2 TIME-SERIES ANALYSIS

1. The regression results from fitting an AR(1) model to the first-differences in enrollment growth rates at a large university includes a Durbin-Watson statistic of 1.58. The number of quarterly observations in the time series is 60. At 5% significance, the critical values for the Durbin-Watson statistic are d_l = 1.55 and d_u = 1.62. Which of the following is the most accurate interpretation of the DW statistic for the model?

   (A) Since $d_l < DW < d_u$, the results of the DW test are inconclusive.

   (B) Since $DW > d_l$, the null hypothesis of no serial correlation is rejected.

   (C) The Durbin-Watson statistic cannot be used with AR(1) models.

2. Which of the following statements regarding seasonality is least accurate?

   (A) A time series that is first differenced can be adjusted for seasonality by incorporating the first-differenced value for the previous year's corresponding period.

   (B) Not correcting for seasonality when, in fact, seasonality exists in the time series results in a violation of an assumption of linear regression.

   (C) The presence of seasonality makes it impossible to forecast using a time-series model.

3. Alexis Popov, CFA, wants to estimate how sales have grown from one quarter to the next on average. The most direct way for Popov to estimate this would be:

   (A) an AR(1) model.

   (B) an AR(1) model with a seasonal lag.

   (C) a linear trend model.

4. Consider the estimated model $x_t = -6.0 + 1.1x_{t-1} + 0.3x_{t-2} + e_t$ that is estimated over 50 periods. The value of the time series for the 49th observation is 20 and the value of the time series for the 50th observation is 22. What is the forecast for the 52nd observation?

   (A) 42

   (B) 24.2

   (C) 27.22.

5. Alexis Popov, CFA, is analyzing monthly data. Popov has estimated the model $x_t = b_0 + b_1 \times x_{t-1} + b_2 \times x_{t-2} + e_t$. The researcher finds that the residuals have a significant ARCH process. The best solution to this is to:
   (A) re-estimate the model with generalized least squares.
   (B) re-estimate the model using a seasonal lag.
   (C) re-estimate the model using only an AR(1) specification.

6. Which of the following is NOT a requirement for a series to be covariance stationary? The:
   (A) expected value of the time series is constant over time.
   (B) time series must have a positive trend.
   (C) covariance of the time series with itself (lead or lag) must be constant.

7. Are either of the slope coefficients statistically significant?
   (A) The simple trend regression is not, but the log-linear trend regression is.
   (B) Yes, both are significant.
   (C) The simple trend regression is, but not the log-linear trend regression.

8 With respect to the possible problems of autocorrelation and nonstationarity, using the log-linear transformation appears to have:
   (A) not improved the results for either possible problems.
   (B) improved the results for nonstationarity but not autocorrelation.
   (C) improved the results for autocorrelation but not nonstationarity.

9. Using the simple linear trend model, the forecast of sales for Very Vegan for the first out-of-sample period is:
   (A) $97.6 million.
   (B) $113.0 million.
   (C) $123.0 million.

10. Using the log-linear trend model, the forecast of sales for Very Vegan for the first out-of-sample period is:
   (A) $109.4 million
   (B) $117.0 million
   (C) $121.2 million

11. Trend models can be useful tools in the evaluation of a time series of data. However, there are limitations to their usage. Trend models are not appropriate when which of the following violations of the linear regression assumptions is present?

(A) Model misspecification.

(B) Serial correlation.

(C) Heteroskedasticity.

12. Consider the estimated model $x_t = -6.0 + 1.1x_{t-1} + 0.3x_{t-2} + \varepsilon_t$ that is estimated over 50 periods. The value of the time series for the 49th observation is 20 and the value of the time series for the 50th observation is 22. What is the forecast for the 51st observation?

(A) 30.2.

(B) 24.2.

(C) 23

13. Modeling the trend in a time series of a variable that grows at a constant rate with continuous compounding is best done with:

(A) a log-linear transformation of the time series.

(B) simple linear regression.

(C) a moving average model.

14. The table below shows the autocorrelations of the lagged residuals for quarterly theater ticket sales that were estimated using the AR(1) model:
$\ln(\text{sales}_t) = b_0 + b_1(\ln \text{sales}_{t-1}) + e_t$ .Assuming the critical t-statistic at 5% significance is 2.0, which of the following is the most likely conclusion about the appropriateness of the model? The time series:

Lagged Autocorrelations of the Log of Quarterly Theater Ticket Sales			
Lag	Autocorrelations	Standard Error	t-Statistic
1	-0.0738	0.1667	-0.44271
2	-0.1047	0.1667	-0.62807
3	-0.0252	0.1667	-0.15117
4	0.5528	0.1667	3.31614

(A) contains ARCH (1) errors.

(B) contains seasonality.

(C) would be more appropriately described with an MA(4) model.

