

## Theoretical questions

1. Explain the difference between time series and cross-sectional data.
2. Write the function form of linear regression model and interpret its elements.
3. Explain the relation between dependent variable, fitted values, coefficients and residuals.
4. Explain the difference between coefficients and estimators, random term and residuals.
5. Explain from where the name "Ordinary Least Squares" is coming.
6. Derive the OLS estimator for the model with constant and one explanatory variable.
7. What is the system of normal equations?
8. Derive the OLS estimator for the model with multiple explanatory variables.
9. Why it is not possible to calculate OLS estimator in the case when the number of parameters is larger than the number of observations?
10. Prove that in the model with constant term the sum of residual is equal to zero.
11. Show that in the model with constant term the mean value of dependent variable is equal to mean value of fitted variable.
12. Prove that in the model with constant  $TSS=ESS+RSS$
13. Explain what is the interpretation of  $R^2$ .
14. Explain why  $R^2$  should not be used as a criterion for comparing models.
15. Give definition of partial effect
16. Give definition of elasticity
17. Give definition of semi-elasticity
18. Why do we decode discrete variable into dummy variables?
19. Why we may not include a constant and all dummies for given discrete variables in a model?
20. What do we mean by interactions in the model?
21. How can we approximate non-linear relation by linear model?
22. Describe Classical Linear Regression Model assumptions.
23. Proof, that in CLRM estimator  $b$  is unbiased.
24. Derive the variance-covariance matrix of  $b$ . Interpret elements of this matrix.
25. Give Gauss-Markov theorem.
26. Prove that  $s^2$  is unbiased estimator of  $\sigma^2$ .
27. Prove that  $s^2(X'X)^{-1}$  is unbiased estimator of  $Var(b)$ .
28. Derive the small-sample distribution of OLS estimator. What is to be assumed, except for CLRM assumptions?

29. Give the form of statistics to test the following hypothesis:  $\beta_k = \beta_k^*$ .
30. We have estimator  $b_k$  and estimator of its standard deviation  $se_{b_k}$ . How should we build the confidence interval for  $\beta_k$ ?  $N$  – number of observations,  $K$  – number of estimated parameters,  $(1 - \alpha)$  – confidence level.
31. How do we test the joint hypothesis, using residual sum of squares from the model with and without restrictions?
32. What are the benefits and dangers of imposing restrictions on the model?
33. For what do we use diagnostic tests?
34. What test can be used to verify if the function form of the model is correct? Give  $H_0$  and  $H_1$ . How it is connected with CLRM assumptions?
35. What test can be used to verify if error term is normally distributed? Give  $H_0$  and  $H_1$ . How it is connected with CLRM assumptions? What are the consequences for OLS estimator properties of rejecting the null hypothesis?
36. What tests can be used to test for homoscedasticity in the model? Give  $H_0$  and  $H_1$ . How it is connected with CLRM assumptions? What are the consequences for OLS estimator properties of rejecting the null hypothesis?
37. What are the consequences of omitting significant variable in the model?
38. When we can get the correct parameter estimates even though variables are omitted?
39. Why we should remove non-significant variables from the model?
40. Parameters for  $x_1$  and  $x_2$  are positive. Variables are negatively correlated. What is the impact of omitting  $x_1$  on parameter for  $x_2$ ?
41. What do we mean by unusual observations? When unusual observations can be considered as outliers?
42. When unusual observations has significant impact on estimation?
43. What statistics can be used to find unusual observations?
44. When we say that the variables in the model are perfect collinear? How can you solve this problem?
45. What are the consequences of imperfect collinearity? Using what statistics you can detect imperfect collinearity in model?