

THE CONCEPT OF DESCRIPTIVE ANALYTICS

Radosław WOLNIAK

Silesian University of Technology, Organization and Management Department, Economics and Informatics
Institute; rwolniak@polsl.pl, ORCID: 0000-0003-0317-9811

Purpose: The goal of the paper is to analyze the main features, benefits and problems with the descriptive analytics usage.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The paper discusses the concept of descriptive analytics, which involves collecting, cleaning, and summarizing historical data from various sources to provide a clear and concise summary that can aid in decision-making. The paper explains the importance of descriptive analytics as the foundation for other types of data analytics, and highlights the steps involved in its implementation, including data collection, cleaning and preparation, exploration and visualization, analysis, interpretation, and reporting. The paper also mentions the advantages of descriptive analytics, such as identifying trends and patterns, optimizing processes, improving decision-making, and simplifying communication, while cautioning businesses about the potential pitfalls and challenges of this approach, such as limited predictive power, incomplete data, data privacy concerns, biased results, and overreliance on historical data. The paper emphasizes the importance of understanding these issues to ensure that the insights generated are relevant, accurate, and useful.

Originality/value: Detailed analysis of all subjects related to the problems connected with the descriptive analytics.

Keywords: Industry 4.0; descriptive analytics, business analytics, data analysis, real-time analytics.

Category of the paper: literature review.

1. Introduction

Descriptive analytics is a branch of data analytics that deals with the examination and interpretation of past data to gain insights into what has happened in a business or organization. It involves collecting, summarizing, and presenting historical data in a way that enables businesses to understand patterns, trends, and relationships.

Descriptive analytics is a crucial aspect of data analysis that involves examining historical data to gain insights and identify trends, patterns, and relationships. This type of analysis is widely used in a range of industries, including finance, marketing, healthcare, and manufacturing. In this essay, we will explore the concept of descriptive analytics, its applications, and its benefits.

The goal of the paper is to analyze the main features, benefits and problems with the descriptive analytics usage.

2. Descriptive analytics - definitions

Descriptive analytics involves collecting, cleaning, and summarizing data from various sources. The goal is to provide a clear and concise summary of the data that can be used to inform decision-making. The data is then presented in a way that is easy to understand, using tools such as charts, tables, and graphs. This approach helps businesses to identify areas of strength and weakness, track progress over time, and make informed decisions based on historical data (Hurwitz et al., 2015).

Descriptive analytics involves the utilization of diverse statistical analysis methods to dissect raw data into a structure that enables individuals to detect patterns, anomalies, enhance planning, and make comparisons. Organizations can maximize the benefits of descriptive analytics by using it to compare different items over time or against each other (Hwang et al., 2017).

Descriptive analytics is a type of data analysis that involves examining historical data to understand past events, trends, and patterns. It is often the first stage of the data analytics process and is used to gain insights into what has happened in the past. Descriptive analytics helps businesses and organizations to understand what has happened, when it happened, and why it happened.

We can find in the literature following examples of descriptive analytics definitions (Patanjali, 2018; Nourani, 2021, Sharma et al., 2020):

- Descriptive analytics is the examination of data or content, usually manually performed, to answer the question 'What happened?'
- Descriptive analytics examines data to describe what has happened in the past, providing context for understanding current operations and predicting future outcomes.
- Descriptive analytics provides insights into what has happened in the past, what is happening now, and what might happen in the future based on past performance.
- Descriptive analytics is a form of business intelligence that examines historical data to identify patterns and trends and to gain insights into what has happened in the past.

The goal of descriptive analytics is to provide a clear and concise summary of the data that can be used to inform decision-making. It involves using tools such as charts, tables, and graphs to visualize data and present it in a way that is easy to understand. This approach can help businesses to identify areas of strength and weakness, track progress over time, and make informed decisions based on historical data.

Descriptive analytics is concerned with answering questions such as (Cam et al., 2021):

- What happened?
- When did it happen?
- Where did it happen?
- How often did it happen?
- What were the main characteristics or features of what happened?

It can be stated that descriptive analytics provides a valuable foundation for other types of data analytics, such as predictive analytics and prescriptive analytics, which use historical data to make predictions about future events or prescribe actions to achieve specific outcomes.

Descriptive analytics is a valuable tool for businesses and organizations looking to gain insights into their operations, improve decision-making, and identify areas for improvement. By analyzing historical data, businesses can identify trends, patterns, and relationships that can be used to optimize processes, improve customer engagement, and increase profitability. With the right tools and techniques, descriptive analytics can help businesses to stay ahead of the competition and achieve long-term success (Greasley, 2019).

