LO.a: Define a hypothesis, describe the steps of hypothesis testing, and describe and interpret the choice of the null and alternative hypotheses.

1. Which of the following steps in hypothesis testing *least likely* includes 'Collecting the data and calculating the statistic'?
   A. Making the economic or investment decision.
   B. Making the statistical decision.
   C. Stating the decision rule.

2. Marco Vitaly is a researcher and wants to test whether a particular parameter is larger than a specific value. In this case, the null and alternative hypothesis would be *best* defined as:
   A. H_0: $\theta = \theta_0$ versus H_a: $\theta \neq \theta_0$.
   B. H_0: $\theta \leq \theta_0$ versus H_a: $\theta > \theta_0$.
   C. H_0: $\theta \geq \theta_0$ versus H_a: $\theta < \theta_0$.

3. Professor Alan Chang is reviewing the following statements made by his students:
   - Beth: The null hypothesis is the hypothesis that is being tested; and a two tailed hypothesis may have either of the two signs: $\leq$ or $\geq$.
   - Donald: Specifying the significance level, α, isn't a necessary step and one could do without it during hypothesis testing.
   - Kevin: The test statistic is a quantity calculated based on a sample, whose value is the basis for deciding whether or not to reject the alternate hypothesis.

   Whose statements will Professor Chang will *least likely* agree to?
   A. Only Donald.
   B. Only Donald and Beth.
   C. All of them.

LO.b: Distinguish between one-tailed and two-tailed tests of hypotheses.

4. Which of the following statements requires a two-tailed test?
   A. H_0: $\mu \leq 0$ versus H_a: $\mu > 0$.
   B. H_0: $\mu = 0$ versus H_a: $\mu \neq 0$.
   C. H_0: $\mu \geq 0$ versus H_a: $\mu < 0$.

LO.c: Explain a test statistic, Type I and Type II errors, a significance level, and how significance levels are used in hypothesis testing.

5. A Type II error is *best* described as when a test:
   A. fails to reject a false null hypothesis.
   B. fails to reject a true null hypothesis.
   C. rejects a true null hypothesis.

6. In order to calculate the test statistic, the difference between the sample statistic and the value of the population parameter under H_0 is *most likely* divided by:

A. appropriate value from the t-distribution.
B. sample standard deviation.
C. standard error of the sample statistic.

7. When a false null hypothesis is not rejected, it leads to a/an:
   A. Type I Error.
   B. Type II Error.
   C. acceptance of the alternate hypothesis.

8. The results of an experiment are statistically significant when:
   A. the null hypothesis is rejected.
   B. the null hypothesis is not rejected.
   C. the level of significance is altered.

LO.d: Explain a decision rule, the power of a test, and the relation between confidence intervals and hypothesis tests.

9. Jane Norah is an analyst for a midcap growth fund. The fund earns a quarterly return of 4.5 percent relative to an estimated return of 6.0 percent. If Norah wishes to test whether the actual results are different from the estimated return of 6 percent, the null hypothesis is *most likely*:
   A. H_0: $\mu \leq 6.0$.
   B. H_0: $\mu = 6.0$.
   C. H_0: $\mu \neq 6.0$.

10. The mean annual return is 8 percent and the standard deviation is 6.4 percent for a sample containing 25 sectors. A fund manager is testing whether the mean annual return is less than 9 percent. The critical value is -1.96. What is the *most likely* conclusion from this test?
    A. Reject the null hypothesis.
    B. Do not reject the null hypothesis.
    C. Additional information is required to decide.

11. Assume that the population mean is μ, sample mean is $\overline{X}$, and $s_{\bar{X}}$ is the standard error of the sample mean. Which of the following is a condition for rejecting the null hypothesis at the 95 percent confidence interval?
    A. $\frac{\overline{X} - \mu_0}{s_{\overline{X}}} > 1.96$.
    B. $(\overline{X} - \mu_0) > 1.96$.
    C. $\frac{\mu_0 - \overline{X}}{s_{\overline{X}}} > 1.96$.

LO.e: Distinguish between a statistical result and an economically meaningful result.

12. Rejecting or not rejecting the null hypothesis is a:

A. Statistical decision.
B. Economic decision.
C. Both statistical and economic decision.

13. What type of consideration is an investor's tolerance for risk and financial position in hypothesis testing?
A. Investment or economic decision.
B. Statistical decision.
C. Both statistical and economic decision.

LO.f: Explain and interpret the p-value as it relates to hypothesis testing.

14. Which of the following statements regarding the p-value is *most likely* to be correct?
A. The p-value is the smallest level of significance at which the null hypothesis can be rejected.
B. The p-value is the smallest level of significance at which the null hypothesis can be accepted.
C. The p-value is the largest level of significance at which the null hypothesis can be rejected.

