

## Economics and Econometrics: second-round sample tasks

### Part 1: Multiple-Choice Questions

#### Thematic block 1. Economic behavior of consumers and firms: select one answer

1. (2 points) The price elasticity of demand will be higher: (select one answer)
  - a) for essential goods than for luxury goods;
  - b) in cases where consumers use this product with the greatest benefit for themselves;
  - c) the less the product is needed by the consumer;**
  - d) in none of the above cases.
2. (2 points) If a one percent reduction in the price of a good does not lead to a change in the quantity demanded for it, then this demand: (select one answer)
  - a) inelastic;
  - b) elastic;
  - c) unit elasticity;
  - d) perfectly inelastic;**
  - e) perfectly elastic.
3. (4 points) Consumer's utility function is:  $U(X, Y) = X^{3/4} Y^{1/4}$ . His weekly income is \$400, but he consistently consumes only two goods X and Y, with  $P_X = \$5$ ,  $P_Y = \$10$ . The consumer's optimal bundle is: (write your answer as a number)

Choose the correct statement

- a)  $X = 24; Y = 36;$
  - b)  $X = 60; Y = 10;$**
  - c)  $X = 30; Y = 35;$
  - d)  $X = 24; Y = 48.$
4. (4 points) The production function is given:  $Q = 3L^{0.4} K^{0.6}$ . What is the ratio of marginal labor productivity to average labor productivity? (write your answer as a number)
    - a) 0,4**
    - b) 1,2
    - c) 2,4
    - d) 3,2

#### Thematic block 2. Macroeconomics: select one answer

5. (2 points) How would taxes and the reserve requirement change in order for the interest rate to fall in a closed economy without changing aggregate output? (select one answer)
  - a) taxes were to rise and the reserve requirement to fall**
  - b) taxes were to be cut and the reserve requirement to be raised
  - c) taxes and reserve requirements were to rise
  - d) taxes and reserve requirements were to fall

6. (2 points) If the economy is characterized by a Keynesian section of the short-run aggregate supply curve, then a fall in aggregate demand will lead to: (select one answer)

- a) decrease in the price level and the volume of aggregate output
- b) decrease in aggregate output at a constant price level**
- c) decrease in the price level with the same output
- d) a decrease in output and an increase in the price level

5. 7. (4 points) If GDP is \$5,565 million, consumption is \$3,657, investment is \$741, and government purchases are \$1,098, then net exports are: (write your answer as a number)

- a) 1908
- b) 810
- c) 69**
- d) -69

6. 8. (4 points) If total output = 5000, taxes 900, consumption 3200, investment spending 900, government spending 1000, then private savings would be: (write your answer as a number)

- a) 900**
- b) 800
- c) 3200
- d) 0

### Thematic block 3. Macroeconomic dynamics. Open economy models:

9. (2 points) Assume that the economic growth rate in country A is 2% per year, and the growth rate of the money supply is 3% per year. Country B has an economic growth rate of 3% per year and a money supply growth rate of 4% per year. The monetization coefficients  $k$  are constant in both countries. In this case, ceteris paribus: (select one answer)

- a) it is most likely that the currency of country B will rise against the currency of country A by 1%
- b) it is most likely that the exchange rates of countries A and B will remain unchanged**
- c) it is most likely that countries A and B will not be able to stabilize the ratio of their currencies
- d) it is most likely that the currency of country A will rise against the currency of country B by 1%

10. (2 points) Devaluation of the national currency: (select one answer)

- a) shifts the LM curve to the left**
- b) shifts the LM curve to the right
- c) changes the slope of the LM curve
- d) does not affect the position of the LM curve

11. (4 points) The IS curve for an open economic system shows that... (select multiple answers)

- a) savings and imports are directly proportional to the size of national income**
- b) savings and imports are inversely proportional to national income
- c) the volume of investments is inversely proportional to the interest rate in the domestic economy**
- d) the volume of investments is directly proportional to the interest rate in the domestic economy
- e) the volume of government spending and exports depend neither on the size of national income, nor on the level of the domestic interest rate**
- f) the volume of government spending and exports depends on the amount of national income and on the level of the domestic interest rate