15. Troy Dillard, CFA, has estimated the following equation using quarterly data: $x_t = 93 - 0.5 \times X_{t-1} + 0.1 \times X_{t-4} + e_t$. Given the data in the table below, what is Dillard's best estimate of the first quarter of 2007?

Time	Value
2005: I	62
2005: II	62
2005: III	66
2005: IV	66
2006: I	72
2006: II	70
2006: III	64
2006: IV	66

(A) 66.60.
(B) 66.40.
(C) 67.20.

16. Rhonda Wilson, CFA, is analyzing sales data for the TUV Corp, a current equity holding in her portfolio. She observes that sales for TUV Corp. have grown at a steadily increasing rate over the past ten years due to the successful introduction of some new products. Wilson anticipates that TUV will continue this pattern of success. Which of the following models is most appropriate in her analysis of sales for TUV Corp?
(A) A log-linear trend model, because the data series exhibits a predictable, exponential growth trend.
(B) A log-linear trend model, because the data series can be graphed using a straight, upward-sloping line.
(C) A linear trend model, because the data series is equally distributed above and below the line and the mean is constant.

17. After discussing the above matter with a colleague, Cranwell finally decides to use an autoregressive model of order one i.e. AR(1) for the above data. Below is a summary of the findings of the model:

b_0	0.4563
b_1	0.6874
Standard error	0.3745
R-squared	0.7548
Durbin Watson	1.23
F	12.63
Observations	180

Calculate the mean reverting level of the series.

(A) 1.26.

(B) 1.46.

(C) 1.66.

18. Cranwell is aware that the Dickey Fuller test can be used to discover whether a model has a unit root. He is also aware that the test would use a revised set of critical t-values. What would it mean to Bert to reject the null of the Dickey Fuller test (H_0: g = 0) ?

(A) There is no unit root.

(B) There is a unit root and the model cannot be used in its current form.

(C) There is a unit root but the model can be used if covariance-stationary.

19. Cranwell would also like to test for serial correlation in his AR(1) model. To do this, Cranwell should:

(A) use the provided Durbin Watson statistic and compare it to a critical value.

(B) use a t-test on the residual autocorrelations over several lags.

(C) determine if the series has a finite and constant covariance between leading and lagged terms of itself.

20. When using the root mean squared error (RMSE) criterion to evaluate the predictive power of the model, which of the following is the most appropriate statement?

(A) Use the model with the highest RMSE calculated using the in-sample data.

(B) Use the model with the lowest RMSE calculated using the out-of-sample data.

(C) Use the model with the lowest RMSE calculated using the in-sample data.

21. Which of the following statements regarding a mean reverting time series is least accurate?

(A) If the current value of the time series is above the mean reverting level, the prediction is that the time series will decrease.

(B) If the current value of the time series is above the mean reverting level, the prediction is that the time series will increase.

(C) If the time-series variable is x, then $x_t = b_0 + b_1 x_{t-1}$

22. The procedure for determining the structure of an autoregressive model is:

(A) estimate an autoregressive model (for example, an AR(1) model), calculate the autocorrelations for the model's residuals, test whether the autocorrelations are different from zero, and add an AR lag for each significant autocorrelation.

(B) estimate an autoregressive model (e.g., an AR(1) model), calculate the autocorrelations for the model's residuals, test whether the autocorrelations are different from zero, and revise the model if there are significant autocorrelations.

(C) test autocorrelations of the residuals for a simple trend model, and specify the number of significant lags.

23. A time series that has a unit root can be transformed into a time series without a unit root through:
    (A) mean reversion.
    (B) first differencing.
    (C) calculating moving average of the residuals.

24. Suppose that the time series designated as Y is mean reverting. If $Y_{t+1} = 0.2 + 0.6\ Y_t$, the best prediction of Y_{t+1} is:
    (A) 0.3.
    (B) 0.5.
    (C) 0.8.

25. Collier's supervisors would probably not want to use the results from the trend model for all of the following reasons EXCEPT:
    (A) the model is a linear trend model and log-linear models are always superior.
    (B) the slope coefficient is not significant.
    (C) it does not give insights into the underlying dynamics of the movement of the dependent variable.

26. For this question only, assume that Winston also ran an AR(1) model with the following results:
    $y_t = -0.9 - 0.23 * y_{t-1} + e_t$
    R-squared = 78.3%
    (0.823) (0.0222)
    The mean reverting level of this model is closed to:
    (A) 1.16
    (B) –0.73
    (C) 0.77

27. Based on the autoregressive model, expected warranty expense in the first quarter of 2005 will be closest to:
    (A) $51 million.
    (B) $60 million.
    (C) $65 million.

28. Based on the results, is there a seasonality component in the data?
    (A) Yes, because the coefficient on y_{t-4} is large compared to its standard error.
    (B) Yes, because the coefficient on y_t is small compared to its standard error.
    (C) No, because the slope coefficients in the autoregressive model have opposite signs.

