Level II of the CFA® 2025 Exam

Item-Set Questions with Answers - Quantitative Methods

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Table of Contents

Case 1: Brittany Ruiz

Brittany Ruiz is the chief investment officer (CIO) at Black-Mount Capital Advisory Firm (BMCA), a leading U.S. based money management firm. Last year, BMCA launched the BMCA Equity Fund that invested in domestic and international markets stocks, including those of Russia, Brazil, Canada, and the U.K. During its annual performance review, Ruiz discovered that the fund earned a considerably less return than that of its benchmark. Concerned with the outcome, Ruiz called a meeting with the fund's portfolio management team to discuss key issues related to the quantitative analysis of the fund's investments. A leading quantitative expert, Anthony Webb, was invited to chair the meeting. While analyzing the regression models used by the PM team to predict stock returns, Webb requested the information provided in Exhibit 1. The information relates to a time-series model for annualized monthly returns to a Brazilian stock index.

Exhibit 1: Annualized Monthly Returns to a Brazilian Stock Index

Lag	Autocorrelation
1	0.1320
2	0.1856
3	-0.0098
4	0.0056
5	-0.0062

Critical t-value	1.96
Number of observations	398

After his analysis, Webb presented the following conclusions to the portfolio management team:

Conclusion 1: "This time series can be best modeled using a moving average (2) model rather than an autoregressive model."

Conclusion 2: "A moving average (2) model would be different from a simple moving average because the former would place different weights on the terms in the moving average. And unlike the MA(2), a simple moving average is based on observed time series values."

Since 10% of the BMCA Equity Fund was invested in large-cap Russian stocks, Webb considered it crucial to study the characteristics of the Russian capital markets. While reviewing BMCA's autoregressive (1) model used to predict the Russian inflation rate, Webb suspected that the model might have a unit root. To accurately test for the presence of a unit root in the time series, Webb decided to regress the first difference of the time series on the first lag of the time series. After obtaining the regression results, Webb calculated the t-statistic conventionally for the coefficient. He then used the critical t-values computed by Dickey and Fuller to determine significance. Since he could not reject the null hypothesis at the 5% significance level, Webb concluded that the series did not have a unit root and was stationary.

When talking to Ruiz about ‘random walks’ Webb stated that a time-series that was a random walk could not be analyzed using standard regression analysis. He made the following statements:

Statement 1: “There is no finite mean-reverting level for a random walk. In addition, the variance of the time-series increases or decreases as we go further into the future without any lower or upper bound. This violates the assumption of a finite variance for the time-series.”

Statement 2: “To model a random walk, we should first-difference it. This results in a mean-reverting level of 0. In addition, the variance of a first-differenced time-series is not only finite, but is also constant. The time-series then becomes covariance stationary.”

Webb continued by stating that if a time-series is a random walk, it is best to model the first-differenced series with an autoregressive model to predict future movements in the time-series. He also stated that the key to choosing the correct model was to analyze each model’s R^2: the first-differenced AR model would generally have an R^2 greater than the R^2 of the original AR model for a random walk, since the first-differenced model better fits the data.

Q.1 Webb is *most accurate* with respect to:

A. Conclusion 1 and conclusion 2.

B. Conclusion 2 only.

C. Neither conclusion 1 nor conclusion 2.

The correct answer is **A.**

Conclusion 1 is correct because it accurately identifies the appropriate model for the data presented in Exhibit 1. The autocorrelations at lags 1 and 2 are 0.1320 and 0.1856 respectively, which are significantly different from zero given the critical t-value of 1.96 and the standard error calculated as

$$\frac{1}{\sqrt{398}} \approx 0.05012$$

. Autocorrelations at higher lags (3, 4, and 5) are very close to zero, indicating no significant autocorrelation at these lags. This pattern suggests that the time series has short-term dependencies that can be captured by a moving average model with two lags (MA(2)), rather than a longer or indefinite series of dependencies that would suggest an autoregressive model. The significant autocorrelations at the first two lags and the insignificance of higher lags support the use of an MA(2) model.

