Economics and Econometrics: Second-round sample tasks for the Open Doors postgraduate Track

You will be asked to complete 35 tasks, including:

- 21 entry-level tasks, each correct answer worth 2 point;
- 11 intermediate-level tasks, each correctly answered task worth 3 points;
- 3 advanced tasks (constructed response), each correctly completed task valued at 8–9 points.

Evaluation criteria and standard answers are provided for the advanced tasks requiring constructed responses.

Economics

Task 1
Entry level (2 points)

The budget line is 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) Will decrease
b) Will increase
c) Will 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 t0, 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 evaluation will consider how you solve the task; providing only the final answer is not sufficient.

Solution:

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

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

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

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 $p = MC_1 = TC_1' = 2q_1$:

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

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

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

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

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

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

Evaluation criteria:

Criterion 1 – 4 points.

Criterion 2 – 4 points.

Regional and Sectoral Economics

Task 1
Entry level (2 points)

Industry structure of gross value added in 2021 (as a percentage of the total)

Region	Total	Agriculture, forestry, hunting,	Mining	Manufacturing industries	Service sector

		fishing and fish farming			
Russian Federation	100	4.5	14.4	17.2	63.9
Kamchatka Krai	100	30.1	5.3	5.0	59.6

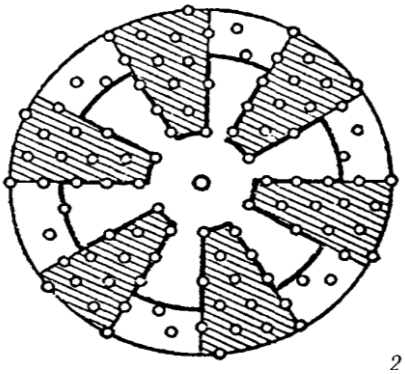
Determine the type of region of the Russian Federation (Kamchatka Krai) by calculating its specialization coefficients.

a) The region specializes in agricultural production
b) The region specializes in mining
c) The region specializes in industrial goods manufacturing
d) The region specializes in providing services

Answer: a

Task 2
Entry level (2 points)

Which of the models is shown in the figure?



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a) Central place theory by Lösch
b) Alonso city model
c) Launhardt's rational standort of the industrial plant
d) Weber's theory of 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. Specify the absolute value of 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's Name	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)

Estimate the total cost of the product (in monetary units), if you know that 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 in order 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 evaluation will consider how you solve the task; providing only the final answer is not sufficient

Solution:

a) The initial value of the fixed assets:

Kinit. = 2.1 + 0.08 + 0.05 = 2.23 million monetary units

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

Krep = $2.23/(1+0.015)^8$ = 1.98 million monetary units

c) The residual value is the initial value reduced by the amount of the transferred value: Kres = 2.23 – 2.23*0.1*8 = 0.446 million monetary units

Answer:

a) 2.23

b) 1.98

d) 0.446

Evaluation criteria:

Criterion 1 – 3 points.

Criterion 2 – 3 points.

Criterion 3 – 2 points.

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)

The largest share in the global cargo turnover belongs to the following types of transport:

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

Answer: c

Task 4
Entry level (2 points)

Essential instruments for protecting domestic markets are:

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

Answer: c

Task 5
Entry level (2 points)

The trend towards a single, interconnected, interdependent, more developed and socially just world, on the basis of which the levels of development of different countries will converge, is:

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

Answer: d

Task 6
Intermediate level (3 points)

Russia is a member of the following three international organizations:

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) in question under free trade conditions (with zero transport costs).
Answer: 3750.

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 market is considered as non-financial (not classified as 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). Which 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)

The International Financial Regulator is:

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, who suffered the shipwreck, are living on the desert island. They do farming and fishing. Trading with each other, they use 7 coins. Within a week in their small economy 6 boxes of vegetables have been sold at 1 coin per box, and 4 fish have been sold at 2 coins each. In accordance with the Fisher equation of exchange (MV=PT), the money value of the goods is equal to 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? To solve the task, you should know the following.

The dynamics of taxes (ΔT) and the dynamics of government spending (ΔG) have a multiplier effect on the increase of the GNP (ΔGNP):

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

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

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)

What is the total amount of obligations (liabilities) of a commercial bank, if the following data are available?

