

## **Economics and Econometrics: Second-round sample tasks for the Open Doors Master's and Doctoral Track**

This sample test comprises 35 tasks, including 21 entry-level tasks with a single correct answer (each correct answer is assigned 2 points), 11 intermediate-level tasks with multiple correct answers (the correct answer is assigned 3 points), 3 advanced-level tasks requiring a detailed answer (the answer is assigned 8-9 points depending on its correctness and completeness). For advanced-level tasks requiring a detailed answer, assessment criteria and a standard answer are provided.

### **Field of Science 1. Economics**

#### **Task 1 Entry level (2 points)**

What is the budget line characterized by?

- a) Consumer income values decrease when moving down the budget line
- b) The points of intersection with the coordinate axes correspond to the maximum consumption of this product when all income is spent on this product
- c) Marginal utility is the same at all points on the budget line
- d) The consumer always receives maximum utility at the points where the budget line intersects the coordinate axes

**Answer:** b

#### **Task 2 Entry level (2 points)**

If an enterprise does not produce output in the short run, its total costs are equal to:

- a) Marginal costs
- b) Variable costs
- c) Average costs
- d) Fixed costs

**Answer:** d

#### **Task 3 Entry level (2 points)**

If corporate income taxes, retained earnings, and social security contributions are subtracted from the value of national income, and then transfer payments are added, the obtained result will characterize:

- a) Household income
- b) Disposable household income
- c) Net national product
- d) Gross national income

**Answer:** a

#### **Task 4**

**Entry level (2 points)**

If the government raises taxes and the Central Bank maintains a constant interest rate policy, the result is that the effective demand for goods will:

- a) decrease
- b) increase
- c) not change
- d) not enough information to answer the question

**Answer:** a

**Task 5****Intermediate level (3 points)**

The economy is described by the following equations:

$C=2800+0.6y_v$  is consumer spending ( $y_v$  is disposable income);  $I=2000-250i$  is investment;  $NE=100-0.05y-50i$  is net export;  $L=0.5Y-250iP$  is monetary demand ( $Y$  is nominal income);  $ty=0.25$  is the rate of taxation;  $G=500$  is government purchases;  $M=3000$  is the nominal supply of money. Derive the equation of the aggregate demand curve.

**Answer:**  $y^d=4500 +3000/P$

**Task 6****Intermediate level (3 points)**

In an economy, the national income generation is represented by the given production function  $y_t = \sqrt{N_t K_t}$ . At the initial time period  $t_0$ , the farm had 10 units of labor and 640 units of capital. The growth rate of labor was 3% per period. The savings rate is 50%. Determine the amount of capital (in units) required for equilibrium growth under the initial conditions.

**Answer:** 2778.9

**Task 7****Advanced level (8 points)**

In a market with demand  $p=220-Q$ , there are 2 similar firms whose costs are given by the functions  $TC_i=q_i^2$ .

1. Find the equilibrium (prices, sales volumes, and profits) in a quantitative Cournot oligopoly in which each firm maximizes profits by referring to the sales volumes of a competitor.
2. What happens to prices, sales volumes, and profits if one of the firms becomes a price taker, i.e., increases output until marginal costs match the price, and the other firm still operates according to Cournot.

**Note** that the assessment will take into account both the solution process and the reasoning behind it; simply providing the final answer will not be sufficient.

**Solution**

1. In the Cournot model, each firm maximizes its profits by referring to the competitor's sales volume:

$$\pi_1 = pq_1 - TC_1 = (220 - q_1 - q_2)q_1 - q_1^2 = 220q_1 - 2q_1^2 - q_2q_1 \rightarrow \max_{q_1},$$

$$220 - 4q_1 - q_2 = 0, \quad q_1 = 55 - 0,25q_2$$

Since the firms are identical and use the same strategies, for the sake of symmetry  $q_2 = 55 - 0,25q_1$ . Solving the resulting system of equations, we obtain

$$q_1 = q_2 = \mathbf{44}, \quad Q = \mathbf{88}, \quad p = 220 - 88 = \mathbf{132}, \quad \pi_1 = \pi_2 = 132 \cdot 44 - 44^2 = \mathbf{3872}.$$

