

# University of Ferrara

## Degree Course in "Economics, Markets and Management"

STATISTICAL METHODS for ECONOMICS and BUSINESS – 24 January 2017

### Q01

If  $B$  is the inverse of the  $4 \times 4$  matrix  $A$ , then...

a)  $A+B = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$ .

b)  $AB = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ .

c) None of the above.

### Q02

If  $a = (0 \ 5 \ 3 \ -1)$  and  $b = \begin{pmatrix} 1 \\ -1 \\ 0 \\ 3 \end{pmatrix}$ , then the result of the product  $ab$  is...

a) -8.

b)  $\begin{pmatrix} 0 & 5 & 3 & -1 \\ 0 & -5 & -3 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 15 & 9 & -3 \end{pmatrix}$ .

c) impossible.

### Q03

The trace of a square matrix  $A = \begin{pmatrix} -1 & 3 & 2 \\ 5 & -2 & 2 \\ 4 & 2 & 3 \end{pmatrix}$  is equal to...

a) 0.

b) 79.

c) 13.

### Q04

Let us consider a multiple linear regression model where  $E$  is the sum of squares of the residuals (sum of squares of the differences between predicted and observed values of the dependent variable) and  $S$  is the sum of squares of regression (sum of squares of the differences between the predicted values and the sample mean of the dependent variable). Which of the following statements is true?

a) the coefficient of determination  $R^2$  is equal to  $E/(S+E)$

b) the coefficient of determination  $R^2$  is equal to  $(S+E)/E$

c) the coefficient of determination  $R^2$  is equal to  $1-E/(S+E)$

**Q05**

Let us consider the following results of a multiple linear regression analysis, where the monthly wage (in euros) of graduates in Economics (Y) is expressed as a function of the degree mark (X1), of the gender (X2: 1=male, 0=female) and of the father income (X3: 1=high, 0=low). Let  $\alpha=0.05$  be the significance level:

	Coefficients	p-value
Intercept	1004.85	0.020
X1	7.65	0.032
X2	30.82	0.454
X3	500.13	0.004

Which of the following statements is true?

- a) only the degree mark significantly affects the monthly wage of graduates.
- b) only the father income significantly affects the monthly wage of graduates.
- c) none of the above.

**Q06**

According to the estimates of the coefficients of the regression model of the previous question, an increase of the degree mark equal to 1, corresponds to an increase of the monthly wage ...

- a) between 7 and 8 euros.
- b) equal to 32 euros.
- c) none of the above.

**Q07**

After the application of the rescaling method, the transformed variable takes values in the set ...

- a)  $(-\infty, +\infty)$ .
- b)  $[0, 1]$ .
- c)  $(0, +\infty)$ .

**Q08**

Let us consider a composite indicator for measuring the customer satisfaction according to  $k > 1$  aspects (numeric informative variables) and the additive aggregation method. When the first  $k-1$  weights (degrees of importance of the informative variables) are equal to  $(1-w)/(k-1)$  and the last one is equal to  $w < 1$ , then...

- a) the composite indicator takes value 1.
- b) when the last variable (the one with weight equal to  $w$ ) takes value 0, the composite indicator takes value 0 if the sum of the other variables is equal to 0.
- c) none of the previous statements is true.

**Q09**

Let us consider the following data related to the normalized scores achieved by three athletes in four different races. The greater the score the better the performance. Race 1 and Race 3 are more important, thus the corresponding weights in the computation of the global score, are greater.

	<b>Race 1</b>	<b>Race 2</b>	<b>Race 3</b>	<b>Race 4</b>
<b>Weight</b>	0.3	0.2	0.3	0.2
<b>Athlete 1</b>	0.75	0.20	0.15	0.50
<b>Athlete 2</b>	0.50	0.60	0.35	0.40
<b>Athlete 3</b>	0.25	0.15	0.50	0.40

By applying the Tippett combining function on the values of the table, which athlete is the winner?

- a) Athlete 1.
- b) Athlete 2.
- c) Athlete 3.

**Q10**

Which of the following statements, concerning Factor Analysis, is true?

- a) the common factors are uncorrelated with each other.
- b) the common factors are uncorrelated with the original observed variables.
- c) the original observed variables are uncorrelated with each other.

**Q11**

The R command to perform principal component analysis is:

- a) `pca(...)`.
- b) `pc.analysis(...)`.
- c) `prcomp(...)`.

**Q12**

Let us consider the following output of a Principal Component Analysis related to the first three components:

Component	Eigenvalue	% Variance	Cumulative %
1	3.927	42	42
2	1.102	12	54
3	0.758	8	62

According to the method based on the eigenvalues, how many components must be considered?

- a) 1.
- b) 2.
- c) 3.

**Q13**

Which of the following linkage methods between two clusters correspond to the smallest distance?

- a) the nearest neighbour method.
- b) the farthest neighbour method.
- c) the average linkage between groups method.

**Q14**

In which of the following methods of Cluster Analysis, the number of groups does not change after each iteration of the algorithm?

- a) hierarchical method.
- b) k-means method.
- c) additive method.

**Q15**

What is the dendrogram in Cluster Analysis?

- a) a graphical tool to represent the eigenvalues.
- b) a graphical tool to represent the clusters obtained with a non-hierarchical method.
- c) a graphical tool to represent the clusters obtained with a hierarchical method.