29. Which of the following statements regarding unit roots in a time series is least accurate?

(A) A time series that is a random walk has a unit root.

(B) A time series with a unit root is not covariance stationary.

(C) Even if a time series has a unit root, the predictions from the estimated model are valid.

30. Suppose you estimate the following model of residuals from an autoregressive model:

$\varepsilon_t^2 = 0.25 + 0.6\varepsilon^2_{t-2} + \mu_t$, where $\varepsilon = \hat{\varepsilon}$

If the residual at time t is 0.9, the forecasted variance for time t+1 is:

(A) 0.736.

(B) 0.790.

(C) 0.850.

31. Suppose that the following time-series model is found to have a unit root:

$\text{Sales}_t = b_0 + b_1 \text{Sales}_{t-1} + \varepsilon_t$

What is the specification of the model if first differences are used?

(A) $\text{Sales}_t = b_0 + b_1 \text{Sales}_{t-1} + b_2 \text{Sales}_{t-2} + \varepsilon_t$

(B) $\text{Sales}_t = b_1 \text{Sales}_{t-1} + \varepsilon_t$

(C) $(\text{Sales}_t - \text{Sales}_{t-1}) = b_0 + b_1 (\text{Sales}_{t-1} - \text{Sales}_{t-2}) + \varepsilon_t$

32. Dianne Hart, CFA, is considering the purchase of an equity position in Book World, Inc, a leading seller of books in the United States. Hart has obtained monthly sales data for the past seven years, and has plotted the data points on a graph. Hart notices that the revenues are growing at approximately 4.5% per year. Which of the following statements regarding Hart's analysis of the data time series of Book World's sales is most accurate? Hart should utilize a:

(A) mean-reverting model to analyze the data because the time series pattern is covariance stationary.

(B) log-linear model to analyze the data because it is likely to exhibit a compound growth trend.

(C) linear model to analyze the data because the mean appears to be constant.

33. The model $x_t = b_0 + b_1 x_{t-1} + b_2 x_{t-2} + b_3 x_{t-12} + \varepsilon_t$ is an autoregressive model of type:

(A) AR(2).

(B) AR(1).

(C) AR(12).

34. The data below yields the following AR(1) specification: $x_t = 0.9 - 0.55x_{t-1} + E_t$ and the indicated fitted values and residuals.

Time	xt	fitted values	residuals
1	1	–	–
2	–1	0.35	–1.35
3	2	1.45	0.55
4	–1	–0.2	–0.8
5	0	1.45	–1.45
6	2	0.9	1.1
7	0	–0.2	0.2
8	1	0.9	0.1
9	2	0.35	1.65

The following sets of data are ordered from earliest to latest. To test for ARCH, the researcher should regress:

(A) (-1.35, 0.55, -0.8, -1.45, 1.1, 0.2, 0.1, 1.65) on (0.35, 1.45, -0.2, 1.45, 0.9, -0.2, 0.9, 0.35)

(B) (1.8225, 0.3025, 0.64, 2.1025, 1.21, 0.04, 0.01) on (0.3025, 0.64, 2.1025, 1.21, 0.04, 0.01, 2.7225)

(C) (1, 4, 1, 0, 4, 0, 1, 4) on (1, 1, 4, 1, 0, 4, 0, 1)

35. The main reason why financial and time series intrinsically exhibit some form of nonstationarity is that:

(A) most financial and time series have a natural tendency to revert toward their means.

(B) most financial and economic relationships are dynamic and the estimated regression coefficients can vary greatly between periods.

(C) serial correlation, a contributing factor to nonstationarity, is always present to a certain degree in most financial and time series.

36. David Brice, CFA, has tried to use an AR(1) model to predict a given exchange rate. Brice has concluded the exchange rate follows a random walk without a drift. The current value of the exchange rate is 2.2. Under these conditions, which of the following would be least likely?

(A) The residuals of the forecasting model are autocorrelated.

(B) The forecast for next period is 2.2.

(C) The process is not covariance stationary.

37. Le can conclude that the model is:

(A) properly specified because the Durbin-Watson statistic is not significant.

(B) properly specified because there is no evidence of autocorrelation in the residuals.

(C) not properly specified because there is evidence of autocorrelation in the residuals and the Durbin-Watson statistic is not significant.

38. What is the forecast for the gross margin in the first quarter of 2004?
    (A) 0.246.
    (B) 0.250.
    (C) 0.256.

39. With respect to heteroskedasticity in the model, we can definitively say:
    (A) nothing.
    (B) an ARCH process exists because the autocorrelation coefficients of the residuals have different signs.
    (C) heteroskedasticity is not a problem because the DW statistic is not significant.

40. Supposing the time series is actually a random walk, which of the following approaches would be appropriate prior to using an autoregressive model?
    (A) First differencing the time series.
    (B) ARCH.
    (C) Convert the time series by taking a natural log of the series.

