Computer problems 03

Task 1. Consider a market for a good where there are two producers and two categories of consumers, the rich and the poor. Rich consumers have high incomes and buy large quantities of the good, while poor consumers have low incomes and buy smaller quantities of the good. The utility functions for each category of consumers are as follows:

Rich: U1(x1, x2) = 10ln(x1) + ln(x2)

Poor: U2(x1, x2) = 2ln(x1) + 4ln(x2)

where x1 and x2 are the quantities of good 1 and good 2, respectively.

Producers have limited resources to produce both goods, so they have production functions of the form:

Producer 1: q1 = f1(K1, L1) = 4sqrt(K1)L^(1/4)

Producer 2: q2 = f2(K2, L2) = 2sqrt(K2)L2^(1/2)

where q1 and q2 are the quantities of goods 1 and goods 2 produced, respectively, K1 and K2 are capital, and L1 and L2 are labor.

For consumers and producers, the prices of goods and wages are set by the government. The initial price of good 1 is p1 = 2, the price of good 2 is p2=1. The wages of poor consumers are w2 = 2, and of rich consumers are w1=10.

At the beginning of the simulation, all consumers buy only good 1, and wages do not change. The government then increases wages, which can lead to changes in income and substitution effects for consumers, who in turn may change their purchases. For example, as wages increase, consumers may buy more of good 1, or they may shift their attention to other goods, depending on the elasticity of demand for different goods and changes in their prices. Such changes can affect the economy and can be studied using simulation modelling.

Task 2. Model the activity of a competitive market with three firms and production functions: Q1 = a1 * P^(b1) , Q2 = a2 * P^(b2), Q3 = a3 * P^(b3), where Q is the quantity of goods produced, P is the price of the goods, a and b are the parameters of the production function of each firm. Each firm maximizes its profit, and each individual maximizes its utility. There are three groups of individuals with utility functions: U1 = X1 * Y1, U2 =

X2 * Y2b, U3 = X3a * Y3, where X and Y are the quantity of goods and incomes, respectively, a, b are the parameters of the individuals (each has its own). Each individual has a limited income and has the opportunity to purchase goods from three firms in the market. Model the market, find equilibrium in the market and estimate the profits of each firm. You can study different parameters of the production function, utility function and cost of production, change in wages depending on the profitability of the company.

Task 3. Model the labor market for two firms with different production functions. Firm 1 has a production function $y1 = a*K_1L_1$, and firm 2 has a production function $y2 = b*K_2L_2$, where y is the volume of output in thousand units, K is the firm's capital, and L is the number of employees. The labor market consists of 2,000 employees. Each employee can receive a salary or dividends from the firm's shares he or she holds. The utility function of each employee consists of income and employment level. The task is to find the equilibrium number of employees and wages for each firm over a given number of periods using simulation modelling. In addition, various scenarios can be conducted, for example, changing the production functions of firms, changing the number of employees in the market, setting a minimum wage, etc.