15. A researcher formulates a null hypothesis that the mean of a distribution is equal to 20. He obtains a p-value of 0.018. Using a 5% level of significance, the *best* conclusion is to:
A. reject the null hypothesis.
B. accept the null hypothesis.
C. decrease the level of significance.

16. A researcher conducted a one-tailed test with the null hypothesis that the mean of a distribution is greater than 2. The *p*-value came out to be 0.0475. If the researcher decides to use a 5% level of significance, the *best* conclusion is to:
A. fail to reject the null hypothesis.
B. reject the null hypothesis.
C. decrease the level of significance to 4.75%.

17. A researcher is using the *p*-value test for conducting hypothesis testing. He is *most likely* to reject the null hypothesis when the *p*-value of the test statistic:
A. exceeds a specified level of significance.
B. falls below a specified level of significance.
C. is negative.

18. A researcher conducts a two-tailed t-test test with a null hypothesis that the population mean differs from zero. If the *p*-value is 0.089 and he is using a significance level of 5%, the *most* appropriate conclusion is:
A. do not reject the null hypothesis.
B. reject the null hypothesis.

C. the chosen significance level is too high.

LO.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 distributed and the variance is 1) known or 2) unknown.

19. Which of the following statistic is *most likely* to be used for the mean of a non-normal distribution with unknown variance and a small sample size?
A. z test statistic.
B. t test statistic.
C. There is no test statistic for such a scenario.

20. Orlando Bloom is analyzing a portfolio's performance for the past 15 years. The mean return for the portfolio is 10.25% with a sample standard deviation of 12.00%. Bloom wants to test the claim that the mean return is less than 12.50%. The null hypothesis is that the mean return is greater than or equal to 12.50%. If the critical value for this test is -2, which of the following is *most likely* the test statistic and the decision of this test?

	Test Statistic	**Decision**
A.	-0.726	Reject H_0
B.	-0.726	Do not rejectH_0
C.	-0.5422	Do not rejectH_0

21. The test statistic for hypothesis test of a single mean where the population sample has unknown variance is *most likely*:
A. $\frac{\bar{X}-\mu}{\frac{s}{\sqrt{n}}}$.
B. $\frac{(n-1)s^2}{\sigma^2}$.
C. $\frac{s_1^2}{s_2^2}$.

22. Peter is studying the earnings per share of 32 companies in an industry. He plans to use the t-test for hypothesis testing. The degrees of freedom Peter will use for defining the critical region is *closest* to:
A. 30.
B. 31.
C. 32.

LO.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.

23. From two normally distributed populations, independent samples were drawn and following observations were made:
    - Sample A: The sample size of 20 observations had a sample mean of 63.
    - Sample B: The sample size of 14 observations had a sample mean of 58.
    - Standard deviations of sample A and sample B were equal. The pooled estimate of common variance was equal to 565.03.

    A researcher devised the hypothesis that the two sample means are equal. In order to test this hypothesis, the t-test statistic to be used is *closest* to:
    A. 0.21.
    B. 0.35.
    C. 0.60.

LO.i: Identify the appropriate test statistic and interpret the results for a hypothesis test concerning the mean difference of two normally distributed populations.

24. The table below shows the return data for samples which have been pooled from two normally distributed populations with equal variance.

Sample #	Sample size	Annual returns
1	60	15.8%
2	112	12.5%

    The standard deviation of the pooled sample, s, is 256.68. Which of the following is the correct test statistic to test for the differences between means?
    A. 0.0006.
    B. 0.0008.
    C. 0.0011.

25. Using the sample results given below, drawn as 25 paired observations from their underlying distributions, test if the mean returns of the two portfolios differ from each other at the 1% level of statistical significance. Assume the underlying distributions of returns for each portfolio are normal and that their population variances are not known.

	Portfolio 1	Portfolio 2	Difference
Mean Return	8.00	11.25	3.25
Standard Deviation	8.80	15.50	6.70
t-statistic for 24 df and at the 1% level of statistical significance = 2.797			

    Based on the paired comparisons test of the two portfolios, the *most* appropriate conclusion is to:
    A. reject the hypothesis that the mean difference equals zero as the computed test statistic exceeds 2.807.

B. accept the hypothesis that the mean difference equals zero as the computed test statistic exceeds 2.807.
C. accept the hypothesis that the mean difference equals zero as the computed test statistic is less than 2.807.

26. An analyst collects the following data related to paired observations for Sample A and Sample B. Assume that both samples are drawn from normally distributed populations and that the population variances are not known:

Paired Observation	**Sample A Value**	**Sample B Value**
1	12	5
2	18	15
3	4	1
4	-6	-9
5	-5	4

The *t*-statistic to test the hypothesis that the mean difference is equal to zero is *closest* to:
A. 0.23.
B. 0.27.
C. 0.52.