41. Frank Batchelder and Miriam Yenkin are analysts for Bishop Econometrics. Batchelder and Yenkin are discussing the models they use to forecast changes in China's GDP and how they can compare the forecasting accuracy of each model. Batchelder states, "The root mean squared error (RMSE) criterion is typically used to evaluate the in-sample forecast accuracy of autoregressive models." Yenkin replies, "If we use the RMSE criterion, the model with the largest RMSE is the one we should judge as the most accurate."
    With regard to their statements about using the RMSE criterion:
    (A) Batchelder is correct; Yenkin is incorrect.
    (B) Batchelder is incorrect; Yenkin is correct.
    (C) Batchelder is incorrect; Yenkin is incorrect.

42. The preceding table will be used by Johnson to forecast values using:
    (A) an autoregressive model with a seasonal lag.
    (B) a serially correlated model with a seasonal lag.
    (C) a log-linear trend model with a seasonal lag.

43. The value that Johnson should enter in the table in place of "w" is:
    (A) –115.
    (B) 164.
    (C) –48.

44. Imagine that Johnson prepares a change-in-sales regression analysis model with seasonality, which includes the following:

	Coefficients
Intercept	–6.032
Lag 1	0.017
Lag 4	0.983

Based on the model, expected sales in the first quarter of 2015 will be closest to:

(A) 210.

(B) 155.

(C) 190.

45. Johnson's model was most likely designed to incorporates correction for:

(A) cointegration in the time series.

(B) non stationarity in time series data.

(C) heteroskedasticity of model residuals.

46. To test for covariance-stationarity in the data, Johnson would most likely use a:

(A) Durbin-Watson test.

(B) Dickey-Fuller test.

(C) t-test.

47. The presence of conditional heteroskedasticity of residuals in Johnson's model is would most likely to lead to:

(A) invalid standard errors of regression coefficients and invalid statistical tests.

(B) invalid standard errors of regression coefficients, but statistical tests will still be valid.

(C) invalid estimates of regression coefficients, but the standard errors will still be valid.

48. One choice a researcher can use to test for nonstationarity is to use a:

(A) Dickey-Fuller test, which uses a modified X^2 statistic.

(B) Dickey-Fuller test, which uses a modified t-statistic.

(C) Breusch-Pagan test, which uses a modified t-statistic.

49. Consider the following estimated model:

$(\text{Sales}_t - \text{Sales}_{t-1}) = 100 - 1.5(\text{Sales}_{t-1} - \text{Sales}_{t-2}) + 1.2(\text{Sales}_{t-4} - \text{Sales}_{t-5})$ t = 1,2,..T

and Sales for the periods 1999.1 through 2000.2:

t	Period	Sales
T	2000.2	$1,000
T-1	2000.1	$900
T-2	1999.4	$1,200
T-3	1999.3	$1,400
T-4	1999.2	$1,000
T-5	1999.1	$800

The forecasted Sales amount for 2000.3 is closest to:

(A) $730.00

(B) $1,430.00

(C) $1,730.00

50. Barry Phillips, CFA, is analyzing quarterly data. He has estimated an AR(1) relationship $(x_t = b_0 + b_1 \times x_{t-1} + e_t)$ and wants to test for seasonality. To do this he would want to see if which of the following statistics is significantly different from zero?

(A) Correlation (e_t, e_{t-4})

(B) Correlation (e_t, $e_{t-}5$)

(C) Correlation (e_t, $e_{t-}1$)

51. Consider the estimated AR(2) model, $x_t = 2.5 + 3.0\,x_{t-1} + 1.5\,x_{t-2} + \varepsilon_t$ t = 1, 2, ... 50.

Making a prediction for values of x for 1 ≤ t ≤ 50 is referred to as:

(A) requires more information to answer the question.

(B) an in-sample forecast.

(C) an out-of-sample forecast.

52. Consider the following estimated model.

$\langle(\text{Sales}_t - \text{Sales}_{t-1}) = 30 + 1.5(\text{Sales}_{t-1} - \text{Sales}_{t-2}) + 1.2(\text{Sales}_{t-4} - \text{Sales}_{t-5})$ t = 1,2$\rangle$ ...T

and Sales for the periods 1999.1 through 2000.2:

t	Period	Sales
T	2000.2	$2,000
T-1	2000.1	$1,800
T-2	1999.4	$1,500
T-3	1999.3	$1,400
T-4	1999.2	$1,900
T-5	1999.1	$1,700

The forecasted Sales amount for 2000.3 is closest to:

(A) $1,730.00

(B) $2,625.00

(C) $2,270.00

53. David Brice, CFA, has used an AR(1) model to forecast the next period's interest rate to be 0.08. The AR(1) has a positive slope coefficient. If the interest rate is a mean reverting process with an unconditional mean, a.k.a., mean reverting level, equal to 0.09, then which of the following could be his forecast for two periods ahead?

(A) 0.081.

