LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

1st year
Academic year 2017-2018

# Economics and Business Information
# Second examination period

2 de February 2018
Duration: 2h30m (150 minutes)

**ANSWER EACH GROUP ON A SEPARATE SHEET OF PAPER.**

**ALWAYS USE 3 DECIMAL PLACES IN YOUR CALCULATIONS.**

## GROUP I

**1.** Consider the distribution of EBI's final exam marks obtained by students in 2015/16 given in the table below.

**Table: Distribution of final exam marks**

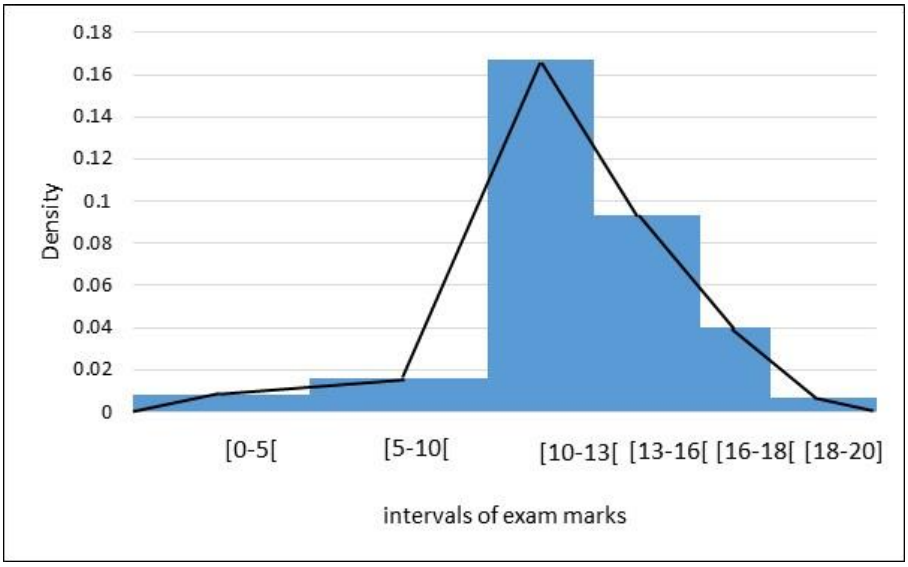
| Classes | Number of students |
|---|---|
| [0-5[ | 10 |
| [5-10[ | 20 |
| [10-13[ | 125 |
| [13-16[ | 70 |
| [16-18[ | 20 |
| [18-20] | 5 |
| **Total** | **250** |

**Source**: Academic registry and student services office, University ABC.

**Note**: The figures are not real.

(1,50 val) a) Compute and draw graphically the histogram and frequency polygon of this distribution.

| Classes | Number students (Fj) | fj | Cum Fj | Cum fj | aj | MPj | hj=fj/aj | fj*MPj | fj*(MPj-mean)^2 |
|---|---|---|---|---|---|---|---|---|---|
| [0-5[ | 10 | 0.040 | 10 | 0.040 | 5 | 2.50 | 0.008 | 0.100 | 3.810 |
| [5-10[ | 20 | 0.080 | 30 | 0.120 | 5 | 7.50 | 0.016 | 0.600 | 1.813 |
| [10-13[ | 125 | 0.500 | 155 | 0.620 | 3 | 11.50 | 0.167 | 5.750 | 0.289 |
| [13-16[ | 70 | 0.280 | 225 | 0.900 | 3 | 14.50 | 0.093 | 4.060 | 1.405 |
| [16-18[ | 20 | 0.080 | 245 | 0.980 | 2 | 17.00 | 0.040 | 1.360 | 1.797 |
| [18-20] | 5 | 0.020 | 250 | 1.000 | 2 | 19.00 | 0.010 | 0.380 | 0.911 |
| **Total** | **250** | **1** | - | - | | | | **12.250** | **10.025** |




(1,00 val) b) Compute the mean and median values of the distribution.

| | | |
|---|---|---|
| **Mean** | $\bar{x} = \frac{1}{n}\sum_{j=1}^{m} F_j MP_j = \sum_{j=1}^{m} f_j MP_j$ | 12.250 |
| **Median** | $x_{Me} = l_{j-1}(Me) + \frac{0.5 - cum\, f(Me-1)}{f(Me)} a(Me)$ | 10+[(0.50-0.12)/0.50]*3=12.280 |

