

ECON 4115/5115 Exam – Fall 2021

Multiple Choice. (50 pts) Each question is worth 2 points.

1. Which time series is most likely to be non-stationary?
 - a) Consumer price index.
 - b) Inflation.
 - c) GDP growth rate.
 - d) Federal funds rate.

2. The command to calculate confidence intervals in R is:
 - a) *descriptive()*.
 - b) *hilo()*.
 - c) *summary()*.
 - d) *rmse()*.

3. An ARMA(1,0) will exhibit
 - a) insignificant ACF and PACF at all lags.
 - b) significant ACF at lag 1 and insignificant PACF at all lags.
 - c) insignificant ACF at lag 1 and significant PACF at lag 1.
 - d) an exponentially declining ACF and a significant PACF at lag 1.

4. If a series is non-stationary, then it must have
 - a) a high F_T value, but a low F_S value.
 - b) a high F_S value, but a low F_T value.
 - c) either a high F_T value or a high F_S value.
 - d) F_T and F_S values equal to zero.

5. A graph with time on the horizontal axis and the main variable on the vertical axis is called a(n)
 - a) regular time series graph.
 - b) seasonal subseries plot.
 - c) ACF.
 - d) lag plot.

6. The naïve model will have future forecasts that are
- a) flat.
 - b) zero.
 - c) just as volatile as the main time series.
 - d) steadily increasing.
7. Autocorrelation coefficients are
- a) bounded between -1 and 1.
 - b) always positive.
 - c) always greater than autocovariances.
 - d) always between 0 and 1.
8. The null hypothesis for the Ljung-Box and Box-Pierce tests is
- a) H_0 : series is autocorrelated.
 - b) H_0 : series is cyclical.
 - c) H_0 : series is exponential.
 - d) H_0 : series is white noise.
9. The process $y_t = c + y_{t-1} + \varepsilon_t$ is called a
- a) moving-average process.
 - b) random walk with drift.
 - c) random walk.
 - d) naïve process.
10. Which accuracy measure is best for choosing the regressors in a time series model?
- a) MAE.
 - b) RMSE.
 - c) R^2 .
 - d) Adjusted R^2 .

11. Overfitting a model refers to selecting too many
- a) regressors.
 - b) intercepts.
 - c) trends.
 - d) seasonal dummies.
12. Which group is the least likely to use a scenario-based forecast?
- a) Fiscal policymakers in Washington D.C.
 - b) Epidemiologists predicting future COVID cases.
 - c) Federal Reserve policymakers.
 - d) Engineers predicting the path of a rocket.
13. The SES model
- a) has a trend.
 - b) has a dampened trend.
 - c) produces flat forecasts.
 - d) allows for both multiplicative and additive seasonality.
14. Which model generates the forecasts: $\hat{y}_{t+h|t} = [\ell_t + (\phi + \phi^2 + \phi^h)b_t]s_{t+h-m(k+1)}$.
- a) ETS(A,Ad,M).
 - b) ETS(N,A,M).
 - c) ETS(M,A,M).
 - d) ARIMA(p,d,q).
15. The 2-period ahead forecast variance for the naïve version of the ETS(A,N,N) is
- a) σ^2 .
 - b) $2\sigma^2$.
 - c) $4\sigma^2$.
 - d) 2σ .

16. The R command for a day-of-the-week seasonal subseries plot is

- a) `gg_subseries(y, period = 7)`.
- b) `gg_subseries(y)`.
- c) `autoplot(y, period = 7)`.
- d) `gg_lag(y, period = 7)`.

17. Using the backshift operator, seasonal quarterly differences can be written as

- a) $(1 - B)^4 y_t$.
- b) $B^4 y_t$.
- c) $(1 - B)^7 y_t$.
- d) $(1 - B^4) y_t$.

18. An ARIMA process with one regular autoregressive lag and monthly seasonal differences would be written as

- a) $\text{ARIMA}(0,1,0)(1,0,0)_{12}$.
- b) $\text{ARIMA}(1,0,0)(1,0,0)_{12}$.
- c) $\text{ARIMA}(1,1,0)(0,1,0)_{12}$.
- d) $\text{ARIMA}(1,0,0)(0,1,0)_{12}$.

19. Which is the best way to remove an outlier from a time series?

- a) Add a dummy variable.
- b) Remove the observation.
- c) Fit a trend line.
- d) Use a moving average process.

20. ETS stands for

- a) Exponential time stamp.
- b) Easy time series.
- c) Error trend seasonal.
- d) Extra terrestrial subject.

21. Natural logarithm transformations

- a) can be used to linearize an exponential trend.
- b) can help to make the variance of a time series more constant.
- c) do not work with negative numbers.
- d) all the above.

22. Which moving average process will generate the smoothest trend estimate:

- a) 1-MA.
- b) 2-MA.
- c) 3-MA.
- d) 4-MA.

23. The remainder (\hat{R}) component from a multiplicative decomposition is given by

- a) $\hat{R} = y_t - \hat{S}_t - \hat{T}_t$.
- b) $\hat{R} = y_t - \hat{x}_t - \hat{z}_t$.
- c) $\hat{R} = y_t + \hat{S}_t + \hat{T}_t$.
- d) $\hat{R} = y_t / (\hat{S}_t \times \hat{T}_t)$.

24. One-period ahead predictions within the training sample should be written as:

- a) $\hat{y}_{t+1|t}$.
- b) $\hat{y}_{T+1|T}$.
- c) $\hat{y}_{T+1|t}$.
- d) $\hat{y}_{T+1|T} \pm c\hat{\sigma}_h$.

25. The R symbol to pipe together functions and objects is:

- a) $\&>\&$.
- b) $<>$.
- c) $\%>\%$.
- d) $\#\#$.

Short Answer. (50 pts). Please upload your R code and answers to each of the questions below in WyoCourses.

Go to FRED and download monthly new privately owned housing units started since 2010. The FRED code for the time series is HOUST. Then answer the following questions.

- (a) (10 pts) Provide a regular time series plot, seasonal subseries plot and lag plot. Write a short paragraph interpreting the results. Also, provide a (properly formatted) table of at least five descriptive statistics and features of your choice that describe the nature of the time series.
- (b) (10 pts) Calculate a time series decomposition and plot the results. Then calculate the correlogram (i.e., ACF plot) of the remainder portion and interpret the results.
- (c) (10 pts) Use the regression method to regress the time series on a linear trend and monthly dummy variables. Then superimpose the fitted values against the actual values, plot the residuals, calculate the ACF, and comment on the appropriateness of the regression model.
- (d) (10 pts) Find the best exponential smoothing model and provide forecasts for the next 12 months with confidence intervals. Comment on the results and residual diagnostics.
- (e) (10 pts) Find the best ARIMA model and provide forecasts for the next 12 months. Which model do you prefer for forecasting, ETS or ARIMA? Defend your answer.