Notes: Answer all the questions on the separate answer sheets provided in Chinese or English. Please label question numbers clearly, and write Legibly.

1. The following figure describes the time series of government spending (solid line) and receipts (dashed lines) of Taiwan since 1962.

Government Spending and Receipts, Total Government, Taiwan
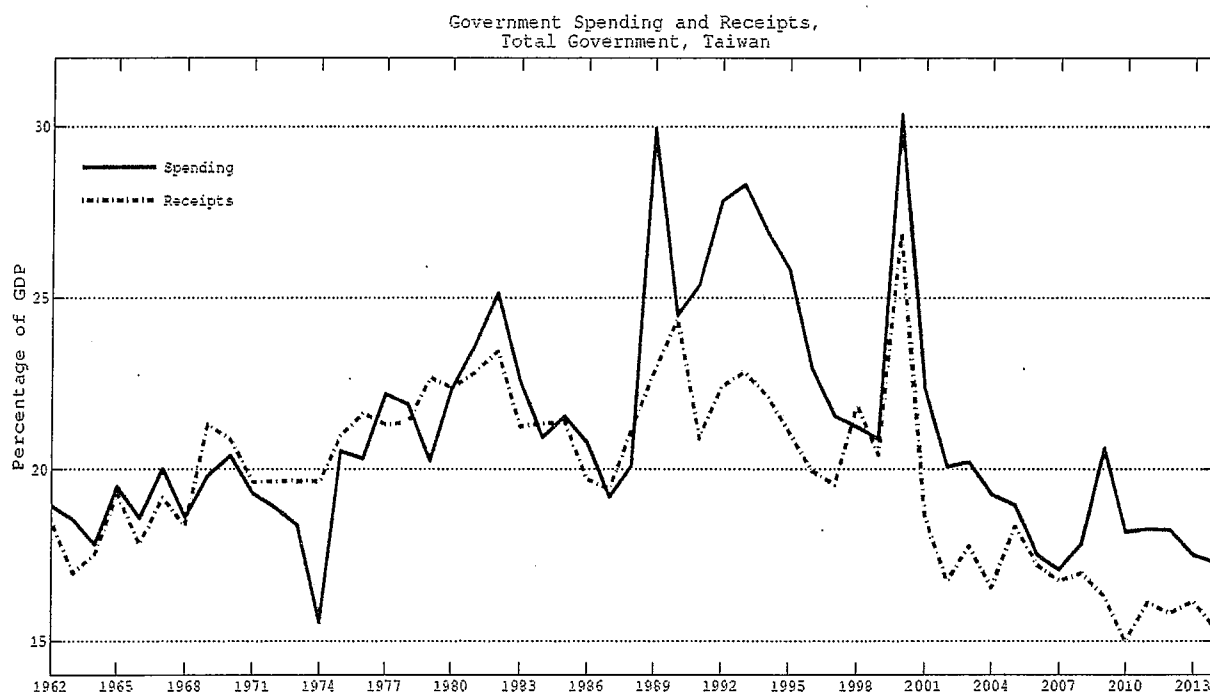
Based on the figure and your understanding of the Taiwanese economy, please answer the following questions about Taiwan's fiscal conditions. Justify your answers briefly with your interpretation of the figure and economic rationale.

a. Based on the figure, would you say Taiwan has run fiscal surplus most of the time since late 1980s? [5 points]

b. Based on the figure, can you conclude that government debt reached the peak in 1989 as the difference between spending and receipts is the largest? [5 points]

c. Based on the figure, can you conclude that government debt has had a downward trend since early 2000 because of the sharp decline in the government spending as a share of GDP? [5 points]

d. Is the consumption coupon program implemented in 2009 (as shown by the rise of government spending around 2009) an example of procyclical fiscal policy to stimulate private demand? [5 points]

2. Consider a Solow growth model. The aggregate production function, $Y = zF(K, N) = zK^\alpha N^{1-\alpha}$, exhibits a constant return to scale, where z is total factor productivity (TFP), K is aggregate capital, N is the total number of workers, and $0 < \alpha < 1$ is the income share of capital. The economy has a constant worker growth rate of n (i.e., the number of workers next period is $N' = (1 + n)N$), a constant saving rate s, and a constant capital depreciation rate of d. The law of motion for K is $K' = I + (1 - d)K$, where I is aggregate investment and K' indicates aggregate capital next period.

   a. Derive the production function per worker ($y = \frac{Y}{N}$) and use the notation $k \equiv \frac{K}{N}$ in your derivation. Your answer should express y as an explicit mathematic function of TFP and capital per worker. [10 points]

   b. Derive the marginal product of labor (MPN). Is MPN an increasing or decreasing function of aggregate capital? Draw a graph with MPN on the y-axis and N on the x-axis and explain its economic meaning. Justify your answer with mathematical derivation. [15 points]

   c. In equilibrium, aggregate investment equal aggregate saving (i.e., $I=sY$). Solve for the steady-state capital per worker (k^*) as a function of exogenous parameters. Explain the economic meaning of the steady state in the context of the Solow model. [15 points]

   d. In the Solow model, the golden rule of saving refers to the saving rate that leads to maximum consumption per worker in the steady state. Derive the condition that pins down the golden rule steady-state capital per worker and compute the golden rule saving rate in this model. [20 points]

3. The birth rate of Taiwan has been one of the lowest in the world in recent years. What is the macroeconomic impact of a low birth rate to an economy? Please answer the question from its effects on aggregate demand, labor force, the sustainability of the pension system, and the government's fiscal position. [20 points]

1. (10pts) If a binding minimum wage, $\underline{w}$, is imposed, what happens to the equilibrium in the labor market? Furthermore, is it possible that the minimum wage could make total wage payments (wage times employment) rise? If it is possible, how can all workers benefit from the minimum wage, not just the workers who remain hired after the implementation of the minimum wage? (Please use a graph to illustrate the effect.)