Conclusion 2 correctly differentiates between a simple moving average and a moving average model like MA(2). A simple moving average assigns equal weights to all observations within the window (the number of lags considered), and it only considers the observed values of the time series. In contrast, a moving average model like MA(2) can assign different weights to different lags and these weights are determined statistically based on the data to best forecast future values. This distinction is crucial for accurate modeling and forecasting, especially in financial time series where recent values might have more predictive power than older values.

B is incorrect. Although Conclusion 2 is correct, option B suggests that only Conclusion 2 is accurate, which is not the case as Conclusion 1 is also correct.

C is incorrect. This option suggests that neither Conclusion 1 nor Conclusion 2 is correct, which is not accurate as both conclusions are correct.

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5(e): explain how autocorrelations of the residuals can be used to test whether the autoregressive model fits the time series

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5(o): determine an appropriate time-series model to analyze a given investment problem and justify that choice

Q.2 Is Webb’s conclusion regarding the presence of a unit root in the inflation rate time-series *most likely* correct:

A. Yes.

B. No, because the regression variables that he used and his computed t-statistic were incorrect.

C. No, because his application of the regression-based unit root test was incorrect.

The correct answer is **C.**

Webb's conclusion that the inflation rate time-series does not have a unit root is incorrect because his interpretation of the test results from the regression-based unit root test was flawed. In the context of unit root testing, particularly using the Dickey-Fuller test, the null hypothesis posits that the time series has a unit root, implying it is non-stationary. To reject this hypothesis, the test statistic calculated (t-statistic) must be more negative than the critical values provided by Dickey and Fuller. If the t-statistic is not sufficiently negative, the null hypothesis cannot be rejected, suggesting that the series likely has a unit root and is non-stationary. Webb's conclusion that the series did not have a unit root because he could not reject the null hypothesis at the 5% significance level indicates a misunderstanding. Not being able to reject the null hypothesis implies that there is not enough statistical evidence to conclude that the series is stationary; hence, it should be assumed to have a unit root.

A is incorrect. Option A is not supported by the methodology of unit root testing. In these tests, failing to reject the null hypothesis (that the series has a unit root) at a conventional significance level (like 5%) means that there is insufficient evidence to conclude the series is stationary. Therefore, the correct interpretation should be that the series likely does have a unit root, contrary to Webb's conclusion. Thus, option A is incorrect because it incorrectly affirms Webb's flawed conclusion.

B is incorrect. Option B states that Webb's conclusion is incorrect due to the use of wrong regression variables and an incorrectly computed t-statistic. While it is crucial to use appropriate variables and accurately compute the t-statistic in a regression-based unit root test, the information provided does not indicate any errors in the selection of variables or in the computation of the t-statistic. Webb's primary error was in the interpretation of the test results, not in the technical execution of the test. Therefore, while option B correctly identifies an issue with Webb's conclusion, it inaccurately attributes the error to factors that are not supported by the provided information.

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5 (j): describe implications of unit roots for time-series analysis, explain when unit roots are likely to occur and how to test for them, and demonstrate how a time series with a unit root can be transformed so it can be analyzed with an AR model

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5(k): describe the steps of the unit root test for nonstationarity and explain the relation of the test to autoregressive time-series models

Q.3 Webb is *most accurate* with respect to:

A. Statement 1 only.

B. Statement 2 only.

C. Neither statement 1 nor statement 2.

The correct answer is **B.**

Webb's accuracy in his statements about modeling random walks can be assessed by understanding the fundamental properties of random walks and the implications for statistical modeling. Statement 2 is correct because it accurately describes the process and benefits of first-differencing a random walk time series. When a time series is a random walk, it means that each value is a random step from the previous one, leading to non-stationarity due to the variance depending on time. By first-differencing the series, each value represents the change from the previous value, effectively eliminating the trend and stabilizing the variance. This transformation results in a series with a mean of zero and constant variance, making it stationary and suitable for further analysis with autoregressive models. The first-differenced series does not depend on time, allowing for consistent application of statistical methods and hypothesis testing.