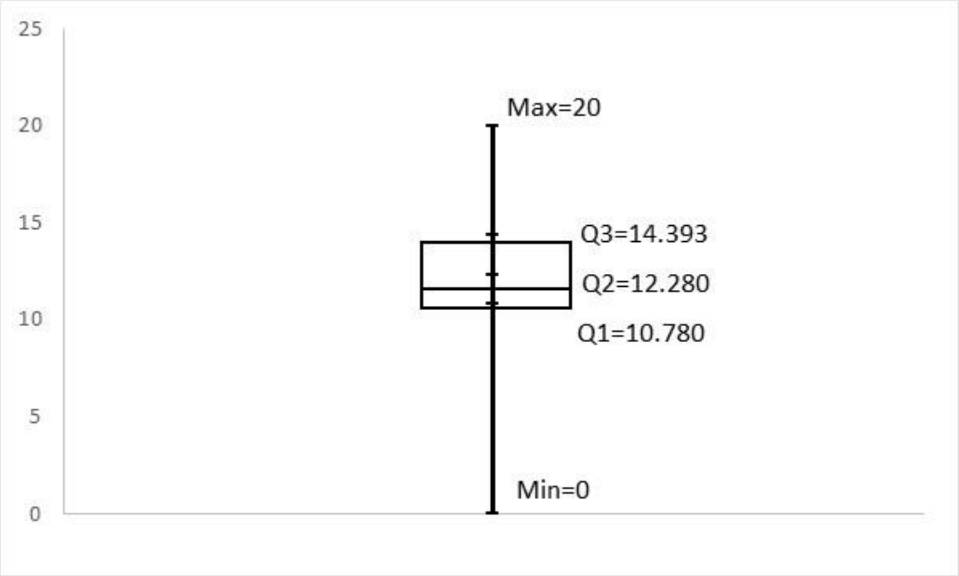
(0,50 val) c) Based on the results from question 1b) classify the asymmetry profile of the distribution. Justify your answer.

Median slightly greater than mean, suggesting the distribution is skewed to the right (negative asymmetry)

(1,00 val) d) Draw the box and whiskers plot for this distribution.

| | |
|---|---:|
| Min | 0 |
| P25 (Q1) | 10.780 |
| P50 (Q2=Mediana) | 12.280 |
| P75 (Q3) | 14.393 |
| Max | 20 |

| | | |
|---|---|---|
| **P25 (Q1)** | $x_{Q_1} = l_{j-1}(Q_1) + \frac{0.\ 25 - cum\, f(Q_1 - 1)}{f(Q_1)} a(Q_1)$ | 10.780 |
| **P75 (Q3)** | $x_{Q_3} = l_{j-1}(Q_3) + \frac{0.\ 75 - cum\, f(Q_3 - 1)}{f(Q_3)} a(Q_3)$ | 14.393 |




(1,00 val) e) Compute the relative interquartile range and the coefficient of variation of this distribution. Explain the meaning of these measures.

| | | |
|---|---|---|
| **RIQR** | $RIQR = \frac{IQR}{Q_2} = \frac{Q_3 - Q_1}{Q_2} = \frac{Q_3 - Q_1}{x_{ME}}$ | **RIQR=0.294** |
| **CV** | $CV_x = \frac{S_x}{\bar{x}}$ | **CV=3.166/12.250=0.258** |
| SD | $S_x = \sqrt{\frac{\sum_{j=1}^{m} n_j \left(MP_j - \bar{x}\right)^2}{n}} = \sqrt{\sum_{j=1}^{m} f_j \left(MP_j - \bar{x}\right)^2}$ | SD=3.166 |

**2.** Table 2 shows the distribution of monthly earnings by quartiles for country A.

**Table: Distribution of monthly earning by quartiles**

| Quartiles | 2010 | 2015 |
|---|---|---|
| 1 - Bottom 25% | 10% | 10% |
| 2 | 30% | 25% |
| 3 | 20% | 35% |
| 4 - Top 25% | 40% | 30% |
| **Total** | **100%** | **100%** |

