



The Certificate in Finance and Technology

Level 3 syllabus

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ABOUT THE CFT

The Certificate in Finance and Technology was created to address the need for a qualification designed for the large number of people who work in technology roles within the financial services sector. The flagship product, the Certificate in Finance and Technology (CFT), combines financial and technology subjects in a syllabus designed by senior staff within the financial services industry.

The CFT is comprised of three levels.

OBJECTIVE OF THE LEVEL 3 EXAMINATION

The objective of Level 3 of the CFT is to ensure that candidates have a thorough understanding of financial services relating to asset management and Risk & Capital. In addition, Level 3 covers the technology topics of Data Science, Enterprise Security, Cloud Computing and Programming Languages; these are all quintessential aspects of technology present in the financial services industry today.

The six modules of Level 3 build upon the foundations of the previous two levels for those who wish to have a comprehensive understanding of FinTech. It will benefit those who are considering, or about to undertake, technology roles within financial services, or anyone already in such a role, looking to broaden and update their skillset with an advanced professional qualification solution.

The Level 3 examination consists of 210 multiple choice questions with 35 questions from each of the six modules. Further details can be found in the Exam Structure section below. The examination will test candidates' knowledge and understanding of the following subject areas:

1. Asset Management
2. Risk & Capital
3. Data Science
4. Enterprise Security
5. Cloud Computing
6. Programming Languages

SYLLABUS STRUCTURE

The level 3 syllabus is divided into six modules, two of which are finance related and four of which are technology. Each module is broken into several sections and each of these into a series of learning objectives.

Each learning objective begins with one of a number of specific words. These words enable candidates to appreciate the level at which they will be tested.

Learning objective prefixes, with clarification:

- **Know** - Demonstrate ability to recall a discrete fact or principle
- **Identify** – Be able to select the most appropriate solution when presented with a number of alternatives
- **Understand** – Demonstrate comprehension of a fact or principle. This is a higher level of knowledge than required for **Know** objectives
- **Apply** – The highest level of comprehension, must be able to adapt facts to a scenario
- **Calculate** – Compute the numerical answer to a problem, task or scenario, using formulae

EXAMINATION STRUCTURE

Time allowed: 4 hours total

Structure: 2-hour exam covering modules 1-3, followed by a 60-minute break and a 2-hour exam covering module 4-6

All questions are multiple choice with four possible answers and a single correct answer

210 multiple choice questions in total (105 per exam paper) consisting of 35 questions for each of the 6 modules detailed above

Some questions show a diagram and the question is based on the diagram, most are text based only.

LEVEL 3 SYLLABUS

Module 1 – Asset Management

- 1.1 Introduction to Asset Management
 - 1.1.1 **Know** the definition of Asset Management
 - 1.1.2 **Understand** the three ways in which assets can be managed
 - Discretionary
 - Advisory
 - Execution only
 - 1.1.3 **Know** the four step Asset Management process
 - Investment objectives
 - Investment policy
 - Asset allocation
 - Measurement & evaluation
 - 1.1.4 **Understand** the key roles in the Asset Management industry
 - Fund manager
 - Buy-side traders
 - Buy-side analysts and economists
 - Buy-side sales and marketing
 - Buy-side technology and support
 - Sell-side sales
 - Sell-side traders
 - 1.1.5 **Understand** the key features of the main assets used in Asset Management
 - Money market instruments
 - Fixed income (bonds)
 - Equity
 - Futures
 - Options
 - Swaps
 - 1.1.6 **Know** the benefits of using Futures for Tactical Asset Allocation
 - 1.1.7 **Understand** the different types of fund investors
 - Institutional
 - Individual
- 1.2 Portfolio construction
 - 1.2.1 **Know** the typical fund objective and constraint categories
 - Income
 - Capital appreciation
 - Taxation
 - Liquidity
 - Regulatory
 - Investor imposed
 - 1.2.2 **Know** the additional contents of an Investment Policy Statement (IPS)