A is incorrect. Statement 1 is incorrect because it mischaracterizes the behavior of variance in a random walk. In a random walk, the variance indeed increases over time, but it does not have bounds—neither lower nor upper. The statement incorrectly suggests that there is no lower bound on the variance, which is misleading because the concept of bounds does not apply in this context. The variance of a random walk is theoretically infinite as time progresses, reflecting the cumulative nature of random fluctuations over time. This characteristic of increasing variance without bounds is precisely why standard regression techniques, which assume finite variance, are not suitable for analyzing random walks directly without transformations such as first-differencing.

C is incorrect. Choosing option C would imply that both statements made by Webb are incorrect. However, as analyzed, Statement 2 is indeed correct in its description of how to handle a random walk for statistical analysis. The process of first-differencing a random walk addresses the non-stationarity issue by stabilizing the variance and centering the mean at zero, which contradicts the choice of option C. Therefore, this option is not the correct choice as it inaccurately dismisses the validity of Statement 2.

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5(i): describe characteristics of random walk processes and contrast them to covariance stationary processes

Q.4 With regards to his comments about random walks, Webb is *most likely*:

A. Correct.

B. Incorrect about the criterion of choosing the correct model.

C. Incorrect about the use of first-differenced AR models and about the criterion of choosing the correct model.

The correct answer is **C.**

Webb's statement that a time-series which is a random walk should be modeled using a first-differenced autoregressive (AR) model to predict future movements, and that the correct model can be chosen by comparing the R^2 values, is flawed. First, while first-differencing a random walk time-series does indeed transform it into a stationary series, this does not necessarily mean that an AR model is the best predictive model. The effectiveness of an AR model in forecasting depends on the specific characteristics and structure of the time-series data after differencing. Moreover, the use of R^2 as a criterion for model selection in time-series analysis is limited. R^2 measures the proportion of variance explained by the model in-sample, but it does not necessarily indicate the model's predictive accuracy out-of-sample. Therefore, relying solely on R^2 to choose between models can be misleading, as it might favor more complex models without genuinely providing better predictive performance.

A is incorrect. Webb's statements about the properties of random walks and the transformation achieved by first-differencing are essentially correct. A random walk is characterized by non-stationarity, with no tendency to return to a long-term mean and an unbounded variance over time. First-differencing a random walk results in a stationary series with a constant mean and variance, which are critical assumptions for many standard time-series models. Therefore, stating that Webb is entirely correct overlooks the nuances and inaccuracies in his approach to model selection and the limitations of using R^2 for this purpose.

B is incorrect. While Webb's comments about the use of first-differenced AR models are not entirely off-base, his suggestion that the correct model can be chosen based solely on the R^2 values is incorrect. The choice of a model in time-series forecasting should consider several factors, including the model's ability to capture the dynamics of the data, its simplicity, its interpretability, and its predictive performance on new, unseen data. R^2 alone does not provide a comprehensive measure of a model's suitability for forecasting, as it does not account for the potential overfitting of data or the model's performance outside the sample used for estimation. This makes option B incorrect as it does not fully capture the extent of Webb's inaccuracies.

Study Session 1, Learning Module 5 Time-Series Analysis, LOS 5(i): describe characteristics of random walk processes and contrast them to covariance stationary processes

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Case 2: Quality Investment Advisory

Quality Investment Advisory (QIA) is a U.S. based asset management firm providing financial advice and portfolio management services to private and institutional clients. Rob Wallace works as the chief portfolio manager at QIA's headquarters in Chicago, USA. Wallace is currently managing a $5 million portfolio of John Mackintosh - one of the firm's oldest high net worth clients. The portfolio invests a significant portion in the stocks of emerging markets, like those of Russia and Brazil.To estimate the returns to Brazilian stock investments, Wallace used a regression model with the dependent variable measuring the Brazilian stock return and the independent variables measuring (I) the growth in the Brazilian GDP and (II) the return on a Brazilian market index. Exhibit 1 displays the results to estimating this regression.

Exhibit 1
Regression Analysis Results

	Coefficient	**Standard Error**
Intercept	0.0095	0.013
Annual % increase in GDP	0.667	0.337
Annual return to Brazilian market index	2.245	0.245

ANOVA	
Regression Sum of Squares	0.9436
Residual Sum of Squares	0.3426
Observations	60

While talking to Mackintosh about the results of the regression, Wallace made the following comment:

"The interpretation of the slope coefficient of the annual percentage increase in GDP is that for every 1 unit increase in GDP, we would expect your return to increase by 0.667 units. The coefficient value of 0.667 will remain constant even if we remove the second independent variable."