2. If the first firm acts as a price taker, it chooses supply volumes from the condition  $p = MC_1 = TC'_1 = 2q_1$ :

$$220 - q_1 - q_2 = 2q_1, \quad q_1 = (220 - q_2)/3.$$

Let us solve the system of equations and find the supply volumes of each firm:

$$\begin{cases} q_1 = (220 - q_2)/3, \\ q_2 = 55 - 0,25q_1. \end{cases}$$

$$3q_1 = 220 - (55 - 0,25q_1) = 165 + 0,25q_1$$

$$q_1 = 165/2,75 = \mathbf{60}, \quad q_2 = 55 - 0,25 \cdot 60 = \mathbf{40}, \quad Q = 60 + 40 = \mathbf{100}.$$

Let us calculate the price that will occur in the market as well as the firms' profits:

$$p = 220 - 100 = \mathbf{120}, \quad \pi_1 = 120 \cdot 60 - 60^2 = \mathbf{3600}, \quad \pi_2 = 120 \cdot 40 - 40^2 = \mathbf{3200}$$

**Answer:**

1.  $q_1 = \mathbf{44}, q_2 = \mathbf{44}, p = \mathbf{132}, \pi_1 = \mathbf{3872}, \pi_2 = \mathbf{3872}$

2.  $q_1 = \mathbf{60}, q_2 = \mathbf{40}, p = \mathbf{120}, \pi_1 = \mathbf{3600}, \pi_2 = \mathbf{3200},$

### Assessment criteria

**Criterion 1** – 4 points.

**Criterion 2** – 4 points.

## Field of Science 2. Regional and Sectoral Economics

### Task 1

#### Entry level (2 points)

The sectoral structure of gross value added in 2021 (as a percentage of the total) is presented in the table.

Region	Total	Agriculture, forestry, hunting, fishing and fish farming	Mining	Manufacturing industries	Service sector
Russian Federation	100	4.5	14.4	17.2	63.9
Kamchatka Krai	100	30.1	5.3	5.0	59.6

Determine the type of region of the Russian Federation (Kamchatka Krai) by calculating its specialization coefficients.

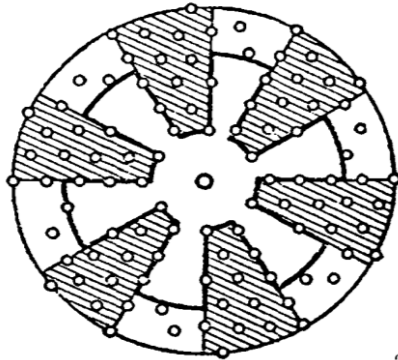
- The region specializes in agricultural production
- The region specializes in mining
- The region specializes in industrial goods manufacturing
- The region specializes in providing services

**Answer:** a

### Task 2

#### Entry level (2 points)

Which of the models is shown in the figure?



- a) Lösch's central place theory
- b) Alonso's city model
- c) Launhardt's rational standort of the industrial plant
- d) Weber's theory of the location of industries

**Answer:** a

**Task 3**  
**Entry level (2 points)**

The birth rate in the Altai Republic was 13.1 ppm for 2022, the mortality rate was 11.6 ppm, and the population was 210.8 thousand people. Calculate the absolute value of the natural increase in the region.

- a) -10753
- b) 316
- c) 26281
- d) -975

**Answer:** b

**Task 3**  
**Entry level (2 points)**

Calculate the year-over-year GDP growth rate of Primorsky Krai as a percentage for 2020 and 2021

Region	2019	2020	2021
Primorsky Krai	1 069 330.7	1 105 672.6	1 308 884.1

- a) 2020: 85.4; 2021: 139.75
- b) 2020: 103.40; 2021: 118.38
- c) 2020: 96.0; 2021: 109.0
- d) 2020: 98.96; 2021: 117.98

**Answer:** b

**Task 5**  
**Intermediate level (3 points)**

Determine the total cost of the product (in monetary units), if the gross weight of the stamped blank is 50 kg; the net weight of the product is 40 kg; the price of the stamped blank is 100 rubles; the price of 1 ton of waste is 1000 monetary units; the basic wage of workers is 50 monetary units /piece; the mandatory insurance premiums are 30.2%; the workshop expenses are 200% of the basic wage of workers; the general business expenses are 150% of the basic wage of workers; the commercial expenses are 20% of the production cost.

