1. Suppose that s fraction of employed workers are separated. Assume that m proportion of unemployment workers meets such a job. Let E and U denote the number of employed workers and unemployed workers, respectively.

   (a) Derive the dynamics of the number of unemployed workers.

   (b) Suppose that $U_{t+1} = U_t$ on the steady state. The natural rate of unemployment is defined as the unemployment on the steady state. Derive the natural rate of unemployment as a function of s and m.

   (c) What influences the natural rate of unemployment through changes in s and m. Discuss it.

2. Suppose that Bank of Japan wants to minimize the following loss function by choosing the inflation rate at date t, g_{pt},

$$L(u, \pi) = u_t + \frac{\gamma}{2} g_{pt}^2,$$

   subject to the following Phillips curve,

$$u_t = u^n - \alpha \left[g_{pt} - g_{pt}^e \right].$$

   where u_t is the unemployment rate at date t, u^n is the natural rate of unemployment g_{pt} is the inflation rate, g_{pt}^e is the expected inflation rate held by Japanese people, and α and γ are parameters.

   (a) Suppose that the Bank of Japan announces that it will choose 0 inflation rate, but they can not commit their announcement. What would be the equilibrium unemployment rate and inflation rate?

   (b) Suppose that the Bank of Japan announces that it will choose 0 inflation rate and builds up a commitment device (for example, the Bank of Japan writes the chosen inflation rate in Japanese constitution). What would be the equilibrium unemployment rate and inflation rate?

   (c) What can you learn from your answers in question (a) and (b)?

3. Answer following questions.

   (a) The permanent income hypothesis predicts that a temporal change in current income should not influence a change in consumption. However, data shows that a change in consumption is partially influenced by the movement of current income. What are two possible explanations?

   (b) What is Ricardian equivalence? Explain its logic.

   (c) Data shows that Ricardian equivalence does not literally hold. What are three possible reasons?

4. Suppose that a consumer lives two periods, dates t and $t+1$. In each period, he earns the same labor income w and initially does not have any asset. When he receives his income at date t, he can consume c_t today or leave it for tomorrow, c_{t+1}. Assume that he consumes every income at date $t+1$ and does not leave asset for future. When he saves for $t+1$, he can earn the interest rate ρ at date $t+1$. Assume that the consumer has an instantaneous utility function $U(c)$ and a discount factor, β. Suppose that there is no tax at date t. Government will levy a lump sum tax, τ at date $t+1$.

   (a) Formulate the consumer's decision problem.

   (b) Assume that the consumer has a quadratic instantaneous utility function: $U(c_t) = ac_t - \frac{b}{2}c_t^2$. Derives the first order condition of the problem above.

   (c) Assume that the consumer has a quadratic instantaneous utility function: $U(c_t) = ac_t - \frac{b}{2}c_t^2$. Derive the optimal c_t . How does a change in τ affect c_t? Why?