Эконометрика — МИЭФ, 2025 midterm 2

МИЭФ | Эконометрика | 2025 | midterm 2

QUESTION 1

Multiple-choice test

A partial-adjustment model is

$$y_t - y_{t-1} = \delta(y_t^* - y_{t-1}),$$

where

$$y_t^* = \beta x_t + u_t.$$

The estimates are $d = 0.4$ for δ and $b = 0.8$ for β. The estimated short-run effect is:

1. 0.16.
2. 0.32.
3. 0.4.
4. 0.64.
5. 0.8.

QUESTION 2

Multiple-choice test

The following information is available for two Logit specifications:

1. y on x_1 and x_2, with a constant;
2. y on x_1 only, with a constant.

	Model (1)	Model (2)
Coefficient on x_1	$\hat{\beta}_1$	$\widehat{\alpha}_1$
Coefficient on x_2	$\hat{\beta}_2$	—
Log-likelihood	-18	-20
McFadden R^2	0.8	?

What is McFadden R^2 for model (2)?

1. 0.64.
2. 0.72.
3. 0.75.
4. 0.778.
5. 0.889.

QUESTION 3

Multiple-choice test

Which is a typical property of maximum-likelihood estimators?

1. Biased but consistent.
2. Unbiased but inefficient.
3. Consistent and asymptotically normal.
4. Always efficient in small samples.
5. Always unbiased.

QUESTION 4

Multiple-choice test

Consider the ADL(1,1) model

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \rho Y_{t-1} + u_t.$$

What does

$$\frac{\beta_0 + \beta_1}{1 - \rho}$$

represent?

1. The short-run effect of a temporary increase in X_t.
2. The long-run effect of a permanent increase in X_t.
3. The coefficient on first differences of X_t.
4. The short-run multiplier on Y_{t-1}.
5. The error correction term.

QUESTION 5

Multiple-choice test

Which processes are at least asymptotically stationary?

I. AR(1):

$$X_t = \beta_1 + \beta_2 X_{t-1} + \varepsilon_t, \qquad |\beta_2| < 1.$$

II. Random walk with an MA(1) error:

$$X_t = X_{t-1} + \varepsilon_t + \mu\varepsilon_{t-1}.$$

III. Quadratic trend:

$$X_t = \alpha + \beta t^2 + \varepsilon_t.$$

IV. MA(1) with a constant:

$$X_t = \alpha + \varepsilon_t + \mu\varepsilon_{t-1}.$$

1. I and II only.
2. II, III, and IV only.
3. I, III, and IV only.
4. I and IV only.
5. I, II, and IV only.

QUESTION 6

Multiple-choice test

In a Logit model, what is the probability of success when $Z = 0$?

1. 0.
2. 0.25.
3. 0.5.
4. 1.
5. It may take different values.

QUESTION 7

Multiple-choice test

Consider the AR(2) process

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \varepsilon_t.$$

Which equation should be used to test y_t for stationarity with the augmented Dickey-Fuller test?

1. $$\Delta y_t = \beta + \theta_1 y_{t-1} + \varepsilon_t.$$

2. $$\Delta y_t = \theta_1 y_{t-1} + \varepsilon_t.$$

3. $$\Delta y_t = \beta + \theta_1 y_{t-1} + \theta_2 \Delta y_{t-1} + \varepsilon_t.$$

4. $$\Delta y_t = \beta + \theta_1 y_{t-1} + \theta_2 \Delta y_{t-1} + \theta_3 \Delta y_{t-2} + \varepsilon_t.$$

5. $$\Delta y_t = \theta_1 y_{t-1} + \theta_2 \Delta y_{t-1} + \theta_3 \Delta y_{t-2} + \varepsilon_t.$$

QUESTION 8

Multiple-choice test

What is a possible drawback of adding lags to time-series models?

1. A decrease in R^2.
2. Multicollinearity.
3. Heteroscedasticity of the error term.
4. Autocorrelation of the error term.
5. None of the above.

QUESTION 9

Multiple-choice test

Which statement about Logit and Probit models is correct?

1. Estimated coefficients are marginal effects of explanatory variables.
2. Estimated coefficients are mean marginal effects of explanatory variables.
3. Estimated coefficients do not directly represent marginal effects of explanatory variables.
4. Probability calculated at the sample means of the regressors equals the sample mean probability.
5. Probability calculated at $Z = 0$ equals the sample mean probability.

QUESTION 10

Multiple-choice test

A model

$$Y_t = \beta_0 + \beta_1 X_t + u_t$$

is estimated using 80 observations. The residuals $\widehat{u}_t$ are regressed on $\widehat{u}_{t-1}$, $\widehat{u}_{t-2}$, and X_t, yielding $R^2 = 0.12$. The Breusch-Godfrey statistic is computed for two lags.

