TREND ANALYSIS OF ANALYTICS DIRECTIONS IN BUSINESS ANALYTICS WITHIN TIME PERIOD OF 2009 – 2019 IN FIELD OF BUSINESS AND INDUSTRY

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Abstract
In this paper, we deal with trend analysis of analytics directions in the field of business analytics within a period of time from 2009 to 2019. We illuminate the trendline in specific types of analytics such as predictive, prescriptive, descriptive, and diagnostics analytics. In the first chapter, we illustrate the theoretical basis for each of the analytics. The following chapter consists of results of the two datasets, where we deliver the results in the form of maps. We summarise the issue on the paper briefly in the last chapter.

Keywords
business analytics, methods, trends, industry, regions, period of 2009-2019

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Introduction

According to author Davenport (2015), we can divide known Analytics into 1.0 to 4.0 (Davenport, 2015). However, these analytics are based on specific types of foundation, so called direction, methodology, or orientation.

Authors Holsapple, Lee-Post and Pakaht (2014) refer that perhaps the most frequently discussed orientation in Business Analytics is predictive analytics (Holsapple, Lee-Post and Pakath, 2014). What's more, according to Ghosh (2018), "*the future of data analytics lies in not only describing what has happened, but in accurately predicting what might happen in the future (Ghosh, 2018a)".* In our field of focus, beside of predictive analytic, we will often use terms as descriptive analytics, diagnostic analytic or prescriptive analytics. These analytics are specific orientations, and, in our case, we can sort them by the influence on timeline. In following lines, we briefly illuminate each of the mentioned orientations and we will focus on brightening the trends over the Internet's search queries.

1 Materials

As the introduction to the issue, we declare main orientations in the field of Business Analytics. Following descriptions will help us to understand the necessity of this paper in the context of future focus in research.

1.1 Descriptive Analytics

Michael Wu, Chief Scientist of Lithium Technologies in San Francisco, describes Descriptive Analytics as the simplest form of Data Analytics, which captures Big Data in small nuggets of information. As Wu observes, 80% of Business Analytics falls within the ambit of

Descriptive Analytics. (Ghosh, 2018a). As stated in the journal *"Analytics in a Big Data World"*, one of the contributors Baesens (2012), declares that descriptive analytics is the interpretation of historical data to better understand changes that have happened in a business. Descriptive analytics **describes the past** using a range of data to draw comparisons. Most commonly reported financial metrics are a product of descriptive analytics, e.g., year-over-year pricing changes, month-over-month sales growth, the number of users, or the total revenue per subscriber. These all describe what has occurred in the business in the time period being measured (Baesens, 2012).

As reported by Gosh (2018), as soon as *the "volume, velocity, and variety"* of Big Data invades the limited business data silos, the game changes. Now, powered by the hidden intelligence of massive amounts of market data, Descriptive Analytics takes new meaning. Whenever Big Data intervenes, vanilla-form Descriptive Analytics is combined with the extensive capabilities of Prescriptive and Predictive Analytics to deliver highly-focused insights into business issues and accurate future predictions based on past data patterns. Descriptive Analytics **mines and prepares the data** for use by Predictive or Prescriptive Analytics. Big Data lends a wide context to the *"nuggets of information"* for telling the whole story. Also view this presentation from Information Builders on four popular types of Business Analytics (Ghosh, 2018a).

We can with agree author's description of descriptive analytics and to sum it up we can say that this kind of orientation focuses on a static view of previous dynamic data, nowadays focused on mining the data as the window to the past events.

1.2 Predictive Analytics

In the wider meaning, predictive analytics describes a range of analytical and statistical techniques used for developing models that may be used to predict future events or behaviours. There are different forms of predictive models, which vary based on the event or behaviour that is being predicted. Nearly all predictive models produce a score; a higher score indicates that a given event or behaviour is very likely to occur (Technopedia.com, 2019).

According to data scientists the term also describes the application of a statistical or machine learning technique to create a quantitative prediction about the future. Frequently, supervised machine learning techniques are used to predict a future value or to estimate a probability (MathWorks.com, 2018). As reported by Ghosh (2018) as Data Mining and Machine Learning jointly offer solutions to predict customer segments and marketing ROIs, the future Predictive Analytics techniques will continue to evolve into Prescriptive Analytics, creating as a mash-up of predictions, simulations, and optimization (Ghosh, 2018b). To summarize introduction to predictive analytics, predictive analytics uses **predictive modelling** which applicate mathematical and computational methods to predict an event or outcome. These models forecast an outcome at some future state or time based upon changes to the model inputs.

1.3 Diagnostic Analytics

According to Olson and Wu (2017) diagnostic analytics may/can apply analysis to sensor input to direct control systems automatically. As authors said, this is especially useful in mechanical or chemical environments where speed and safety considerations make it attractive to replace human monitors with automated systems as much as possible. However, it can lead to some problems, such as bringing stock markets to their knees for short periods (until humans can regain control) (Olson and Wu, 2017).