12. (4 points) In the absence of capital flow across national borders in the IS - LM - BP model (select multiple answers)

- a) **a change in the internal rate will not change the state of the capital account**
- b) a change in the domestic rate will affect the state of the capital account
- c) **the BP curve will be a vertical line**
- d) the BP curve will be a horizontal line

**Thematic block 4. Financial markets and financial instruments:**

13.(2 points) The circulation of securities in a developed market economy occurs mainly: (select one answers)

- a) in the primary securities market;
- b) **in the secondary securities market;**
- c) in the secondary unorganized securities market;
- d) in the shadow stock market.

14.(2 points) Variance in portfolio investment is a measure of: (select one answers)

- a) portfolio yield
- b) market risk of a portfolio of securities and/or an individual security
- c) **specific risk of a portfolio of securities and/or an individual security**
- d) the total risk of a portfolio of securities and/or an individual security

15. (4 points) The stock index consists of shares of four companies A, B, C, D. The index is calculated as an arithmetic weighted average of companies' capitalization. At the beginning of the calculation of the index, the price of stock A was 5 dollars, B was 4 dollars, C was 6.8 dollars, and D was 8.6 dollars. Total issued shares of company A 100,000 pieces, B - 250,000 pieces and C - 140,000 pieces, D - 320,000 pieces. At time T, the share prices were: A was equal to 7.5 dollars B - 3.6 dollars, C - 8 dollars, D - 9 dollars. The value of the index at the start of its calculation is assumed to be 10. Determine the value of the stock index at time T. (write your answer as a number)

- a) **10.857**
- b) 1.08
- c) 0.92
- d) 9.2

16. (4 points) During what period will the deposit amount of 6 million monetary units grow to 15 million monetary units at a simple interest rate of 15% per annum. (write your answer as a number)

- a) 5 years
- b) **10 years**
- c) 6 years
- d) 3.7 years

**Thematic block 5. Econometrics:**

17. (2 points) The average mileage of old cars is 155,342 km, and the average price is 650,000 rubles. Does the regression line pass through the point (155342, 650,000)? (select one answers)

- a) No, but simple linear regression sometimes passes through the midpoint
- b) **Yes, simple linear regression always goes through the midpoint**
- c) Yes, but simple linear regression does not always pass through the midpoint
- d) No, this can never be

18. (2 points) The researcher decided to check whether there was discrimination in the labor market in the city where he lived. To do this, he interviewed employees of 10 firms (firms were randomly selected from the database) about their official wages and length of service. A total of 250 people were interviewed, 130 of them were female. After performing the Chow test, the researcher found that the p -value for the test was 0.045321. Based on this, we can conclude (at the 5% significance level): (select one answers)

- a) **there was discrimination in the labor market, it is recommended to use a dummy variable to measure the impact of gender on wages**
- b) there was no gender discrimination in the labor market
- c) it is impossible to understand whether there is discrimination in the labor market

19. (4 points) Based on 700 observations, the following model was obtained:  $Y_x = 10.8 + 1.45 \cdot x_i$ . The standard error of the free coefficient was 4.3. The standard error of the regression coefficient was 0.6. The tabular value of Student's statistics for a significance level of 0.01 was 2.58, for a significance level of 0.05 it was 1.96. Variable coefficient was: (select multiple answers)

- a) Significant at the 1% significance level
- b) **Significant at the 5% significance level**
- c) **Not significant at the 1 percent level**
- d) Not significant at the 5% significance level

20. (4 points) In linear regression, the results were obtained: the coefficient of determination was 0.6, the residual sum of squared deviations was 150. What is the total sum of squared deviations? (write your answer as a number)

- a) 325
- b) **375**
- c) 150

## Part 2: Tasks.

(Attention: each version of the Olympiad will include tasks from any two thematic blocks)

### 1. Thematic block 1. Economic behavior of consumers and firms

1. (20 points) A price experiment is being conducted in a hypermarket. In August, the price of Cactus ice cream (Chistaya Liniya, 80 g) is reduced from 120 to 96 rubles. At the same time, the sales volume increases from 3,000 units in July to 4,200 units in August.