What is the conclusion at the 5% level, given

$$\chi^2_2 = 5.99?$$

1. Reject H_0 of no autocorrelation through lag 2.
2. Fail to reject H_0 of no autocorrelation through lag 2.
3. H_0 may or may not be rejected.
4. The Breusch-Godfrey test can detect only first-order autocorrelation.
5. The test statistic falls in an uncertainty region.

QUESTION 11

Multiple-choice test

Which is **not** required for the Durbin-Watson test?

1. Regressors are non-stochastic.
2. The model contains a constant.
3. Only first-order autocorrelation is tested.
4. The error term has zero expected value.
5. A lagged dependent variable is a regressor.

QUESTION 12

Multiple-choice test

The higher power of the ADF $T(\hat{\beta}_2 - 1)$ test compared with the ADF t test means that the $T(\hat{\beta}_2 - 1)$ test is:

1. Relatively more likely to signal stationarity when the examined series is non-stationary.

2. Relatively less likely to signal stationarity when the examined series is non-stationary.

3. Relatively less likely to signal non-stationarity when the examined series is stationary.

4. Relatively more likely to signal non-stationarity when the examined series is stationary.

5. None of the above.

Part 2. Free-response questions — one session, 2 hours without a break.

Structure your answers according to the structure of the questions. When testing hypotheses, state the critical values, degrees of freedom, and significance level used.

Section A. Answer all questions from this section (original Questions 1-2).

QUESTION 13

Written Question 1 — 25 marks

A researcher studies the reading habits of residents of a small Russian town. She interviews 50 respondents and defines

$$Y_i = \begin{cases} 1, & \text{if respondent } i \text{ bought a book during the current year,} \\ 0, & \text{otherwise.} \end{cases}$$

She believes that buying books depends on:

- S_i: years of full-time schooling;
- E_i: average monthly income, in thousands of roubles.

Two models are estimated:

Linear Probability Model

$$\widehat{Y_i} = 0.015 + 0.099 S_i + 0.012 E_i,$$

with standard errors

$$(0.094) \qquad (0.024) \qquad (0.005).$$

Logit

$$\widehat{Y_i} = -4.75 + 0.521 S_i + 0.067 E_i,$$

with asymptotic standard errors

$$(1.33) \qquad (0.168) \qquad (0.036).$$

(a)

- What is the difference between the estimation methods used for the LPM and Logit models?
- How does the interpretation of the dependent variable differ?
- What are the main differences in interpreting the coefficients of the LPM and Logit models?

- Do the estimates indicate that the explanatory factors are significant?
- Are there differences between the two models?
- Which model's results are more trustworthy, and why?
- Calculate the predicted probability of buying a book from both models for a respondent with $S_i = 11$ and $E_i = 10$.
- Interpret the results and explain why the two predicted probabilities differ.

(b)

- Calculate and compare the marginal effect of schooling S_i for:
  - a respondent with a high-school diploma, $S_i = 11$, and monthly income $E_i = 10$;
  - a respondent with a university diploma, $S_i = 15$, and monthly income $E_i = 20$.
- Give an economic explanation for the results.
- The maximum marginal effect of any factor in a Logit model occurs at index value zero. Determine the education level S at which the marginal effect of schooling is maximised when monthly income is 10 thousand roubles.
- Suggest a possible explanation for the result.
- Can the same result be obtained using the LPM?

QUESTION 14

Written Question 2 — 25 marks

Using a sample of 36 annual observations for one country, a researcher studies:

- tobacco expenditure x_t, in national currency;
- a tobacco price index p_t.

Standard errors are in parentheses, t denotes time, and e_t denotes residuals. The researcher estimates four Dickey-Fuller equations:

$$\Delta x_t = 5.55 - 0.033 x_{t-1} - 0.16 \Delta x_{t-1} - 0.13 t + e_t,$$

with standard errors

$$(6.36) \qquad (0.065) \qquad (0.19) \qquad (0.057), \tag{1}$$

$$\Delta^2 x_t = -1.004 \Delta x_{t-1} + e_t,$$

with standard error

$$(0.174), \tag{2}$$

$$\Delta p_t = 0.117 - 0.106 p_{t-1} + 1.18 \Delta p_{t-1} + 0.10 t + e_t,$$

with standard errors

$$(0.40) \qquad (0.033) \qquad (0.23) \qquad (0.044), \tag{3}$$

and

$$\Delta^2 p_t = -0.126 \Delta p_{t-1} + e_t,$$

with standard error

$$(0.091). \tag{4}$$

(a) (12 marks)

- Why is it important to test time series for non-stationarity?
- Discuss the consequences of non-stationarity in regression analysis.

- Using equations (1)-(4), conduct the appropriate tests. Clearly state and explain the critical values used.
- Do the results indicate that x_t and p_t are stationary?
- Do the results indicate that x_t and p_t are difference-stationary?
- What does difference stationarity mean?

(b) (13 marks)

- Equations (2) and (4) do not contain a time trend. Show that taking first differences of a series with a trend, for example

$$y_t = \beta_1 + \beta_2 y_{t-1} + \beta_3 t + u_t,$$

causes the trend to disappear.

