Learning Module 8: Hypothesis Testing

Q.423 Which statistic should you use to *most appropriately* compare two population variances with a sample size smaller than 30?

A. z-test.

B. t-test.

C. F-test.

The correct answer is **C.**

An F-test is used to compare two populations' variances. The samples can be of any size.
The test statistic used to obtain the ratio of 2 population variances is:

$$\frac{S_1{}^2}{S_2{}^2} \sim F_{(n1-1)(n2-2)}$$

A is incorrect. The z test is used when the underlying variable follows a normal distribution or when the sample size is large (n>30). When the sample size is large (n>30), the distribution is assumed to be approximately normal according to the central limit theorem.

B is incorrect. A t-test is appropriate when testing for the means.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.425 Which of the following statements is *least accurate*?

A. A 1% significance level is the same as a 99% confidence.

B. The alternative hypothesis (H_a) always includes an equal sign.

C. The alternative hypothesis (H_a) is usually the hypothesis which we are trying to assess.

The correct answer is **B.**

The NULL hypothesis (H_0) always includes an equal sign.The null hypothesis represents the current known state of the population parameter being tested. The NULL hypothesis always includes an equal sign.
On the other hand, the alternative hypothesis is concluded if there is sufficient evidence to reject the null hypothesis. For a two-tailed test, the alternative hypothesis will contain an equal sign. For a one-tailed test, the alternative hypothesis will either have a “>” or a “<” sign.

A is incorrect. It is a true statement. To get the significance level or the alpha, we subtract the given confidence percentage from 100. 100%-99%(given percentage alpha)=1% (significance level).

C is incorrect. The alternative hypothesis is chosen if there is sufficient evidence to reject the null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1110 Which of the following statements is *most accurate*?

A. The null hypothesis is the hypothesis that the researcher wants to reject.

B. The null hypothesis is the hypothesis that the researcher wants to accept.

C. The alternative hypothesis is the hypothesis that the researcher wants to reject.

The correct answer is **A.**

The null hypothesis, designated by H0, is the hypothesis that the researcher wants to reject. It represents the current known state about the parameter to be tested. In the presence of sufficient evidence, the null hypothesis is meant to be rejected.

B is incorrect. Researchers want to accept the alternative hypothesis by rejecting the null hypothesis. Besides, it is statistically incorrect to say “accept the null hypothesis because of the fact that you cannot prove a negative” Statisticians use the term “fail to reject” and not “accept” because insufficient evidence only means that you have failed to prove that something exists. It does not necessarily mean that something is non-existent.

C is incorrect. Researchers want to accept the alternative hypothesis by rejecting the null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1112 Which of the following assumptions is *least likely* required for the difference in means test based on two samples?

A. The two samples are independent.

B. The two populations have equal variances.

C. The two populations are normally distributed.

The correct answer is **B.**

We can still calculate the difference in means even when the populations' variances are not equal. When variances are assumed to be unequal, we use both sample variations to calculate the t- statistic.

A and C are incorrect. For difference in means test based on two samples, the samples must be independent and normally distributed!

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.1113 Which of the following statements is *most accurate*?

A. The alternative hypothesis is what is accepted if there is sufficient evidence to reject the null hypothesis.

B. The alternative hypothesis is what is accepted if there is sufficient evidence to accept the null hypothesis.

C. The null hypothesis is what is accepted if there is sufficient evidence to reject the alternative hypothesis.

The correct answer is **A.**

The alternative hypothesis, designated by Ha, is what is accepted if there is sufficient evidence to reject the null hypothesis.

B is incorrect. Statistical tests try to find evidence to reject or to fail to reject the null hypothesis. If the null hypothesis has been rejected, then we accept the alternative hypothesis. If we fail to reject the null hypothesis, then we reject the alternative hypothesis.

C is incorrect. The alternative hypothesis, designated by Ha, is what is accepted if there is sufficient evidence to reject the null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1114 When hypothesis testing, the choice between using a critical value based on the z-distribution or the t-distribution *most likely* depends on:

A. The sample size.

B. The distribution of the population.

C. The sample size and the distribution of the population.

The correct answer is **C.**

When hypothesis testing, the choice between using a critical value based on the z-distribution or the t-distribution depends on sample size, the distribution of the population, and whether or not the variance of the population is known.

A is incorrect. It suggests that the choice depends solely on the sample size. While the sample size is indeed a critical factor—typically, a z-distribution is used when the sample size is large ($n > 30$) and the population variance is known, and a t-distribution is used for smaller samples ($n \leq 30$) where the population variance is unknown—it does not account for the importance of the population distribution. The assumption of normality or near-normality of the population distribution is crucial when deciding between the z and t distributions, especially for smaller sample sizes.

B is incorrect. It suggests that the choice depends solely on the distribution of the population. While the population distribution is an important consideration, especially in cases where the sample size is small and the central limit theorem cannot be applied to assume a normal distribution of sample means, it is not the only factor. The sample size plays a significant role in determining whether the distribution of the sample means can be approximated to a normal distribution (using the z-distribution) or if a t-distribution should be used due to the increased uncertainty associated with smaller samples and unknown population variance.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1115 Which of the following statements is *most accurate*?

A. The p-value is the probability of obtaining a test statistic that would lead to a rejection of the null hypothesis, assuming the null hypothesis is not true.

B. The p-value is the probability of obtaining a test statistic that would lead to a rejection of the null hypothesis, assuming the null hypothesis is true.

C. Neither A) nor B)

The correct answer is **B.**

The p-value is the probability of obtaining a test statistic that would lead to a rejection of the null hypothesis, assuming the null hypothesis is true. It is the smallest level of significance at which the null hypothesis can be rejected.

B is incorrect. This option suggests that researchers aim to accept the null hypothesis, which misrepresents the goal of hypothesis testing. The primary aim is not to accept the null hypothesis but to test it against the alternative hypothesis. If the evidence does not strongly support the alternative hypothesis, researchers may fail to reject the null hypothesis, but this does not equate to accepting it as true.

C is incorrect. In fact, the alternative hypothesis (H1 or Ha) represents the outcome that researchers are typically interested in demonstrating to be plausible. The alternative hypothesis posits the existence of an effect, difference, or relationship that the research aims to support by rejecting the null hypothesis. The process of hypothesis testing is structured to assess the strength of evidence against the null hypothesis, and if sufficient evidence is found, to reject H0 in favor of Ha.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1116 The *most appropriate* test statistic for a test of the equality of variances for two normally distributed random variables, based on two independent random samples, is the:

A. t-test.

B. F-test.

C. Chi-squared test.

The correct answer is **B.**

The F-test is the appropriate test for a test of the equality of variances for two normally distributed random variables, based on two independent random samples.

A is incorrect. The t-test is the appropriate test for a population whose mean and standard deviation are not given.

C is incorrect. The chi-squared test is the appropriate test for testing whether a hypothesized value of variance is equal to, less than, or greater than the true population variance.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1117 Which of the following statements about the F-distribution and the chi-square distribution is *least accurate*?

A. Both distributions are asymmetrical.

B. Both distributions are bound by zero on the left.

C. Both distributions have means that are less than their standard deviations.

The correct answer is **C.**

To answer this question, we will review the properties of each of the two distributions:

Chi-Square Distribution

1. Chi-square distribution is a ratio of two non-negative values. As a result, it is a non-negative distribution. This implies that it has a positive skew (skewed to the right).
2. Chi-square distribution is a non-symmetric distribution.
3. Each degree of freedom has its chi-square distribution.

F Distribution

1. The F distribution is positively skewed (skewed to the right).
2. Values of the F distribution are either zero or positive.
3. The shape of the F-distribution depends on its (a) parameters and (b) degrees of freedom.

There is no consistent relationship between the mean and the standard deviation of the chi-square distribution or the F-distribution.

A is incorrect. It represents a true statement. Both distributions are skewed to the right. Any distribution that is skewed is asymmetrical.

B is incorrect. It represents a true statement. Both distributions are positively skewed. This implies that they are both bound by zero on the left.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.1118 The *most appropriate* test statistic to test the hypothesis that the variance of a normally distributed population is equal to 13 is the:

A. t-test.

B. F-test.

C. Chi-squared test.

The correct answer is **C.**

The chi-squared test is used to test whether a hypothesized value of variance is equal to, less than, or greater than the true value of the population variance.