- 1) (8 points) Determine the price elasticity of demand (using the method of the midpoint of the interval)
- 2) (8 points) Determine the optimal sales price that maximizes the revenue of the retail chain, provided that the demand function is linear.
- 3) (4 points) What can be the maximum income of the trading network?

**Solution:**

$$1) \quad E_p^Q = \frac{\Delta Q}{\Delta P} \cdot \frac{\bar{P}}{\bar{Q}} = \frac{1200}{24} \cdot \frac{108}{3600} = 1,5$$

- 2) The optimal price is achieved when the price elasticity of demand is equal to 1:

$$E = \frac{\Delta Q}{\Delta P} \cdot \frac{P_0}{Q_0} = 1 \quad Q = a - bP; \quad b = \frac{\Delta Q}{\Delta P} = \frac{1200}{24} = 50 \rightarrow Q = a - 50P \rightarrow$$

$$3000 = a - 50 \cdot 120; \quad a = 9000 \rightarrow Q = 9000 - 50P$$

$$E = b \cdot \frac{P_0}{Q_0} = 1 \rightarrow 50 \cdot \frac{P_0}{9000 - 50P} = 1; \quad 9000 - 50P = 50P; \quad P = 90$$

3) Income is determined by the formula:

$$R = P \cdot Q; \quad R_1 = P_1 \cdot Q_1 = 120 \cdot 3000 = 360\,000$$

$$R_2 = P_2 \cdot Q_2 = 96 \cdot 4200 = 403\,200$$

$$R_0 = P_0 \cdot Q_0 = 90 \cdot 4500 = 405\,000 \text{ is the maximum income}$$

**Answer:**

1)  $E = 1.5;$

2)  $P = 90;$

3)  $R_0 = 405\,000.$

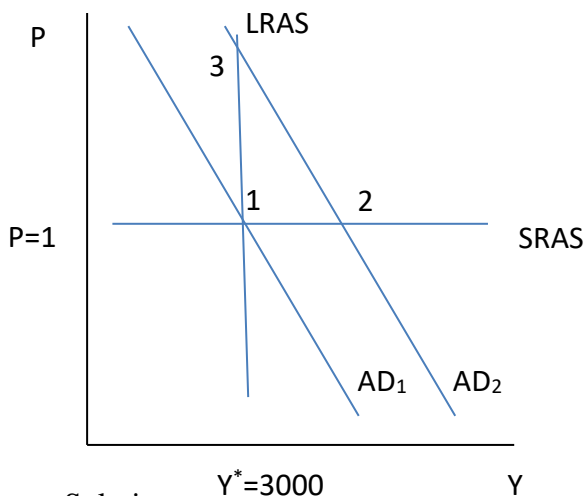
### Thematic block 2. Macroeconomics

2. (20 points) The long-term AS curve is vertical at  $Y = 3000$ . The short-term AS curve is horizontal at  $P = 1.0$ . The aggregate demand curve is presented as  $Y = 2000 + 1.0M/P$ , where  $M$  is the money supply,  $M = 1000$ . Initially, the economy is in long-term equilibrium at  $Y = 3000$  and  $P = 1.0$ . Suppose the money supply has increased to 1500.

1) (4 points) Determine the new equilibrium values of output and price level in the short and long run.

2) (8 points) Determine the velocity of money circulation for the initial ( $V_1$ ) equilibrium state for the short-term ( $V_2$ ) and long-term ( $V_3$ ) equilibrium of the system after the changes that have occurred in it.

3) (8 points) Determine the inflation rate in the long run.