Mackintosh requested to know exactly how changes in market return would impact the return on his Brazilian investment. Wallace gave the following response:

"Let's assume the change in market return over a year is 1%. If we compared the return on your investment at the beginning of the year with the return at the end of the year, we would expect an increase of 2.245%. However, to ensure that this holds, we would have to calculate the F-statistic using data from the regression, particularly the sum of squared residuals and the regression sum of squares."

After he met with Mackintosh, Wallace met with Colin Edwards - a statistician at QIA's headquarters - with whom he had been managing a multimillion dollar institutional fund. Edwards suggested using a multiple regression model to determine whether (I) an increase in the U.S. literacy rate and (II) an improvement in technology would affect the stocks' P/E.

Q.1 Which of the following statements about the regression on Brazilian stocks return is *most accurate* :

A. The Brazilian stocks return is very closely related to the annual return on the Brazilian market index.

B. The Brazilian stocks return is closely related to the annual percentage increase in GDP.

C. The Brazilian stocks return is unrelated to both the annual return on the Brazilian market index and the annual percentage increase in GDP.

The correct answer is **A.**

The regression analysis results show a strong and statistically significant relationship between the Brazilian stocks return and the annual return on the Brazilian market index. The coefficient for the annual return on the Brazilian market index is 2.245 with a standard error of 0.245. To determine the significance of this coefficient, we calculate the t-statistic as follows:

$$\frac{2.245}{0.245} = 9.163.$$

With 57 degrees of freedom (60 observations minus 3 for the intercept and two predictors), the critical t-value at the 0.05 significance level is approximately 2.00. Since 9.163 is significantly greater than 2.00, we conclude that the coefficient is statistically significant, indicating a strong relationship between the market index return and the stocks return.

B is incorrect. While the coefficient for the annual percentage increase in GDP is positive (0.667), its statistical significance is questionable. The t-statistic for this coefficient is calculated as follows:

$$\frac{0.667}{0.337} = 1.979.$$

This value is slightly below the critical t-value of 2.00 at the 0.05 significance level, suggesting that the relationship between GDP growth and Brazilian stocks return is not statistically significant at conventional levels. Therefore, we cannot confidently assert that the stocks return is closely related to GDP growth based on this analysis.

C is incorrect. Claiming that the Brazilian stocks return is unrelated to both the annual return on the Brazilian market index and the annual percentage increase in GDP is contradicted by the regression results. As discussed, the coefficient for the annual return on the Brazilian market index is highly significant, indicating a strong relationship. Although the GDP growth's coefficient is not statistically significant, the presence of a significant relationship with the market index return is enough to refute the claim that the stocks return is unrelated to both predictors.

Learning Module 2: Evaluating Regression Model Fit and Interpreting Model Results, LOS 2(b): formulate hypotheses on the significance of two or more coefficients in a multiple regression model and interpret the results of the joint hypothesis tests.

Q.2 Using the information provided in Exhibits 1, the F-statistic is *closest* to:

A. 2.754.

B. 78.49.

C. 79.87.

The correct answer is **B.**

The F-statistic is calculated to assess the overall significance of a regression model. It is derived by dividing the mean square due to regression (MSR) by the mean square error (MSE). In this case, the regression sum of squares (SSR) is 0.9436 and the residual sum of squares (SSE) is 0.3426 with a total of 60 observations and 2 predictors. The formula for the F-statistic is:

$$\text{F-Statistic} = \frac{\text{MSR}}{\text{MSE}} = \frac{\frac{\text{SSR}}{k}}{\frac{\text{SSE}}{n-k-1}}$$

Where k is the number of predictors (2 in this case) and n is the total number of observations (60). Plugging in the values:

$$\text{MSR} = \frac{0.9436}{2} = 0.4718$$

$$\text{MSE} = \frac{0.3426}{57} = 0.00601$$

$$\text{F-Statistic} = \frac{0.4718}{0.00601} = 78.49$$

A is incorrect. The value 2.754 does not correspond to the correct calculation of the F-statistic based on the given data. The correct F-statistic calculation, as shown above, results in 78.49. The value 2.754 might result from an incorrect application of the formula, perhaps by misplacing the values of SSR or SSE, or incorrect division of these sums by their respective degrees of freedom. It is essential to accurately apply the formula and use the correct values to ensure the validity of the statistical inference of the regression model.

