This study session introduces the common probability distributions used to describe the behavior of random variables, such as asset prices and returns. How to estimate measures of a population (mean, standard deviation) based on a population sample is shown. A framework for hypothesis testing, used for validating dataset hypotheses, follows, along with techniques to accept or reject the assumed hypothesis. The session ends with coverage of technical analysis, a set of tools that uses asset price, trading volume, and other similar data for making investment decisions.

**READING ASSIGNMENTS**

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LEARNING OUTCOMES

READING 10. COMMON PROBABILITY DISTRIBUTIONS

The candidate should be able to:

a. define a probability distribution and distinguish between discrete and continuous random variables and their probability functions;

b. describe the set of possible outcomes of a specified discrete random variable;

c. interpret a cumulative distribution function;

d. calculate and interpret probabilities for a random variable, given its cumulative distribution function;

e. define a discrete uniform random variable, a Bernoulli random variable, and a binomial random variable;

f. calculate and interpret probabilities given the discrete uniform and the binomial distribution functions;

g. construct a binomial tree to describe stock price movement;

h. define the continuous uniform distribution and calculate and interpret probabilities, given a continuous uniform distribution;

i. explain the key properties of the normal distribution;

j. distinguish between a univariate and a multivariate distribution and explain the role of correlation in the multivariate normal distribution;

k. determine the probability that a normally distributed random variable lies inside a given interval;

l. define the standard normal distribution, explain how to standardize a random variable, and calculate and interpret probabilities using the standard normal distribution;

m. define shortfall risk, calculate the safety-first ratio, and select an optimal portfolio using Roy’s safety-first criterion;

n. explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices;

o. distinguish between discretely and continuously compounded rates of return and calculate and interpret a continuously compounded rate of return, given a specific holding period return;

p. explain Monte Carlo simulation and describe its applications and limitations;

q. compare Monte Carlo simulation and historical simulation.

READING 11. SAMPLING AND ESTIMATION

The candidate should be able to:

a. define simple random sampling and a sampling distribution;

b. explain sampling error;

c. distinguish between simple random and stratified random sampling;

d. distinguish between time-series and cross-sectional data;

e. explain the central limit theorem and its importance;

f. calculate and interpret the standard error of the sample mean;

g. identify and describe desirable properties of an estimator;
h distinguish between a point estimate and a confidence interval estimate of a population parameter;

i describe properties of Student’s $t$-distribution and calculate and interpret its degrees of freedom;

j 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;

k describe the issues regarding selection of the appropriate sample size, data-mining bias, sample selection bias, survivorship bias, look-ahead bias, and time-period bias.

**READING 12. 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 distinguish between one-tailed and two-tailed tests of hypotheses;

c explain a test statistic, Type I and Type II errors, a significance level, and how significance levels are used in hypothesis testing;

d explain a decision rule, the power of a test, and the relation between confidence intervals and hypothesis tests;

e distinguish between a statistical result and an economically meaningful result;

f explain and interpret the $p$-value as it relates to hypothesis testing;

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 1) equal or 2) unequal 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 distinguish between parametric and nonparametric tests and describe situations in which the use of nonparametric tests may be appropriate.

**READING 13. TECHNICAL ANALYSIS**

The candidate should be able to:

a explain principles of technical analysis, its applications, and its underlying assumptions;

b describe the construction of different types of technical analysis charts and interpret them;

c explain uses of trend, support, resistance lines, and change in polarity;
d. describe common chart patterns;

e. describe common technical analysis indicators (price-based, momentum oscillators, sentiment, and flow of funds);

f. explain how technical analysts use cycles;

g. describe the key tenets of Elliott Wave Theory and the importance of Fibonacci numbers;

h. describe intermarket analysis as it relates to technical analysis and asset allocation.