BUSTA N.2

- Comportamento organizzativo: il candidato tracci un inquadramento generale e proceda quindi con la contestualizzazione nell'ambito universitario

- Sicurezza sul lavoro: il candidato ne illustri i punti salienti, con particolare riferimento ai laboratori di didattica e di ricerca

BUSTA N.3

- La gestione per progetti: il candidato tracci un inquadramento generale e proceda quindi con la contestualizzazione nell'ambito universitario

- Programmi di finanziamento alla ricerca: il candidato faccia una premessa generale e proceda quindi a definire nello specifico le caratteristiche del programma Horizon 2020

and more sophisticated procedures are available. Among the many existing statistical software, an interesting option is R (see www.r-project.org), that is, an open source software, extremely powerful and versatile, which is increasingly growing in popularity. Detailed information about this tool can be found in many textbooks (such as Hothorn & Everitt, 2004), as well as in the website of the software https://cran.r-project.org/manuals.html). As far as commercial software is concerned, the most widespread tools are SPSS and STATA (see Field, 2009, and Acock, 2018, respectively, for a detailed presentation of these tools).

3.2. Descriptive Statistics

Basic techniques for data description include *summary statistics* and *graphical representations*. The analysis is usually limited to the application of simple methods, but there are also sophisticated descriptive techniques that can be applied to datasets with a complex structure.

The description of the data available should be the first step of any analysis and requires significant attention.

3.2.1. Summary Statistics

Available data are measured starting from the observation of some *statistical units*, such as the products of a production plant or a production line. These units often represent a *sample*, which is a subset of randomly extracted units (i.e., without favoring any unit compared to the others) from a much larger set called *population* or *universe*. The *sample size* is usually indicated with n, which represents the number of statistical units available for data collection. Some *variables* are detected from the statistical units, and they are usually denoted with uppercase letter, such as X, Y, Z. Variables can be *numerical* or *qualitative*. We refer to values (or modalities, for qualitative variables) detected in the sample of a certain variable Y with $y_1, \ldots, y_n$.

Statistics is defined as a function of the sampled data. We also call *statistics* all the quantities used for the description of the data.

The *position indexes* identify a representative value for the whole sample, according to an appropriate criterion. The most used measure is the *average*

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

Another position index is the *median*, which requires the reorganization of the sample, placing the observations in ascending order

$$y_{(1)}, y_{(2)}, \ldots, y_{(n)},$$

where $y_{(1)}$ denotes the smallest observation of the sample, $y_{(2)}$ the second one, and so on, until the highest observation of the sample $y(n)$. The sample median is defined as follows:

$$y_{0,n} = \begin{cases} y_{\left[\frac{n+1}{2}\right]} & \text{the central value if } n \text{ is odd} \\ \dfrac{y_{\left[\frac{n}{2}\right]} + y_{\left[\frac{n}{2}+1\right]}}{2} & \text{the average of the two central values if } n \text{ is even} \end{cases}.$$

Unlike the average, the median is not influenced by abnormal observations (also called *outliers*), which are often present in samples, and constitutes therefore a *robust* statistic.

The median divides the sample into two equal subsets. More information about the sample can be identified considering additional position indices. *Quartiles* divide sample into four equal parts, while p^{th} *percentile* (or *quantile*) (with $0 < p < 100$) indicates the value below which a given percentage of observations in a group of observations may be found. For example, the 10th percentile (quantile) is the value (or score) below which 10% of the observations may be found.

The dispersion indexes are another important category of statistics, which describe the degree of heterogeneity existing between sampled observations. The most used index is the *sample variance*

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})^2,$$

or its square root, the *standard deviation* $s = \sqrt{s^2}$, which is expressed in the same measurement unit of the variable itself (Y). Both s^2 and s are null in total absence of variability in sampled data $(y_i = \bar{y},\ i = 1,\ldots,n)$. Otherwise, they both assume higher values when observations are more different from the sample average.