C is incorrect. The value 79.87 is close to the correct F-statistic but is not accurate. This discrepancy could arise from a minor miscalculation or rounding error in the final steps of computing the F-statistic. It is crucial to follow the mathematical calculations meticulously to avoid such errors, especially in statistical analysis, where precision is key to deriving valid conclusions. The correct F-statistic, as calculated, should be 78.49, not 79.87.

Study Session 1, Learning Module 2: Evaluating Regression Model Fit and Interpreting Model Results, LOS 2(c) Calculate and interpret a predicted value for the dependent variable, given the estimated regression model and assumed values for the independent variable.

Q.3 With respect to his comment, Wallace will *most likely* be correct only if the:

A. Second independent variable is uncorrelated with the annual % increase in GDP.

B. Intercept and the second independent variable are uncorrelated with the annual % increase in GDP.

C. Residuals of the regression represent the expected net effect on Brazilian stock returns of a 1 unit increase in annual GDP after removing that part of GDP that is correlated with the market index return.

The correct answer is **A.**

Rob Wallace's statement that the coefficient value of 0.667 for the annual percentage increase in GDP will remain constant even if the second independent variable is removed is contingent on the lack of correlation between the two independent variables. In regression analysis, the stability of a coefficient when another variable is removed depends on the independence of the variables involved. If the second variable, which in this case is the annual return to the Brazilian market index, is uncorrelated with the GDP growth, removing it from the model will not affect the coefficient estimate for GDP growth. This is because the unique contribution of GDP growth to the model's explanation of Brazilian stock returns is isolated from the influence of the market index return. Therefore, Wallace's statement holds true under the condition that there is no multicollinearity between the GDP growth and the market index return.

B is incorrect. Option B suggests that both the intercept and the second independent variable need to be uncorrelated with the annual percentage increase in GDP for the coefficient to remain constant. However, the intercept in a regression model does not typically correlate with the independent variables as it represents the expected value of the dependent variable when all independent variables are zero. The stability of the GDP growth coefficient is primarily concerned with the relationship between the two independent variables, not the intercept. Therefore, the correlation status of the intercept is irrelevant to the constancy of the GDP growth coefficient when the market index return is removed.

C is incorrect. Option C describes a scenario where the residuals of the regression represent the net effect on Brazilian stock returns of a GDP increase, adjusted for any correlation with the market index return. This option misinterprets the nature of regression residuals, which actually represent the portion of the dependent variable not explained by the model rather than a direct effect of adjusting for correlated independent variables. Furthermore, the statement in option C does not directly address the issue of whether the GDP growth coefficient remains constant when the market index return is removed, which is the core of Wallace's statement.

Study Session 1, Learning Module 1: Basics of Multiple Regression and Underlying Assumptions, LOS 1(b) Formulate a multiple linear regression model, describe the relation between the dependent variable and several independent variables and interpret estimated regression coefficients

Q.4 With respect to the effect of change in market return on the Brazilian investment return, Wallace is *least* accurate with respect to:

A. The comparison of returns only.

B. Neither the comparison of returns nor the F-statistic.

C. Both the comparison of returns and the F-statistic.

The correct answer is **C.**

Wallace's explanation regarding the impact of a change in market return on the Brazilian investment return is inaccurate in both the aspects he discussed: the comparison of returns and the calculation of the F-statistic. Firstly, Wallace suggests that a 1% increase in the market return would lead to a 2.245% increase in the investment return. This statement oversimplifies the relationship because it assumes that other variables, particularly the GDP growth, remain constant. However, in a multiple regression model like the one used, the effect of one independent variable on the dependent variable is contingent on the values of other variables in the model. The coefficient of 2.245 for the market return is an estimate based on the specific data set and model used, including the presence of the GDP growth variable. If the GDP growth changes, it could significantly alter the impact of market return on the investment return.