**Answer:** 396.12

**Task 6**  
**Intermediate level (3 points)**

Calculate what the selling price of the industrial product (in monetary units per piece) has to be to obtain the desired profit, given the following data: the volume of products sold is 11 thousand units; the VAT rate is 20%; the total cost of products sold is 850 thousand monetary units, the profit from the sale of fixed production assets is 300 thousand monetary units, the income from equity participation in the activities of other enterprises is 180 thousand monetary units, the costs of equity participation in the activities of other enterprises are 130 thousand monetary units, the desired profit of the enterprise is 450 thousand monetary units.

**Answer:** 103.64

**Task 7**  
**Advanced level (8 points)**

The purchase price of the equipment is 2.1 million monetary units; the transportation costs are 80 thousand monetary units; the installation costs are 50 thousand monetary units; the average annual growth rate of labor productivity in the industry is 1.5%; the depreciation rate is 10%; the operation period is 8 years. Calculate in million monetary units: a) the initial value, b) the replacement cost and c) the residual value of the equipment (using the straight-line depreciation method).

**Note** that the assessment will take into account both the solution process and the reasoning behind it; simply providing the final answer will not be sufficient.

**Solution**

a) The initial value of the fixed assets:

$$K_{\text{init.}} = 2.1 + 0.08 + 0.05 = 2.23 \text{ million monetary units}$$

b) The replacement cost (cost of the equipment for the year of revaluation):

$$K_{\text{rep}} = 2.23 / (1 + 0.015)^8 = 1.98 \text{ million monetary units}$$

c) The residual value is the initial value reduced by the amount of the transferred value:  $K_{\text{res}} = 2.23 - 2.23 * 0.1 * 8 = 0.446 \text{ million monetary units}$

**Answer**

- a) 2.23
- b) 1.98
- d) 0.446

**Assessment criteria**

Criterion 1 – 3 points.

Criterion 2 – 3 points.

Criterion 3 – 2 points.

**Field of Science 3. Global Economy**

**Task 1**  
**Entry level (2 points)**

The ability to effectively organize the interaction of the remaining economic resources (labor, land, capital, knowledge) to carry out economic activity is:

- a) global workforce
- b) global entrepreneurial resources

- c) global scientific resources
- d) global financial resources

**Answer: b**

### **Task 2**

#### **Entry level (2 points)**

An association of independent states that have concluded a free trade agreement with the establishment of a common external customs tariff in relation to third countries is:

- a) free trade zone
- b) free economic zone
- c) customs union
- d) trade group

**Answer: c**

### **Task 3**

#### **Entry level (2 points)**

Which mode of transport has the largest share in the global cargo turnover?

- a) railway
- b) automobile;
- c) maritime
- d) air

**Answer: c**

### **Task 4**

#### **Entry level (2 points)**

Which of the following is an essential instrument for protecting domestic markets?

- a) export duties
- b) import quotas
- c) import duties
- d) export subsidies

**Answer: c**

### **Task 5**

#### **Entry level (2 points)**

The trend toward a unified, interconnected, and interdependent world, characterized by higher levels of development and greater social equity, leading to the convergence of development levels across countries, is:

- a) internationalization
- b) integration
- c) convergence
- d) globalization

**Answer: d**

### **Task 6**

#### **Intermediate level (3 points)**

Select the three international organizations of which Russia is a member.

- a) IMF
- b) BRICS
- c) OPEC
- d) 'Paris Club'

- e) ASEAN
- f) OECD

**Answer:** a, b, d

**Task 7**  
**Intermediate level (3 points)**

Supply and demand in the domestic market for a certain product are described using analytical dependencies:  $QD = 770 - 35P$ ;  $QS = -30 + 35P$ .