- Time horizon
 - Risk/return appetite
 - Performance monitoring and reporting
 - 1.2.3 **Know** the definition of asset allocation
 - 1.2.4 **Understand** the concept of asset correlation
 - 1.2.5 **Understand** the meaning of a correlation coefficient between -1 and +1
 - 1.2.6 **Understand** the importance of examining asset correlation when building portfolios
 - 1.2.7 **Calculate** the expected return from a two asset portfolio given individual portfolio weights and returns
 - 1.2.8 **Understand** the meaning of the efficient frontier
 - 1.2.9 **Know** that increasing the number of assets can shift the efficient frontier up and to the left
 - 1.2.10 **Understand** the features and differences between Top-down and Bottom-up portfolio construction
 - 1.2.11 **Understand** the process and meaning of Strategic Asset Allocation (SAA) and Tactical Asset Allocation (TAA)
 - 1.2.12 **Understand** the difference between Fundamental and Technical analysis when selecting securities
 - 1.2.13 **Understand** the importance and uses of Benchmarks in fund management
 - 1.2.14 **Know** the difference between Active and Passive fund management
 - 1.2.15 **Understand** the relative advantage and disadvantages of Active versus Passive fund management
 - 1.2.16 **Understand** the three methods of index tracking used by a passive fund
 - Full replication
 - Stratified sampling
 - Optimisation
 - 1.2.17 **Calculate** the simple Tracking Error of a passive fund one period performance versus the benchmark performance for the same period
- 1.3 Fund types
- 1.3.1 **Know** that the majority of fund management assets are invested in equities and fixed income securities
 - 1.3.2 **Understand** the difference between Pooled and Segregated (Separately Managed) Accounts
 - 1.3.3 **Know** that more money is invested on a Segregated (Separately Managed) basis than Pooled
 - 1.3.4 **Know** that more money is invested on an Actively Managed basis than Passively Managed
 - 1.3.5 **Know** the key ways in which a Fixed Income fund can achieve diversification
 - Geography
 - Credit quality
 - Issuer type (e.g. Government)
 - Maturity
 - Duration

- Type (e.g. Convertibles)
- 1.3.6 **Know** the two axes of the Morningstar style matrix for Fixed Income funds
- 1.3.7 **Know** the two axes of the Morningstar style matrix for Equity funds
- 1.3.8 **Understand** the common fund structure features
 - Legal status (e.g. Corporation or Trust)
 - Investment unit (e.g. Stock or Unit)
 - Open or Closed ended
 - Purchase method (e.g. On exchange or from manager)
 - Valuation (e.g. NAV or supply and demand)
- 1.3.9 **Understand** the main features of an Exchange Traded Fund (ETF)
 - Usually track an index or benchmark
 - Exchange traded
 - Unit of investment is a stock
 - Trades near NAV because of designated sponsor system
- 1.3.10 **Know** the two largest fund types by Assets Under Management
 - Pension funds
 - Insurance company funds
- 1.3.11 **Understand** the two types of pension fund
 - Defined contribution
 - Defined benefit
- 1.3.12 **Know** the main allocation of pension fund assets is, usually, to domestic government bonds
- 1.3.13 **Know** the two sources of profit for an insurance company
 - Underwriting
 - Investment returns
- 1.3.14 **Know** that Insurance companies invest mainly in lower risk assets such as bonds versus equity
- 1.3.15 **Understand** the mechanism of insurance and the three components
 - Exposure
 - Loss
 - Claim
- 1.3.16 **Know** the four requirements for a loss to be insurable
 - Homogenous group
 - Quantifiable loss
 - Independent, non-catastrophic loss
 - Loss is accidental
- 1.3.17 **Understand** the main categories of insurance
 - Property and Casualty
 - Life
 - Health
- 1.3.18 **Understand** three key methods of managing insurance risk
 - Risk pooling
 - Diversification
 - Reinsurance

- 1.3.19 **Know** that generally the major technology spend in an insurance company is in front, middle and back office integration followed by data security
- 1.3.20 **Understand** the following Auto insurance technology changes and innovations
 - Telematics
 - Sharing economy
 - Autonomous vehicles
- 1.3.21 **Understand** the following Home insurance technology changes and innovations
 - Connected devices
 - Drones
- 1.3.22 **Understand** the following Health insurance technology changes and innovations
 - Medical grade wearables
 - Telemedicine

- 1.4 Measuring return
 - 1.4.1 **Calculate** basic return from an investment, income received and a value at the end of a period ignoring cash flow timings
 - 1.4.2 **Calculate** a compounded rate from a maximum of four consecutive rates of return
 - 1.4.3 **Calculate** an annualized return from a regular return for a smaller period
 - 1.4.4 **Understand** with the arithmetic method for combining returns would be used
 - 1.4.5 **Understand** the impact of withdrawals and deposits on returns
 - 1.4.6 **Know** that the Money Weighted Rate of Return (MWRR) calculates the Internal Rate of Return (IRR) for a series of cash flows
 - 1.4.7 **Calculate** the Standard Time Weighted Rate of Return (TWRR) for a portfolio with a maximum of two additional cash flows during the period
 - 1.4.8 **Know** that the difficulty with Standard TWRR is the need to value the fund at the point of every cash flow
 - 1.4.9 **Know** that the Modified Dietz method weights cash flows for the amount of time they had an impact on the portfolio
 - 1.4.10 **Calculate** the Modified Dietz TWRR given all cash flows and the adjusted cash flow number
 - 1.4.11 **Know** that the Original Dietz method uses a mid-month assumption
 - 1.4.12 **Calculate** the Original Dietz TWRR given all cash flows
 - 1.4.13 **Know** that Peer Group comparison is an alternative method of judging performance