A is incorrect. Wallace's statement about the comparison of returns only being affected by the market return is misleading because it ignores the influence of other variables in the regression model, specifically the GDP growth. The return on investment is dependent on multiple factors, and any change in these factors can alter the outcome. Therefore, stating that a 1% change in market return directly results in a 2.245% increase in investment return without considering the potential variability in GDP growth or other factors oversimplifies the dynamics of the investment's return.

B is incorrect. Wallace's reference to the F-statistic is also incorrect. He suggests using the F-statistic to verify if the change in market return significantly affects the investment return. However, the F-statistic in a multiple regression context is generally used to test the joint significance of all regression coefficients in the model, not just a single coefficient. To assess the impact of the market return independently, a t-test should be used to determine if the coefficient for the market return is significantly different from zero, assuming other factors are held constant. Wallace's suggestion of using the F-statistic for this purpose indicates a misunderstanding of the appropriate statistical tests used in regression analysis.

Study Session 1, Learning Module 2: Evaluating Regression Model Fit and Interpreting Model Results, LOS 2(c) Calculate and interpret a predicted value for the dependent variable, given the estimated regression model and assumed values for the independent variable.

Case 3: Jack Blessing

Jack Blessing, a portfolio manager, follows stocks in the telecommunication industry. Currently, Blessing is researching TeleBrand Enterprises (TBE), a leading competitor in the industry. Initially, Blessing estimated a linear trend model, with a trend coefficient of 1154.78, to fit the data on annual sales of TBE, but found out that the regression errors were correlated across observations. He, therefore, rejected the model and estimated a linear trend in lognormal TeleBrand sales. Exhibit 1 displays some information related to the current regression. Blessing used the most recent 20-year data to estimate the regression coefficients.

Exhibit 1

Regression Statistics	
R-squared	0.9588
Standard error	0.1563
Observations	20

	Coefficient	**Standard error**
Intercept	6.789	0.02745
Trend	0.0965	0.01301

Blessing invited Shane Sweet, his colleague, to discuss the output of his analysis. Sweet made the following comments:

Statement 1: "Based on your current model, the sales of TeleBrand Enterprises are expected to grow at a constant rate of 10.13% per year. In contrast, the previous model predicted that sales would increase by $1154.78 from one year to the next."

Statement 2: "Using the current model, the predicted sales for next year are approximately $977.99 million."

Blessing has short-listed another company -- CareLink Ltd -- for inclusion in his portfolio. Blessing plans to use a time-series model to predict CareLink's profit margin for future periods. He believes that the current period's profit margin is significantly related to the most recent profit margin. To test this, Blessing uses figures for the quarterly profit margin from the second quarter of 2005 through the fourth quarter of 2019. He estimated the intercept and coefficient to be 0.0934 and 0.7986, respectively and concluded that the two were statistically significant. However, Sweet told Blessing to test the residual autocorrelations to determine whether the model is correctly specified. She made the following comment:

Statement 3: “In a regression such as this one, serial correlation in the error term is much more critical in its consequences than for cross-sectional models since it causes estimates of the intercept and slope coefficient to be inconsistent. Also, if CareLink's profit margin has always been more volatile in certain periods than in others, likely, the profit margin is not covariance stationary."

Following Sweet's advice, Blessing calculated the following autocorrelations:

Exhibit 2

Lag	Autocorrelations
1	0.0986
2	0.0438
3	-0.1743
4	-0.2319

Blessing uses his estimated regression equation to predict CareLink's profit margin in six months. The current profit margin is 35%.

Sweet manages the fixed income allocation of an institutional fund. Since bond returns largely depend on current and future inflation rates, Sweet is building a time-series model for U.S. inflation, using monthly observations. She has estimated two models, an AR (1) and an AR (2) model. Exhibit 3 presents a contrast between the regression statistics of the two models.

Exhibit 3

Regression statistics	AR(1)	AR(2)
R-squared	0.586	0.657
Standard error	3.129	3.325
Observations	249	248
Average squared error	15.963	15.158

Sweet is assessing the predictive capabilities of the models to determine their real-world contribution.

