Time Series Modeling and Forecasting **Final Exam—In Class**

Part A: Theory and Specification Questions

1) Derive the autoregressive representation of the MA(1) process $u_t = \varepsilon_t + \theta\varepsilon_{t-1}$ where $0<\theta<1$ and ε is a typical mean zero disturbance. Explain why for modeling a limited number of AR terms can represent this process well even though there are an arbitrarily large number of AR terms in the exact representation (one for each period since the beginning no matter how long).

2) What is the Wold representation theorem, why is it important for time series modeling and forecasting, and how does this relate to your answer to (1) above?

3) Consider the model $y_t = y_{t-1} + \delta J_t + \lambda t + \beta x_t + \varepsilon_t$ where *t* is the time index, *J* is 1 in January and 0 otherwise, *x* is a predictor variable, and ε is a mean zero disturbance. Write out the first difference. Explain why the first difference is stationary and not trending while the undifferenced process is trending and not trend stationary (will not tend to return quickly to trend after a large shock). In the differenced model, what is δ multiplied by in February? Interpret the meaning of this—it makes sense in context of the difference given the underlying model, explain why.

Data for Parts B and C

In addition to month indicators and the date, definitions of monthly variables used below are:

- nonfarm: total nonfarm employment.
- amspk: employment in amusement parks and arcades.
- bldpmt: housing units authorized by building permit.

All are for Florida and ln appearing before a variable denotes its natural log.

Background: Tourism and retirement are important drivers of Florida's economy, and thus of total nonfarm employment. The retirement related sector shows up in a large construction industry—building homes for retirees and homes and places of businesses for those that serve them. These two drivers are somewhat captured by employment in amusement parks and building permits. We could get better fitting models by including other variables, but the point is just to demonstrate your knowledge in a reasonably realistic yet easy to work with context.

Part B: Time Series Modeling (Not Forecasting)

1) Refer to the part of the Stata output for Part B Question 1:

i) Explain why model B.1.2 is preferable to model B.1.1.

ii) Interpret the results of model B.1.2. What does the model say about the structural relationship between total employment and the two components?

2) Refer to the part of the Stata output for Part B Question 2:

i) Why are the results of model B.2.2 preferable to those of model B.2.1?

ii) Explain how adding lags 1 and 12 of (the log difference of) nonfarm employment makes sense in a dynamic structural model of this type. (Think in terms of modeling the adjustment process.) Interpret these two coefficients in terms of what they imply for the adjustment process of nonfarm employment over time.

Part C: Forecasting

1) Refer to the output for Part C Question 1

i) Argue that model C.1.2 is better than model C.1.1 or model C.1.3 for its intended purpose.

ii) What is the purpose of model C.1.2 and why should it differ from B.2.2 to that end?

2) Refer to the output for Part C Question 2:

i) Argue that model C.2.3 is better than model C.2.1 or model C.2.2 for its intended purpose.

ii) What is the purpose of model C.2.3 and why ***MUST*** it differ from C.1.2 to that end?

3) Refer to the output for Part C Question 2:

i) Refer to lines 500-523 and the figure that follows. What is that code doing and what is illustrated by the figure?

ii) Refer to lines 524-547 and the figure that follows. What is that code doing and what is illustrated by the figure?

iii) Refer to lines 548-566 and the figure that follows. What is that code doing and what is illustrated by the figure?

iv) Briefly discuss the forecast for January and February 2018 nonfarm employment from the output for Part C, particularly in terms of the accuracy of the model historically (the first two figures and the LOOCV RMSE) and the width of the forecast interval (in the last figure).

v) Why is the method used in Part C for forecasting two periods out conceptually better than a dynamic autoregressive or vector autoregressive approach?