**Source**: National statistics office. **Note**: The figures are not real.

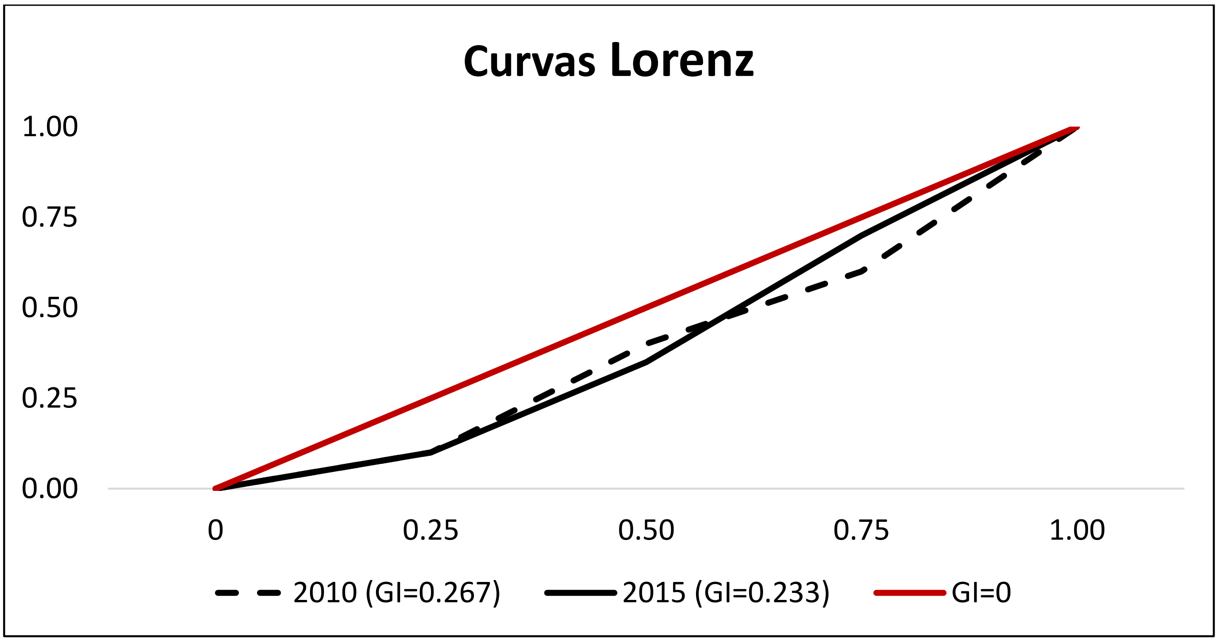
(2,00 val) a) Analyse and compare the degree of inequality in the distribution of earnings in country A in 2010 and 2015 using the Gini coefficient and Lorenz curve.

| x | y1 | y2 | x | | y1 | | y2 | |
|---|---|---|---|---|---|---|---|---|
| **Quartis** | **2010** | **2015** | **fj(x)** | **pj=cum fj(x)** | **fj(y1)** | **qj=cum fj(y1)** | **fj(y2)** | **qj=cum fj(y2)** |
| 1 - Bottom 25% | 10% | 10% | 0.25 | 0.25 | 0.10 | 0.10 | 0.10 | 0.10 |
| 2 | 30% | 25% | 0.25 | 0.50 | 0.30 | 0.40 | 0.25 | 0.35 |
| 3 | 20% | 35% | 0.25 | 0.75 | 0.20 | 0.60 | 0.35 | 0.70 |
| 4 - Top 25% | 40% | 30% | 0.25 | 1.00 | 0.40 | 1.00 | 0.30 | 1.00 |
| **Total** | **100%** | **100%** | **1.00** | | **1.00** | | **1.00** | |

$$GI = \frac{\sum_{j=1}^{m-1}(cumf_j(x) - cum\ f_j(y))}{\sum_{j=1}^{m-1} cumf_j(x)} = \frac{\sum_{j=1}^{m-1}(p_j - q_j)}{\sum_{j=1}^{m-1} p_j} = 1 - \frac{\sum_{j=1}^{m-1} q_j}{\sum_{j=1}^{m-1} p_j}$$

| GI (2010) | GI (2015) |
|---|---|
| 0.267 | 0.233 |

The degree of inequality increased between 2010 and 2015.



## GROUP II

Consider the information on the evolution of exports in Petroland:

| Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| Rate of change (%) | 0.2 | 11.6 | 7.5 | -0.1 | -10.9 | 10.2 | 7.2 | 3.3 |

(1,00 val) a) Knowing that exports in 2005 were 44,549.4 M€, compute the value of exports in 2009.
EXP 2009= +44,549.4 *1.116*1.075*0.999*0.891= 47,572.6901 M€

(1,00 val) b) Compute the rate of change of exports between 2007 and 2012.