- 1.5 Measuring Risk
 - 1.5.1 **Know** the following methods of measuring risk
 - Range
 - Mean Absolute Deviation (MAD)
 - Standard deviation
 - VaR
 - Beta
 - 1.5.2 **Calculate** the Mean Absolute Deviation for a maximum of four return values
 - 1.5.3 **Understand** the method of calculation Standard Deviation and what it shows

- 1.5.4 **Understand** the Normal Distribution and the significance of one (68%), two (95%) and three (99.7%) Standard Deviations either side of the mean
- 1.5.5 **Calculate** the expected range of returns given an average return, the Standard Deviation and the level of confidence (or number of Standard Deviations)
- 1.5.6 **Understand** the terms Skewness and Kurtosis
- 1.5.7 **Understand** the features of a positively and negatively skewed distribution
- 1.5.8 **Understand** the features of a Leptokurtic and Platykurtic distribution
- 1.5.9 **Understand** Value at Risk (VaR)
- 1.5.10 **Calculate** the VaR for a fund given the mean and Standard Deviation with either 84%, 97.5% or 99.85% confidence
- 1.5.11 **Understand** the difference between Systematic risk and Unsystematic risk
- 1.5.12 **Know** the alternative names for Systematic risk
 - Non-specific
 - Market
 - Business
- 1.5.13 **Know** the alternative names for Unsystematic risk
 - Specific
 - Idiosyncratic
 - Unique
- 1.5.14 **Understand** how Beta is calculated and what it represents
- 1.5.15 **Know** the dangers of using a non-correlated Beta

- 1.6 Performance Attribution
 - 1.6.1 **Understand** the reasons for undertaking a Performance Attribution analysis
 - 1.6.2 **Know** that the Mix variance shows the impact of the asset allocation deviations from the benchmark at either the asset class or sector level
 - 1.6.3 **Know** the Selection variance shows the impact of the security selection within asset classes or sectors
 - 1.6.4 **Apply** performance attribution variances to a scenario to show correct interpretation of all variances
 - 1.6.5 **Calculate** the Mix variance (maximum two asset classes) given benchmark weights, actual weights, benchmark returns by asset class and total benchmark return
 - 1.6.6 **Calculate** the Selection variance (maximum two asset classes) given actual return, benchmark return and actual weights

- 1.7 Risk adjusted performance and analysis
 - 1.7.1 **Know** the following risk adjusted performance measures
 - Sharpe
 - Alpha
 - Treynor
 - Information ratio
 - 1.7.2 **Calculate** the Sharpe Ratio given return on a portfolio, risk free rate of return and Standard Deviation of the portfolio
 - 1.7.3 **Understand** the meaning of a Sharpe ratio

- 1.7.4 **Calculate** the expected return under the Capital Asset Pricing Model (CAPM) given the risk free rate of return, the Beta of the portfolio and the return on the market
 - 1.7.5 **Know** the Market Risk Premium is the return on the market minus the risk free rate of return
 - 1.7.6 **Calculate** the Alpha for a portfolio given the return on the portfolio, the risk free rate of return, the Beta of the portfolio and the return on the market
 - 1.7.7 **Calculate** the Alpha given the portfolio return and the CAPM expected rate of return
 - 1.7.8 Understand the meaning of an Alpha number
 - 1.7.9 **Calculate** the Treynor measure given return on a portfolio, risk free rate of return and the Beta of the portfolio
 - 1.7.10 **Understand** the meaning of a Treynor ratio
 - 1.7.11 **Calculate** the Information ratio given the average excess returns and the Standard Deviation of those excess returns
 - 1.7.12 **Understand** what each of the four possible outcomes for Information ratio tell us
 - High positive
 - Low positive
 - High negative
 - Low negative
 - 1.7.13 **Understand** the method of building and running a Monte Carlo simulation and that it forecasts a large number of possible futures
 - 1.7.14 **Know** what a Monte Carlo simulation shows us
 - 1.7.15 **Understand** the process behind Backtesting and that it uses real historical scenarios
 - 1.7.16 **Know** the two sources of data that can be used in Backtesting
 - All historical data from a period of time
 - A certain number of specific events selected from a large period of history
 - 1.7.17 **Understand** that Monte Carlo simulation and Backtesting do not predict the future but highlight possible outcomes
- 1.8 Behavioral finance
- 1.8.1 **Understand** the concept of Behavioral finance and how it differs from traditional analysis
 - 1.8.2 **Know** why the study of Behavioral finance may be useful
 - 1.8.3 **Know** the difference between Cognitive errors and Emotional Biases
 - 1.8.4 **Understand** Horizon Bias
 - 1.8.5 **Understand** Herd behavior and why it occurs
 - 1.8.6 **Understand** Overconfidence and the consequences of it in finance
 - Overtrading
 - Early decision making
 - Attributing success to yourself, failure to others
 - Misrepresenting profits mentally
 - 1.8.7 **Understand** the impact of reliance on forecasts without adequate independent research