(B) 0.072.

(C) 0.113.

54. Troy Dillard, CFA, has estimated the following equation using semiannual data: $x_t = 44 + 0.1 \text{ x } X_{t-1} - 0.25 \text{ x } X_{t-2} - 0.15 \text{ x } X_{t-3} + e_t$. Given the data in the table below, what is Dillard's best forecast of the second half of 2007?

Time	Value
2003: I	31
2003: II	31
2004: I	33
2004: II	33
2005: I	36
2005: II	35
2006: I	32
2006: II	33

(A) 34.36.

(B) 34.05.

(C) 33.74.

55. Barry Phillips, CFA, has the following time series observations from earliest to latest: (5, 6, 5, 7, 6, 6, 8, 8, 9, 11). Phillips transforms the series so that he will estimate an autoregressive process on the following data (1, -1, 2, -1, 0, 2, 0, 1, 2). The transformation Phillips employed is called:

(A) moving average.

(B) beta drift.

(C) first differencing.

56. The regression results from fitting an AR(1) to a monthly time series are presented below. What is the mean-reverting level for the model?

Model: $\Delta Exp_t = b_0 + b_1 \Delta Exp_{t-1} + \varepsilon_t$				
	Coefficients	Standard Error	t-Statistic	p-value
Intercept	1.3304	0.0089	112.2849	< 0.0001
Lag-1	0.1817	0.0061	30.0125	< 0.0001

(A) 7.3220.
(B) 0.6151.
(C) 1.6258.

57. Which of the following statements regarding covariance stationarity is CORRECT?
(A) A time series may be both covariance stationary and heteroskedastic.
(B) The estimation results of an AR model involving a time series that is not covariance stationary are meaningless.
(C) A time series that is covariance stationary may have residuals whose mean changes over time.

58. A time series x that is a random walk with a drift is best described as:
(A) $x_t = x_{t-1} + \varepsilon_t$.
(B) $x_t = b_0 + b_i x_{t-1} + \varepsilon_t$.
(C) $x_t = b_0 + b_1 x_{t-1}$.

59. Which of the following is least likely a consequence of a model containing ARCH(1) errors? The:
(A) regression parameters will be incorrect.
(B) model's specification can be corrected by adding an additional lag variable.
(C) variance of the errors can be predicted.

60. Which of the following is a seasonally adjusted model?
(A) $Sales_t = b_0 + b_1 Sales_{t-1} + b_2 Sales_{t-2} + \varepsilon_t$.
(B) $(Sales_t - Sales_{t-1}) = b_0 + b_1 (Sales_{t-1} - Sales_{t-2}) + b_2 (Sales_{t-4} - Sales_{t-5}) + \varepsilon_t$.
(C) $Sales_t = b_1 Sales_{t-1} + \varepsilon_t$.

61. Barry Phillips, CFA, has estimated an AR(1) relationship ($x_t = b_0 + b_1 \times x_{t-1} + e_t$) and got the following result: $x_{t+1} = 0.5 + 1.0x_t + e_t$. Phillips should:
(A) first difference the data because $b_1 = 1$.
(B) not first difference the data because $b_0 = 0.5 < 1$.
(C) not first difference the data because $b_1 - b_0 = 1.0 - 0.5 = 0.5 < 1$.

62. The table below includes the first eight residual autocorrelations from fitting the first differenced time series of the absenteeism rates (ABS) at a manufacturing firm with the model

$$\Delta ABS_t = b_0 + b_1 \Delta ABS_{t-1} + \varepsilon_t$$

Based on the results in the table, which of the following statements most accurately describes the appropriateness of the specification of the model,

$\Delta ABS_t = b_0 + b_1 \Delta ABS_{t-1} + \varepsilon_1$?

Lagged Autocorrelations of the Residuals of the First Differences in Absenteeism Rates			
Lag	Autocorrelation	Standard Error	t-Statistic
1	-0.0738	0.1667	-0.44271
2	-0.1047	0.1667	-0.62807
3	-0.0252	0.1667	-0.15117
4	-0.0157	0.1667	-0.09418
5	-0.1262	0.1667	-0.75705
6	0.0768	0.1667	0.46071
7	0.0038	0.1667	0.02280
8	-0.0188	0.166	-0.11278

(A) The negative values for the autocorrelations indicate that the model does not fit the time series.

(B) The low values for the t-satistics indicate that the model fits the time series.

(C) The Durbin-Watson statistic is needed to determine the presence of significant correlation of the residuals.

63. Alexis Popov, CFA, has estimated the following specification: $x_t = b_0 + b_1 \times x_{t-1} + e_t$. Which of the following would most likely lead Popov to want to change the model's specification?

(A) Correlation (e_t, e_{t-1}) is not significantly different from zero.

(B) $b_0 < 0$.

C) Correlation (e_t, e_{t-2}) is significantly different from zero.