Solution:

1) Point 2 (short-term equilibrium)

$P = 1, SRAS = AD_2$

**ONE CLICK TO OPEN ALL DOORS**

$$Y = 2000 + 1500/P = 3500$$

Point 3 (long-term equilibrium)

$$Y = 3000, LRAS = AD_2$$

$$3000 = 2000 + 1500/P$$

$$P = 1.5$$

$$2) MV = PY, \text{ hence } V = PY / M$$

$$V_1 = (3000 * 1) / 1000 = 3$$

$$V_2 = (3500 * 1) / 1500 = 2,333$$

$$V_3 = (3000 * 1.5) / 1500 = 3$$

3) The rate of inflation in the long run

$$\pi = (P_3 - P_1) / P_1 = (1.5 - 1) / 1 = 0.5$$

**Answer:**

$$1) Y = 3500; P = 1.5;$$

$$2) V_1 = 3; V_2 = 2.333; V_3 = 3;$$

$$3) \pi = 0.5.$$

### Thematic block 3. Macroeconomic dynamics. Open Economy Models

3. (20 points) The production function is given by  $Y = 1.5K^{0.5}L^{0.5}$ . The retirement rate is 5% per year. The savings rate is 24% of GDP. The population is increasing at a rate of 1% per year. Define:

- 1) (4 points) capital-labor ratio, output level, consumption level per employee in steady state (round your answer to three decimal places);
- 2) (8 points) the level of capital-labor ratio, the level of output in conditions corresponding to the "golden rule" (round your answer to three decimal places);
- 3) (8 points) the savings rate and the level of consumption under conditions corresponding to the "golden rule" (round your answer to three decimal places).

**Solution:**

1) Since the calculation is performed per employee, to solve the problem, we write the production function for a unit of labor, dividing both parts of the equation of this production function by  $L$ . The production function for one employee is a function of one variable  $y = 1.5k^{0.5}$ , where  $k$  is the capital-labor ratio.

The condition for a steady state of the economy:

$$s * y = (d + n) * k,$$

where  $s$  is the savings rate;  $y$  is the production function for one employed person;  $d$  is the retirement rate;  $n$  is the population growth rate.

For this problem, this condition can be written as follows:

$$0.24 * 1.5 k^{0.5} = (0.05 + 0.01) * k. \text{ Solving this equation, we get: } k^{0.5} = 6,$$

hence the stable capital-labor ratio  $k(\text{stable}) = 36$ .

We find the output by substituting the obtained value  $k(\text{stable})$  into the production function for one employed  $y = 1.5k^{0.5}$ , hence  $y(\text{stable}) = 1.5 * 6 = 9$ .

Consumption per employee

$c = (1 - s) * y$ . Then the level of consumption in the steady state according to the conditions of this problem is  $c(\text{stable}) = 9 * (1 - 0.24) = 6.84$ .

2) Condition corresponding to the "golden rule":

$$MPK = d + n,$$

where  $MPK$  is the marginal product of capital.

$MPK$  is the first derivative of the production function per employee.

$$MPK = 1.5 * 0.5 k^{0.5 - 1} = 0.75 / k^{0.5}.$$

Since  $d + n = 0.06$ , substituting 0.06 into the previous equation, we find a stable capital-labor ratio corresponding to the "golden rule":

$k(\text{gold})^{0.5} = 12.5$ . Hence  $k(\text{gold}) = 156.25$ . Therefore:

$y(\text{gold}) = 1.5 k^{0.5} = 1.5 * 12.5 = 18.75$ .

3) Considering that the state of the economy corresponding to the "golden rule" is also stable, let's substitute the value of  $k(\text{gold})$  into the corresponding formula:  $s * y = (d + n) * k$ , or  $s * 1.5 k^{0.5} = (d + n) * k$ .

Let's get the savings rate for the "golden rule":  $s(\text{gold}) = 0.5$ . The level of consumption depends on the savings rate  $c = y * (1 - s)$ . Then under the conditions of the "golden rule"

$c(\text{gold}) = 18.75 * (1 - 0.5) = 9.375$ .