A is incorrect. The t-test is an appropriate test for a population whose mean and standard deviation is not given.

B is incorrect. The F-test is an appropriate test statistic for testing the equality of variances for two normally distributed random variables based on two independent random samples.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1120 For two independent samples from two normally distributed populations, the difference in means can *most likely* be tested using the:

A. F-test.

B. t-statistic.

C. Chi-squared test.

The correct answer is **B.**

For two independent samples from two normally distributed populations, the difference in means can be tested using the t-statistic.

A is incorrect. The F-test is used to test for the equality in population variance, not mean differences.

C is incorrect. The chi-square test is used to test for dependence/ independence between categorical variables.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1121 Which of the following statements is *most likely* correct?

A. Parametric tests do not rely on assumptions regarding the distribution of the population but are specific to population parameters.

B. Parametric tests rely on assumptions regarding the distribution of the population but are not specific to population parameters.

C. Neither A) nor B)

The correct answer is **C.**

Parametric tests are statistical tests in which we make assumptions regarding the distribution of a population. They rely on assumptions regarding the distribution of the population and are specific to population parameters. Assuming that a variable follows a normal distribution is an example of a parametric test.

Non-parametric tests, on the other hand, do not make any assumptions regarding the distribution of the parameter under study. Non-parametric tests are used by researchers in cases where; the median is more desirable than the mean, the data under study is ordinal, and the sample size is very small.

A is incorrect. This option inaccurately states that parametric tests do not rely on assumptions regarding the distribution of the population. In reality, the defining characteristic of parametric tests is their reliance on such assumptions. These tests assume that the data follow a certain distribution (often normal), which is crucial for the validity of the test results. The assumption about the distribution allows for the derivation of exact sampling distributions of test statistics under the null hypothesis, facilitating precise probability calculations and decision-making regarding the hypothesis being tested.

B is incorrect. However, it inaccurately claims that these tests are not specific to population parameters. On the contrary, parametric tests are specifically designed to make inferences about population parameters, such as means, variances, and proportions. These tests utilize sample data to estimate the parameters of interest and test hypotheses about their values. The specificity to population parameters is a key feature of parametric tests, distinguishing them from non-parametric tests, which do not make such specific inferences about population parameters.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.1887 Which of the following is the *most accurate* sequence of steps in hypothesis testing?

A. State the hypothesis, select the level of significance, compute the test statistic, formulate the decision rule, and make a decision.

B. State the hypothesis, select the significance level, formulate the decision rule, compute the test statistic, and make a decision.

C. State the hypothesis, formulate the decision rule, select the significance level, compute the test statistic, and make a decision.

The correct answer is **B.**

The correct sequence is:

1. State the hypothesis

2. Select the level of significance

3. Formulate the decision rule

4. Compute the test statistic

5. Make a decision

A is incorrect. It suggests computing the test statistic before formulating the decision rule. This sequence is not optimal as the decision rule, which is based on the significance level and the distribution of the test statistic under the null hypothesis, should be established before computing the test statistic. This ensures that the researcher knows in advance how to interpret the computed test statistic in the context of the hypothesis being tested.

C is incorrect. The significance level is a critical component in formulating the decision rule. The significance level, often denoted as α, determines the threshold for rejecting the null hypothesis. Without selecting the significance level first, it would not be possible to formulate an appropriate decision rule that accurately reflects the researcher's criteria for making a decision about the hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1888 Which of the following statements about hypothesis testing is the *least accurate*?

A. A Type II error is failing to reject a false null hypothesis.

B. The null hypothesis is a statement about the value of a population parameter.

C. If the alternative hypothesis is H_a: M > Mo, a two-tailed test is appropriate.

The correct answer is **C.**

The alternative is a one-sided test if the ">" or "<" sign is used and two-sided when the "=" sign is used.

A is incorrect. Type II error is failing to reject a false null hypothesis.

B is incorrect. The hypotheses are always stated in terms of a population parameter.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1890 For the calculation of the test statistic, the *most appropriate* formula is:

A. $\frac{\text{Sample Mean - Hypothesized mean}}{\text{Standard error of sample mean.}}$

B. $\frac{\text{Population Mean - Sample Mean}}{\text{Standard error of sample mean.}}$

C. $\frac{\text{Population Mean - Sample Mean}}{\text{Standard Deviation.}}$

The correct answer is **A.**

The test statistic is a quantity that is calculated based on a sample. The value of a test statistic is used to determine whether or not to reject the null hypothesis.

The appropriate formula for the calculation of the test statistic is `

$$\text{Test statistic} = \frac{\text{Sample Mean - Hypothesized mean}}{\text{Standard error of the sample mean.}}$$

B is incorrect. In hypothesis testing, the focus is on how the sample mean compares to a hypothesized population mean, not the other way around. Additionally, the denominator should be the standard error of the sample mean, not the standard deviation of the sample. The standard error accounts for the sample size, making it a more appropriate measure of variability for hypothesis testing.

C is incorrect. This option suggests using the population mean minus the sample mean divided by the standard deviation. The use of the standard deviation instead of the standard error of the sample mean does not account for the size of the sample, which is crucial in determining the variability of the sample mean. Furthermore, the order of subtraction (population mean - sample mean) is not standard practice in hypothesis testing, where the focus is on the deviation of the sample mean from a hypothesized value.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1891 While performing a hypothesis test, Albert Khan is told that his analysis suffers from a Type I error. It therefore *most likely* indicates that:

A. Khan rejected the null hypothesis when it was actually false.

B. Khan rejected the null hypothesis when it was actually true.

C. Khan failed to reject the null hypothesis when it was actually false.

The correct answer is **B.**

A Type I error means that Khan rejected the null hypothesis when it was actually true.

A is incorrect. It does not represent any error. We reject the null hypothesis when it is false.

C is incorrect. It represents type II error. Type II error occurs when analysts fail to reject a false null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1893 Is the following statement *most likely* correct?
'' The decision rule for rejecting or failing to reject the null hypothesis is based on the distribution of the test statistic. If the test statistic follows a normal distribution, the decision rule is based on critical values determined from the z-distribution.''

A. Yes.

B. No, because if the test statistic follows a normal distribution, the decision rule is based on critical values determined from the t-distribution.

C. No, because the decision rule for rejecting or failing to reject the null hypothesis is based on the value of the test statistic and the critical value.

The correct answer is **A.**

The statement is correct. The decision rule for rejecting or failing to reject the null hypothesis is based on the distribution of the test statistic. If the test statistic follows a normal distribution, the decision rule is based on critical values determined from the z-distribution.

B is incorrect. This option incorrectly suggests that the decision rule for rejecting or failing to reject the null hypothesis does not rely on the distribution of the test statistic and the critical values from the z-distribution when the test statistic follows a normal distribution. This misunderstanding could lead to the incorrect application of hypothesis testing principles. The z-distribution is specifically used for test statistics that follow a normal distribution, especially in cases where the population variance is known, or the sample size is sufficiently large for the Central Limit Theorem to apply, ensuring the sample mean's distribution approximates a normal distribution.

C is incorrect. This option misstates the conditions under which the t-distribution is used. The t-distribution is applied when the population variance is unknown, and the sample size is small ($n \leq 30$). It is broader and flatter than the z-distribution, accounting for the increased uncertainty in estimating the population standard deviation from the sample. While it is true that the decision rule for hypothesis testing involves comparing the test statistic to critical values, the choice of distribution (z or t) depends on the known or unknown status of the population variance and the sample size. Therefore, stating that the decision rule should always be based on the t-distribution when the test statistic follows a normal distribution is incorrect.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1894 A two-tailed hypothesis test at the 95% significance level with a p-value of 2.14% *most likely* indicates that:

A. at a 2% significance level, we can reject the null hypothesis.

B. at a 3% significance level, we can reject the null hypothesis.

C. at a 3% significance level, we cannot reject the null hypothesis.

The correct answer is **B.**

The p-value is the smallest level of significance for which the null hypothesis can be rejected. At 2.14% and any level above 2.14%, the null hypothesis can be rejected.