The global equilibrium price for this product  $PW$  is set at 15 monetary units per unit of production. Determine the value of the country's exports of the product (in monetary units) under free trade conditions (with zero transport costs).

**Answer:** 3750.

**Field of Science 4. Finance**

**Task 1**  
**Entry level (2 points)**

What is another term (synonym) for State Tax Policy?

- a) Fiscal policy
- b) Monetary policy
- c) Socio-economic policy
- d) Financial policy

**Answer:** a

**Task 2**  
**Entry level (2 points)**

Which of the following markets is classified as non-financial?

- a) Real estate market
- b) Loan market
- c) Stock market
- d) Forex market

**Answer:** a

**Task 3**  
**Entry level (2 points)**

John Keynes in his work “General Theory...” identified three motives for spending money by households. The first is the transaction motive (consumption), the second is the precautionary motive (saving). What is the third motive?

- a) The information motive
- b) The absolute motive
- c) The speculative motive
- d) The real estate motive

**Answer:** c

**Task 4**  
**Entry level (2 points)**

Which of the following institutions functions as an international financial regulator?

- e) International Monetary Fund (IMF)
- f) World Bank (WB)
- g) Bank for International Settlements (BIS)
- h) International Chamber of Commerce (ICC)

**Answer:** a

**Task 5**  
**Intermediate level (3 points)**

Two people, stranded on an uninhabited island after a shipwreck, do farming and fishing. For trade between themselves, they use 7 coins. Within a week in their small economy, 6 boxes of vegetables were sold at a price of 1 coin per box, and 4 fish were sold at 2 coins each. According to the Fisher equation of exchange ( $MV = PT$ ), the money value of the goods equals the total amount of money spent on the goods. Determine these values.

**Answer:** 14

**Task 6**  
**Intermediate level (3 points)**

The Gross National Product (GNP) of the country is 1500 monetary units. The potential GNP equals 1800 monetary units. By how many monetary units should government spending be increased to reach the potential national output if the marginal propensity to consume (MPC) is 0.75?

The following theoretical framework and formulas are relevant for solving the task.

The dynamics of taxes ( $\Delta T$ ) and the dynamics of government spending ( $\Delta G$ ) have a multiplier effect on the increase of the GNP ( $\Delta GNP$ ):

$$\Delta GNP = M_T \times \Delta T$$

$$\Delta GNP = K_G \times \Delta G,$$

$M_T$  and  $K_G$  are a tax multiplier and a government spending multiplier, respectively.

The tax multiplier ( $M_T$ ) is equal to the ratio of the marginal propensity to consume (MPC) to the marginal propensity to save (MPS):  $M_T = \frac{MPC}{MPS}$ . With this,  $MPC + MPS = 1$

The government spending multiplier ( $K_G$ ) can also be determined using the marginal propensity to save:  $K_G = \frac{1}{MPS}$

**Answer:** 75

**Task 7**  
**Intermediate level (3 points)**



Determine the total amount of liabilities (obligations) of a commercial bank, given the following data (in monetary units):

Authorized capital (issued shares): 10,000

Trading portfolio (stocks): 4,000

Discounted promissory notes of external issuers: 2,000

Issued savings certificates: 7,000

Current accounts (demand deposits): 20,000

Loans granted: 15,000

Correspondent nostro accounts: 1,000

Required reserves at the National Bank: 500

Provisions for possible losses: 2,000

**Answer:** 39,000

## Field of Science 5. Mathematical, Statistical and Instrumental Methods in Economics

### Task 1

#### Entry level (2 points)

A sample is given: 4, 6, 6, 8, 8, 0, 4, 14, 10, 20. Calculate the sampling average and variance.