27. Which of the following is *true* for a paired comparison test?
A. The samples are independent.
B. The samples are dependent.
C. The test conducted is a test concerning differences between mean and not mean differences.

28. The table below shows the annual return summary for KSE-50 and KSE-100 portfolios.

Portfolio	**Mean Return**	**Standard Deviation**
KSE – 50	19.25%	20.05%
KSE – 100	15.98%	17.11%
Difference	3.27%	5.48%

The null hypothesis for the test conducted is H_o: $\mu_d = 0$. The sample size is 64.
Which of the following *most likely* represent the test conducted and the value of the test statistic?
A. A chi square test with t statistic = 4.77.
B. A paired comparison test with t statistic = 5.27.
C. A paired comparison test with t statistic = 4.77.

29. A hypothesis test is to be conducted in order to test the differences between means. Which of the following will *least likely* be used as a null hypothesis for this test?
A. H_o: $\mu_1 + \mu_2 = 0$.
B. H_o: $\mu_1 - \mu_2 = 0$.

C. $H_o: \mu_1 \leq \mu_2$.

LO.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.

30. A researcher drew two samples from two normally distributed populations. The mean and standard deviation of the first sample were 4 and 48 respectively. The mean and standard deviation of the second sample were 6 and 52 respectively. The number of observations in the first sample was 30 and second sample was 32. Given a null hypothesis of $\sigma_1^2 = \sigma_2^2$ versus an alternate hypothesis of $\sigma_1^2 \neq \sigma_2^2$, which of the following is *most likely* to be the test statistic?
    A. 0.235.
    B. 0.852.
    C. 1.170.

31. The null hypothesis $H_o: \sigma_1^2 = \sigma_2^2$ *most likely* tests:
    A. the mean differences.
    B. a single variance.
    C. the equality of two variances.

32. For an F-test specified as $\frac{s_1^2}{s_2^2}$, which of the following is used as the actual test statistic?
    A. s_1 should be greater than s_2.
    B. s_1 should be less than s_2.
    C. It does not matter whether s_1 is greater or less than s_2.

33. Which test should be used for hypothesis related to a single population variance?
    A. A chi-square test with degrees of freedom, n.
    B. A chi-square test with degrees of freedom, n-1.
    C. An F-test with degrees of freedom, n-1.

LO.k: Distinguish between parametric and nonparametric tests and describe situations in which the use of nonparametric tests may be appropriate.

34. A test that makes minimal assumptions about the population from which the sample comes is known as a:
    A. paired comparisons test.
    B. parametric test.
    C. nonparametric test.

35. An investment analyst will *least likely* use a non-parametric test in which of the following situations?

A. When the data does not meet distributional assumptions.
B. When the data provided is given in ranks.
C. When the hypothesis being addressed concerns a parameter.

Solutions

1. C is correct. The seven steps in hypothesis testing are:
   1) Stating the hypothesis.
   2) Identifying the appropriate test statistic and its probability distribution.
   3) Specifying the significance level.
   4) Stating the decision rule.
   5) Collecting the data and calculating the test statistic.
   6) Making the statistical decision.
   7) Making the economic or investment decision.

2. B is correct. A positive "hoped for" condition means that we will only reject the null (and accept the alternative) if the evidence indicates that the population parameter is greater than θ_0. Thus, H_0: $\theta \leq \theta_0$ versus Ha: $\theta > \theta_0$ is the correct statement of the null and alternative hypotheses.

3. C is correct. The null hypothesis is the hypothesis that is tested, and a two tailed hypothesis has the sign: =. Specifying the significance level, α, is a necessary step and one cannot do without it during hypothesis testing. The test statistic is a quantity calculated based on a sample, whose value is the basis for deciding whether or not to reject the null hypothesis.

4. B is correct. A two-tailed test for the population mean is structured as: H_o: $\mu = 0$ versus H_a: $\mu \neq 0$.

5. A is correct. When we do not reject a false null hypothesis we have a Type II error.

6. C is correct. A test statistic is defined as the difference between the sample statistic and the value of the population parameter under H_0 divided by the standard error of the sample statistic.

7. B is correct. Type II error arises when a false null hypothesis is not rejected. Type I error is rejecting the null hypothesis when it is true.

8. A is correct. The results of an experiment are statistically significant when the null hypothesis is rejected.

9. B is correct. The null hypothesis for this test will be $H_0 = 6.0$.

10. B is correct. The test statistic is
    $\frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}} = \frac{8 - 9}{\frac{6.4}{\sqrt{25}}} = -0.78$
    Since the test statistic is less negative (lower absolute value) than the critical value, the null hypothesis is not rejected.

