Syllabus – Statistics Pre-Course

University of Rome "Tor Vergata", Fall 2017

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Outline of the course

The aim of the preparatory course, held in the first half of September, is to review the fundamental concepts of both descriptive and inferential statistics and to provide students with all the necessary tools to successfully attend either the MSc in Economics or the MSc in Finance and Banking. Attendance is highly recommended for those students that do not have a strong background in statistics, but it can be a good opportunity to review and deepen the understanding of several key issues for students with solid statistical foundations. As a benchmark to evaluate your background, try to solve the following Evaluation Test.

Syllabus

Possible reference book for the course is

- Newbold, P., Carlson, W.L., and B. Thorne, (2012), "Statistics for Business and Economics", Pearson, 8^{th} *Edition*.

Here below a detailed report of the topics that will be covered:

- **Part I: Descriptive Statistics**
  1. Introduction
  2. Types of Data
  3. Frequency Distribution
  4. Data Presentation
  5. Measuring Central Tendency
  6. Measuring Variation
  7. Dependence and Association

- **Part II: Probability**
  8. Random Variables
  9. Discrete Distributions: Probability Distribution Function and Cumulative Probability Function
  10. Continuous Distributions: Density Probability Function and Cumulative Density Function
  11. Expected Value and Variance of a Random Variable
  12. The Normal Distribution
  13. Common Distributions and their Moments: Bernoulli, Binomial, Poisson, Uniform, Gamma, Exponential, Chi-Square.

- **Part III: Inferential Statistics**
  14. Introduction to Inferential Statistics
  15. Sample Mean
  16. Central Limit Theorem
  17. Estimation: Unbiasedness, Mean Square Error, Consistency
  18. Maximum Likelihood
  19. Test of Hypothesis

Evaluation Test

Please solve the following exercises.

Exercise 1
Verify whether the following function $f(x)$ is a valid probability density function. Compute expected value and variance of the random variable distributed according to $f(x)$.

$$f(x;\theta) = \theta^2 x e^{-\theta x}, x > 0 \tag{1}$$

Exercise 2
Let (X_1, X_2, X_3, X_4) be Normal random variables with $\mu = 0$ and $\sigma^2 = 1$. Specify the distribution of the following variable:

$$Y = X_1 - 2X_2 + X_3 - X_4 \tag{2}$$

under the hypothesis of independence between X_1 and X_2.

Exercise 3
From past experience, it is known that the number of tickets purchased by a student standing in line at the ticket window for the football match of Roma against Milan follows a distribution that has mean $\mu = 2.4$ and standard deviation $\sigma^2 = 2$. Suppose that few hours before the start of one of these matches there are 100 eager students standing in line to purchase tickets. If only 250 tickets remain, what is the probability that all 100 students will be able to purchase the tickets they desire?

Exercise 4
Suppose that a book publisher is interested in the number of fiction paperbacks adult consumers purchase per month. The publisher conducts a survey. In the survey, each adult is asked the number of fiction paperbacks he/she has purchased the previous month.
Exploing the results reported in the Table next page, compute:

- The mean, the median and the mode of the number of books purchased.
- The variance of the number of books purchased.
- The frequency of adult consumers purchasing less than 4 books in a months.

Figure 1: Survey's Results

Number of books	n_j
0	10
1	12
2	16
3	12
4	8
5	6
6	2
8	2

Exercise 5

Given that X is a Normal random variable with $\mu = 10$ and $\sigma^2 = 9$, find:

- $P(X > 12)$
- $P(X > 8)$
- $P(X <= 15)$
- $P(9 < X <= 13)$