- 1.8.8 **Understand** the Framing effect
 - Framing the positives leads to a lower risk approach
 - Framing the negatives leads to a high risk approach
- 1.8.9 **Understand** that Prospect theory states that one unit of loss has a greater psychological impact than one unit of gain
- 1.8.10 **Understand** the concept of Magical thinking or Superstitions
- 1.8.11 **Understand** each of the following common behavioral finance biases
 - Hindsight bias
 - Confirmation bias
 - Availability Heuristic
 - Anchoring bias

Module 2 – Risk and Capital Adequacy

2.1. Overview of Risk and Bank Capital

- 2.1.1. **Know** the major sources of risk faced by financial firms: market risk, credit risk, liquidity risk, operational risk
- 2.1.2. **Know** other types of risk which arise in the industry: reputational risk, systemic risk
- 2.1.3. **Understand** the concept of maturity transformation as the fundamental business model of a commercial bank
- 2.1.4. **Understand** how/why banks become exposed to risk as part of their business
- 2.1.5. **Understand** why regulations have been devised to influence the amount of risk which banks can take
- 2.1.6. **Know** the concepts of macroprudential and microprudential regulation
- 2.1.7. **Know** the function of the BCBS and the general aims of the Basel rules
- 2.1.8. **Understand** the 3 pillars of Basel regulation
- 2.1.9. **Understand** the use of stress tests in addition to Basel rules

2.2. Market Risk

- 2.2.1. **Know** the definition of market risk
- 2.2.2. **Understand** the elementary statistical concepts of a probability distribution, random variable, expected value, mean, variance, standard deviation, percentile, correlation
- 2.2.3. **Understand** how statistical concepts can be used to model the random nature of financial market prices
- 2.2.4. **Understand** the use of the natural logarithm and exponential function when modelling financial market prices
- 2.2.5. **Know** the shape of the normal distribution and the lognormal distribution
- 2.2.6. **Understand** the concept of Value-at-Risk
- 2.2.7. **Understand** the concept of Expected Shortfall
- 2.2.8. **Understand** the concept of normal linear VaR
- 2.2.9. **Understand** the concept of historical simulation VaR
- 2.2.10. **Calculate** the Value-at-Risk of a long position in a single security using normal linear VaR
- 2.2.11. **Calculate** the Value-at-Risk of a long position in a single security using historical simulation
- 2.2.12. **Understand** how correlations can be used to calculate Value-at-Risk of a portfolio consisting of more than one security
- 2.2.13. **Understand** the drawbacks of using correlation
- 2.2.14. **Understand** how Monte-Carlo simulation methods can be used to calculate VaR (e.g. for the case of option positions)
- 2.2.15. **Understand** the strengths and weaknesses of Value-at-Risk
- 2.2.16. **Know** the concept of Stressed Value-at-Risk

2.3. Credit Risk

- 2.3.1. **Know** the definition of credit risk

- 2.3.2. **Understand** the concepts of default probability, Loss Given Default (LGD), Recovery Rate (RR) and Exposure at Default (EAD)
 - 2.3.3. **Understand** the concept of Expected Loss
 - 2.3.4. **Understand** the function of Credit Rating Agencies
 - 2.3.5. **Know** how to find historical data about default probabilities and Recovery Rates from information published by Credit Rating Agencies
 - 2.3.6. **Calculate** Expected Loss for a loan, given information about the borrower and the amount of money involved
 - 2.3.7. **Know** the definition of a credit spread
 - 2.3.8. **Understand** how credit spreads relate to expected losses
 - 2.3.9. **Know** the definition of a copula
 - 2.3.10. **Understand** how a copula can be used to calculate default probability of a portfolio consisting of more than one security
 - 2.3.11. **Understand** the drawbacks of using a copula
 - 2.3.12. **Know** the definition of counterparty credit risk and understand why this arises in OTC derivative trades
 - 2.3.13. **Understand** the concepts of Potential Future Exposure (PFE) and Expected Positive Exposure (EPE) in OTC derivative positions
 - 2.3.14. **Know** the definition of Credit Valuation Adjustment (CVA)
 - 2.3.15. **Know** the definition of Wrong-Way Risk
 - 2.3.16. **Understand** the use of collateral to reduce credit risk on OTC derivatives
 - 2.3.17. **Understand** the use of a Central Counterparty (CCP) in the OTC markets
- 2.4. Operational Risk
- 2.4.1. **Know** the definition of operational risk
 - 2.4.2. **Know** the definition of rogue trader risk as a specific example of operational risk
 - 2.4.3. **Know** case studies of rogue traders: Nick Leeson and Jerome Kerviel
 - 2.4.4. **Know** the key aspects of the BCBS 11 Principles for the Management of Operational Risk
 - 2.4.5. **Understand** the Basel II Advanced Measurement Approach (AMA) to quantifying operational risk
 - 2.4.6. **Understand** how insurance can be used to mitigate operational risk
- 2.5. Bank Balance Sheet
- 2.5.1. **Know** the key components of a bank's balance sheet at high level: assets, liabilities and capital
 - 2.5.2. **Know** the main alternative sources of bank funding: equity capital, preferred stock, convertibles, bond issues, interbank borrowing, cash from depositors
 - 2.5.3. **Understand** the strengths and weaknesses of each of the sources of funding
 - 2.5.4. **Know** the concepts of Net Interest Margin (NIM) and Non Performing Loans (NPL)
 - 2.5.5. **Understand** the concept of Risk Weighted Assets (RWA)
 - 2.5.6. **Calculate** the RWA of a loan using the Basel II Standardised Approach, given the type of borrower and their credit rating
 - 2.5.7. **Understand** the concept of the Internal Models Approach for calculation of RWA