A is incorrect. It suggests that at a 2% significance level, we can reject the null hypothesis. However, since the p-value of 2.14% is greater than 2%, it does not meet the criteria for rejection at this stricter significance level. The p-value must be less than or equal to the significance level to justify rejecting the null hypothesis.

C is incorrect. The p-value indicates the probability of obtaining a result at least as extreme as the one observed, assuming the null hypothesis is true. A p-value lower than the significance level suggests that such extreme results are unlikely under the null hypothesis, leading to its rejection. Therefore, this option misinterprets the relationship between the p-value and the significance level.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1895 Which of the following statement(s) is/are *most accurate*?
I. Decreasing the significance level will decrease the probability of failing to reject a false null
II. Decreasing the significance level will increase the power of the test.

A. Only II is correct.

B. I and II are correct.

C. I and II are incorrect.

The correct answer is **C.**

Decreasing the significance level will INCREASE the probability of failing to reject a false null and DECREASE the power of the test.

A is incorrect. As α decreases, the likelihood of rejecting the null hypothesis when it is false (i.e., detecting a true effect) decreases, thus reducing the power of the test.

B is incorrect. Statement I posits that decreasing the significance level will decrease the probability of failing to reject a false null hypothesis. In reality, decreasing the significance level increases the probability of failing to reject a false null hypothesis (β), which is the definition of a Type II error. When the significance level is lower, the criteria for rejecting the null hypothesis are more stringent, making it more difficult to detect a true effect when it exists. This leads to an increased likelihood of failing to reject the null hypothesis when it is indeed false, thereby increasing β and decreasing the test's power.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1896 A survey is conducted to determine if the average starting salary of investment bankers is equal to or greater than $57,000 per year. Given a sample of 115 newly employed investment bankers with a mean starting salary of $65,000 and a standard deviation of $4,500, and assuming a normal distribution, the test statistic is *closest to*:

A. 19.06

B. 204.40.

C. 419.62

The correct answer is **A.**

$$\text{Standard error of the sample mean } = \frac{\text{Standard deviation}}{\sqrt{\text{Sample size}}} = \frac{\$4,500}{\sqrt{115}} = 419.6272$$

And

$$\text{Test statistic } = \frac{\text{Sample mean - Hypothesized value}}{\text{Standard error of the sample mean}} = \frac{65,000 - 57,000}{419.6272} = 19.06$$

B is incorrect. It indicates the test statistic without finding the square root of the sample size.

C is incorrect. It is the standard error of the mean.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1897 Hilda believes that the average return on equity in the consumer durables industry is greater than 8%. The null (H_0) and the alternative (H_a) hypotheses for this study are *most likely*:

A. H_0: M = 0.08 versus H_a: M ≠ 0.08

B. H_0: M ≥ 0.08 versus H_a: M < 0.08

C. H_0: M ≤ 0.08 versus H_a: M > 0.08

The correct answer is **C.**

This is a one-sided alternative (so we cannot use =) because of the "greater than" belief. The null hypothesis is formulated as follows: H_0: M ≤ 0.08 versus H_a: M > 0.08. It tests whether there is evidence that the actual parameter (Average return) is significantly greater than the hypothesized value (8%). If there is enough evidence, we reject the null hypothesis. If there is not, we accept the null hypothesis.

A is incorrect. It is a one-sided alternative (so we cannot use =) because of the "greater than" belief.

B is incorrect. The choice indicates that Ha M< 0.08, which negates the statement.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1899 The *most appropriate* hypothesis test concerning the variance of a normally distributed population is referred to as the:

A. Z-test.

B. F-test.

C. Chi-squared test.

The correct answer is **C.**

A chi-squared (X^2) statistic is used to investigate whether distributions of categorical variables differ from one another.

A is incorrect. The Z test is used when comparing the means of two distributions with known variances.

B is incorrect. The F test is used when checking for the equality of two population variances

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.1900 Which of the following statement(s) is/are *most accurate*?
I. Nonparametric tests have more assumptions than parametric tests.
II. When data is based on ordinal measurements, we use nonparametric tests.

A. Both statements are correct.

B. Both statements are incorrect.

C. Only one statement is correct

The correct answer is **C.**

Statement I is incorrect. Nonparametric tests have fewer assumptions than parametric tests.
Statement II is correct. When data is based on ordinal measurements, we use nonparametric tests. Non-parametric tests are also used when: the median is more desirable than the mean and when the sample size is extremely small.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.1901 A large positive value of the Spearman rank correlation such as 0.90 would *most likely* indicate that:

A. a high rank in one year is associated with a low rank in the second year.

B. a high rank in one year is associated with a high rank in the second year.

C. a high rank in one year will not have any impact on the rank in the second year.

The correct answer is **B.**

A large positive value of the Spearman rank correlation such as 0.90 would most likely indicate that a high rank in one year is associated with a high rank in the second year.

Note: In statistics, Spearman's rank correlation coefficient or Spearman's rho is a non-parametric measure of statistical dependence between two variables. It takes values from -1 to 1. The closer to 1 or to -1, the stronger the relationship. 1 indicates a perfect positive association/relationship, whereas -1 indicates a perfect negative association between variables.

A is incorrect. This option suggests that a high rank in one year is associated with a low rank in the second year, which would be indicative of a negative Spearman rank correlation. A negative correlation would have a coefficient closer to -1, not 0.90. A coefficient of 0.90, being positive and close to 1, clearly indicates a positive association between the ranks, where high ranks in one year are associated with high ranks in the subsequent year, not low ranks.

C is incorrect. This option suggests that the rank in one year does not impact the rank in the second year, implying no correlation between the ranks across years. However, a Spearman rank correlation of 0.90 significantly contradicts this notion, as it indicates a strong positive correlation. A coefficient near 0 would suggest no correlation, but a value of 0.90 demonstrates a strong, direct relationship between the ranks in two different years, where a high rank in one year is likely to be associated with a high rank in the next year.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2763 A sample of 100 students is currently renting rooms in the mean distance of 18 miles from a small U.S. College. Assuming that the population is normally distributed and the standard deviation of the sample is 14 miles, the 99% confidence interval for the population mean is *closest to*:
(See Z-table)

A. [15.26 miles; 20.74 miles]

B. [16.6 miles; 19.4 miles]

C. [14.4 miles; 21.6 miles]

The correct answer is **C.**

$$\text{Standard error of the sample} = \frac{\text{Standard deviation of sample mean}}{\sqrt{\text{Sample size}}} = \frac{14}{\sqrt{100}} = 1.4$$

Z-static (Reliability factor) at 99% confidence interval = 2.58

$$\text{Confidence interval} = \text{Point estimate} \pm \text{Reliability factor} \times \text{Standard error}$$

Lower limit of the confidence interval = 18 - (2.58 × 1.4) = 14.39 miles
Upper limit of the confidence interval = 18 + (2.58 × 1.4) = 21.6 miles.
The 99% confidence interval of the population lies within the range (14.39; 21.6) This means that 99% of the students rent rooms within a distance of (14.39; 21.6) miles.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2764 The mean return of a sample of 36 BB+ corporate bonds is 7.5%, and the sample's standard deviation is 14%. Assuming that the population is normally distributed and the population variance is unknown, based on t-distribution, the 95% confidence interval for the population mean is *closest to*?
(See t-table)

A. [2.77%; 12.23%]

B. [2.93%; 12.06%]

C. [3.56%; 11.43%]

The correct answer is **A.**

Since the population variance is unknown and the population is normally distributed, we will use a t-statistic. The t-statistic for a 95% confidence interval and 35 degrees of freedom (df=n-1=) is 2.030.
The standard error of the sample = Standard Deviation of sample mean/√Sample size = 14/√36 = 2.33

$$\text{Confidence interval} = \text{Point estimate} \pm \text{Reliability factor} \times \text{Standard error}$$

The confidence interval is 7.5 - (2.03 * 2.33) = 2.77 and 7.5 + (2.03 * 2.33) = 12.23

Approximately 95% of the mean returns of BB+ corporate bonds fall within the interval (2.77;12.23)

Using a reliability factor based on the t-distribution is essential for a small sample size. Using a t reliability factor is appropriate when the population variance is unknown, even when we have a large sample, and could use the central limit theorem to justify using a z reliability factor. In this large sample case, the t-distribution provides more-conservative (wider) confidence intervals.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2765 Which of the following is the *most appropriate* test statistic for calculating confidence intervals for a normally distributed population mean whose variance is unknown and the sample size is less than 30?