64. William Zox, an analyst for Opal Mountain Capital Management, uses two different models to forecast changes in the inflation rate in the United Kingdom. Both models were constructed using U.K. inflation data from 1988-2002. In order to compare the forecasting accuracy of the models, Zox collected actual U.K. inflation data from 2004-2005, and compared the actual data to what each model predicted. The first model is an AR(1) model that was found to have an average squared error of 10.429 over the

12 month period. The second model is an AR(2) model that was found to have an average squared error of 11.642 over the 12 month period. Zox then computed the root mean squared error for each model to use as a basis of comparison. Based on the results of his analysis, which model should Zox conclude is the most accurate?

(A) Model 2 because it has an RMSE of 3.41.
(B) Model 1 because it has an RMSE of 3.23.
(C) Model 1 because it has an RMSE of 5.21.

65. If his assumption about a constant is correct, which of the following models is most appropriate for modeling these data?

(A) $\ln(\text{LuxCarSales}) = b_0 + b_1(t) + e_t$.
(B) $\text{LuxCarSales} = b_0 + b_1(t) + e_t$.
(C) $\text{LuxCarSalest} = b_0 + b_1\text{LuxCarSales}_{(t-1)} + e_t$.

66. After discussing the above matter with a colleague, Bert finally decides to use an annual autoregressive model of Order One [i.e., AR(1)]. Using the data in Exhibit 1, calculate the mean reverting level of the series.

(A) 1.66.
(B) 1.26.
(C) 1.46.

67. Bert is aware that the Dickey Fuller test can be used to discover whether a model has a unit root. He is also aware that the test would use a revised set of critical t-values. What would it mean to Bert to reject the null of the Dickey Fuller test (H_o: g = 0)?

(A) There is a unit root and the model cannot be used in its current form.
(B) There is no unit root.
(C) There is a unit root but the model can be used if covariance-stationary.

68. Bert would also like to test for serial correlation in his AR(1) model. How could this be done?

(A) use a t-test on the residual autocorrelations over several lags.
(B) determine if the series has a finite and constant covariance between leading and lagged terms of itself.
(C) use the provided Durbin-Watson statistic and compare it to a critical value.

69. When using the root mean squared error (RMSE) criterion to evaluate the predictive power of the model, which of the following is the most appropriate statement?

(A) Use the model with the highest RMSE calculated using the in-sample data.
(B) Use the model with the lowest RMSE calculated using the in-sample data.
(C) Use the model with the lowest RMSE calculated using the out-of-sample data.

70. Bert would like to use his AR(1) model to forecast future sales of luxury automobiles. What is the annualized growth rate between today and 20X3?

(A) 12%

(B) 11%

(C) 10%

71. A monthly time series of changes in maintenance expenses (ΔExp) for an equipment rental company was fit to an AR(1) model over 100 months. The results of the regression and the first twelve lagged residual autocorrelations are shown in the tables below. Based on the information in these tables, does the model appear to be appropriately specified? (Assume a 5% level of significance.)

Regression Results for Maintenance Expense Changes Model: $DExp_t = b_0 + b_1 DExp_{t-1} + e_t$				
	Coefficients	Standard Error	t-Statistic	p-value
Intercept	1.3304	0.0089	112.2849	< 0.0001
Lag-1	0.1817	0.0061	30.0125	< 0.0001

Lagged Autocorrelations for Maintenance Expense Changes					
Lag	Autocorrelation	t-Statistic	Lag	Autocorrelation	t-Statistic
1	-0.239	-2.39	7	-0.018	-0.18
2	-0.278	-2.78	8	-0.033	-0.33
3	-0.045	-0.45	9	0.261	2.61
4	-0.033	-0.33	10	0.060	-0.60
5	-0.180	-1.80	11	0.212	2.12
6	-0.110	-1.10	12	0.022	0.22

(A) No, because several of the residual autocorrelations are significant.

(B) Yes, because the intercept and the lag coefficient are significant.

(C) Yes, because most of the residual autocorrelations are negative.

72. Which of the following statements regarding time series analysis is least accurate?

(A) We cannot use an AR(1) model on a time series that consists of a random walk.

(B) If a time series is a random walk, first differencing will result in covariance stationarity.

(C) An autoregressive model with two lags is equivalent to a moving-average model with two lags.

73. Which of the following statements regarding the instability of time-series models is most accurate? Models estimated with:
   (A) shorter time series are usually more stable than those with longer time series.
   (B) a greater number of independent variables are usually more stable than those with a smaller number.
   (C) longer time series are usually more stable than those with shorter time series.

74. The value for WPM this period is 544 billion. Using the results of the model, the forecast Wireless Phone Minutes three periods in the future is:
   (A) 691.30.
   (B) 586.35.
   (C) 683.18.

75. The WPM model was specified as a(n):
   (A) Moving Average (MA) Model.
   (B) Autoregressive (AR) Model.
   (C) Autoregressive (AR) Model with a seasonal lag.