- 2.5.8. **Understand** the difference between the banking book and trading book
- 2.5.9. **Understand** how RWA can be computed for market risk, credit risk and operational risk

2.6. Basel III: Bank Solvency and Leverage Ratios

- 2.6.1. **Know** the key minimum Capital Adequacy Ratios (CAR) specified under Basel III
- 2.6.2. **Understand** how these differ from the previous minimum ratios of Basel II
- 2.6.3. **Understand** the Capital Conservation Buffer
- 2.6.4. **Understand** the Countercyclical Buffer
- 2.6.5. **Know** the concept of a Systemically Important Financial Institution (SIFI) and related implications for minimum capital ratios
- 2.6.6. **Know** the Leverage Ratio and Supplementary Leverage Ratio
- 2.6.7. **Calculate** Capital Adequacy Ratios given a bank balance sheet and enough information to compute the amount of RWA
- 2.6.8. **Calculate** Leverage Ratio given a bank balance sheet
- 2.6.9. **Calculate** the capital required to support a loan, given information about the risk-weighting of the counterparty
- 2.6.10. **Calculate** the return on equity (ROE) of a loan, given information about the risk-weighting of the counterparty and details of the interest rates involved
- 2.6.11. **Know** the major elements contained in a Pillar 3 report

2.7. Basel III: Bank Liquidity Ratios

- 2.7.1. **Know** the definition of liquidity risk
- 2.7.2. **Know** the definition of the Liquidity Coverage Ratio (LCR)
- 2.7.3. **Know** the definition of HQLA (High Quality Liquid Assets)
- 2.7.4. **Know** the definition of Required Stable Funding (RSF)
- 2.7.5. **Know** the definition of Available Stable Funding (ASF)
- 2.7.6. **Know** the definition of the Net Stable Funding Ratio (NSFR)
- 2.7.7. **Understand** the purpose of the LCR
- 2.7.8. **Understand** the purpose of the NSFR
- 2.7.9. **Calculate** LCR given HQLA and information about estimated net cash outflows in stressed conditions
- 2.7.10. **Calculate** NSFR given ASF and RSF

Module 3 – Data Science

3.1 Data Science in Finance

- 3.1.1 **Know** the reasons for data science within finance
- 3.1.2 **Identify** the various data sources within finance
- 3.1.3 **Apply** the relevant data analysis questions
 - Descriptive
 - Exploratory
 - Inferential
 - Predictive
 - Causal
 - Mechanistic
- 3.1.4 **Know** the 3V's of 'Big data'
 - Volume
 - Variety
 - Velocity
- 3.1.5 **Know** the common mistakes made in data analysis
 - Correlation vs Causality
 - Overfitting
 - Small sample size
- 3.1.6 **Know** the features of common data sources in finance
- 3.1.7 **Apply** principles of tidy data to ensure data is ready for analysis

3.2 Big data

- 3.2.1 **Understand** the impact of the 3Vs on big data
 - Volume
 - Variety
 - Velocity
- 3.2.2 **Know** the challenges of big data in finance
- 3.2.3 **Identify** the difference between the structure of data
 - Structured
 - Unstructured
 - Semi-structured
- 3.2.4 **Know** the principles of big data
 - Business integration
 - Analysis
 - Visualization
 - System optimization
 - Security
 - Governance
- 3.2.5 **Know** the key differences between SQL and NoSQL
 - Storage
 - Capacity
 - Technology