A. z-statistic.

B. t-statistic.

C. F-statistic.

The correct answer is **B.**

The t-statistic is most appropriate for constructing confidence intervals for normally distributed population means whose variance is unknown and the sample size is less than 30. At the same time, the z- statistic is appropriate for constructing confidence intervals for normally distributed population means whose variance is known (regardless of the sample size).
A is incorrect. The z- statistic is appropriate for constructing confidence intervals for normally distributed population means whose variance is known (regardless of the sample size).

C is incorrect. The F statistic is most appropriate when testing for the differences in population variances.

CFA Level I, Volume 1, Topic 3 - Quantitative Methods, Learning Module 8, Hypothesis Testing, LOS 8b: Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and power of the test given a significance level.

Q.2773 If a researcher wants to test that the mean return of 50 small-cap stocks from the Singapore Exchange is greater than 14%, the alternative hypothesis for the test is *most likely*:

A. H_a: $\mu \neq 14\%$.

B. H_a: $\mu > 14\%$.

C. H_a: $\mu < 14\%$.

The correct answer is **B.**

Since the researcher wants to test that if the mean of 50 small-cap stocks is greater than 14%, the null hypothesis is H_0: $\mu \leq 14\%$ and the alternative hypothesis is H_a: $\mu > 14\%$.

We always want to reject the null hypothesis and accept the alternative. Since the researcher wants to prove that the mean returns are greater than 14%, H_a: $\mu > 14\%$; H_0: $\mu < 14\%$.

A is incorrect. It denotes that the alternative hypothesis is not equal to 14%, which is not the case.

C is incorrect. It indicates that the alternative hypothesis for the mean return of 50 small-cap stocks from the Singapore Exchange is less than 14%.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2775 An analyst believes that the mean return over 24 months on Geko Corp. shares is different from 0%. Determine which of the following is the *most likely* decision rule?

A. Reject H_0 if the test statistic > the upper critical value.

B. Reject H_0 if the test statistic < the lower critical value.

C. Reject H_0 if the test statistic > the upper critical value OR if the test statistic < the lower critical value.

The correct answer is **C.**

Since the analyst wants to test if the mean is different from zero, it is a two-tail test and the appropriate hypotheses are H_0: $\mu = 0\%$ and H_a: $\mu \neq 0\%$.

The appropriate decision rule is to reject H_0 if the test statistic > the upper critical value OR if the test statistic < the lower critical value.

A and B are incorrect. They both are incomplete. For two-tailed tests, the decision rule should consider both cases (when the Test Statistic is greater than the upper critical value and when it is less than the lower critical value).

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2776 A quantitative analyst has calculated the mean holding period return (HPR) of 1% for 110 European corporate bonds with a standard deviation of 2%. If the analyst wants to test at a 5% level of significance that the mean HPR on European corporate bonds is different from zero, then the test statistic is *closest to*:

A. 0.19

B. 1.96

C. 5.24

The correct answer is **C.**

$$\text{Test statistc} = \frac{\text{Sample mean - Hypothesized value}}{\text{Standard Error}}$$

Where

$$\text{Standard Error} = \frac{\text{Standard deviation}}{\sqrt{\text{Sample Size}}} = \frac{2\%}{\sqrt{110}}$$

Therefore

$$\text{Test Statistic} = \frac{1\% - 0}{\frac{2\%}{\sqrt{110}}} = 5.24$$

A is incorrect. A test statistic of 0.19 would suggest a very small difference between the sample mean and the hypothesized value, which is not consistent with the calculated test statistic of 5.24. This discrepancy indicates that the calculation or interpretation that leads to a test statistic of 0.19 does not accurately reflect the significant difference between the sample mean HPR and the hypothesized value of zero.

B is incorrect. A test statistic of 1.96 is the critical value at a 5% level of significance for a two-tailed test under the assumption of a normal distribution. However, the calculated test statistic of 5.24 far exceeds this critical value, indicating a stronger evidence against the null hypothesis than what a test statistic of 1.96 would suggest. Therefore, option B does not accurately represent the strength of the evidence against the null hypothesis in this scenario.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2777 A quantitative analyst has calculated a mean HPR of 1% and a standard deviation of 2% for 110 European corporate bonds. If the analyst wants to test at a 5% level of significance that the mean HPR on European corporate bonds is different from zero, then which of the following is the *most accurate* result of the test?

A. Reject H_0: μ = 0%

B. Reject H_a: μ ≠ 0%

C. Accept H_0: μ = 0%

The correct answer is **A.**

Since the quantitative analyst wants to test if the returns are different from zero, the appropriate hypotheses are H_0: μ = 0% and H_a: μ ≠ 0%.
The decision rule is to reject H_0 if the test statistic > the upper critical value OR if the test statistic < the lower critical value.

At a 5% level of significance, the z-critical value is +/- 1.96.

$$\text{Test statistc} = \frac{\text{Sample mean - Hypothesized value}}{\text{Standard Error}}$$

Where

$$\text{Standard Error} = \frac{\text{Standard deviation}}{\sqrt{\text{Sample Size}}} = \frac{2\%}{\sqrt{110}}$$

Therefore

$$\text{Test Statistic} = \frac{1\% - 0}{\frac{2\%}{\sqrt{110}}} = 5.24$$

Since the test statistic > the upper critical value (or 5.24 > 1.96), the null hypothesis is rejected and the alternative hypothesis is accepted.

B is incorrect. Since the test statistic > the upper critical value (or 5.24 > 1.96), the null hypothesis is rejected, and the alternative hypothesis is concluded.

C is incorrect. The evidence suggests the rejection of the null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2778 Gerry Smithson conducted a hypothesis test at a 1% level of significance to check if the mean return of a population of stocks is greater than zero. The mean of the sample of 121 stocks is 1% with a standard deviation of 5%. Suppose Smithson accepted the alternative hypothesis, which of the following statements is *most accurate*? (See Normal Table)

A. Smithson committed a Type I error by accepting the alternative hypothesis.

B. Smithson committed a Type II error by accepting the alternative hypothesis.

C. Smithson correctly accepted the alternative hypothesis; no error was made.

The correct answer is **A.**

Since Smithson wants to test if the mean return is greater than 0% the hypotheses are:
H_0: $\mu \leq 0\%$ and H_a: $\mu > 0\%$.

$$\text{Test statistc} = \frac{\text{Sample mean - Hypothesized value}}{\text{Standard Error}}$$

Where

$$\text{Standard Error} = \frac{\text{Standard deviation}}{\sqrt{\text{Sample Size}}} = \frac{5\%}{\sqrt{121}}$$

Therefore

$$\text{Test Statistic} = \frac{1\% - 0}{\frac{5\%}{\sqrt{121}}} = 2.20$$

Since the z-critical value at a 1% level significance is 2.33, the test statistic $2.2 \leq 2.33$. Hence, the null hypothesis is true.

Since Smithson rejected the null hypothesis (accepted the alternative hypothesis) when the null hypothesis was in fact true, he committed a Type I error.

B is incorrect. A Type II error is the failure to reject the null hypothesis when it is false.

C is incorrect. Smithson rejected the null hypothesis (accepted the alternative hypothesis) when the null hypothesis was true, thus committed a Type I error.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2779 Which of the following is the *most appropriate* explanation of a Type II error?

A. A Type II error refers to rejecting the null hypothesis when it is actually true.

B. A Type II error refers to the failure to reject the null hypothesis when it is false.

C. A Type II error refers to a failure to reject the null hypothesis when it is actually true.

The correct answer is **B.**

A Type II error refers to a failure to reject the null hypothesis when it is false, while a Type I error refers to rejecting the null hypothesis when it is actually true.