- a) Average=3; Variance=2.2
- b) Average=5.5; Variance=8.25
- c) Average=12; Variance=36
- d) Average=8; Variance=28.8

**Answer:** d

### Task 2

#### Entry level (2 points)

The problem of optimizing the movement of a uniform product from uniform supply points to uniform demand points using identical vehicles is known as:

- a) the problem of finding the shortest distance over a given grid
- b) the traveling salesman problem
- c) the transportation problem of linear programming
- d) the problem of allocation

**Answer:** c

### Task 3

#### Entry level (2 points)

For a CCR model with one input and one output parameter, choose the linear programming problem statement for DMU A:

DMU	A	B	C	D
Input	2	3	3	4
Output	1	3	2	3

- a)  $\max_{u,v} \theta = u$  subject to condition  $2v = 1$  and limitations:  $u \leq 2v$ ;  $2u \leq 3v$ ;  $2u \leq 3v$ ;  $3u \leq 4v$
- b)  $\max_{u,v} \theta = 3u$  subject to condition  $3v = 1$  and limitations:  $u \leq 2v$ ;  $2u \leq 3v$ ;  $2u \leq 3v$ ;  $3u \leq 4v$

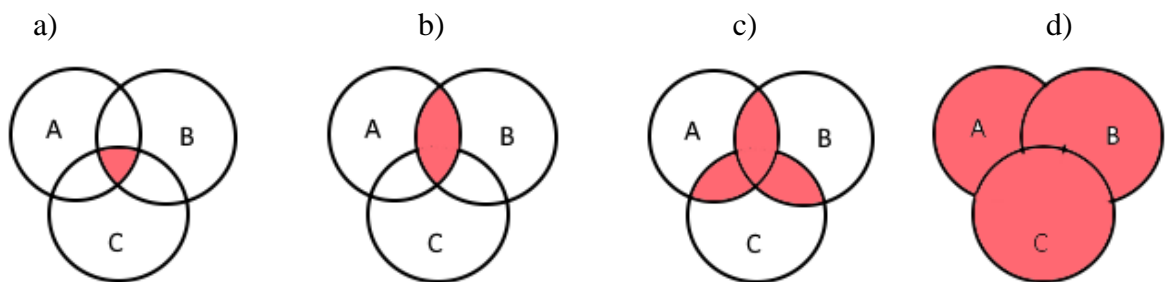
- c)  $\max_{u,v} \theta = 2u$  subject to condition  $3v = 1$  and limitations:  $u \leq 2v$ ;  $2u \leq 3v$ ;  $2u \leq 3v$ ;  $3u \leq 4v$
- d)  $\max_{u,v} \theta = 3u$  subject to condition  $4v = 1$  and limitations:  $u \leq 2v$ ;  $2u \leq 3v$ ;  $2u \leq 3v$ ;  $3u \leq 4v$

**Answer:** a

#### Task 4

##### Entry level (2 points)

Which Euler/Venn diagram shows  $A \cap B \cap C$ ?



**Answer:** a

#### Task 5

##### Intermediate level (3 points)

The covariance between two variables,  $y$  and  $x$ , is  $-200$ . The standard deviation of  $x$  is 25, and the standard deviation of  $y$  is 10. Calculate the Pearson correlation coefficient between  $y$  and  $x$ . If the resulting value is negative, indicate this with the appropriate symbol.

**Answer:** - 0,8

#### Task 6

##### Intermediate level (3 points)

The following equation has been obtained in the course of regression modeling:  $y = 1 + 4x_1 - 2x_2$ . Number of observations: 20. The sum of the squared errors of the model is 4. The total sum of squared deviations is 10. Calculate the coefficient of determination.

**Answer:** 0,6

#### Task 7

##### Advanced level (9 points)

It is hypothesized that the cardiovascular mortality rate in the region (death\_heart) is linearly associated with three factors: the availability of cardiologists (doctors\_heart), the level of real income of the population (income), and the average body weight of the population (weight). An analyst was provided with a dataset containing information on cardiovascular mortality, cardiologist availability, and average body weight for 89 regions of the Russian Federation.