1.4 Prescriptive Analytics

As we start this chapter we want to highlight one sentence delivered by Mathwork's scientist (2018): *"Prescriptive analytics starts with data and ends with decisions."* This sentence is critical in understandig what is the main purpose prescriptive analytics. The term prescriptive analytics was coined by IBM and described in detail in a 2010 piece an IBM team wrote for Analytics Magazine. Prescriptive analytics is also the third and final phase of business analytics, which also includes descriptive and predictive analytics. Conforming to authors Šikšnin and Pedersen (2016) prescriptive analytics refers to analytics that seek to **provide optimal recommendations** during a decision-making process. Unlike observational analytics or predictive analytics, prescriptive analytics determines ways in which business processes should evolve or be modified (Šikšnys and Pedersen, 2016).

2 Methods

As we will contribute the results, the provided numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 or 100% is the peak popularity for the term. A value of 50 or 50% means that the term is half as popular. A score of 0 means there was not enough data for this term. We provide two sets of results for two datasets. Datasets collected data for one decade, for period of time from 2009 to 2019. **Dataset 1)** contains overall results for all of the four directions of analytics (in ratio) and **dataset 2)** consist of result with excluded term 'predictive analytics' (in ratio). We decided to exclude the term, just because the term 'predictive analyticis' is widely much more popular in search queries, than the rest of three orientations, which would lead the results to be un-accurate or not representative in ratio of the rest three terms. Nevertheless, we understand necessity of the right comparation, so we present proper ratio on first dataset and then in second, excluded, dataset.Ratio for Dataset 1 is measured via equation (1) and for Dataset 1 is measured via equation (2).

$$(1)\quad RQD_{PredA} + RQD_{PresA} + RQD_{DiA} + RQD_{DeA} = 100\%$$

$$(2)\quad RQD_{PresA} + RQD_{DiA} + RQD_{DeA} = 100\%$$

RQD	Ratio of Queried Data in Context of Business and Industry in Time
RQD_{PredA}	Ratio of Queried Data for Predictive Analytics
RQD_{PresA}	Ratio of Queried Data for Prescriptive Analytics
RQD_{DiA}	Ratio of Queried Data for Diagnostic Analytic
RQD_{DeA}	Ratio of Queried Data for Descriptive Analytics

3 Results

As is presented on the figure bellow, on firs sight, we can notice significant disproportion between predictive analytics. We can see predictive analytics trend is increasing by the time and in comparison, with another tree of analytics we can spot mentioned disproportion.

As we already know, the term prescriptive analytics was coined in 2010 we can clearly see that the term prescriptive analytics is not presented before 2010, which ensure us that the term was not discussed on the Internet based on search queries. All of the orientations of analytics have increasing trend. However, the descriptive, diagnostics and prescriptive analytics linear trend is increasing much slower than predictive analytics search query.