In the process of descriptive analytics implementation following steps should be used (Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023, Scappini, 2016, Peter et al., 2023):

- Data collection: Gather the data that you want to analyze from various sources, such as databases, spreadsheets, or other data repositories.
- Data cleaning and preparation: Clean the data by removing irrelevant or duplicated data, correcting errors, and ensuring that the data is in a format that can be analyzed.
- Data exploration and visualization: Explore the data to understand its characteristics, such as distributions, correlations, and outliers. Visualize the data using charts, graphs, or other visual aids to make it easier to understand.
- Data analysis: Apply statistical techniques to the data to identify patterns, trends, and relationships. Common techniques include mean, median, mode, standard deviation, and regression analysis.
- Interpretation and reporting: Analyze the results of the data analysis and interpret the findings in a way that is meaningful to stakeholders. Report the findings in a clear and concise manner using charts, graphs, or other visual aids.
- Very important thing is to differentiate the descriptive analytics and others types of analytics especially real-time analytics. The differences were summed up in the table 1. We can differentiate following main differences between them:

- **Timeframe:** Descriptive analytics is a type of data analysis that examines historical data to understand past events, trends, and patterns. Real-time analytics, on the other hand, involves analyzing data in real-time or near real-time as it is generated.
- **Purpose:** The purpose of descriptive analytics is to gain insights into what has happened in the past. It is often used to identify patterns and trends, and to provide context for understanding current operations and predicting future outcomes. Real-time analytics, on the other hand, is used to provide immediate insights into what is happening right now, and to enable real-time decision-making.
- **Data sources:** Descriptive analytics typically relies on structured data from databases, data warehouses, and other historical data sources. Real-time analytics, on the other hand, can analyze structured and unstructured data from a variety of sources, including sensors, social media, and other real-time data streams.
- **Analytics tools:** Descriptive analytics often involves the use of traditional analytics tools, such as business intelligence software, data visualization tools, and statistical analysis tools. Real-time analytics, on the other hand, often requires specialized tools and technologies that can process and analyze data in real-time, such as stream processing engines, complex event processing systems, and machine learning algorithms.
- **Applications:** Descriptive analytics is often used in applications such as sales analysis, customer segmentation, and supply chain management. Real-time analytics, on the other hand, is used in applications such as fraud detection, predictive maintenance, and real-time marketing.

Table 1.
Comparison of descriptive analytics and real-time analytics

	Descriptive Analytics	Real-time Analytics
Timeframe	Examines historical data	Analyzes data in real-time or near real-time
Purpose	Gain insights into past events and identify patterns and trends	Provide immediate insights and enable real-time decision-making
Data Sources	Relies on structured data from databases and historical data sources	Analyzes structured and unstructured data from various sources, including sensors and real-time data streams
Analytics Tools	Uses traditional analytics tools such as business intelligence software and statistical analysis tools	Requires specialized tools such as stream processing engines and machine learning algorithms
Applications	Used in applications such as sales analysis, customer segmentation, and supply chain management	Used in applications such as fraud detection, predictive maintenance, and real-time marketing

Source: Authors own work on the basis of: (Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023, Scappini, 2016, Peter et al., 2023).

Descriptive analytics is a type of data analytics that involves analyzing historical data to gain insights into past events and trends. Industry 4.0, on the other hand, refers to the current trend of using advanced technologies like artificial intelligence, the Internet of Things (IoT), and machine learning to create more intelligent and connected manufacturing processes (Jonek-

Kowalska, Wolniak, 2021, 2022; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021, 2023; Rosak-Szyrocka et al., 2023; Gajdzik et al., 2023, Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021).

By analyzing historical data from production processes, businesses can identify patterns and trends that can inform decisions about optimizing manufacturing processes, reducing waste, improving quality control, and identifying areas for improvement (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023). For example, in a smart factory that utilizes Industry 4.0 technologies, data from IoT sensors on production lines can be analyzed using descriptive analytics to identify patterns in equipment performance or detect anomalies that could indicate a problem. This data can then be used to optimize production processes, reduce downtime, and improve product quality (Wolniak, Sułkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022).

Furthermore, descriptive analytics can also help industries to track and analyze key performance indicators (KPIs) such as production output, inventory levels, and customer demand. By using data analysis tools, businesses can gain a better understanding of how these factors are affecting their operations and make data-driven decisions to improve their processes (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018, 2023; Grabowska et al., 2019, 2020, 2021).

