

*Elements of Econometrics, 2023-2024*

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**Class 8: Variable transformation**

**Problem 1**

Interpret the coefficients in the following models:

- (a)  $y_i = \beta_0 + \beta_1 x_i + \epsilon_i$
- (b)  $\log(y)_i = \beta_0 + \beta_1 \log(x)_i + \epsilon_i$
- (c)  $y_i = \beta_0 + \beta_1 \log(x)_i + \epsilon_i$
- (d)  $\log(y)_i = \beta_0 + \beta_1 x_i + \epsilon_i$

**Problem 2**

Show that for a model with a dummy variable

$$y_i = \beta_0 + \beta_1 x_i + \beta_2 d_i + \epsilon_i$$

the percent change associated with switching from 0 to 1 is  $100 \cdot (e^{\beta_2} - 1)$ .

**Problem 3**

Interpret the coefficients in the following models:

- (a)  $y_i = \beta_0 + \beta_1 x_i + \beta_2 x_i^2 + \epsilon_i$
- (b)  $y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{1i} x_{2i} + \epsilon_i$

**Problem 4**

A researcher studies the dependence of the prices on the paintings (in thousands of dollars) on various factors, in particular on the "age" of the painting  $Age_i$  (in decades from the current year to the year of creation of the piece of art) and on the size of the canvas  $S_i$  (in square feet). She collected data on 19 paintings sold at a certain auction to estimate equation (1)

$$(1) \hat{P}_i = \underset{(0.57)}{2.35} - \underset{(0.011)}{0.028} Age_i + \underset{(0.02)}{0.037} S_i, R^2 = 0.325, \quad RSS = 0.417$$

- (a) Give the interpretation to all coefficients of this equation.
- (b) The supervisor advised the student to take into account also the availability of the provenance (a history of possession of an artwork, confirming the authenticity of the object) – score from 0 to 10. The researcher estimates two additional equations (2), (3)

$$(2) \hat{P}_i = \underset{(0.71)}{0.87} - \underset{(0.016)}{0.062} Age_i + \underset{(0.024)}{0.02} S_i + \underset{(0.13)}{0.36} PV_i, R^2 = 0.554, \quad RSS = 0.276$$

and

$$(3) \hat{P}_i = \underset{(0.75)}{-0.097} - \underset{(0.017)}{0.085} Age_i + \underset{(0.025)}{0.11} S_i + \underset{(3.55)}{2.69} PV_i - \underset{(0.05)}{0.07} PV_i Age_i - \underset{(0.14)}{0.08} PV_i S_i, R^2 = 0.691, RSS = 0.191$$

What is the difference in interpretation of coefficients of the equations (1), (2), (3)? Is provenance significant according (2) and (3)?