A is incorrect. It refers to Type I error: rejecting the null hypothesis when it is true.

C is incorrect. It is not an error.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2780 If the level of significance is 5%, the type I error is 15%, and the Type II error is 20%, then the probability of correctly rejecting the null hypothesis when it, in fact, false is *closest to*:

A. 80%.

B. 85%.

C. 95%.

The correct answer is **A.**

$$\begin{aligned}\text{Power of test (or the probability of correctly rejecting the null hypothesis when it's false)} &= 1 \text{ - p(} \\ &= 1 - 0\end{aligned}$$

So, the probability of correctly rejecting the null hypothesis when it is, in fact, false is closest to 80%. Therefore, the correct answer is A. 80%. Please note that the level of significance and the Type I error rate are not needed to answer this question. They are not directly related to the power of the test. The power of the test is only related to the Type II error rate.

Note: Type 1 error occurs when we reject a true null hypothesis, whereas type II error occurs when we fail to reject a false null hypothesis.

B is incorrect. It suggests an 85% probability of correctly rejecting the null hypothesis when it is false, which does not align with the given Type II error rate of 20%.

C is incorrect. It implies a 95% probability of correctly rejecting the null hypothesis when it is false, which significantly overestimates the power of the test given the provided Type II error rate. This option might confuse the level of significance (α) with the power of the test. The level of significance is the threshold for deciding whether to reject the null hypothesis and is related to the probability of making a Type I error, not the power of the test or the Type II error rate.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2781 A one-tailed (H_0: μ ≥ 0%) test statistic has a p-value of 0.0228. At a 1% significance level, which of the following statements is *most accurate*?

A. The null hypothesis is rejected as the p-value is greater than the significance level.

B. The null hypothesis is not rejected as the p-value is greater than the significance level.

C. The null hypothesis is not rejected as the p-value is not greater than the significance level.

The correct answer is **B.**

The decision rule for the p-value is we reject the null hypothesis if p-value is less than the significance level. Since the p-value 0.0228 > 0.01 significance level, we fail to reject the null hypothesis.

A is incorrect. The null hypothesis is not rejected.

C is incorrect. The p-value is more significant than the significance level.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2783 An analyst is conducting a test to identify if the mean return of one sample of a population is greater than the other sample of the same population. If the H_0: μ1 - μ2 ≥ 0 is rejected, which of the following option is *most likely* true?

A. H_a: μ1 ≠ μ2

B. H_a: μ1 > μ2

C. H_a: μ1 < μ2

The correct answer is **C.**

Since the null hypothesis H_0: μ1 - μ2 ≥ 0 is rejected, the alternative hypothesis H_a: μ1 - μ2 < 0 is accepted which can also be interpreted as H_a: μ1 < μ2.

Note: $H_0 : \mu_1 - \mu_2 \leq 0$ can be written as $H_0 : \mu_1 \leq \mu_2$.

A is incorrect. The test is to identify if the mean return of one sample of a population is greater than the other sample of the same population and not equal to as depicted in the answer.

B is incorrect. The alternative hypothesis cannot imply the same thing as the null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2785 An analyst drew 27 paired observations to test if the mean return of two portfolios differs from each other at a 1% level of significance. Assume that the distribution of each portfolio is normal with an unknown population variance. Using the following table, construct the appropriate hypothesis.

	Portfolio 1	Portfolio 2	Differences
Mean Return	17	21.25	4.25
Standard Deviation	10.5	16.75	6.25

A. H_0: μ1 ≥ μ2 and H_a: μ < μ2

B. H_0: μ1 ≤ μ2 and H_a: μ1 > μ2

C. H_0: μd = 0 and H_a: μd ≠ 0

The correct answer is **C.**

This is a two-tailed test.The analyst is testing the difference between the mean of paired observations. It is unknown if the difference is positive or negative so the hypothesis is constructed as H_0: μd = 0 and H_a: μd ≠ 0.

A is incorrect. It formulates a one-tailed test that hypothesizes Portfolio 1 has a mean return greater than or equal to Portfolio 2 ($H_0 : \mu 1 \geq \mu 2$) and the alternative that Portfolio 1 has a mean return less than Portfolio 2 ($H_a : \mu 1 < \mu 2$). This formulation is inappropriate for two reasons. Second, it does not utilize the concept of paired observations, which is crucial in this context as the analyst is comparing the means of two related samples.

B is incorrect. For similar reasons to option A. It proposes a one-tailed test with the null hypothesis suggesting Portfolio 1 has a mean return less than or equal to Portfolio 2 ($H_0 : \mu 1 \leq \mu 2$) and the alternative hypothesis suggesting Portfolio 1 has a greater mean return ($H_a : \mu 1 > \mu 2$). This choice also fails to address the analyst's objective of determining if any difference exists between the two portfolios without presupposing the direction of this difference. Additionally, it overlooks the paired nature of the observations, which is critical for the analysis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2786 An analyst drew 27 paired observations to test if the mean return of two portfolios differs from each other at a 1% level of significance. Assume that the distribution of each portfolio is normal with an unknown population variance. Using the following table, the test statistic is *closest* to:

	Portfolio 1	Portfolio 2	Differences
Mean Return	17	21.25	4.25
Standard Deviation	10.5	16.75	6.25

A. 3.53

B. 7.51

C. 18.36

The correct answer is **A.**

The analyst is testing the difference between the mean of paired observations. It is not known if the difference is positive or negative so the hypothesis is constructed as H_0: μd = 0 and H_a: μd ≠ 0.
Thus,

$$\text{test statistic} = \frac{\text{Mean difference}}{\text{Standard error of mean}} = \frac{4.25}{\left(\frac{6.25}{\sqrt{27}}\right)} = 3.53.$$

Further Explanation.

To test whether the observed difference between two means is statistically significant, we must first decide whether the samples are independent or dependent (paired/related). If the samples are independent, we conduct tests concerning differences between means. If the samples are dependent, we conduct tests of mean differences (paired comparisons tests).

Notice the examiner has mentioned 27 paired observations. This helps you to know that you need to conduct a paired comparison test. Additionally, the hypothesis test concerns the population mean of a normally distributed population with unknown variances, thus, the theoretically correct test statistic is the t-statistic.

Thus, test statistic = Mean difference/Standard error of mean differences.

$$t - \text{Statistic} = \frac{(\bar{X} - \mu_0)}{\left(\frac{\sigma}{\sqrt{n}}\right)} = \frac{4.25}{\frac{6.25}{\sqrt{27}}} = 3.53$$

B is incorrect. Uses the variance instead of the standard deviation:

$$\text{Test Statistic} = \frac{4.25}{\left(\frac{6.25^2}{\sqrt{27}}\right)} = 7.51.$$

C is incorrect. Fails to find the square root of the sample size.

$$\text{Test Statistic} = \frac{4.25}{\left(\frac{6.25^2}{27}\right)} = 18.36$$

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2788 Which of the following probability distributions is *least likely* bounded by 0?

A. z-distribution.

B. F-distribution.

C. Chi-distribution.

The correct answer is **A.**

The z-distribution is least likely bounded by 0. It can take on both negative and positive values. The Chi-distribution and the f-distribution are both distributions that are skewed to the right, meaning that they do not take negative values and that they are bounded by 0.

B is incorrect. The F-distribution is used primarily in the analysis of variance (ANOVA) and is always right-skewed. This means that its values start from 0 and extend indefinitely to the right, without taking negative values. The F-distribution's shape and properties are determined by two sets of degrees of freedom, which influence its skewness and kurtosis but do not alter its boundedness by 0.

C is incorrect. The Chi-square distribution is a special case of the gamma distribution and is used extensively in hypothesis testing and confidence interval estimation for variance in the field of statistics. Like the F-distribution, the Chi-square distribution is right-skewed and does not take negative values. Its values start from 0 and extend to the right indefinitely, which is a characteristic of distributions that are bounded by 0.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2789 Which of the following is the *most appropriate* test statistic of an F-test?