**Answer:**

- 1)  $k(\text{stable}) = 36$ ,  $y(\text{stable}) = 9$ ,  $c(\text{stable}) = 6.84$
- 2)  $k(\text{gold}) = 156.25$ ,  $y(\text{gold}) = 18.75$
- 3)  $s(\text{gold}) = 0.5$ ,  $c(\text{gold}) = 9.375$

#### Thematic block 4. Financial markets and financial instruments:

4. (20 points) The investor is offered 2 bonds A and B for purchase:

A: coupon bond with a face value of 1000 rubles. and a coupon rate of 17% paid once a year. The bond has a maturity of 3 years.

B: coupon bond with a face value of 2000 rubles. and a coupon rate of 13% paid once a year. The bond has a maturity of 3 years.

Define:

- 1) (4 points) the current value of each bond (round your answer to three decimal places);
- 2) (8 points) return on investment (maturity period) of each bond in terms of the weighted average duration of payments at a required rate of return of 10% (round your answer to three decimal places);
- 3) (8 points) the return on investment of the preferred bond to invest in (round your answer to three decimal places).

Solution:

1) Determine the current value of each bond:

$$PV = \sum_{i=1}^n (C/(1+r)^i + H/(1+r)^n)$$

where:

PV - present value

C - coupon payments

r - rate of return

n - number of coupon payment periods

H - bond face value

BUT:

$$PV = \frac{170}{(1+0,1)} + \frac{170}{(1+0,1)^2} + \frac{170}{(1+0,1)^3} + \frac{1000}{(1+0,1)^3} = 1\,174,080$$

B:

$$PV = \frac{260}{(1+0,1)} + \frac{260}{(1+0,1)^2} + \frac{260}{(1+0,1)^3} + \frac{2000}{(1+0,1)^3} = 2\,149,211$$

2) To calculate the weighted average duration of payments on a bond, we use the Macaulay Duration indicator (ordinary duration):



$$D = \frac{\sum_{i=1}^n (C * \tau / (1 + r)^n + H / (1 + r)^n)}{PV}$$

D - normal duration  
 PV - present value  
 C - coupon payments  
 r - rate of return  
 n - number of coupon payment periods  
 H - bond face value  
 τ- repayment period  
 BUT:

$$D = \frac{\frac{170 * 1}{(1 + 0,1)} + \frac{170 * 2}{(1 + 0,1)^2} + \frac{170 * 3}{(1 + 0,1)^3} + \frac{1000 * 3}{(1 + 0,1)^3}}{1\ 174,080} = \frac{(154,545 + 280,992 + 383,172 + 2\ 253,944)}{1\ 174,080} = 2,617$$

Repayment period A- 2,617 years

B:

$$= \frac{\frac{260 * 1}{(1 + 0,1)} + \frac{260 * 2}{(1 + 0,1)^2} + \frac{260 * 3}{(1 + 0,1)^3} + \frac{2000 * 3}{(1 + 0,1)^3}}{2\ 149,211} = \frac{236,364 + 429,752 + 586,026 + 4507,889}{2\ 149,211} = 2,680$$

Maturity B- 2,680 years

3) from the standpoint of the investment return period, in terms of the weighted average duration of payments, a bond with a shorter investment return period is preferable. It is necessary to compare the terms of investment return: 2,617 years < 2,680 years. This means that the preferred bond has a return on investment of 2.617 years.

**Answer:**

- 1) The current value of bond A was 1174,080; the current value of bond B was 2149.211;
- 2) Return on investment Bond A was 2,617 years; the payback period of bond B was 2,680
- 3) The preferred bond has a return on investment of 2,617 years.

