Think Right, Decide Right, Act Right: The Role of Statistical Methods

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Abstract

All kinds of statistical methods are developed for decision-making based on strong evidence. How can strong evidence be created? Only statistical methods with high levels of evidence create strong evidence. Statistical methods play an important role in data analysis used in decision-making processes.

AI (Artificial Intelligence) and Machine Learning are statistical methods. Today, highly intelligent, very talented, capable of doing everything they are told, and capable of making decisions, AI methods are developed by the field of Statistics.

After AI was put into practice, it became apparent what the field of statistics truly entails. For this reason, Karl Pearson stated, "Statistics is the grammar of science", and Florence Nightingale remarked, "To understand God's thoughts, we must study statistics, for they are the measure of her purpose".

These quotes explain the title very well. Therefore, as you learn the numerous methods available in the field of statistics, the mind significantly improves in decision-making.

Keywords: Statistical methods, Decision-making, Artificial intelligence, Machine learning

Introduction

All kinds of statistical methods are developed for decision-making based on strong evidence. How can strong evidence be created? Only statistical methods with high levels of evidence create strong evidence. Statistical methods play an important role in data analysis used in decision-making processes.

There are univariate and multivariate methods in the science of statistics. Multivariate methods identify factors in the relationships among multiple variables related to the hypothesis. Multivariate analysis is useful for analyzing data sets involving multiple variables in complex problems.

All these methods have become indispensable and important tools in the decision-making process of many different fields. Karl Pearson, the English statistician and pioneer founder of the modern field of statistics, defined statistics as: "Statistics is the grammar of science." Florence Nightingale said, "To understand God's thoughts, we must study statistics, for they are the measure of her purpose" (1).

Artificial intelligence (AI) and machine learning are widely used today. Statistics has enabled the formation of these two fields with its methods. The main purpose of AI is to imitate human intelligence. Machine learning, however, does not aim to imitate human intelligence. Instead, machine learning focuses on teaching a machine how to perform a specific task.

Artificial Intelligence

The purpose of AI is to transfer human intelligence and instincts to a computer. The scientific methods it uses generally belong to the field of Statistics.

Health Services of artificial intelligence can be listed as follows (1):

1. Early detection of diseases

2. Improved decision-making

3. Help in treatment

4. End-of-life care

5. Associated care

6. Providing a superior experience

7. Monitoring health through wearable devices

Causality, correlation, and artificial intelligence for rational decision-making cover five significant areas of intellectual inquiry: causality, correlation, artificial intelligence, rationality, and decision-making.

The concepts of causality, correlation, and artificial intelligence yield important results in condition monitoring and various biomedical applications (2). Artificial intelligence refers to the ability of controlled machines/robots to perform tasks that are practically similar to those performed by humans.

As a rule, AI is known as the capacity or ability of advanced robotics to decide, solve problems, and reason. Today, the applications and use cases of this emerging technology are endless. These include gaming, robotics, biological discoveries, neuroscience, software error detection, business process improvement, social media emotion analysis, depression studies, and disease detection (3–6).

We can use statistics to theoretically analyze the behavior of proposed AI systems. Most machine learning algorithms have settings called hyperparameters that must be determined externally to the learning algorithm itself; we discuss how to set these using additional data. Machine learning is essentially a form of applied statistics with an increased emphasis on the use of computers to statistically estimate complicated functions and a decreased emphasis on proving confidence intervals around these functions. The two central approaches to statistics are: frequentist estimators and Bayesian inference (7).

Machine Learning

Machine learning is the process of computers learning and improving at a specific task using input data and predefined rules. Special algorithms based on the branch of statistics are combined into a complex system to make this possible.

When it comes to artificial intelligence, it is the combination of several machine learning algorithms that learn and improve at several connected or independent tasks (8). That is to say, some rules are introduced in statistics-based methods to combine machine learning and human wisdom (9).

The connection between artificial intelligence and the field of statistics began in 1988 (10). Machine learning is based on statistics; it is a statistical process. It can be used for various tasks, but the underlying task is often pattern recognition. Algorithms identify patterns or rules in data and use those patterns or rules to explain the data and make predictions for future data (11).

Machine learning is therefore linked to data science. Statistical methods aim to extract meaningful and useful patterns from data. Machine learning can automatically analyze these large data sets. Machine learning and data science rely on statistical methods (12).

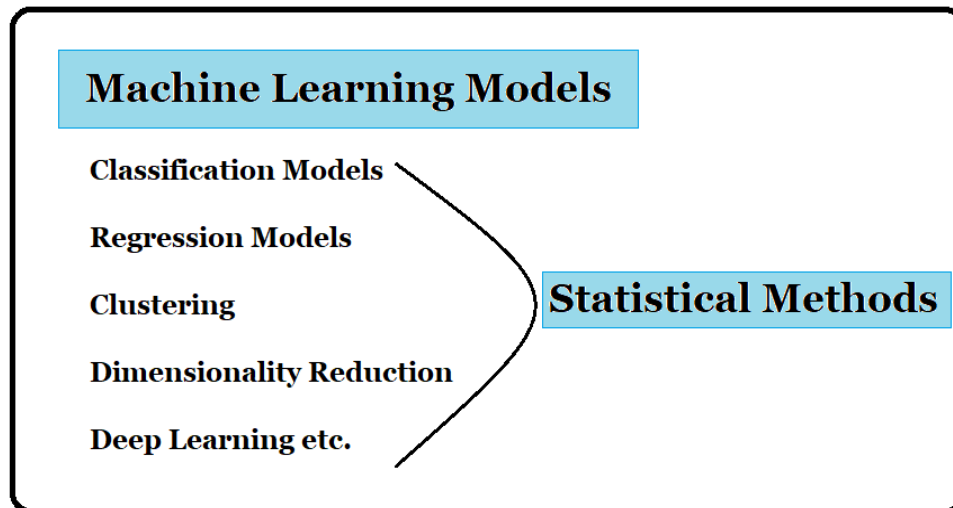Machine learning models include statistical methods as presented in Figure 1 (1).

Figure 1. Machine learning models include statistical methods

As can be seen, the methods used by AI and Machine Learning are statistical methods. Today, the AI methods that are highly intelligent, very skilled, capable of performing all tasks as instructed, and capable of making decisions are developed by the field of Statistics.

After AI was put into practice, it became apparent what the field of statistics truly entails. For this reason, Karl Pearson stated, "Statistics is the grammar of science", and Florence Nightingale remarked, "To understand God's thoughts, we must study statistics, for they are the measure of her purpose" (1).

These quotations explain the title very well. Therefore, as one learns the numerous methods

available in the field of statistics, it will significantly improve the mind in decision-making.

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