76. The mean reverting level of monthly sales is closest to:
   (A) 381.29 million.
   (B) 8.83 million.
   (C) 43.2 million.

77. Morris concludes that the current price of Car-tel stock is consistent with single stage constant growth model (with g = 3%). Based on this information, the sales model is most likely:
   (A) Incorrectly specified and first differencing the data would be an appropriate remedy.
   (B) Correctly specified.
   (C) Incorrectly specified and first differencing the natural log of the data would be an appropriate remedy.

78. Which of the following statements regarding an out-of-sample forecast is least accurate?
   (A) Forecasting is not possible for autoregressive models with more than two lags.
   (B) There is more error associated with out-of-sample forecasts, as compared to in-sample forecasts.
   (C) Out-of-sample forecasts are of more importance than in-sample forecasts to the analyst using an estimated time-series model.

79. Suppose you estimate the following model of residuals from an autoregressive model.

$\varepsilon_t^2 = 0.4 + 0.80\varepsilon_{t-1}^{\ 2} + \mu_t$, where $\varepsilon = \hat{\varepsilon}$

If the residual at time t is 2.0, the forecasted variance for time t+1 is:

(A) 2.0.

(B) 3.6.

(C) 3.2.

80. David Wellington, CFA, has estimated the following log-linear trend model: $LN(x_t) = b_0 + b_1 t + \varepsilon_t$ Using six years of quarterly observations, 2001:1 to 2006:1V, Wellington gets the following estimated equation: $LN(x_t) = 1.4 + 0.02t$. The first out-of-sample forecast of x_t for 2007:I is closest to:

(A) 6.69.

(B) 1.88.

(C) 4.14.

81. Given an AR(1) process represented by $x_{t+1} = b_0 + b_1 \times x_t + e_t$, the process would not be a random walk if:

(A) $E(e_t) = 0$.

(B) the long run mean is $b_0 / (1 - b_1)$.

(C) $b_1 = 1$.

82. With respect to the statement that the company's statistician made concerning the consequences of serial correlation, assuming the company's statistician is competent, we would most likely deduce that Holmes and Briars did not tell the statistician:

(A) the sample size.

(B) the model's specification.

(C) the value of the Durbin-Watson statistic.

83. The statistician's statement concerning the benefits of the Hansen method is:

(A) correct, because the Hansen method adjusts for problems associated with both serial correlation and heteroskedasticity.

(B) not correct, because the Hansen method only adjusts for problems associated with serial correlation but not heteroskedasticity.

(C) not correct, because the Hansen method only adjusts for problems associated with heteroskedasticity but not serial correlation.

84. Using the model's results, Briar's forecast for three years into the future is:

(A) $47.151 million.

(B) $54.543 million.

(C) $54.108 million.

85. With respect to the comments of Holmes and Briars concerning the mean reversion of the import data, the long-run mean value that:

(A) Briars computes is correct.

(B) Briars computes is not correct, and his conclusion is probably not accurate.

(C) Briars computes is not correct, but his conclusion is probably accurate.

86. To qualify as a covariance stationary process, which of the following does not have to be true?

(A) Covariance(x_t, x_{t-2}) = Covariance(x_t, x_{t+2}).

(B) Covariance(x_t, x_{t-1}) = Covariance(x_t, x_{t-2}).

(C) $E[x_t] = E[x_{t+1}]$

87. An analyst modeled the time series of annual earnings per share in the specialty department store industry as an AR(3) process. Upon examination of the residuals from this model, she found that there is a significant autocorrelation for the residuals of this model. This indicates that she needs to:

(A) alter the model to an ARCH model.

(B) revise the model to include at least another lag of the dependent variable.

(C) switch models to a moving average model.

88. An analyst wants to model quarterly sales data using an autoregressive model. She has found that an AR(1) model with a seasonal lag has significant slope coefficients. She also finds that when a second and third seasonal lag are added to the model, all slope coefficients are significant too.

Based on this, the best model to use would most likely be an:

(A) ARCH(1).

(B) AR(1) model with no seasonal lags.

(C) AR(1) model with 3 seasonal lags.

89. The table below shows the autocorrelations of the lagged residuals for the first differences of the natural logarithm of quarterly motorcycle sales that were fit to the AR(1) model: $(\ln sales_t - \ln sales_{t-1}) = b_0 + b_1(\ln sales_{t-1} - \ln sales_{t-2}) + \varepsilon_t$. The critical t-statistic at 5% significance is 2.0, which means that there is significant autocorrelation for the lag-4 residual, indicating the presence of seasonality. Assuming the time series

is covariance stationary, which of the following models is most likely to CORRECT for this apparent seasonality?