A. $\frac{\bar{X}-\mu_0}{\sigma/\sqrt{n}}$

B. $\frac{s_1^2}{s_2^2}$

C. $\frac{(n-1)s_1^2}{s_2^2}$

The correct answer is **B.**

The f-test statistic = Variance of a sample of n_1 observations drawn from population 1 divided by variance of a sample of n_2 observations drawn from population 2 = s_1^2 / s_2^2.

Chi-test statistic = $(n-1)s^2 / s^2$

A is incorrect. A represents the z test statistic

C is incorrect. C represents the Chi-test statistic.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.2790 Which of the following tests is the *least appropriate* when testing the hypothesis of whether a variable is normally distributed?

A. Runs tests.

B. Parametric tests.

C. Non-parametric tests.

The correct answer is **B.**

A parametric test is least suitable to test whether a variable is normally distributed.

A is incorrect. A runs test is a type of non-parametric test.

C is incorrect. Non- parametric tests are used when the hypothesis does not involve the distribution parameters, of the distribution for instance testing if the variable is normally distributed.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.2791 Which of the following tests is *most appropriately* used to assess the linear relationship between the ranks of two variables within their sample when the sample data is not normally distributed?

A. Parametric tests.

B. Correlation coefficients.

C. Spearman rank correlation tests.

The correct answer is **C.**

The Spearman rank correlation test is used to assess the linear relationship between the ranks of two variables within their sample when the sample data is not normally distributed.

A is incorrect. Parametric tests are statistical tests that require analysts to make assumptions regarding the distribution of the population.

B is incorrect. Correlations coefficients are simply a measure (between -1 and 1) of the strength of the relationship between two variables.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.3446 Consider the following tests:

I. Testing a drug for its effect on humans.
II. Testing the manufacturing process of a screwdriver.

Which of the following statements is *most accurate*?

A. The p-value for test I will be equal to the p-value for test II.

B. The p-value for test I will be lower than the p-value for test II.

C. The p-value for test I will be higher than the p-value for test II.

The correct answer is **B.**

The p-value is the level of marginal significance within a statistical hypothesis test representing the probability of the occurrence of a given event. An alternative interpretation of the p-value is that it represents the statistical probability of the occurrence of an event happening by chance. Hence, a lower p-value will lead to “more confidence.”

For a drug trial, a small error can have serious implications; however, in the manufacturing process of a screwdriver, the concerns are not as high. Therefore, the p-value of a drug trial must be lower than the p-value of the manufacturing process of a screwdriver.

A is incorrect. Suggesting that the p-value for testing a drug's effect on humans will be equal to the p-value for testing the manufacturing process of a screwdriver overlooks the fundamental differences in the nature of these tests and their implications. Drug tests are subject to stringent regulatory standards and require a high level of confidence in the results due to the potential impact on human health. This typically necessitates a lower p-value to assert the significance of the findings. In contrast, the manufacturing process of a screwdriver, while important for quality control, does not directly impact human health in the same way and may tolerate a higher p-value.

C is incorrect. Suggesting that the p-value for testing a drug's effect on humans will be higher than the p-value for testing the manufacturing process of a screwdriver misunderstands the importance of statistical significance in different contexts. The implications of errors in drug trials can be severe, including adverse health effects or ineffective treatment. Therefore, a lower p-value is sought to ensure that the results are not due to random chance but indicate a true effect of the drug.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3453 Rick Gervais has gathered data on the daily returns generated by the Dow Jones Index. He believes that the mean daily return generated by the index is greater than 0.10%, so Gervais constructs a hypothesis test. If he wants to minimize the probability of a Type I error, then he is *most likely* to:

A. Increase α.

B. Minimize Type II error.

C. Increase the sample size.

The correct answer is **C.**

Type I error occurs when analysts reject a true null hypothesis, whereas type II error occurs when analysts fail to reject a false null hypothesis. Increasing the sample size increases the chances of capturing the differences in the data, thereby reducing the chances of committing both type I and type II errors.

A is incorrect. α, also known as the significance level, is defined as the probability of making a type I error. Therefore, if α is increased, the probability of committing a type I error also increases.

B is incorrect. By minimizing Type II error, the probability of committing a type, I error increases.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3471 If the population variance is known, then the *most appropriate* hypothesis test is the:

A. t-test.

B. z-test.

C. F-test.

The correct answer is **B.**

If the population variance is known, then the appropriate hypothesis test is the z-test. Option A is incorrect. A t-test is used mostly when the population variance and the mean are unknown. Option C is incorrect. An F-test is used to test if the variances of two populations are equal.

A is incorrect. A t-test is used mostly when the population variance and the mean are unknown.

C is incorrect. An F-test is used to test if the variances of two populations are equal.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3474 A chi-square test is *most appropriate* for tests concerning:

A. a single variance.

B. differences between two population means with variances assumed to be equal.

C. differences between two population variances assumed to not be equal.

The correct answer is **A.**

A chi-square test is used for tests concerning the variance of a single normally distributed population. The test statistic used is $\lambda^2_{n-1} = \frac{(n-1)S^2}{\sigma^2}$

B is incorrect. The most appropriate test statistic for B would be the t-test. The test statistic used is

$$t_{n_1+n_2-2} = \frac{\bar{X}_1 - \bar{X}_2}{S_p\sqrt{\frac{1}{n1} + \frac{1}{n2}}}$$

Where;

$\bar{X}_1$ and $\bar{X}_2$ are the sample means.

n_1 and n_2 are the sample sizes.

S_p is the common or the pooled variance and is given by

$$S_p = \frac{(n_1 - 1)S_1{}^2 + (n_2 - 1)S_2{}^2}{n_1 + n_2 - 2}$$

C is incorrect. The most appropriate test statistic for A would be the F-test. The test statistic used is

$$F_{(n_1-1)(n_2-1)} = \frac{S_1{}^2}{S_2{}^2}$$

where s_1 and s_2 are the sample variances.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3477 While conducting a study, a researcher computes the probability of Type I and Type II errors that stood at 5% and 2%, respectively. The power of the test is *closest* to:

A. 93%.

B. 95%.

C. 98%.

The correct answer is **C.**

The power of the test is defined as the probability of correctly rejecting the null hypothesis when it is false.

The power of a test is obtained by subtracting the probability of failing to reject the null hypothesis when it is false (which is type II error) from 1 (since all probabilities must add up to 1)

Power of the test = 1 - probability of Type II error = 100% - 2% = 98%

A is incorrect. Suggesting a power of 93% does not align with the given probabilities of Type I and Type II errors. The power of a test is directly related to the probability of a Type II error, not a Type I error.

B is incorrect. While 95% might seem like a reasonable estimate given the common threshold for Type I errors (α) in hypothesis testing, it does not accurately reflect the calculation for the power of a test. The power is determined by subtracting the probability of a Type II error from 1. Given that the probability of a Type II error is 2%, the power of the test is 98%, not 95%. The confusion might arise from conflating the concept of the confidence level (commonly set at 95% to correspond with a 5% Type I error rate) with the power of the test, which are related but distinct statistical concepts.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3478 A portfolio manager observes that the weekly return generated by a portfolio of high-beta stocks stood at 5%. The standard deviation of the portfolio return stood at 1.50%. However, the manager observes that the standard deviation of the portfolio return for the recent 15 weeks stood at 2.00%. The portfolio manager wants to determine whether the standard deviation of the portfolio return has increased from 1.50% to 2.00%.
The test statistic to test for the above hypothesis is *closest* to:

A. 0.37

B. 1.78

C. 24.89.

The correct answer is **C.**

The chi-square test is used for hypothesis tests regarding population variance.

$$\text{Test statistic} = \frac{(n-1) \times S^2}{\sigma^2}$$

Where n is the sample size, S^2 the sample variance and σ^2 the hypothesized population variance.

$$\text{Test statistic} = \frac{(15-1) \times 0.02^2}{1.5\%^2} = 24.89$$

A is incorrect. Uses the standard deviation instead of the variance:

$$\text{Test statistic} = \frac{(15-1) \times 0.02^2}{1.5\%} = 0.37$$

B is incorrect. It fails to include the sample size effect:

$$\text{Test statistic} = \frac{0.02^2}{(1.5\%)^2} = 1.78$$

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3479 A portfolio manager believes that returns on pharmaceutical stocks are more volatile than the returns generated on e-commerce stocks. To check this hypothesis, the portfolio manager collects the data summarized in exhibit 1.