Units of measurement for the variables are as follows:

- Cardiovascular mortality rate: number of deaths per 100,000 population per year
- Availability of cardiologists: number of cardiologists per 100,000 population
- Average body weight: kilograms (kg)

In order to empirically assess the impact of the level of availability of cardiologists on the mortality rate from cardiovascular diseases, the analyst considered the following model (1).

$$\text{death\_heart}_i = \beta_0 + \beta_1 * \text{doctors\_heart}_i + \beta_2 * \text{weight}_i + \xi_i \quad (1)$$

After estimating the coefficients in the model (1) using the least squares method, the following information was obtained (Figure 1).

```
Call:
lm(formula = death_heart ~ doctors_heart + weight)

Residuals:
    Min       1Q   Median       3Q      Max
-140.669  -44.940   -0.227   44.009  141.679

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1383.14574    4.98868   277.257  <2e-16 ***
doctors_heart -62.81773    0.19068  -329.438  <2e-16 ***
weight       -0.04482    0.04153   -1.079    0.28
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 59.67 on 9997 degrees of freedom
Multiple R-squared:  0.9157,    Adjusted R-squared:  0.9156
F-statistic: 5.427e+04 on 2 and 9997 DF,  p-value: < 2.2e-16
```

Figure 1. The results of the coefficient estimation in the statistical package R

## Questions

**Note** that the assessment will take into account both the solution process and the reasoning behind it; simply providing the final answer will not be sufficient.

1. According to the results obtained, on average, does an increase in the level of availability of cardiologists by 1 doctor per 100,000 population lead to a decrease in mortality from cardiovascular diseases by N people per 100,000 population? What is N equal to? (Figure 1)

- a) 4.99
- b) 277.257
- c) <2e-16
- d) 62.81**
- e) 1383.14+277.257
- f) 1383.14+277.257+62.81
- g) 1383.14+277.257-62.81
- h) 329.438
- i) 0.28

2. At what level of statistical significance can the null hypothesis for the coefficient for the variable doctors\_heart be rejected? Select the minimum possible value. (Figure 1)

- a) 0.15
- b) 0.16
- c) 0.17
- d) 0.05
- e) 0.02
- f) 0.015
- g) 0.018
- h) 0.012
- i) 0.0001**

3. Can the obtained estimate of the impact of years of education on wages be considered an overestimate or an underestimate? Why or why not?

- a) No, because in this case, the regression discontinuity design addresses the problem of omitted variables.
- b) No, because in this case, the synthetic control method addresses both reverse causality and omitted variable bias.
- c) No, because in this case, the ordinary least squares (OLS) method addresses the problem of reverse causality.
- d) Yes, the estimate may be an overestimate due to omitted variable bias and reverse causality.
- e) The estimate may be an overestimate due to omitted variables, and an underestimate due to reverse causality.
- f) The estimate may be an overestimate due to reverse causality, and an underestimate due to omitted variables.
- g) The estimate may be an underestimate due to omitted variable bias.
- h) The estimate may be an underestimate due to reverse causality, and an overestimate due to omitted variables.
- i) The estimate may be an underestimate due to omitted variables.

4. Suggest a solution to the problem of endogeneity in Model 1 when evaluating it using the method of least squares (if the problem of endogeneity is present).

- a) There is no endogeneity problem.
- b) Use the instrumental variable method. As an instrument, consider the variable: the average level of alcohol consumption in the region.
- c) Use the instrumental variable method. Consider as the instrument: the average level of tobacco consumption in the region.
- d) Use the method of instrumental variables. The variable to be used as an instrument: a binary variable that takes the value 1 if there was a medical university in the region 20 years ago.
- e) Use the instrumental variable method. The variable to be used as an instrument: a binary variable that takes the value 1 if the region has a program to combat cardiovascular disease at the time of the research.
- f) Use of the instrumental variable method. The variable to be used as an instrument: a binary variable that takes the value 1 if the region had a program to combat cardiovascular disease 20 years ago.
- g) Use the instrumental variable method. The variable to be used as an instrument: the proportion of people with a higher education in the region.
- h) Using the instrumental variable method. As an instrument, consider the variable: the marriage rate in the region.
- i) Use the instrumental variable method. As an instrument, consider the variable: the divorce rate in the region.

**Answer:** 1. – d; 2. – I; 3. – d; 4. – d.

#### **Assessment criteria**

Criterion 1 – 2 points.

Criterion 2 – 2 points.

Criterion 3 – 2 points.

Criterion 4 – 3 points.