1 Econometrics: Answer 3 out of 4 questions. Each question is equally weighted.

1. Consider the model,
$$y_i = X_i\beta + z_i\gamma + u_i$$
where $Ez_iu_i \neq 0$ and $\gamma = 0$. Find the asymptotic distribution of the OLS estimator of (β, γ). Provide an example of an empirical problem where this would be relevant and explain the implications of your asymptotics results.

2. Consider the model,
$$\begin{aligned} y_{it}^* &= X_{it}\beta + e_i + u_{it}, \\ e_i &\sim iidN\left(0, \sigma_e^2\right), \\ u_{it} &\sim iidN\left(0, 1\right), \\ y_{it} &= 1\left(y_{it}^* > 0\right). \end{aligned}$$
Construct the likelihood function for this model.

3. Consider the model,
$$y_t = X_t\beta + z_t\gamma + u_t.$$
Assume that z_t is not observed, so the econometrician estimates the model,
$$y_t = X_tb + e_t.$$
What are the statistical properties of the OLS estimator of b?

4. Consider the model,
$$\begin{aligned} y_t &= \rho y_{t-2} + u_t, \\ u_t &\sim iid\left(0, \sigma^2\right). \end{aligned}$$
Derive the necessary and sufficient conditions for y_t to be stationary. Find $Var\left(y_t\right)$ if the stationarity conditions are not satisfied.