- What can be concluded from the resulting expression for the transformed disturbance term?
- In the ADF approach, the researcher includes an additional lag x_{t-2} in the representation

$$x_t = \beta_1 + \beta_2 x_{t-1} + \beta_3 x_{t-2} + u_t,$$

and similarly for p_t. What are the advantages and disadvantages of adding this lag?

- Derive the appropriate Dickey-Fuller equation from

$$Y_t = \beta_1 + \beta_2 Y_{t-1} + \beta_3 Y_{t-2} + \gamma t + u_t.$$

- Using equations (1) and (3), recover all coefficients in

$$x_t = \beta_1 + \beta_2 x_{t-1} + \beta_3 x_{t-2} + \gamma t + u_t,$$

and

$$p_t = \alpha_1 + \alpha_2 p_{t-1} + \alpha_3 p_{t-2} + \delta t + u_t.$$

- Draw conclusions about the behaviour of tobacco expenditure and prices.

- Why should Dickey-Fuller equations (1) and (3) be used to estimate coefficients of a series of the form

$$Y_t = \beta_1 + \beta_2 Y_{t-1} + \beta_3 Y_{t-2} + \gamma t + u_t$$

instead of estimating that equation directly by OLS?

Section B. Answer only one question from this section (original Question 3 or Question 4).

QUESTION 15

Written Question 3 — 25 marks

According to the Lintner model, the target dividend is determined by earnings, while the actual dividend adjusts gradually toward the target:

$$D_t^* = \alpha + \gamma P_t + u_t,$$

$$D_t - D_{t-1} = \lambda(D_t^* - D_{t-1}),$$

where:

- D_t is the actual dividend;
- P_t is profit;
- D_t^* is the target dividend.

The disturbance satisfies

$$E(u_t) = 0, \qquad E(u_t^2) = \sigma_u^2,$$

u_t is uncorrelated with P_t, and it is not contemporaneously correlated with D_t:

$$\mathrm{Cov}(u_t, D_t) = 0.$$

(a) (10 marks)

- What is the basic economic idea behind Lintner's model?
- What advantages does it have over a simple regression of actual dividends on profit?
- Describe the model's dynamics.
- Since D_t^* is unobservable, show how the model can be reduced to an ADL(1,0) model.
- What is the purpose of that transformation?

Lintner's model is extended with an additional error-correction mechanism that accounts for changes in profit:

$$D_t^* = \beta_1 + \beta_2 P_t + u_t,$$

$$D_t - D_{t-1} = \lambda(D_t^* - D_{t-1}) + \delta(P_t - P_{t-1}).$$

(b) (8 marks)

- Explain the logic and economic meaning of the extended model compared with the original model.
- Show that the extended model can be reduced to an ADL(1,1) specification.
- How do its short-run and long-run dynamics differ?
- Derive the short-run and long-run profit effects in terms of the original model parameters.

(c) (7 marks) Estimation using data for several US airline companies, with dividends and profits measured in billions of dollars, gives

$$\widehat{D}_t = -15.0 + 0.047P_t - 0.031P_{t-1} + 0.82D_{t-1}.$$

- Reconstruct the extended model by calculating numerical values of its parameters.
- What conclusions can be drawn about dividend-policy adjustment?
- How many times larger is the long-run profit effect than the short-run profit effect?

QUESTION 16

Written Question 4 — 25 marks

Consider a Friedman-type model:

$$C_t = \beta_2 Y_t^P + u_t,$$

$$Y_t = Y_t^P + Y_t^T,$$

$$Y_t^P - Y_{t-1}^P = \lambda(Y_t - Y_{t-1}^P),$$

where:

- C_t is actual consumption;
- Y_t is actual income;
- Y_t^P is permanent income;
- Y_t^T is transitory income.

Permanent income is a subjective measure of likely medium-run future income, or expected income. The disturbance satisfies

$$E(u_t) = 0, \qquad E(u_t^2) = \sigma_u^2,$$

and u_t is uncorrelated with Y_t.

(a) (10 marks)

- What is the basic economic idea behind Friedman's model?
- What advantages does it have over the simple regression

$$C_t = \beta_2 Y_t + u_t?$$

- Describe how permanent income evolves over time.
- Since Y_t^P is unobservable, show how the model can be represented as a Koyck distribution. Give the key steps without unnecessarily long transformations.

(b) (8 marks)

- Represent the model as an ADL(1,0) model using a Koyck transformation.
- What are the properties of estimates obtained from the resulting ADL(1,0) model?

(c) (7 marks) For a developed country, the estimated model is

$$\widehat{C}_t = 0.065Y_t + 0.91C_{t-1}.$$

- Find and compare the short-run and long-run marginal propensities to consume.
- Explain the comparison.
- What conclusions can be drawn about the dynamic properties of the estimated model?