The authorized capital (issued stocks) is (10000). The stock trading portfolio is (4000). The discounted promissory notes of external issuers are (2000). The issued saving certificates amount to (7000). The current accounts are (20000); The loans provided are (15000). The correspondent nostro accounts are (1000); The required reserves at the National Bank amount to (500); The reserves for possible losses are (2000).

Answer: 39 000

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 uniform 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) 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

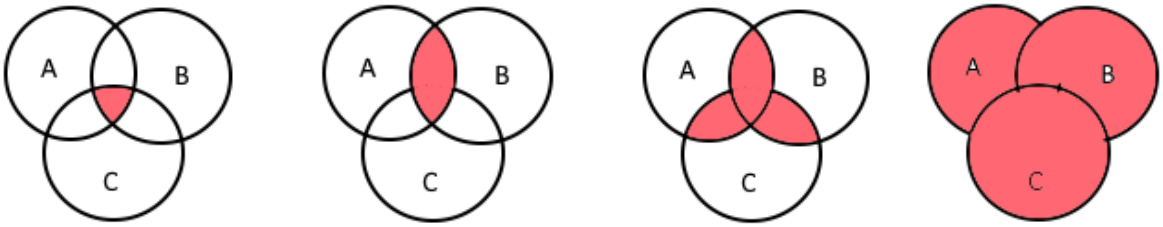
a) $\max_{u,v} \theta = u$ subject to condition $2v = 1$ and limitations: $u \leq 2v; 2u \leq 3v; 2u \leq 3v; 3u \leq 4v$
b) $\max_{u,v} \theta = 3u$ subject to condition $3v = 1$ and limitations: $u \leq 2v; 2u \leq 3v; 2u \leq 3v; 3u \leq 4v$
c) $\max_{u,v} \theta = 2u$ subject to condition $3v = 1$ 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 $\mathbf{A} \cap \mathbf{B} \cap \mathbf{C}$

a) b) c) d)



Answer: a

Task 5
Intermediate level (3 points)

The covariance between two variables, y and x, is equal to: -200. The standard deviation of the x values is 25. The standard deviation of the y values is 10. Calculate the correlation coefficient between y and x. If the indicator value is negative, show this in your response with the appropriate symbol.

Answer: - 0,8

Task 6
Intermediate level (3 points)

Suppose that you have obtained the following regression model in the course of regression modeling: $\mathbf{y = 1 + 4x_1 - 2x_2}$. 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)

The mortality rate from cardiovascular diseases in the region (death_heart) is hypothesized to be influenced by only three factors (has a linear correlation with them): the level of availability of cardiologists (doctors_heart), the amount of real income of the population in the region (income) and the average body weight of the population (weight). The analyst had a table with data on cardiovascular mortality, the level of availability of cardiologists, and the average body weight of the population of 89 regions of the Russian Federation. Units of measurement of indicators:

- Mortality rate from cardiovascular diseases: deaths per 100,000 population per year
- The level of availability of cardiologists: the number of cardiologists per 100,000 people per year
- The average body weight of the population, 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
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Figure 1. The results of the coefficient estimation in the statistical package R

Questions:

Note that the evaluation will consider how you solve the task; providing only the final answer is not 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 study on salaries be considered an overestimate or an underestimate? Why (why not)?
a) No, because in this case the discontinuous design method helps to solve the problem of missing variables.
b) No, because in this case the synthetic control method helps to solve the problem of reverse causality and the problem of missing variables.
c) No, because in this case the method of least squares helps to solve the problem of reverse causality.
d) Because of the problem of missing variables and reverse causality, the estimate may be an overestimate.
e) Due to the problem of missing variables, the estimate may be an overestimate, and due to reverse causality, the estimate may be an underestimate.
f) Due to reverse causality, the estimate may be an overestimate, and due to the problem of missing variables, the estimate may be an underestimate.
g) The estimate may be an underestimate due to the problem of missing variables.
p) The estimate may be an underestimate due to reverse causality and an overestimate due to the problem of missing variables.
i) The estimate may be an underestimate due to the problem of missing variables.
4. Suggest a solution to the problem of endogeneity in model 1 when evaluating it with 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) Using the instrumental variable method. Consider as the instrument: the average level of tobacco consumption in the region.
d) Using 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) Using 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) Using 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) Using 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.

Evaluation criteria:
Criterion 1 – 2 points.
Criterion 2 – 2 points.

Criterion 3 – 2 points.
Criterion 4 – 3 points.