2. (10pts) If a government decides to temporarily suspend the current gasoline tax, which is a unit tax, will this policy benefit the firms or consumers in the short run? (Note: In the short run, all the oil refineries can produce at most $\bar{Q}$ units of gasoline and please draw a graph to support your answer.)

3. (10pts) The property of local nonsatiation of consumer preferences states that for any bundle of goods there is always another bundle of goods arbitrarily close that is preferred to it. What this means is that a consumer always either prefers more of an item or less of an item. Please draw an indifference curve that violates such a property.

4. (10pts) Is it possible for all goods to be inferior? Please provide the assumption made on the preferences that leads to your answer. We do sometimes observe that an individual does not buy more usual goods and services when her income goes up. Where can the rest of the money go? Does this observation contradict the answer you had for the first part of this question?

5. (10pts) Suppose that two linear demand curves go through the initial equilibrium, (p_1, q_1). One demand curve is less elastic than the other at (p_1, q_1). For which demand curve will a price increase cause the larger consumer surplus loss? Please draw a graph to illustrate your answer.

6. (10pts) Please use the Edgeworth box to show the difference between a Pareto efficient point and a competitive equilibrium point.

7. (10pts) Will the price be lower if duopoly firms engage in a Cournot competition or if they engage in a Bertrand competition? Under what conditions can you give a definite answer to this question?

8. (10pts) Consider the following sequential game: If the potential entrant stays out of the market, it makes no profit, $\pi_e = 0$, and the incumbent firm makes the monopoly profit, $\pi_i = \pi_m$. If the potential entrant enters the market, the incumbent earns π_d and the entrant makes $\pi_d - F$. Now, if the incumbent firm can choose to pay the landlord \$$b$ for exclusive rights to deter the potential entry, will it pay?

9. (20pts) John has a house worth \$80,000. Because John is risk-averse, he wants to fully insure his house. Assume that his house has 25% chance to burn next year. If it does burn, the house will be worth \$40,000. The insurance company offers a fair insurance to let John trade \$1 in the good state (no fire) for \$3 in the bad state (fire). In other words, John can pay \$1 premium and he will receive \$3 if the house burns. Now, the local government assesses a property tax of \$4,000 on John's house. If the tax is collected whether or not the house burns, how much fair insurance does John buy? If the tax is only collected when the house does not burn, how much fair insurance does John buy? Explain the results.

Answer the following five questions, equally weighted

請務必依題序在答案卷上作答 (5 大題, 共100分)

1. (20%) A random sample of size $n = 1$ is drawn from a uniform pdf defined over the interval $[0, \theta]$, i.e.

$$f_Y(y; \theta) = \begin{cases} \frac{1}{\theta}, & 0 < y < \theta; \\ 0, & \text{otherwise.} \end{cases}$$

We decide to test $H_0 : \theta = 2$ versus $H_1 : \theta \neq 2$ by rejecting H_0 if either $y \leq 0.1$ or $y \geq 1.9$, where y is the value drawn. Find the type I error α. Also, find the type II error β if the true value of θ is 2.5. ∎

2. (20%) Suppose X is a random variable with distribution function

$$F(x) = \begin{cases} 0 & \text{if } x < 0; \\ 0.4 & \text{if } 0 \leq x < 1; \\ 1 & \text{if } x \geq 1. \end{cases}$$

Find the density function of X, $f(x)$. ∎

3. (20%) Let (X, Y) be a continuous random vector with joint density function $f(x, y) = cx^2 y, 0 < x < 1, 0 < y < 1$.

   (a) What is c ?
   (b) Are the events $\{X \leq 0.5\}$ and $\{Y \leq 0.5\}$ independent ? ∎

4. (20%) Let $X_1, ..., X_n$ be independently identically distributed with X_i having density $f(x; \theta) = \theta x^{\theta-1}, 0 < x < 1, \theta > 0$. Find the MLE of θ. ∎

5. (20%) Let $Y_1, Y_2, ..., Y_n$ be a random sample from the Bernoulli pdf,

$$f_{Y_i}(y_i; p) = p^{y_i}(1 - p)^{1-y_i}, \quad y_i = 0, 1; \quad 0 < p < 1.$$

It has already been suggested that

$$W = \frac{Y}{n}$$

be used as an unbiased estimator for p, where $Y = \sum_{i=1}^{n} Y_i$. How does Var(W) compare with the Cramer-Rao lower bound ? ∎

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