11. A is correct.

12. A is correct. The economic decision considers economic issues.

13. A is correct. Investor's risk tolerance is an investment decision, and not a statistical decision.

14. A is correct. The p-value is defined as the smallest level of significance at which the null hypothesis can be rejected.

15. A is correct. As the p-value is less than the stated level of significance, we reject the null hypothesis.

16. B is correct. Because the p-value (0.0475) is lower than the stated level of significance (0.05), we will reject the null hypothesis.

17. B is correct. If the p-value is less than the specified level of significance, the null hypothesis is rejected.

18. A is correct. The *p*-value is the smallest level of significance at which the null hypothesis can be rejected. In this case, the given *p*-value is greater than the given level of significance. Hence, we cannot reject the null hypothesis. Note that we simply compare the given p-value with the level of significance. Even though this is a two-tailed test we **do not** divide the p-value by 2.

19. C is correct. The statistic for small sample size of a non-normal distribution with unknown variance is not available. z-test statistic is used for large sample size of a non-normal distribution with known variance while t-test statistic is used for large sample size of a non-normal distribution with unknown variance.

20. B is correct.

$$t = \frac{10.25 - 12.50}{12/\sqrt{15}} = -0.726$$

Since the absolute value of -0.726 is less than the absolute value of -2, we cannot reject the null hypothesis.

21. A is correct. The test statistic shown in option A is correct as the description given in the question requires a t-test.

22. B is correct. In a t-test, the degree of freedom is 1 less than the sample size. Therefore, it will be 31 in this case.

23. C is correct. The appropriate t-statistic can be calculated using the formula:

t-statistic

$$= \frac{[(X_1 - X_2) - (\mu 1 - \mu 2)]}{\sqrt{\left[\left(\frac{s_p^2}{n_1}\right) + \left(\frac{s_p^2}{n_2}\right)\right]}}$$

$$= \frac{[(63 - 58) - 0]}{\sqrt{\left[\left(\frac{565.03}{20}\right) + \left(\frac{565.03}{14}\right)\right]}}$$

= 0.604

24. A is correct.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\left[\left(\frac{s^2}{n_1}\right) + \left(\frac{s^2}{n_2}\right)\right]^{\frac{1}{2}}} = \frac{.158 - .125}{\left[\left(\frac{256.68^2}{60}\right) + \left(\frac{256.68^2}{112}\right)\right]^{\frac{1}{2}}} = 0.0008.$$

25. C is correct. The test statistic is: $\frac{3.25 - 0}{\frac{6.70}{\sqrt{25}}} = 2.425.$

As 2.425 < 2.807, we do not reject the null hypothesis that the mean difference is zero. This is a two tail test.

26. C is correct.

Paired Observation	**Sample A Value**	**Sample B Value**	**Differences**	**Differences Minus the Mean Difference, Then Squared**
1	12	5	7	$(7 - 1.4)^2 = 31.36$
2	18	15	3	$(3 - 1.4)^2 = 2.56$
3	4	1	3	$(3 - 1.4)^2 = 2.56$
4	-6	-9	3	$(3 - 1.4)^2 = 2.56$
5	-5	4	–9	$(-9 - 1.4)^2 = 108.16$
			Sum = 7 Mean = 1.4	Sum of squared differences = 147.2
			Sample variance:	$\frac{147.2}{4} = 36.8$
			Standard error:	$2.712932 = \sqrt{\frac{36.8}{5}}$
			t-Statistic:	$0.51605 = \frac{1.4 - 0}{2.712932}$

27. B is correct. A paired comparison test is conducted for mean differences and the samples are dependent.

28. C is correct. Since the test concerns mean differences, it is a paired comparisons test.
$t = (3.27 - 0)/(5.48/\sqrt{64}) = 4.77.$

29. A is correct. The incorrect null hypothesis is H_o: $\mu_1 + \mu_2 = 0$.

30. C is correct. The test that compares the variances using two independent samples from two different populations makes use of the F-distributed t-statistic:
$$\frac{\sigma_1^2}{\sigma_2^2}$$
The smaller variance is the denominator, thus:
$$\frac{52^2}{48^2} = 1.17.$$

31. C is correct. The test concerns the equality of two variances. It is known as the F-test.

32. A is correct. A common convention or a usual practice is that the ratio should be greater than or equal to 1, which is only possible if option A is true.

33. B is correct. To test for a single population variance, select a chi-square test with (n – 1) degrees of freedom.

34. C is correct. A test that makes minimal assumptions about the population from which the sample comes is known as a non-parametric test. It is not concerned with a parameter.

35. C is correct. In nonparametric tests, the hypothesis being addressed should not concern a parameter.