- 3.2.6 **Understand** the Hadoop HDFS framework
- 3.2.7 **Apply** NoSQL storage methodologies
 - Document pairs
 - Key value pairs
 - Column family data store
- 3.2.8 **Know** the elements of the Hadoop ecosystem
 - MapReduce
 - Impala
 - HBase
 - Pig
 - Hive
 - Hue
- 3.2.9 **Know** the key features of tick database using MongoDB
 - Real-time market data
 - Historical data
 - News storage and analysis
 - Speed
 - Signals
- 3.3 Machine Learning
 - 3.3.1 **Know** the definition of machine learning (ML)
 - 3.3.2 **Understand** the process of building a machine learning model
 - 3.3.3 **Know** the key uses of ML within finance
 - Fraud detection
 - Advice
 - Investment recommendation
 - SPAM detection
 - Asset allocation
 - Price prediction
 - 3.3.4 **Understand** the types of machine Learning
 - Unsupervised
 - Supervised
 - 3.3.5 **Apply** a scatter graph to compare features of a data set
 - 3.3.6 **Identify** suitable features of a given data set
 - 3.3.7 **Know** the key unsupervised ML algorithms
 - Naïve Bayes (NB)
 - Support Vector Machine (SVM)
 - Decision tree
 - 3.3.8 **Calculate** classifications using Bayes theorem
 - 3.3.9 **Apply** a decision tree to a set of training data
 - 3.3.10 **Identify** the correct decision surface for a set of data
 - 3.3.11 **Identify** features and labels of a data set
 - 3.3.12 **Understand** the key principles in unsupervised learning
 - Clustering
 - Dimensionality reduction

- 3.4 R programming
 - 3.4.1 **Know** the main uses for R in financial data analysis
 - Statistics
 - Machine learning
 - Visualisation
 - High performance computing
 - Complex financial analysis
 - 3.4.2 **Know** how to navigate through RStudio
 - 3.4.3 **Understand** how to create and assign variable
 - 3.4.4 **Apply** basic arithmetic and logical operations
 - Addition
 - Subtraction
 - Multiplication
 - Division
 - Value comparisons
 - 3.4.5 **Know** how to create data frames
 - 3.4.6 **Know** how to set a working directory
 - 3.4.7 **Understand** how to import data into R
 - 3.4.8 **Calculate** a comparison table of features
 - 3.4.9 **Know** how to create a decision tree on a set of data
 - 3.4.10 **Calculate** a ML model given a set of training data
 - 3.4.11 **Understand** how to export data from R

Module 4 – Enterprise Security

- 4.1 Introduction to Enterprise Security
 - 4.1.1 **Understand** what is Enterprise security
 - 4.1.2 **Identify** the seven areas of Enterprise security

- 4.2 Access Control
 - 4.2.1 **Identify** the elements of access control
 - 4.2.2 **Understand** implementation of access control
 - 4.2.3 **Know** the types of authentication
 - 4.2.4 **Identify** the goals of secure access control
 - 4.2.5 **Understand** enterprise authentication
 - 4.2.6 **Understand** the elements of remote access authentication
 - 4.2.7 **Understand** concepts of password management
 - 4.2.8 **Know** the types of access control policies
 - 4.2.9 **Know** the features of access control
 - Methodologies
 - Models
 - Object management

- 4.3 Administration
 - 4.3.1 **Understand** the principles of administration
 - 4.3.2 **Know** the objectives of enterprise security
 - 4.3.3 **Identify** the lifecycle of information security
 - 4.3.4 **Know** terms used in enterprise security
 - 4.3.5 **Understand** security in quality testing
 - 4.3.6 **Identify** separation of duties
 - 4.3.7 **Understand** the steps in risk assessment
 - 4.3.8 **Understand** security in change control
 - 4.3.9 **Know** the change control tools
 - 4.3.10 **Understand** the hiring process
 - 4.3.11 **Understand** the importance of security awareness

- 4.4 Monitoring and audit
 - 4.4.1 **Understand** concepts of security audit
 - 4.4.2 **Know** the role of auditors
 - 4.4.3 **Understand** the process of security audit
 - 4.4.4 **Know** the methods of security audit
 - 4.4.5 **Identify** the various security audit data sources
 - 4.4.6 **Know** the different methods of risk monitoring

- 4.5 Response & Recovery
 - 4.5.1 **Identify** approach to risk management

- 4.5.2 **Understand** risk management cycle
- 4.5.3 **Understand** various risks and threats
- 4.5.4 **Identify** types of risks and threats
- 4.5.5 **Understand** risk mitigation
- 4.5.6 **Identify** risks to be mitigated
- 4.5.7 **Understand** how to analyse risk mitigation
- 4.5.8 **Identify** business continuity plans (BCP)
- 4.5.9 **Understand** impact assessment of BCP
- 4.5.10 **Know** how to plan for disaster recovery
- 4.5.11 **Understand** the process of disaster recovery
- 4.5.12 **Know** the goals, tools and steps of incident investigation
- 4.5.13 **Understand** concepts and process of computer forensics

