Homework 5: Practice Questions

Introduction to Time Series, Stat 153

Due December 1, 2023

Name:

Each question is either in true/false format, or multiple choice. For multiple choice, just choose the single best option. In each case, make sure to fill in the box according to the answer you choose (true or false, or the multiple choice option) completely. All questions are worth 1 point.

1. In defining AR and MA models, it is convenient to use an operator B, such that $Bx_t = x_{t-1}$, which we call the:
   ☐ a. Bernstein operator
   ■ b. backshift operator
   ☐ c. backspace operator
   ☐ d. bilateral shift map

2. Causality implies stationarity.
   ■ True
   ☐ False

3. Which of the following defines a ARIMA$(p, d, q)(P, D, Q)_s$ model?
   ☐ a. $\phi(B)\Phi(B)\nabla^d\nabla^D x_t = \theta(B)\Theta(B)w_t$
   ☐ b. $\phi(B)\Phi(B^s)\nabla^d\nabla_s^D x_t = \theta(B)\Theta(B^s)w_t$
   ☐ c. $\Phi(B^s)\phi(B)\nabla_s^D\nabla^d x_t = \Theta(B^s)\theta(B)w_t$
   ■ d. either b or c

4. A process x_t is called causal provided that we can write it as:
   ☐ a. $x_t = \sum_{j=0}^{\infty}\psi_j w_{t-j}$, where w_t is a white noise sequence
   ■ b. $x_t = \sum_{j=0}^{\infty}\psi_j w_{t-j}$, where w_t is a white noise sequence and $\sum_{j=0}^{\infty}|\psi_j| < \infty$
   ☐ c. $w_t = \sum_{j=0}^{\infty}\pi_j x_{t-j}$, where w_t is a white noise sequence
   ☐ d. $w_t = \sum_{j=0}^{\infty}\pi_j x_{t-j}$, where w_t is a white noise sequence, $\pi_0 = 1$, and $\sum_{j=0}^{\infty}|\pi_j| < \infty$

5. An MA(p) process is invertible provided that the roots of the MA polynomial $\theta(z)$ lie outside of the unit circle.
   ■ True
   ☐ False

6. Let c be the constant (intercept) in an ARIMA model and d be the differencing order. In which of the following situations will long-term forecasts converge to a constant?
   ☐ a. $c = 0$ and $d = 0$
   ☐ b. $c = 0$ and $d = 1$
   ☐ c. $c \neq 0$ and $d = 0$
   ■ d. all of the above

7. The "S" in SARIMA stands for:
   ☐ a. spectral
   ☐ b. satisfiability
   ■ c. seasonality
   ☐ d. it doesn't stand for anything

8. Integration in ARIMA models is used to handle:
   - [x] a. nonstationarity, typically in the form of drift
   - [ ] b. nonstationarity, in the form of seasonality
   - [ ] c. auto-correlations that cannot be handled by AR or MA
   - [ ] d. either a or c

9. In traditional diagnostics used to suggest the structure of an ARMA model, we use shape of the ___ to choose the ___ order.
   - [ ] a. "sample auto-correlation function", "AR"
   - [ ] b. "sample auto-correlation function", "MA"
   - [ ] c. "sample partial auto-correlation function", "AR"
   - [x] d. both b and c

10. Consider an MA(1) process: $x_t = w_t + \theta w_{t-1}$. Under what conditions on θ is this process stationary?
    - [ ] a. $|\theta| > 1$
    - [ ] b. $|\theta| = 1$
    - [ ] c. $|\theta| < 1$
    - [x] d. any θ will yield a stationary process

11. An MA(q) process is always invertible.
    - [ ] True
    - [x] False

12. An MA(q) process is always causal.
    - [x] True
    - [ ] False

13. An invertible ARMA(p, q) model can be rewritten as an AR(∞) process.
    - [x] True
    - [ ] False

14. The Holt-Winters method is an extension of Holt's method that accommodates:
    - [ ] a. damped trends
    - [ ] b. short memory
    - [x] c. seasonality
    - [ ] d. outliers

15. In Holt's method,
$$\begin{aligned} \hat{x}_{t+h|t} &= \ell_t + b_t h \\ \ell_t &= \alpha x_t + (1-\alpha)(\ell_{t-1} + b_{t-1}) \\ b_t &= \beta(\ell_t - \ell_{t-1}) + (1-\beta) b_{t-1} \end{aligned}$$
    the closer its parameter β is to 1, the ___ its ___ parameter changes over time.
    - [ ] a. "less rapidly", "level"
    - [ ] b. "more rapidly", "level"
    - [ ] c. "less rapidly", "slope"
    - [x] d. "more rapidly", "slope"

16. Our general philosophy in this course, when it comes to choosing between ETS models: an ETS model is useful provided that it ___ and we can appeal to ___ to help us determine this.
    - [ ] a. "has stationary residuals", "traditional diagnostics"
    - [ ] b. "has white noise residuals", "traditional diagnostics"
    - [ ] c. "predicts well", "traditional diagnostics"
    - [x] d. "predicts well", "time series cross-validation"

17. Any nonlinear ETS model (with a multiplicative model for the error or seasonal component) is not a special case of ARIMA.
    - [x] True
    - [ ] False

18. In an ETS(x, y, z) model, the z component determines the ___ and can take on the values ___ in standard notation.
    - ☐ a. "error model", "A or M"
    - ☐ b. "trend model", "N, A, or Ad"
    - ☐ c. "seasonality model", "N, A, or Ad"
    - ■ d. "seasonality model", "N, A, or M"

19. In general, damped Holt's method can be preferred over Holt's method because:
    - ■ a. linear extrapolation can be volatile, especially for large horizons
    - ☐ b. real forecasts trends are usually nonlinear in practice
    - ☐ c. the additive error model is rarely true in practice
    - ☐ d. seasonality is usually present in practice

20. In general, Holt's method produces ___ forecast trajectories.
    - ☐ a. "flat"
    - ■ b. "linear"
    - ☐ c. "damped"
    - ☐ d. "curved"

21. An advantage of neural network time series models like DeepAR is that they can be faster and simpler to train than traditional ARIMA or ETS models.
    - ☐ True
    - ■ False

22. The Prophet model takes a ___ approach to forecasting, estimating separate ___ components.
    - ☐ a. "decomposition", "error, trend, and seasonal"
    - ■ b. "decomposition", "trend, seasonal, and holiday"
    - ☐ c. "auto-correlation", "AR and MA"
    - ☐ d. "co-integrated", "trend and drift"

23. An advantage of neural network time series models like DeepAR is that they can learn rich, joint correlation structures between multiple time series, and produce forecasts which respect this correlation structure.
    - ■ True
    - ☐ False

24. A Theta model is based on an equation that sets the ___ of the estimated sequence to θ times the ___ of the data.
    - ☐ a. "first differences", "first differences"
    - ■ b. "second differences", "second differences"
    - ☐ c. "second differences", "de-trended"
    - ☐ d. "second differences", "seasonally-adjusted"

25. DeepAR is a neural network forecaster based on:
    - ☐ a. a fully-connected feedforward architecture
    - ■ b. a long short term memory (LSTM) architecture
    - ☐ c. a transformer architecture
    - ☐ d. ChatGPT