a firm operates.

10. Aggregate Output, Prices, and Economic Growth

The candidate should be able to:

- a. calculate and explain gross domestic product (GDP) using expenditure and income approaches.
- b. compare the sum-of-value-added and value-of-final-output methods of calculating GDP.
- c. compare nominal and real GDP and calculate and interpret the GDP deflator.
- d. compare GDP, national income, personal income, and personal disposable income.
- e. explain the fundamental relationship among saving, investment, the fiscal balance, and the trade balance.
- f. explain how the aggregate demand curve is generated.
- g. explain the aggregate supply curve in the short run and long run.
- h. explain causes of movements along and shifts in aggregate demand and supply curves.
- i. describe how fluctuations in aggregate demand and aggregate supply cause short-run changes in the economy and the business cycle.
- j. distinguish among the following types of macroeconomic equilibria: long-run full employment, short-run recessionary gap, short-run inflationary gap, and short-run stagflation.
- k. explain how a short-run macroeconomic equilibrium may occur at a level above or below full employment.
- l. analyze the effect of combined changes in aggregate supply and demand on the economy.

- m. describe sources, measurement, and sustainability of economic growth.
- n. describe the production function approach to analyzing the sources of economic growth.
- o. define and contrast input growth with growth of total factor productivity as components of economic growth.

11. Understanding Business Cycles

The candidate should be able to:

- a. describe the business cycle and its phases.
- b. describe credit cycles.
- c. describe how resource use, consumer and business activity, housing sector activity, and external trade sector activity vary as an economy moves through the business cycle.
- d. describe theories of the business cycle.
- e. interpret a set of economic indicators, and describe their uses and limitations.
- f. describe types of unemployment, and compare measures of unemployment.
- g. explain inflation, hyperinflation, disinflation, and deflation.
- h. explain the construction of indexes used to measure inflation.
- i. compare inflation measures, including their uses and limitations.
- j. contrast cost-push and demand-pull inflation.

12. Monetary and Fiscal Policy

The candidate should be able to:

- a. compare monetary and fiscal policy.
- b. describe functions and definitions of money.
- c. explain the money creation process.
- d. describe theories of the demand for and supply of money.
- e. describe the Fisher effect.
- f. describe roles and objectives of central banks.
- g. contrast the costs of expected and unexpected inflation.
- h. describe tools used to implement monetary policy.
- i. describe the monetary transmission mechanism.
- j. explain the relationships between monetary policy and economic growth, inflation, interest, and exchange rates.
- k. describe qualities of effective central banks.
- l. contrast the use of inflation, interest rate, and exchange rate targeting by central banks.
- m. determine whether a monetary policy is expansionary or contractionary.
- n. describe limitations of monetary policy.
- o. describe roles and objectives of fiscal policy.
- p. describe the arguments about whether the size of a national debt relative to GDP matters.
- q. describe tools of fiscal policy, including their advantages and disadvantages.
- r. explain the implementation of fiscal policy and difficulties of implementation.
- s. determine whether a fiscal policy is expansionary or contractionary.
- t. explain the interaction of monetary and fiscal policy.

13. Introduction to Geopolitics

The candidate should be able to:

- a. describe geopolitics from a cooperation versus competition perspective.
- b. describe geopolitics and its relationship with globalization.
- c. describe tools of geopolitics and their impact on regions and economies.
- d. describe geopolitical risk and its impact on investments.

14. International Trade and Capital Flows

The candidate should be able to:

- a. compare gross domestic product and gross national product.
- b. describe benefits and costs of international trade.
- c. contrast comparative advantage and absolute advantage.
- d. compare the Ricardian and Heckscher–Ohlin models of trade and the source(s) of comparative advantage in each model.
- e. compare types of trade and capital restrictions and their economic implications.
- f. explain motivations for and advantages of trading blocs, common markets, and economic unions.
- g. describe common objectives of capital restrictions imposed by governments.
- h. describe the balance of payments accounts including their components.
- i. explain how decisions by consumers, firms, and governments affect the balance of payments.

- j. describe functions and objectives of the international organizations that facilitate trade, including the World Bank, the International Monetary Fund, and the World Trade Organization.

15. Currency Exchange Rates

The candidate should be able to:

- a. define an exchange rate and distinguish between nominal and real exchange rates and spot and forward exchange rates.
- b. calculate and interpret the percentage change in a currency relative to another currency.
- c. describe functions of and participants in the foreign exchange market.
- d. calculate and interpret currency cross-rates.
- e. calculate an outright forward quotation from forward quotations expressed on a points basis or in percentage terms.
- f. explain the arbitrage relationship between spot rates, forward rates, and interest rates.
- g. calculate and interpret a forward discount or premium.
- h. calculate and interpret the forward rate consistent with the spot rate and the interest rate in each currency.
- i. describe exchange rate regimes.
- j. explain the effects of exchange rates on countries' international trade and capital flows.