Q.1 Sweet is *most* accurate with respect to:

A. statement 1 only.

B. statement 2 only.

C. both statements 1 and 2.

The correct answer is **A.**

Statement 1 accurately describes the implications of using a log-linear trend model for predicting sales growth. In a log-linear model, the coefficient of the trend variable represents the continuous growth rate, which can be transformed into an annual growth rate by using the exponential function. Specifically, the coefficient of 0.0965 in the model implies an annual growth rate of sales calculated as

$$e^{0.0965} - 1 \approx 10.13\%.$$

This calculation is based on the exponential growth formula, where the exponentiation of the trend coefficient minus one gives the percentage growth. This model contrasts with the previous linear trend model, which predicted a constant dollar increase in sales year over year, specifically by $1154.78. The log-linear model instead provides a percentage growth rate, which is more appropriate for long-term forecasts where growth compounding is expected.

B is incorrect. Statement 2 misinterprets the output of the log-linear model. The predicted sales for the next year cannot be directly stated as $977.99 million without proper calculation from the model's output. To find the predicted sales, we use the regression equation from the log-linear model:

$$\ln(\text{Sales}) = 6.789 + 0.0965 \times 21.$$

Solving this equation gives the natural logarithm of the predicted sales. To find the sales in actual dollars, we must exponentiate the result:

$$e^{6.789+0.0965\times 21}.$$

This calculation involves using the exponential function to convert the logarithmic forecast back to a dollar amount, which does not simplistically equate to $977.99 million without performing the necessary exponential calculation. The incorrect statement likely arises from a misunderstanding of how to apply and interpret the coefficients in a log-linear regression model.

C is incorrect. Choosing both statements as accurate is incorrect because, as explained.

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5(a): calculate and evaluate the predicted trend value for a time series, modeled as either a linear trend or a log-linear trend, given the estimated trend coefficients

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Q.2 Is Sweet *most likely* correct with respect to statement 3, and is the time-series model for estimating CareLink's profit margin correctly specified?

A. Yes.

B. Statement 3 is correct, but the model is misspecified.

C. Statement 3 is incorrect, but the model is correctly specified.

The correct answer is **A.**

Shane Sweet's statement about the importance of serial correlation in the error term for time-series models is accurate. In autoregressive models, such as the one used by Jack Blessing for CareLink's profit margins, the presence of serial correlation can lead to inconsistent estimates of the model parameters (intercept and slope). This inconsistency arises because the error terms are not independent from one period to another, violating one of the key assumptions of classical linear regression models. Furthermore, Sweet's comment about the potential non-stationarity of the profit margin series is crucial. If the profit margin exhibits volatility that varies over time, it suggests that the series may not have a constant mean and variance, a condition known as covariance stationarity. This lack of stationarity can further complicate the model's ability to provide reliable forecasts.

B is incorrect. While statement 3 is indeed correct, the conclusion that the model is misspecified is not supported by the data. The autocorrelation values calculated by Blessing, as shown in Exhibit 2, are used to test for serial correlation in the residuals of the model. These autocorrelations are 0.0986, 0.0438, -0.1743, and -0.2319 for lags 1 through 4, respectively. To determine if these autocorrelations are significantly different from zero, we calculate the t-statistics using the formula

$$t = \frac{\text{autocorrelation}}{\text{standard error}}$$

where the standard error is given by

$$\text{standard error} = \frac{1}{\sqrt{T}} = \frac{1}{\sqrt{59}} = 0.1302.$$

The resulting t-statistics are 0.7574, 0.3364, -1.3388, and -1.7813 for lags 1 through 4. None of these t-statistics exceed the critical value of approximately 2.0 at a 0.05 level of significance, indicating that there is no significant serial correlation.

C is incorrect. This option incorrectly states that statement 3 is incorrect. As explained, statement 3 is correct in highlighting the critical consequences of serial correlation in time-series models and the potential issues with non-stationarity in the data series.

Study Session 1, Reading 3: Time-Series Analysis, LOS 3(c): explain the requirement for

a time series to be covariance stationary and describe the significance of a series that is not stationary

Study Session 1, Learning Module 5: Time-Series Analysis, LOS 5(e): explain how autocorrelations of the residuals can be used to test whether the autoregressive model fits the time series

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