

Name: _____

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ECONOMETRICS - 25-06-2021 - Time: 2 h 30'

1. Say if the following statements are unambiguously true (True), unambiguously false (False) or impossible to classify the way they are stated (Not necessarily). Write the motivations to your answers **only** in the space provided. A “Not necessarily” answer with no adequate motivation will be considered wrong.

- (a) The rank of a matrix whose elements are all 0 is 0.

True ☐

False ☐

Not necessarily ☐

- (b) The rank of a matrix whose elements are all 1 is 1.

True ☐

False ☐

Not necessarily ☐

- (c) If $X_n \xrightarrow{d} N(0, 1)$, then $P(|X_n| < \varepsilon)$ tends to 0 for $n \rightarrow \infty$ and any $\varepsilon > 0$.

True ☐

False ☐

Not necessarily ☐

- (d) A Wald test statistic may take the value 0.

True ☐

False ☐

Not necessarily ☐

- (e) Given two linear models for the same dependent variable, estimated on the same data, A and B , if $R_A^2 > R_B^2$, then $AIC_A < AIC_B$.

True ☐

False ☐

Not necessarily ☐

2. Suppose you have a continuous variable y_i and a dummy¹ variable x_i , observed over a sample with $n = 400$ observations, and you are given the following quantities

$$\bar{X} = n^{-1} \sum_{i=1}^n x_i = 0.75 \quad \bar{Y} = n^{-1} \sum_{i=1}^n y_i = 4.5 \quad \sum_{i=1}^n x_i y_i = 600 \quad \sum_{i=1}^n y_i^2 = 24000$$

- (a) Compute the OLS estimates for the model $y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$:

$$\hat{\beta}_0 = \quad \quad \quad \hat{\beta}_1 = \quad \quad \quad$$

- (b) Compute the sum of squared residuals and the R^2 index:

$$\sum_{i=1}^n e_i^2 = \quad \quad \quad R^2 = \quad \quad \quad$$

- (c) Test the hypothesis $\beta_1 = 0$

Test type: _____ Distribution: _____ Test statistic: _____
 Decision: ☐ Reject ☐ Don't reject

- (d) Test the hypothesis $E(y_i|x_i = 1) = E(y_i|x_i = 0)$

Test type: _____ Distribution: _____ Test statistic: _____
 Decision: ☐ Reject ☐ Don't reject

3. You have data on 869 American households for the following variables:

Variable	Description	Mean	Median	S.D.	Min	Max
s_i	Food share on total expenditure ($\times 100$)	18.2	16.8	8.30	2.13	74.2
y_i	Log of total expenditure	10.1	10.1	0.650	8.05	11.9
m_i	Log of households size (no. of members)	0.824	0.693	0.577	0.00	2.40
c_i	Education dummy (1=college degree)	0.239	0.00	0.427	0.00	1.00
w_i	Ethnicity dummy (1=white)	0.867	1.00	0.340	0.00	1.00

The following model was estimated by OLS

$$s_i = \beta_0 + \beta_1 y_i + \beta_2 y_i^2 + \beta_3 m_i + \beta_4 m_i \cdot y_i + \beta_5 c_i + \beta_6 w_i + \varepsilon_i \quad (1)$$

Answer the following questions, using the numerical estimates that you find in table 1:

- (a) Do we have to worry about heteroskedasticity here? Why?

¹Hint: this is important.

OLS, using observations 1–869
Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
β_0	339.4677	65.6968	5.1672	0.0000
β_1	−58.5286	13.2571	−4.4149	0.0000
β_2	2.5931	0.6687	3.8777	0.0001
β_3	38.9704	9.5026	4.1010	0.0000
β_4	−3.3050	0.9255	−3.5709	0.0004
β_5	−0.3050	0.4431	−0.6882	0.4915
β_6	0.4054	0.6649	0.6097	0.5422
Mean dependent var	18.20962	S.D. dependent var	8.298722	
Sum squared resid	34493.30	S.E. of regression	6.325775	
R^2	0.422978	Adjusted R^2	0.418961	
$F(6, 862)$	85.53660	P-value(F)	4.82e−84	

White's test for heteroskedasticity: LM = 82.7435, with p-value = 5.69962e-09
RESET test for specification: $F(2, 860) = 1.16458$, with p-value = 0.312546

Table 1: Model for the share of food on the total budget

(b) Comment on the result of RESET test.

(c) Comment on the estimated coefficients for the two dummy variables w_i and c_i and give a brief interpretation of the results:

- (d) Consider two households: one “poor” (call it P), one and one “rich” (call it R). The data for P and R are as follows:

	Total expenditure	Number of members
P	20000	4
R	100000	3

Compute the marginal effect of y_i on s_i for the two households:

$$\text{meff}_P = \underline{\hspace{2cm}} \qquad \text{meff}_R = \underline{\hspace{2cm}}$$

- (e) Do the signs and magnitudes of the estimated marginal effects conform to your economic intuition? Motivate your answer.