Exhibit 1: Volatility in Pharmaceutical vs. e-Commerce Stocks

	Pharma Stock	e-Commerce Stocks
Standard Deviation	1.50%	2.10%
Sample Size	20	25

The value of the test statistic is *closest* to:

A. 1.51.

B. 1.70

C. 1.96

The correct answer is **C.**

As the test requires testing the equality of variances of two populations, the appropriate test is the F-test.

$$\text{Test statistic} = \frac{(\text{Standard deviation of Ecommerce stocks})^2}{(\text{Standard deviation of the pharmaceutical stocks})^2} = \frac{(2.10\%)^2}{(1.50\%)^2} = 1.96$$

Note: A convention, or usual practice, uses the larger of the two standard deviations on top (in the numerator). When we follow this convention, the value of the test statistic is always greater than or equal to 1; tables of critical values of F then need to include only values greater than or equal to 1. Under this convention, the rejection point for any formulation of hypotheses is a single value on the right-hand side of the relevant F-distribution. However, even without following this convention, we would still arrive at the same conclusion (whether or not to reject the null).

A is incorrect. A test statistic value of 1.51 would suggest a different ratio of variances between the two sets of stocks. This value does not accurately reflect the calculated ratio based on the provided standard deviations. The calculation of the F-test statistic directly from the given standard deviations leads to a value of 1.96, not 1.51.

B is incorrect. A test statistic value of 1.7 does not accurately represent the ratio of variances derived from the given data. The value of 1.7 might suggest a misunderstanding or miscalculation of the variances of the two samples, which is not supported by the data provided in the question.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3480 A quantitative analyst made the following statements:
I. Parametric tests are recommended for observations that follow a Bernoulli distribution.
II. Non-parametric tests are recommended for normally distributed observations.
III. The Spearman rank correlation test is recommended for normally distributed observations.

Which of these statements is/are *most accurate*:?

A. I only

B. I & III only

C. I, II & III

The correct answer is **A.**

Statement I is accurate. A parametric test is a hypothesis testing procedure based on the assumption that observed data are distributed according to some distributions of well-known form (e.g., normal, Bernoulli, and so on).

Statement II is incorrect. Nonparametric statistics refer to a statistical method in which the data is NOT required to fit a normal distribution. Nonparametric statistics uses data that is often ordinal, meaning it does not rely on numbers, but rather on a ranking or order of sorts.

Statement III is inaccurate. When the variables are not normally distributed or the relationship between the variables is not linear, it may be more recommended to use the Spearman rank correlation method. A coefficient of correlation does not have any distributional assumptions.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.3510 Consider the following hypotheses:

I. The quarterly returns generated by US Pharmaceutical companies is greater than 2.25%.
II. The average GMAT score of students studying Finance in the University of Alberta is more than 700.
III. The average height of Dublin College students is not equal to 180 centimeters.

Which of these hypotheses will *most likely* be tested using a two-tailed test?

A. III only

B. II & III only

C. I & II only

The correct answer is **A.**

Hypothesis III should be verified using a two-tailed test. A two-tailed test considers the possibility of a change in either direction. It looks for a statistical relationship in both the positive and the negative directions of the distribution.The hypothesis of a two-tailed test will have either "an equal to" or "a not equal to sign."

Hypotheses I & II should be verified using one-tailed tests. A one-tailed test (one-sided test) is a statistical test that considers a change in only one direction. In such a test, the alternative hypothesis has either a < (less than sign) or > (greater than sign) i.e. we consider either an increase or reduction but not both.

B is incorrect. It is concerned only with returns exceeding 2.25%, not with returns being either significantly higher or lower. Therefore, suggesting that Hypothesis I should be tested with a two-tailed test overlooks the directional nature of the hypothesis.

C is incorrect. It specifies an interest in values exceeding 700, not in deviations in both directions from this threshold. Suggesting that Hypotheses II and III should both be tested using a two-tailed test fails to recognize the directional nature of Hypothesis II, which is explicitly looking for scores greater than 700.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3515 Given a z-test, the *most appropriate* decision rule is to:

A. Reject H_1.

B. Reject H_0 if the z-statistic falls within the critical region.

C. Accept H_0 if the z-statistic falls within the critical region.

The correct answer is **B.**

Once computed, the z-statistic is compared to the critical value that corresponds to the level of significance of the test. For example, if the significance level is 5%, the z-statistic is screened against the upper/lower 95% point of the normal distribution (±1.96). The decision rule is to reject H_0 if the z-statistic falls within the critical/rejection region.

A is incorrect. We do not just reject/accept the alternative hypothesis without reason. There has to be a reason as to why we are rejecting/accepting the alternative hypothesis.

C is incorrect. If the z statistic falls within the critical region, then we accept the alternative hypothesis and reject the null hypothesis.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3516 A portfolio manager wants to compare the returns generated by actively and passively managed funds. He believes that both methods generate the same exact return. The data collected by the manager is given in the following exhibit.

Exhibit: Data Compiled - Passive vs. Active Management

	Passive Management	Active Management
Mean Return	1.25%	2.00%
Standard Deviation	0.50%	0.75%
Sample Size	30	32

Assuming that the samples are independent, the population means are normally distributed, and the population variances are equal, the degrees of freedom for the test are *closest* to:

A. 60.

B. 61.

C. 62.

The correct answer is **A.**

Because we have two different population; Each of the two population has n-1 degrees of freedom. Let the passive management population be n_1, and the active be n_2. Combine the two to get Degrees of freedom $= n_1 + n_2 - 2 = 30 + 32 - 2 = 60$.

B is incorrect. It assumes n-1 df.

C is incorrect. It assumes zero df.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3738 50 CFA exam candidates were randomly sampled and were found to have an average IQ of 130. The standard deviation among candidates is known (approximately 20). Assuming that IQs follow a normal distribution, a 2-sided 95% confidence interval for the mean IQ of CFA candidates is *closest* to:

A. [125; 135]

B. [130; 135.5]

C. [124.5; 135.5]

The correct answer is **C.**

For any sample that comes from a normally distributed population, we know that:

$$\frac{\bar{X}-\mu}{\frac{\sigma}{\sqrt{n}}} \sim N(0,1)$$

Recall also that

Confidence Interval = Point estimate ± Reliability factor × standard error

Thus, a 95% CI for the mean,

$$\begin{aligned}\mu &= \bar{X} \pm Z_{\frac{\alpha}{2}} \times \frac{\sigma}{\sqrt{n}}\\ &= 130 \pm 1.96 \times \frac{20}{\sqrt{50}}\\ &= 130 \pm 5.5437\\ &= [124.5; 135.5].\end{aligned}$$

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3739 After 72 CFA candidates took a mock exam, the mean score was 75. Assuming that the population standard deviation is 10, construct a 99% confidence interval for the mean score on the mock exam, and the result will be *closest* to:

A. [75; 85]

B. [65; 75]

C. [71.96; 78.04]

The correct answer is **C.**

For any sample that comes from a normally distributed population, we know that:

$$\frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \sim N(0, 1)$$

Recall also that

Confidence Interval = Point estimate ± Reliability factor × standard error

From the normal dist. table, $Z_{0.005} = 2.58$.Thus, a 99% CI for the mean,

$$\begin{aligned} \mu &= \bar{X} \pm Z_{\frac{\alpha}{2}} \times \frac{\sigma}{\sqrt{n}} \\ &= 75 \pm 2.58 \times \frac{10}{\sqrt{72}} \\ &= 75 \pm 3.04 \\ &= 71.96 \leq \mu \leq 78.04. \end{aligned}$$

Interpretation: We are 99% certain that the students scored between 71.96 and 78.04.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3740 An investment firm intends to conduct a test to determine whether bonuses have any significant effect on job performance. The head of the human resource department develops the following sets of possible hypotheses.

I. H_0: Bonuses do not have any effect on job performance.

H_1: Bonuses improve job performance

II. H_0: Bonuses do not have any effect on job performance

H_1: Bonuses reduce job performance

III. H_0: Bonuses do not have any effect on job performance

H_1: Bonuses affect job performance

Which of the above hypotheses *most accurately* imply a two-sided test?

