ECO 341, The Midterm

1. **Some General Questions**

a. Consider the following stochastic process: $q_t = \frac{1}{\alpha t+1} q_{t-1} + e_t$. Is this process stationary? Explain.

b. Now consider the following non-stationary process: $x_t = 0.5x_{t-1} + t^2 + e_t$. Will differencing make this process stationary

c. Why are lags often used as a way to remedy endogeneity when working with time series data?

d. Why did Eichenbaum and Fisher (2005) use Ramey-Shapiro episodes to identify the effects of fiscal policy instead of just, for example, calculating the IRF of GDP to a shock to taxes or government spending?

2. **VARs**

The theory of covered interest rate parity predicts:

$$(i_t^h - i_t^f) = \frac{f_{t,t+1} - e_t}{e_t} \tag{1}$$

where $(i_t^h - i_t^f)$ is the difference in interest rates between home and foreign (known as the interest rate spread). e_t is the exchange rate between home and foreign. $f_{t,t+1}$ is the exchange rate in a futures market. I can contract in period t to use this exchange rate in period $t+1$.

You are handed 100 years of data on U.S. and U.K interest rates, exchange rates, and futures prices for exchange rates.

Dickey Fuller tests show that all variables are I(1) with no trend.

Your initial job is to run the best possible VAR to estimate how shocks to interest rate spreads affect futures exchange rate prices.

a. Represent your VAR in matrix form while clearly describing each element of your vector of dependent variables.

b. Describe how you would choose the lag length for your VAR.

c. True or False? OLS is an inefficient way to obtain your VAR regression coefficients?

Your VAR yields the following estimated variance-covariance matrix:

$$\Sigma = \begin{bmatrix} 1 & -0.5 \\ -0.5 & 0.1 \end{bmatrix} \tag{2}$$

d. Using the Cholesley Decomposition approach, calculate IRFs at time t for a shock to each variable at time t. [Note: I am only asking for the IRFs at the time of each shock. You do not need to calculate them for future periods]

e. Now, instead of using the Cholesky Decomposition, I instead insist that you identify the IRFs under the assumption that the response of variable 1 to a shock to variable 2 in period t, must be identical to the response of variable 2 to a shock to variable 1 in period t. [Again, I am only asking about the impact in time t, not future periods.] Show how you would impose this restriction.

f. Identify and fix a major source of misspecification in your VAR.

3. **Panel Data**

You are given the following variables:

i. $Murder_{it}$, the # of murders in 3 Maine metropolitan areas: Lewiston-Auburn, Portland, and Bangor. The data are annual from 1988-2017. Due to missing observations, the sample size is 75.

ii. $Guns_{it}$, the total number of firearms in each city.

iii. $Population_{it}$, the population of each city.

Your dependent variable is $Muder_{it}$ and your research objective to to determine the effect of guns on murders:

a. Do you think that city fixed effects are likely to be a better specification than random effects or pooled OLS.

b. Describe how you would formally test among the models from a.

Consider the following specification:

$$Murder_{it} = \alpha_i + \gamma_t + \beta_1 Guns_{it} + \beta Population_{it} + \beta_3 X_{it} + u_{it} \tag{3}$$

where α_i are city fixed effects, γ_t are year fixed effects, and X_{it} is an appropriate set of controls.

c-e. Identify the three most serious potential sources of misspecification from (3) and describe how you would fix each of them.

Bonus: Describe how you would use the local projection approach to generate an IRF for how murders respond to a shock to guns. Do you think this would be an appropriate way to address this research question?