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 test a 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**

**Reading 10**  
Common Probability Distributions  
by Richard A. DeFusco, PhD, CFA, Dennis W. McLeavey, CFA, Jerald E. Pinto, PhD, CFA, and David E. Runkle, PhD, CFA

**Reading 11**  
Sampling and Estimation  
by Richard A. DeFusco, PhD, CFA, Dennis W. McLeavey, CFA, Jerald E. Pinto, PhD, CFA, and David E. Runkle, PhD, CFA

**Reading 12**  
Hypothesis Testing  
by Richard A. DeFusco, PhD, CFA, Dennis W. McLeavey, CFA, Jerald E. Pinto, PhD, CFA, and David E. Runkle, PhD, CFA

**Reading 13**  
Technical Analysis  
by Barry M. Sine, CMT, CFA, and Robert A. Strong, PhD, CFA
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.