$d_{2012,2007}$ =0.999*0.891*1.102*1.072*1.033 -1 = 8.623%

(1,25 val) c) Compute, for each year, the index of exports with fixed base for 2009.

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|
| Fixed Base Index 2009=100 | 93.458 | 93.645 | 104.508 | 112.346 | 112.233 | 100.000 | 110.200 | 118.134 | 122.033 |

(1,25 val) d) Assuming that the average annual rate of change of exports between 1999 and 2004 is 0.8% per year, compute the value of exports in 1999.

EXP 1999 = EXP 2004 /(1+0.008)^5 = +44,549.4 /(1.002*(1+0.008)^5)= 42,723.958 M€

## GROUP III

1. Consider the information on the evolution of sales of a given firm. You also know that the value of sales in 2015 at current prices was 5,390 Euros.

**Table: Evolution of sales of a given firm**

| Year | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Annual rate of change at constant prices (%) | 0.1 | 2.2 | 2.7 | 3.1 |
| Chain Price Index | 101.3 | 100.9 | 101.4 | 101.0 |

**Source**: Firm annual reports

(1,00 val) a) Compute the nominal growth of sales between 2014 and 2016.

1.027*1.014*1.031*1.01=1.08440. Nominal growth = 8.44%

(1,50 val) b) Compute the value of sales in 2016 at current prices and at 2015 prices.

Value of sales in 2016 at current prices= 5390*1.031*1.01 = 5612.661
Value of sales in 2016 at 2015 prices = 5390*1.031 = 5557.09

(1,50 val) c) Compute the value of sales in 2017 at current prices and at 2014 prices, knowing that the predicted rate of change of prices and quantities in that year is 1.3% and 2.4% respectively.

Value of sales in 2017 at curren tprices = 5612.661*1.013*1.024= 5822.081
Value of sales in 2017 at 2014 prices= 5822.081 /(1.013*1.01*1.014)= 5611.894

**2.** Comment on the following statement:

(1,50 val) a) "The division of the values of a given variable by a chain price index gives the same variable at constant prices."

The statement is false. The division of the values of a given variable by the chain price index allows obtaining the variable at previous year prices (t-1) not constant prices (for some t baseline fixed year).

## GROUP IV

The directors of the human resources and quality control departments are analysing the effect of a new training scheme introduced in the firm with the aim of reducing the level of manufacturing faults. The relationship between the number of defective units produced (Y) and the hours of training received by each worker (X) is given by the equation: $Y=10.218-0.098X$.

(0,75 val) a) Knowing that a given worker received 20 hours of training, calculate the number of defective units produced.

$10.218 – 0.098*20= 8.258$. The predicted number of defective units produced is 8.

(0,75 val) b) The coefficient of correlation between Y and X is -0.85. How much confidence should the directors of the human resources and quality control departments give to this estimate of the correlation coefficient given what you know about the linear regression model?

There are some similarities between b1 (the regression slope) and the linear correlation coefficient, namely, both give information on the direction of correlation (i.e. positive or negative) and thus always have the same sign. The two measures are positively correlated with each other because the stronger the linear correlation between Y and X (that is, the closer the coefficient of correlation is to 1 in the case of positive association), the steeper the line of the scatterplot between Y and X. That is, the regression slope can be seen as a measure of "steepness" and its values can in principle range between $-\infty$ and $+\infty$. Given the coefficient of linear correlation is negative and very strong (-0.85), we should have a strong degree of confidence on the regression slope b1.

(1,50 val) c) Knowing that the variance of X is 32.64, calculate the covariance between X and Y. Explain the main differences between the covariance and the coefficient of correlation.

We know that b1 is equal to the ratio between the covariance (X,Y) and the variance(X), so we can obtain the covariance as: covariance(X,Y )= -0.098*32.64 = -3.198.

The coefficient of correlation takes values ranging between 1 and -1. The closer the value is to 1/-1 the stronger the degree of positive/negative linear association. The closer the value is to 0, the weaker the degree of linear correlation between any two variables. Therefore, the interpretation of the coefficient of correlation is very straightforward. Furthermore, because it is a unit free measure (because it normalizes the covariance between X and Y by the product of the standard deviation of X and the standard deviation of Y), it can be used to compare the degree of linear correlation in a direct way for any pair of variables. On the contrary, the covariance between X and Y is scale dependent and cannot be easily interpreted nor used to compare the degree of linear correlation between different pairs of variables