- 4.6 Cryptography
 - 4.6.1 **Know** the meaning and history of cryptography
 - 4.6.2 **Understand** the objectives of cryptography
 - 4.6.3 **Know** the types of encryption algorithms
 - 4.6.3.1 Asymmetric
 - 4.6.3.2 Symmetric
 - 4.6.4 **Understand** the concept of hashing
 - 4.6.5 **Know** various methods of encryption
 - 4.6.6 **Identify** different types of keys
 - 4.6.7 **Know** how to manage keys
 - 4.6.8 **Understand** the process of key selection
 - 4.6.9 **Know** what is public key infrastructure
 - 4.6.10 **Understand** the elements of a digital certificate
 - Standard
 - Policies
 - Revocation
 - Trust models
 - Protocols
 - 4.6.11 **Understand** certificate management concepts
 - 4.6.12 **Know** and identify cryptographic attacks

- 4.7 Communication & Networking
 - 4.7.1 **Understand** the OSI model
 - 4.7.2 **Understand** the concepts in local area networks (LAN)
 - 4.7.3 **Identify** LAN topologies
 - 4.7.4 **Understand** how ethernet works
 - 4.7.5 **Know** the features of wide area networks (WAN)
 - 4.7.6 **Understand** various networking protocols
 - 4.7.7 **Identify** various types of network devices
 - 4.7.8 **Know** the features of a virtual private network
 - 4.7.9 **Identify** common attacks against a network

- 4.8 Threats
 - 4.8.1 **Understand** what is malware
 - 4.8.2 **Identify** viruses and types of viruses
 - 4.8.3 **Identify** malware and its types
 - 4.8.4 **Understand** how to protect from malware
 - 4.8.5 **Know** the classification of hackers
 - 4.8.6 **Understand** various types of malicious attacks
 - 4.8.7 **Understand** different network based attacks
 - 4.8.8 **Identify** enterprise security threats in the cloud

Module 5 - Cloud Computing Fundamentals

- 5.1 Introduction to Cloud Computing
 - 5.1.1 **Understand** the term “cloud computing”
 - 5.1.2 **Know** how cloud computing relates to the real world
 - 5.1.2.1 **Understand** cloud computing payment models
 - 5.1.3 **Know** the evolution of cloud computing
 - 5.1.4 **Identify** the features of leading cloud providers

- 5.2 Important Terminology and Concepts
 - 5.2.1 **Understand** the term cloud computing
 - 5.2.2 **Know** that “cloud” can be thought of as an abstraction layer
 - 5.2.3 **Understand** redundancy and scalability in cloud computing
 - 5.2.4 **Know** the definition of virtualization
 - 5.2.5 **Understand** that virtualization is a powerful enabler of cloud computing
 - 5.2.6 **Apply** knowledge of virtualization to a real-world scenario
 - 5.2.7 **Identify** four components of cloud computing architecture
 - Front end platforms
 - Back end platforms
 - Cloud-based delivery model
 - Network
 - 5.2.8 **Identify** four common cloud deployment models
 - Public
 - Private
 - Hybrid
 - Community
 - 5.2.9 **Understand** three common service models
 - Software as a Service (SaaS)
 - Platform as a Service (PaaS)
 - Infrastructure as a Service (IaaS)
 - 5.2.10 **Understand** the five key characteristics of cloud computing
 - On-demand self-service
 - Ubiquitous network access
 - Resource pooling
 - Rapid elasticity
 - Pay-per use
 - 5.2.11 **Understand** common advantages and disadvantages of cloud computing
 - 5.2.12 **Know** the most common challenges companies face when operating in the cloud

- 5.3 Core Services: Security, Compute, Storage, and Database
 - 5.3.1 **Understand** the four components of security in the cloud
 - Identity management
 - Physical security

- Personnel security
- Privacy
- 5.3.2 **Understand** the difference between authentication and authorization
- 5.3.3 **Know** what protections fall under the category of physical security
- 5.3.4 **Know** some of the activities that take place to ensure security of personnel
- 5.3.5 **Know** that privacy is concerned with security of data
- 5.3.6 **Understand** the shared responsibility model in the cloud
- 5.3.7 **Understand** general best practices for using different account types in AWS and Azure
- 5.3.8 **Know** what the term “compute” refers to in the context of cloud service models
- 5.3.9 **Identify** two cloud storage solutions for either personal or business use
- 5.3.10 **Know** that SQL and NoSQL database options are available from the major cloud providers

- 5.4 Creating Your First Cloud Application
 - 5.4.1 **Know** how to navigate to frequently-used features in the AWS Management Console
 - 5.4.2 **Know** how to navigate to frequently-used features in the Microsoft Azure Portal
 - 5.4.3 **Know** how to navigate the “Getting Started” section of AWS
 - 5.4.4 **Know** how to navigate the “Getting Started” section of Azure
 - 5.4.5 **Identify** at least one option for creating and deploying your first app in AWS
 - 5.4.6 **Identify** at least one option for creating and deploying your first app in Azure
 - 5.4.7 **Identify** two development tools for creating and deploying applications to the cloud