A. I

B. II

C. III

The correct answer is **C.**

The difference between a one-sided test and a two-sided test is that while the alternative hypothesis in the former explores the possibility of a change in only one direction (increase or decrease), the latter explores the possibility of a change in either direction.
While the alternative hypothesis in sets I and II explores an increase or decrease, respectively, the word "affect" in the H_1 of set III leaves open the possibility of either an increase or a decrease in job performance.

A and B are incorrect.A one-sided test will have either a greater than or less than sign, whereas a two-sided test will have either an equal to or a not equal to sign.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3741 A random sample of 50 CFA exam candidates was found to have an average IQ of 125. The standard deviation among candidates is known (approximately 20). Assuming that IQs follow a normal distribution, the statistical test (5% significance level) to determine whether the average IQ of CFA candidates is greater than 120 is *closest* to.
(Compute the test statistic and give a conclusion).
Note: 5% significant level = z score value of 1.6449.

A. Test statistic: 1.768; Reject H_0

B. Test statistic: 1.768; Fail to reject H_0

C. Test statistic: 1.0606; Fail to reject H_0

The correct answer is **A.**

The first step: Formulate H_0 and H_1

H_0: $\mu \leq 120$

H_1: $\mu > 120$

Note that this is a one-sided test because H_1 explores a change in one direction only

Under H_0, $(\bar{x} - 120)/(\sigma/\sqrt{n}) \sim N(0,1)$

Next, compute the test statistic:

$$\text{Test statistic} = \frac{\text{Sample statistic-Hypothesized value}}{\text{Standard error of the sample statistic}} = \frac{125 - 120}{\frac{20}{\sqrt{50}}} = 1.768$$

The decision rule is to reject the null hypothesis if the test statistic falls within the critical region. Please confirm that $P(Z > 1.6449) = 0.05$, which means our critical value is the upper 5% point of the normal distribution, i.e., 1.6449. Since 1.768 is greater than 1.6449, it lies in the rejection region. As such, we have sufficient evidence to reject H_0 and conclude that the average IQ of FRM candidates is indeed greater than 120.

Alternatively, we could go the 'p-value way'

$P(Z > 1.768) = 1 - P(Z < 1.768) = 1 - 0.96147 = 0.03853$ or 3.853%

This probability is less than 5% meaning that we have sufficient evidence against H_0. This approach leads to a similar conclusion.

B is incorrect. This option correctly identifies the test statistic as 1.768 and correctly concludes to reject H_0, which aligns with the correct analysis and conclusion based on the calculated test statistic and the comparison to the critical value.

C is incorrect. This option provides a different test statistic of 1.0606 and concludes to fail to reject H_0.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3742 Decreasing the level of significance of a hypothesis test will *most likely*:

A. Increase the type I error

B. Decrease the likelihood of committing a type II error

C. Decrease the likelihood of rejecting the null hypothesis when it's in fact true

The correct answer is **C.**

Having seen that the significance level gives the probability of rejecting a true null hypothesis, it follows that a decrease in a (the level of significance) effectively decreases this probability. That means a decrease of, say, 5% to 1%, would mean less frequent rejection of a true null hypothesis(will decrease the probability of making a type I error)

A is incorrect. The likelihood of a type 1 error will decrease and not increase, reducing the significance level.
B is incorrect. A Type II error occurs when a false null hypothesis is incorrectly accepted, or in other words, when we fail to reject a null hypothesis that is actually untrue. Adjusting the level of significance influences the likelihood of making a Type II error. Specifically, lowering the level of significance makes the criteria for rejecting the null hypothesis more stringent.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3743 Justin Heinz, CFA, suspects that the earnings of the insurance industry are more divergent than those of the banking industry. In a bid to confirm his suspicion, Heinz collects data from a total of 31 insurance companies and establishes that the standard deviation of earnings across that industry is $4.8. Similarly, he collects data from 41 banks and establishes that the standard deviation of earnings across that industry is $4.3. Conduct a hypothesis test at the 5% level of significance to determine if the earnings of the insurance industry have a greater standard deviation than those of the banking industry. Which of the following choices is *most likely* correct? **Choice I.** H0: $s_1^2 \leq s_2^2$ and H1: $s_1^2 > s_2^2$ Critical Value: 1.2461 Decision: Earnings are statistically not significant from one another **Choice II.** H0: $s_1^2 \leq s_2^2$ and H1: $s_1^2 > s_2^2$ Critical value: 1.74 Decision: Earnings are statistically not significant from one another **Choice III.** H0: $s_1^2 = s_2^2$ and H1: $s_1^2 \neq s_2^2$ Critical value: 1.2461 Decision: Earnings are statistically significant from one another

A. I

B. II

C. III

The correct answer is **A.**

As always, the first step involves formulating a relevant hypothesis. We are concerned that the earnings of the insurance company could be greater (more variant) than those of the banking industry. Therefore, the appropriate hypothesis is:

H_0: $s_1^2 \leq s_2^2$ and H1: $s_1^2 > s_2^2$

Where s_1^2 is the variance of earnings for the insurance industry, and s_2^2 is the corresponding variance for the banking industry.

Next in line is the selection of the test statistic. When comparing the variances of two different populations, we use the F-statistic, computed as:

$F = (S_1^2/S_2^2)$ where S_1^2 and S_2^2 are the sample variances

The F-statistic has (n_1 - 1, n_2 - 2) degrees of freedom. i.e. $F_{30,40}$

$F = 4.8^2/4.3^2 = 1.2461$

Note that this is a one-sided test. As such, our critical value should be the upper 5% point of the F-distribution with (30, 40) degrees of freedom. This value = 1.74

Since 1.2461 is less than 1.74, it lies in the non-rejection, and therefore, we have insufficient evidence to reject H_0 at the 5% level of significance.

Decision: Heinz could argue that at the 5% level, the earnings of the insurance sector and those of the banking sector are not significantly different from one another.

B is incorrect. It correctly identifies the critical value for the F-test as 1.74 but incorrectly concludes that the earnings are statistically not significant from one another without providing the calculated F-statistic for comparison. The decision should be based on whether the calculated F-statistic exceeds the critical value, indicating a significant difference in variances.

C is incorrect. It sets up a two-tailed test ($H0 : s_1^2 = s_2^2$ and $H1 : s_1^2 \neq s_2^2$), which is not aligned with Heinz's suspicion that the variance in the insurance industry is greater than in the banking industry. This choice also misapplies the critical value and the decision regarding the significance of the earnings difference.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (b): Construct hypothesis tests and determine their statistical significance, the associated Type I and Type II errors, and the power of the test given a significance level.

Q.3823 A nonparametric test is *most likely* preferred to a parametric test when:

A. Stronger measurement scales are required.

B. The randomness of a sample is being questioned.

C. The population from which the sample is drawn is assumed to be normally distributed.

The correct answer is **B.**

A nonparametric test is preferred to a parametric one when the data do not meet distributional assumptions, when the original data are given in ranks (and a stronger measurement scale is not required), or when the hypothesis being tested does not concern a parameter. For instance, one may need to test whether a sample is random or not rather than testing a parameter.

A is incorrect. A nonparametric test is considered when a stronger measurement scale is not required.

C is incorrect. Nonparametric tests either do not consider a particular population parameter or have few assumptions about the sampled population.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.

Q.4026 Which of the following test is *most appropriate* when testing the difference between the variances of two normally distributed populations?

A. t-test.

B. F-test.

C. Chi-square test.

The correct answer is **B.**

An F-test is the most appropriate when conducting tests relating to the difference between the variances of two normally distributed populations with random independent samples.

A is incorrect. A t-statistic is the most appropriate for hypothesis tests of the population mean with unknown variance, a small sample size, and a normally distributed population.

C is incorrect. A chi-square test is appropriate for tests relating to the variance of a single normally distributed population.

CFA Level I, Quantitative Methods, Learning Module 8: Hypothesis Testing. LOS (c): Compare and contrast parametric and nonparametric tests, and describe situations where each is the more appropriate type of test.