3. Benefits and problems of descriptive analytics usage

The significant benefits of descriptive analytics is its ability to help businesses identify areas of improvement. By analyzing historical data, businesses can identify areas where they are underperforming and take corrective action. For example, a business may identify a decline in sales in a particular region and adjust its marketing strategy to increase sales in that region. Descriptive analytics also helps businesses to track progress over time, providing a baseline for measuring success and identifying areas for improvement.

On the basis of literature analysis following benefits of descriptive analytics can be formulated (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- Identifying trends and patterns: Descriptive analytics allows businesses to identify trends and patterns in historical data. This information can be used to understand customer behavior, sales performance, and market trends. Identifying these trends and patterns helps businesses to make informed decisions, optimize processes, and improve customer engagement.

- Measuring progress: By analyzing historical data, businesses can track progress over time. This provides a baseline for measuring success and identifying areas for improvement. Descriptive analytics helps businesses to set realistic goals and track progress towards those goals.
- Improving decision-making: Descriptive analytics provides businesses with valuable insights that can be used to make informed decisions. For example, businesses can use historical data to identify which products or services are selling well and which ones are not. This information can be used to adjust marketing strategies, optimize pricing, and improve customer satisfaction.
- Optimizing processes: Descriptive analytics helps businesses to identify areas where they are underperforming and take corrective action. By analyzing historical data, businesses can identify bottlenecks in their processes and take steps to improve efficiency and productivity.
- Increasing profitability: By using descriptive analytics to identify areas for improvement, businesses can increase profitability. For example, businesses can use historical data to identify which customers are most profitable and focus their marketing efforts on those customers.
- Preventing problems: Descriptive analytics can be used to identify potential problems before they occur. For example, businesses can use historical data to identify trends in customer complaints and take steps to address those complaints before they become a more significant issue.
- It can simplify communication about numerical data.
- It can improve understanding of complex situations.
- Companies can compare performance against the competition or across product lines.
- It can be used to help motivate teams to reach new goals.

The use of descriptive analytics provides several benefits to businesses and organizations. By analyzing historical data, businesses can identify trends and patterns, measure progress, improve decision-making, optimize processes, increase profitability, and prevent problems. With the right tools and techniques, businesses can use descriptive analytics to gain a competitive advantage and achieve long-term success (Sharma et al., 2020; Wolniak, 2013; 2016; Hys, Wolniak, 2018).

While there are several benefits to the use of descriptive analytics, there are also some potential disadvantages and problems that businesses and organizations should be aware of. Below are some of the key disadvantages and problems associated with the usage of descriptive analytics (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- Limited predictive power: Descriptive analytics is focused on analyzing past data to identify trends and patterns. While this information can be useful for making informed decisions, it has limited predictive power. Descriptive analytics cannot predict future events or outcomes.
- Incomplete data: Descriptive analytics is only as good as the data that is used to analyze it. If the data is incomplete, inaccurate, or biased, the insights generated by descriptive analytics may be flawed or misleading.
- Data privacy concerns: The use of descriptive analytics may raise data privacy concerns. Businesses need to be mindful of the data they are collecting, how it is being used, and who has access to it. They must also ensure that they are compliant with relevant data privacy regulations.
- Difficulty in interpreting results: Descriptive analytics can generate a large amount of data that may be difficult to interpret. It can be challenging to identify which insights are most relevant and useful, particularly for businesses without an experienced data analytics team.
- Costly data storage and processing: Storing and processing large amounts of data can be costly. Businesses must invest in the necessary infrastructure, software, and personnel to collect, store, and process data effectively.
- Overreliance on historical data: Descriptive analytics is based on analyzing historical data. While this can be useful for identifying trends and patterns, it may lead to an overreliance on past data and an inability to adapt to changing market conditions or customer preferences.
- Existing biases can be amplified either accidentally or deliberately.
- Results can direct a company's focus to metrics that are not helpful, like sales versus profits.
- Motivational metrics can be gamed to encourage unintended behavior, such as mouse movers or sales fraud.
- Poorly chosen metrics can lead to a false sense of security.

While descriptive analytics can provide valuable insights into past trends and patterns, it has some potential disadvantages and problems that businesses and organizations should be aware of. These include limited predictive power, incomplete data, data privacy concerns, difficulty in interpreting results, costly data storage and processing, and overreliance on historical data. It is essential to understand these issues when implementing a descriptive analytics strategy to ensure that the insights generated are relevant, accurate, and useful.