- 5.5 Summarizing and Looking Forward
 - 5.5.1 **Know** that cloud best practices fall into three categories: technology, people and process
 - 5.5.2 **Identify** at least one best practice in the area of technology
 - 5.5.3 **Identify** at least one best practice in the area of people
 - 5.5.4 **Identify** at least one best practice in the area of process
 - 5.5.5 **Apply** your knowledge of cloud best practices to make a recommendation for moving to the cloud
 - 5.5.6 **Know** that the cloud market is expected to grow for the foreseeable future
 - 5.5.7 **Identify** at least two factors driving the growth of cloud computing in the future

Module 6 – Programming Languages

- 6.1 Introduction to programming languages
 - 6.1.1 **Understand** the importance of programming for an enterprise
- 6.2 Java
 - 6.2.1 **Know** a brief history of Java
 - 6.2.2 **Know** the different editions of Java
 - 6.2.3 **Understand** application tiers
 - 6.2.4 **Identify** different aspects of Java Enterprise Edition (Java EE)
 - 6.2.5 **Know** about Java EE Server and Container
 - 6.2.6 **Understand** about Java EE components
 - 6.2.7 **Understand** various features of Java EE
- 6.3 .net
 - 6.3.1 **Know** about the history of dot net
 - 6.3.2 **Understand** the features of dot net core
 - 6.3.3 **Know** about the asp.net core stack
 - 6.3.4 **Identify** the advantages of asp.net core
 - 6.3.5 **Understand** the fundamentals of asp.net core
 - 6.3.6 **Understand** security provided by asp.net core
 - 6.3.7 **Know** about the C# language
- 6.4 JavaScript
 - 6.4.1 **Know** about the history of JavaScript and get an overview of JavaScript
 - 6.4.2 **Understand** the language paradigms
 - 6.4.3 **Identify** the nature of asynchronous programming
 - 6.4.4 **Know** about AJAX application
 - 6.4.5 **Understand** the commonJS specification
 - 6.4.6 **Know** about NodeJS
 - 6.4.7 **Identify** asynchronous nature of NodeJS
 - 6.4.8 **Know** the features of NodeJS
 - 6.4.9 **Know** about NodeJS package manager
 - 6.4.10 **Identify** frameworks in NodeJS
 - 6.4.11 **Understand** the use of MongoDB as a database
 - 6.4.12 **Know** about JavaScript frontend frameworks
 - 6.4.13 **Know** about JavaScript test frameworks
- 6.5 Ruby and Rails
 - 6.5.1 **Know** the history of the Ruby language
 - 6.5.2 **Understand** the paradigms of Ruby
 - 6.5.3 **Understand** objects in Ruby
 - 6.5.4 **Identify** the aspects of functional programming in Ruby
 - 6.5.5 **Know** the features of Ruby

- 6.5.6 **Understand** how to setup Ruby
- 6.5.7 **Know** about Ruby Gems
- 6.5.8 **Understand** various tools used in Ruby
- 6.5.9 **Understand** the application of the Rails framework
- 6.5.10 **Know** the conventions used in Rails
- 6.5.11 **Understand** the use of DRY code in Rails
- 6.5.12 **Identify** the Rails stack
- 6.5.13 **Understand** the use of MVC in Rails
- 6.5.14 **Know** aspects of testing in Rails

- 6.6 Python
 - 6.6.1 **Understand** the use of Python and get an overview of the language
 - 6.6.2 **Know** the features of Python
 - 6.6.3 **Know** about Python's history
 - 6.6.4 **Identify** python tools and libraries
 - 6.6.5 **Identify** the different implementation of Python
 - 6.6.6 **Know** of packages in python for financial applications
 - 6.6.7 **Understand** the use of python for data analysis
 - 6.6.8 **Identify** the advantages of python for finance

- 6.7 Infrastructure as code
 - 6.7.1 **Know** the definition of infrastructure as code (IAC)
 - 6.7.2 **Know** the features of infrastructure as code
 - 6.7.3 **Understand** the drawbacks of traditional infrastructure
 - 6.7.4 **Identify** the process
 - 6.7.5 **Understand** the values added by Infrastructure as code
 - 6.7.6 **Identify** the advantages of Infrastructure as code
 - 6.7.7 **Know** the various approaches and methods of Infrastructure as code
 - 6.7.8 **Identify** the capabilities and features of the tools used in Infrastructure as code
 - 6.7.9 **Know** about the tools Chef and Saltstack
 - 6.7.10 **Identify** the general specifications of Infrastructure as code
 - 6.7.11 **Know** the use of virtual machines
 - 6.7.12 **Identify** the uses of Vagrant
 - 6.7.13 **Know** the functions of Docker
 - 6.7.14 **Understand** the process and use of Docker
 - 6.7.15 **Know** about Docker registry
 - 6.7.16 **Identify** Docker images
 - 6.7.17 **Know** the use of a Dockerfile
 - 6.7.18 **Understand** the essence of Infrastructure as code