**Thematic block 5. Econometrics:**

5. (20 points). Here are the results of evaluating the equation for the dependence of the cost of a diamond ( PRICE , USD) on weight ( CARAT , carat), clarity ( CLARITY , dummy), cut quality ( CUT , dummy) and depth ( DEPTH , dummy).

dependent Variable : PRICE  
 Included observations: 132  
 Method : Least Squares

variable	Coefficient	Std. error	t-statistic	Prob.
C		465.1035	1.695403	0.0901
CARAT	4860.789	47.35434		0.0000
CLARITY	405.6879		10.59176	0.0000



CUT		23.58738	-3.485603	0.0005
DEPTH	-20.03942	7.410963	-2.704024	0.0069
R-squared	0.837029	Mean dependent var		4192.567
Adjusted R-squared	0.836726	SD dependent var		1288.113
SE of regression	520.4899	Akaike info criterion		15.34973
Sum squared resid	5.83E+08	Schwarz criteria		15.36290
log likelihood	-16542.01	Hannan Quinn Criter.		15.35455
F-statistic		Durbin-Watson stat		1.450254
Prob(F-statistic)	0.000000			

- 1) (4 points) Calculate the missing indicators (give formulas for calculations, round the answer to three decimal places)
- 2) (8 points) Calculate the observed value of the Fisher statistic to test the null hypothesis that the equation as a whole is not significant. How many times it exceeds the critical value for  $\alpha=0.05$ . How many dollars on average will the cost of a diamond increase with an increase in weight by 1 carat? (round your answer to three decimal places)
- 3) (8 points) Using the resulting regression equation, estimate the price of a 2.2-carat diamond with above-average clarity ( CLARITY =1), high cut quality (CUT =1) and low depth (DEPTH =0). What is an "unconditional" value of a diamond be? (Round your answer to three decimal places).

**Solution :**

1) Based on the formula  $t$  of the observed, you can calculate all the missing indicators.  $t = \frac{Coef}{Std.Error}$ . In this case:

- $Coef_c = t_c * SE_c = 465.1035 * 1.695403 \approx 788.538$
- $t_{CARAT} = \frac{Coef_{CARAT}}{SE_{CARAT}} = \frac{4860.789}{47.35434} = 102.647$
- $SE_{CLARITY} = \frac{Coef_{CLARITY}}{t_{CLARITY}} = \frac{405.6879}{10.59176} = 38.302$
- $Coef_{CUT} = t_{CUT} * SE_{CUT} = 23.58738 * -3.485603 = -82.216$

2) It is necessary to calculate F observable.  $F_{observ} = \frac{R^2}{1-R^2} * \frac{(n-m-1)}{m}$ , where  $R^2$  is the coefficient of determination,  $n$  is the number of observations,  $m$  are pure regressors. Then  $F_{observ} = \frac{0.837}{1-0.837} * \frac{(132-4-1)}{4} \approx 163.035$ . The critical value of Fisher statistics for  $\alpha=0.05$ ;  $v_1=4$ ,  $v_2=127$  was 2.443. The observed value exceeds the critical one by 66.736 times.

The value of the regression coefficient with the CARAT factor was 4860.789, which means that with an increase in weight by 1 carat, the cost can increase by an average of 4860.789 dollars.

3)  $PRICE = 788.538 + 4860.789 * 2.2 + 405.6879 * 1 - 82.2162 * 1 - 20.03942 * 0 = 11805.7454$ . The cost of a diamond with such parameters should be 11805.746 dollars. The free coefficient shows the predicted value of the dependent quantity, with all factors equal to zero. It can be interpreted as the influence of factors not taken into account in the model. In this case, the obtained estimate of the free coefficient  $Coef_c = 788,538$  shows the "unconditional" price of a diamond, which is not determined by weight, cut quality, clarity and depth.

**Answer:**

- 1)  $Coef_C = 788.538$ .  $t_{CARAT} = 102.647$ .  $SE_{CLARITY} = 38.302$ .  $Coef_{CUT} = -82.216$
- 3) 66.736 times. On 4860, \$789
- 4) The cost of the diamond should be \$11,805.746. The "unconditional" value of a diamond could be \$788,538.