Lagged Autocorrelations of First Differences in the Log of Motorcycle Sales			
Lag	Autocorrelation	Standard Error	t-Statistic
1	-0.0738	0.1667	-0.44271
2	-0.1047	0.1667	-0.62807
3	-0.0252	0.1667	-0.15117
4	0.5528	0.1667	3.31614

(A) $\ln sales_t = b_0 + b_1(\ln sales_{t-1}) - b_2(\ln sales_{t-4}) + \varepsilon_t$.

(B) $(\ln sales_t - \ln sales_{t-4}) = b_0 + b_1(\ln sales_{t-1} - \ln sales_{t-2}) + \varepsilon_t$.

(C) $(\ln sale_t - \ln sales_{t-1}) = b_0 + b_1 (\ln sales_{t-1} - \ln sales_{t-2}) + b_2 (\ln sales_{t-4} - \ln sales_{t-5}) + \varepsilon_t$.

90. The primary concern when deciding upon a time series sample period is which of the following factors?

(A) Current underlying economic and market conditions.

(B) The length of the sample time period.

(C) The total number of observations.

91. In the time series model: $y_t = b_0 + b_1 t + \varepsilon_t$, t = 1,2,...,T, the:

(A) disturbance term is mean-reverting.

(B) change in the dependent variable per time period is b_1.

(C) disturbance terms are autocorrelated.

92. The model $x_t = b_0 + b_1 x_{t-1} + b_2 x_{t-2} + b_3 x_{t-3} + b_4 x_{t-4} + \varepsilon_t$ is:

(A) an autoregressive conditional heteroskedastic model, ARCH.

(B) a moving average model, MA(4).

(C) an autoregressive model, AR(4).

93. An AR(1) autoregressive time series model:

(A) can be used to test for a unit root, which exists if the slope coefficient is less than one.

(B) can be used to test for a unit root, which exists if the slope coefficient equals one.

(C) cannot be used to test for a unit root.

94. The most appropriate interpretation from the foreclosure share regression equation model is:

(A) Multiple-R of the model is 0.75.

(B) Multiple-R of the model is 0.87.

(C) Variable STIM explains 37.5% of the variation in foreclosure share.

95. Based on her regression results in Exhibit 2, using a 5% level of significance, Smith should conclude that:
   (A) stimulus packages have significant effects on foreclosure percentages, but housing crises do not have significant effects on foreclosure percentages.
   (B) both stimulus packages and housing crises have significant effects on foreclosure percentages.
   (C) stimulus packages do not have significant effects on foreclosure percentages, but housing crises do have significant effects on foreclosure percentages.

96. The standard error of estimate for Smith's regression is closest to:
   (A) 0.53
   (B) 0.16
   (C) 0.56

97. Is Smith correct or incorrect regarding Concerns 1 and 2?
   (A) Correct on both Concerns.
   (B) Incorrect on both Concerns.
   (C) Only correct on one concern and incorrect on the other.

98. The most recent change in foreclosure share was +1 percent. Smith decides to base her analysis on the data and methods provided in Exhibit 4 and Exhibit 5, and determines that the two-step ahead forecast for the change in foreclosure share (in percent) is 0.125, and that the mean reverting value for the change in foreclosure share (in percent) is 0.071. Is Smith correct?
   (A) Smith is correct on both the forecast and the mean reverting level.
   (B) Smith is correct on the two-step ahead forecast for change in foreclosure share only.
   (C) Smith is correct on the mean-reverting level for forecast of change in foreclosure share only.

99. Assume for this question that Smith finds that the foreclosure share series has a unit root. Under these conditions, she can most reliably regress foreclosure share against the change in interest rates (ΔINT) if:
   (A) ΔINT has unit root and is not cointegrated with foreclosure share.
   (B) ΔINT does not have unit root.
   (C) ΔINT has unit root and is cointegrated with foreclosure share.

100. How many dummy variables should Rathod use?
   (A) Six
   (B) Four
   (C) Five

101. What is most likely represented by the intercept of the regression?
   (A) The intercept is not a driver of returns, only the independent variables.
   (B) The return on a particular trading day.
   (C) The drift of a random walk.

102. What can be said of the overall explanatory power of the model at the 5% significance?
   (A) There is no value to calendar trading.
   (B) There is value to calendar trading.
   (C) The coefficient of determination for the above regression is significantly higher than the standard error of the estimate, and therefore there is value to calendar trading.

103. The test mentioned by Jessica is known as the:
   (A) Breusch-Pagan, which is a one-tailed test
   (B) Durbin-Watson, which is a two-tailed test
   (C) Breusch-Pagan, which is a two-tailed test

104. Are Jessica and her son Jonathan, correct in terms of the method used to correct for heteroskedasticity and the likely effects?
   (A) Neither is correct
   (B) One is correct
   (C) Both are correct

105. Assuming the a_1 term of an ARCH(1) model is significant, the following can be forecast:
   (A) A significant a1 implies that the ARCH framework cannot be used.
   (B) The variance of the error term.
   (C) The square of the error term.