4. Example of descriptive analytics usage in business

One of the primary applications of descriptive analytics is in business intelligence. Businesses use this approach to gain insights into their operations, including sales, marketing, and customer behavior. By analyzing historical data, businesses can identify trends and patterns in customer behavior, sales performance, and marketing campaigns. This information can be used to optimize business processes, improve customer engagement, and increase profitability.

The descriptive analytics is commonly used in following areas (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- financial reports,
- planning a new program,
- measuring effectiveness of a new program,
- understanding sales trends,
- comparing companies,
- motivating behavior with KPIs,
- recognizing anomalous behavior,
- interpreting survey results.

In sales analysis businesses can use descriptive analytics to examine sales data from the past to identify trends in sales volume, revenue, and customer behavior. By understanding past sales patterns, businesses can make informed decisions about inventory management, pricing strategies, and marketing campaigns (Cam et al., 2021).

Descriptive analytics can be used to segment customers based on their demographics, behaviors, and purchase history. This information can help businesses to better understand their customers and tailor their marketing and product offerings to meet their specific needs.

In finance, descriptive analytics is used to analyze financial statements, track investments, and identify trends in the stock market. By analyzing historical data, financial analysts can identify patterns in market trends and make informed decisions about investments. Descriptive analytics is also used in healthcare to analyze patient data, track disease outbreaks, and identify trends in patient health. This information is used to improve patient care, develop treatment plans, and prevent the spread of disease (Peter et al., 2023).

Descriptive analytics is also used to website traffic analysis. By analyzing website traffic data, businesses can identify which pages on their website are most popular, how long visitors stay on the site, and what actions they take. This information can help businesses to optimize their website design, content, and user experience to improve engagement and conversion rates.

Descriptive analytics can be used in logistic to analyze historical data on supply chain performance, such as lead times, inventory levels, and delivery times. This information can help businesses to identify bottlenecks in the supply chain and make data-driven decisions to optimize inventory management and reduce costs (Hurwitz et al., 2015).

By analyzing social media data, businesses can gain insights into customer sentiment, brand awareness, and engagement. This information can help businesses to adjust their marketing strategies and improve their social media presence.

Quality management is also an area where the descriptive analytics can be used in extensive way. Below are some of examples of usage of descriptive analytics in quality management (Hwang et al., 2017; 2015; Lawton, 2019; Charles et al., 2023, Scappini, 2016; Peter et al., 2023):

- Descriptive analytics can be used to analyze historical data on product defects to identify patterns and trends. By understanding the root causes of defects, businesses can make data-driven decisions to improve product quality and reduce waste.
- Descriptive analytics can be used to analyze customer complaints to identify the most common issues and areas for improvement. By addressing these issues, businesses can improve customer satisfaction and loyalty.
- The concept can be used to analyze data on process performance, such as cycle time, throughput, and yield. By understanding how processes perform over time, businesses can identify opportunities for improvement and make data-driven decisions to optimize operations.
- Descriptive analytics can be used to analyze data on supplier performance, such as delivery times, quality, and cost. By understanding supplier performance over time, businesses can identify opportunities to improve supplier relationships and reduce costs.
- This type of analytics can be used to analyze data from audits to identify areas of non-compliance and opportunities for improvement. By addressing these issues, businesses can reduce the risk of regulatory fines and improve overall compliance.

5. Conclusion

The paper describes descriptive analytics as a process of collecting, cleaning, and summarizing data from various sources to provide a clear and concise summary that can inform decision-making. It is the first stage of the data analytics process and involves examining historical data to understand past events, trends, and patterns. The goal is to identify areas of strength and weakness, track progress over time, and make informed decisions based on historical data. Descriptive analytics involves using tools such as charts, tables, and graphs to visualize data and present it in a way that is easy to understand. It can provide a valuable foundation for other types of data analytics, such as predictive and prescriptive analytics. The implementation of descriptive analytics involves several steps, including data collection, cleaning and preparation, data exploration and visualization, data analysis, interpretation and reporting.

Descriptive analytics allows businesses to analyze historical data to identify trends and patterns, measure progress, optimize processes, improve decision-making, increase profitability, prevent problems, and simplify communication about numerical data. However, businesses should be aware of its potential disadvantages and problems, including limited predictive power, incomplete data, data privacy concerns, difficulty in interpreting results, costly data storage and processing, overreliance on historical data, existing biases, the potential to direct focus to unhelpful metrics, gamification of motivational metrics, and the potential for a false sense of security. Businesses need to understand these issues to ensure that the insights generated are relevant, accurate, and useful.

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