Other dispersion indexes are the *interquartile range* (*IQR*), equal to the difference between the 75th and the 25th percentiles ($IQR = y_{0.75} - y_{0.25}$) and the *range of variation* (or *range*), equal to the difference between the highest and the lowest values in the sample (range $= y_{(n)} - y_{(1)}$)

6.2. Origins and Evolution of the Benchmarking Concept

Benchmarking, intended as the process that facilitates the improvement of management practices, began to spread in the first half of the 1980s, in response to a greater competition, a more dynamic context and to the crisis that significantly struck large Western companies in those years. To face the rapid increase in the performance gap compared to some competitors, it became essential to introduce innovative practices capable of improving business processes quickly, reducing costs, and increasing both performance and products and services quality. Many of the US multinationals, such as Xerox, IBM, Ford, Compaq and Digital, started important innovation processes based on the observation of the managerial practices of excellent organizations.

Xerox Corporation acted as pioneer and quickly became a symbol for benchmarking. To contrast the gradual decrease in profitability and market share caused by the strong Japanese competition, the company started several benchmarking projects. In 1979, it started to analyze the costs of the various production units; a careful comparison between the copiers produced by the Japanese affiliate Fuji-Xerox and those produced by other Japanese companies, highlighted that competitors were selling machines at a price that matched Xerox manufacturing price. David Kearns and Robert Camp, CEO and Logistics Manager of the company, respectively, following the observation of organizational structures adopted by some successful enterprises, introduced radical changes in critical process handling procedures, modified some manufacturing components and managed to reduce production costs. After a few years, the company management decided to extend benchmarking to all business units and all cost centers. The benchmarking process was soon recognized as one of the key components toward the achievement of a higher quality in all processes and products. With the introduction of benchmarking, Xerox changed its business model and redefined its mission and organizational structure, moving from a functional logic to a process logic. The experience of Xerox was published by Robert Camp (1989), in the text *Benchmarking. The search for Industry Best Practices that lead to superior Performance*, which soon became a best seller worldwide and from which a rich body of literature and interesting managerial experiences emerged.

As documented by Camp (1989), in the light of Xerox experience and its subsequent applications, it is possible to identify an evolutionary path of the benchmarking concept comprising five generations (Watson, 2007).

The first generation, called *Reverse Engineering* and *product competitive analysis*, compares the features, functionality and performance of a company's products and services with similar products and services produced by competitors. The characterizing aspects of this methodology, such as the dismantling of a product, the assessment and comparison of its technical features, act as an important incentive for improvement and even today, they are used by many organizations as a learning resource.

The second generation, *competitive benchmarking*, reaches maturity in the 1976–1986 decade and acts as an extension of competitive analysis and market research. Competitive benchmarking aims at identifying the actions taken by competitors to gain competitive advantage and carefully analyzes strategic decisions and investments in products and services that define the superior performance of some leading companies. Its analysis goes beyond comparisons only focused on products to include comparisons between internal and competitors' processes, soon becoming one of the tools used in strategic planning process.

The third generation, called *process benchmarking*, spread over the period 1982–1988, thanks to the start of some major improvement projects promoted by a group of companies' leaders in quality management. Process comparison spread quickly because of its highlighting interesting learning opportunities and the possibility of involving companies operating in different sectors, thus gaining a greater information sharing compared to projects involving only competitors. For example, to optimize the order fulfillment process, Xerox analyzed the process handling procedure in organizations operating in different sectors and found an analogy between the shipment of copiers and the shipping process of boots and other fishing equipment developed by L.L. Bean. A thorough study of the fulfillment of L.L. Bean order process allowed Xerox to identify important improvements in its order fulfillment process.

In the fourth generation, *strategic benchmarking* is introduced as a systematic process to evaluate alternatives, implement strategies, and improve performance through the understanding and adapting of other organizations' successful strategies. Strategic benchmarking differs from process benchmarking especially for the entity and depth of companies' commitment; together the two kinds of benchmarking represent the heart of scientific studies on the subject.

The latest generation, *global benchmarking*, extends the geographic boundaries of the analysis and implies the overcoming of existing