Question 1: Empirical Analysis of Economic Growth (100 points)

In empirical analyses of economic growth, cross-section regressions are often employed to assess the relevance of various growth determinants. In these regressions, different countries are assumed to obey a common growth model.

A. Describe a cross-section growth regression based on the Solow neoclassical growth model. Using only those growth controls suggested by the Solow model, propose a test of the hypothesis that the sub-Saharan African countries obey a different growth equation than the other countries in the world. (25 points).

B. How would a finding of differences, as formulated in your test, relate to the convergence hypothesis? (15 points)

C. Suppose that the analysis in A. leads you to conclude that the African countries do in fact obey a different growth equation than the rest of the world. Describe a set of empirical strategies, including those which include variables other than the Solow controls, for determining the economic explanations of this difference. (60 points)
Question 2: Optimal Sorting

Suppose that you are a policymaker who is deciding how to allocate students across two classrooms in order to maximize student performance. Each student’s performance $\omega_i$ is described by an equation of the form

$$\omega_i = k + \alpha x_i + \beta y_c(i) + Jm_{c(i)} + \epsilon_i$$

Here, $x_i$ is an individual characteristic, say education of the student’s mother, $y_c(i)$ is a classroom average characteristic, say average education of all parents, and $m_{c(i)}$ is the expected value of the average of the within-classroom performances.

Suppose that there are 2 classrooms and $2N$ students. Each classroom must contain $N$ students. Suppose $N$ students are such that $x_i = \bar{x}$ and $y_i = \bar{y}$ and $N$ students are such that $x_i = \bar{x}$ and $y_i = \bar{y}$.

A. What allocation(s) of students maximizes expected average performance across all students? (30 points)

B. What allocation(s) of students maximizes the expected average performance of type 2 (i.e. $x_i = \bar{x}$ and $y_i = \bar{y}$) students? (30 points)

C. Under what conditions is the performance equation econometrically identified? Suppose that you had data from classrooms across the country; could you construct an “excess volatility test” for whether $J = 0$? (40 points)
Problem #3 “Interest Rates and Consumption in Open and Closed Economies”

Consider an economy populated by a large number of identical households each maximizing the following utility function

$$U = E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) \right\}, \quad 0 \leq \beta < 1,$$

where \( u(c) = u_0 - \frac{(u_0)^2c}{2} \) is such that, for all feasible values of \( c \), \( u_0 - u_0c > 0 \); that is, the marginal utility of consumption is positive. Assume that each family’s income follows the following stochastic process:

$$y_{t+1} = (1-\rho)y^* + \rho y_t + \varepsilon_{t+1}, \quad 0 < \rho < 1,$$

and \( \{\varepsilon_t\} \) a sequence of i.i.d. zero mean, bounded random variables independent of past \( y_t \). Let the variance of \( \varepsilon_t \) be \( \sigma^2 \).

a) Consider first a closed economy in which, in equilibrium, consumption equals income \( (c_t = y_t) \). Provide an expression for the one period real interest rate, \( R_{t+1} \). Economist A argues that in “good” times \( (y_t > y^*) \) interest rates are below \( 1/\beta \), while in “bad” times the opposite is true. Do you agree? Justify your answer.

b) Let the world interest rate be given by \( R^* \). Let this economy be open to international borrowing and lending at the world interest rate. In this case, the country’s budget constraint is given by,

$$c_t + b_{t+1} = y_t + R^*b_t,$$

where \( b_t \) is the stock of foreign bonds (and it could be negative). Assume that \( b_0 = 0 \). Write down the Euler equation for borrowing and lending in the international market and show that equilibrium consumption is of the form,

$$c_t = \alpha_0 + \alpha_1 b_t + \alpha_2 y_t,$$

for some coefficients \( \alpha_i \).

Note: “Guess” that the equilibrium consumption function has the given form and “verify” your guess. Do not check the transversality condition.

c) Describe the equilibrium behavior of the stock of foreign bonds. How does the stock of foreign debt vary with domestic GDP? What is the mean (or expected) value of the stock of foreign bonds? Explain your results.

d) Go as far as you can comparing the mean and variance of consumption in the closed (section a) and open (sections b and c) economy cases.
Problem #1  “Profit Taxes and Unemployment”

Consider an economy populated by risk neutral, income maximizing workers, with preferences given by,

\[ U = E \sum_{t=0}^{\infty} \beta^t y_{t+1}, \quad 0 < \beta < 1, \quad 1 + r = \beta^{-1}. \]

Assume that workers produce \( z \) at home if they are unemployed, and that they are endowed with one unit of labor.

Assume that all jobs have productivity \( y > z \), and that to create a vacancy firms have to pay a cost of \( c > 0 \) units of output per period. Jobs are destroyed with probability \( s \). Let the number of matches per period is given by,

\[ M(u,v), \]

where \( M \) is concave, increasing in each argument, and homogeneous of degree one. In this setting, \( u \) is interpreted as the total number of unemployed workers, and \( v \) is the total number of vacancies. Let \( \theta = v/u \), and let \( q(\theta) = M(u,v)/v. \)

Assume that workers and firms bargain over wages, and that the outcome is described by a Nash Bargaining outcome with the workers’ bargaining power equal to \( \varphi \).

In this economy firms pay taxes on profits at the rate \( \tau \). Specifically, when a vacancy is filled, the flow of profits is \((1-\tau)(y-w)\), where \( w \) is the wage. When the firm is waiting to fill its vacancy, the flow of profits is given by \(-c(1-\tau). \) Thus, effectively, we are assuming that losses are tax deductible. There are no taxes on workers. There is free entry into the “production” of vacancies.

a) Describe a “demand for labor” function (expressed in the form of wage as a function of \( \theta \) and other variables) implied by the zero profit condition. Do corporate taxes affect this relationship?

b) Describe a “supply of labor” function (expressed in the form of wage as a function of \( \theta \) and other variables) implied by the zero profit condition.

c) This country is currently considering a decrease in the corporate tax rate. One economist -- Economist A-- argues that, in the long-run, this will result in higher wages and a lower unemployment rate. Another economist --Economist B-- claims that, in the long-run, wages will increase but that the unemployment rate will increase as well. Use your model to analyze these two claims. Please be explicit about your.

Note: This last part (which will receive the highest weight) may require you to use local “sign” conditions; that is, conditions on the sign of an expression that are known to hold only in equilibrium.