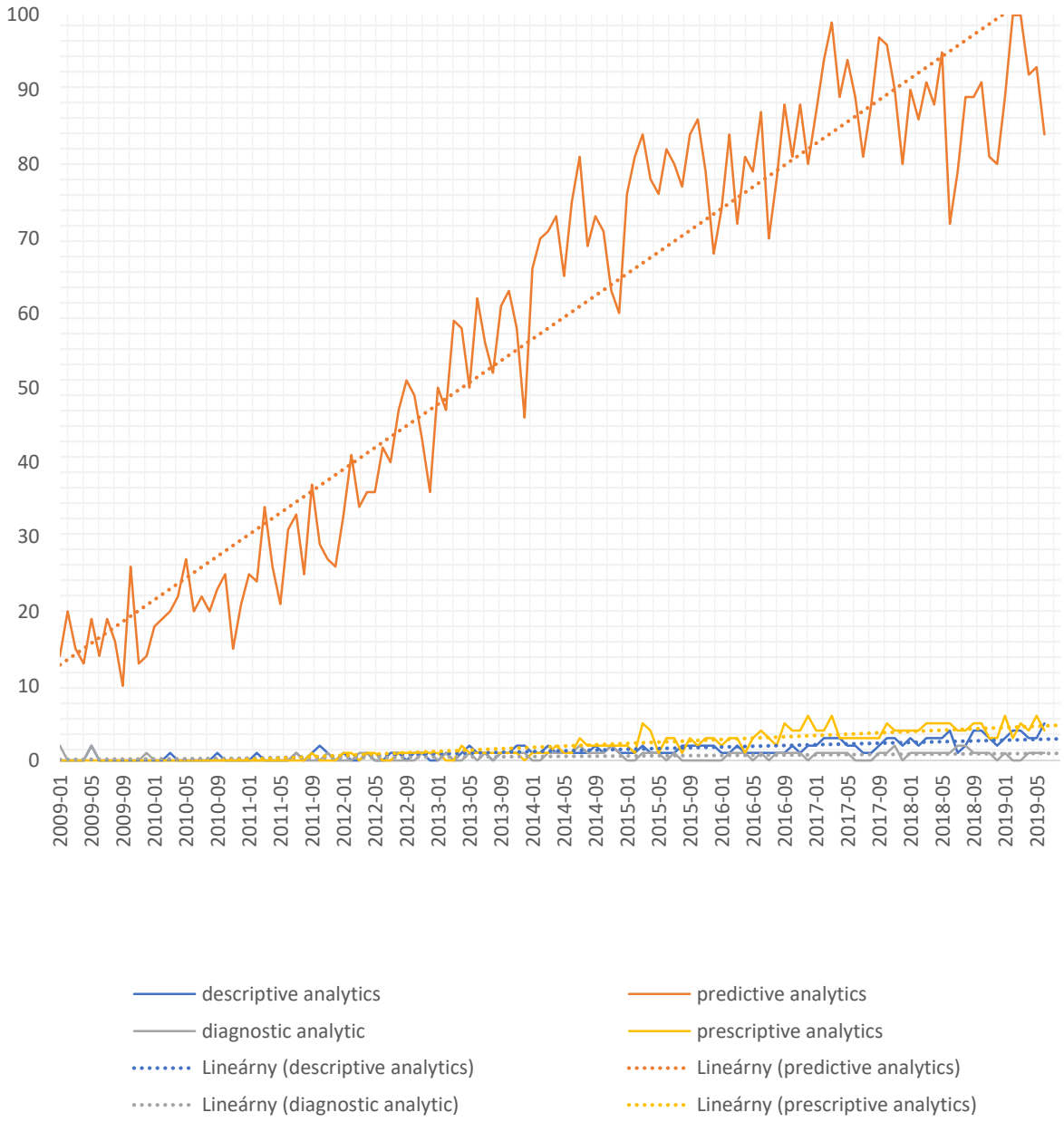

Figure 1 Overall results with linear trend lines (own processing)

3.1 Overall Results by Region

If we look further, on overall result by region on figure 2, we can see descriptive analytics with leading countries such as, India with 4% of queries, followed by United States, Canada and Australia with 2% of queries in ratio with the rest of presented analytics.

As we mentioned, the predictive analytics is much more popular, then the rest of analytics, we can see the major countries with 98% off all queries came from Brazil, followed by United States Canada with 2%, India with 4% and Australia with 2%, 8% of queries belong to Philippines.

We had discovered that diagnostic analytics is still unpopular with researchers in terms of business and industry as we can see on a figure 4, less then 1% of queries came from the United States in India.

In terms of prescriptive analytics as a can see on figure number five 8% of queries came from Philippines how old my 6% of queries from Australia Malaysia in 4% of queries from India followed by 3% of queries from Germany, United Kingdom, and United States with Canada.

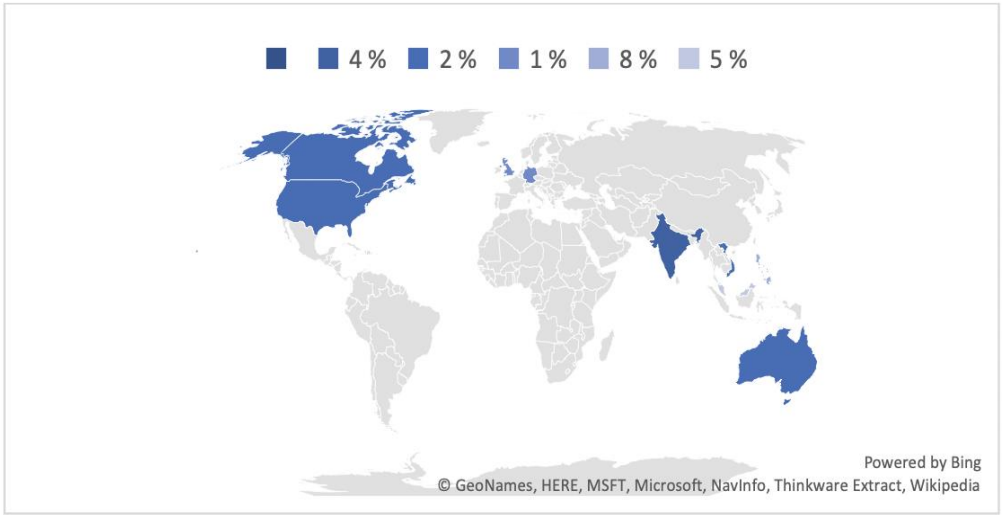

Figure 2 Descriptive Analytics (own processing)

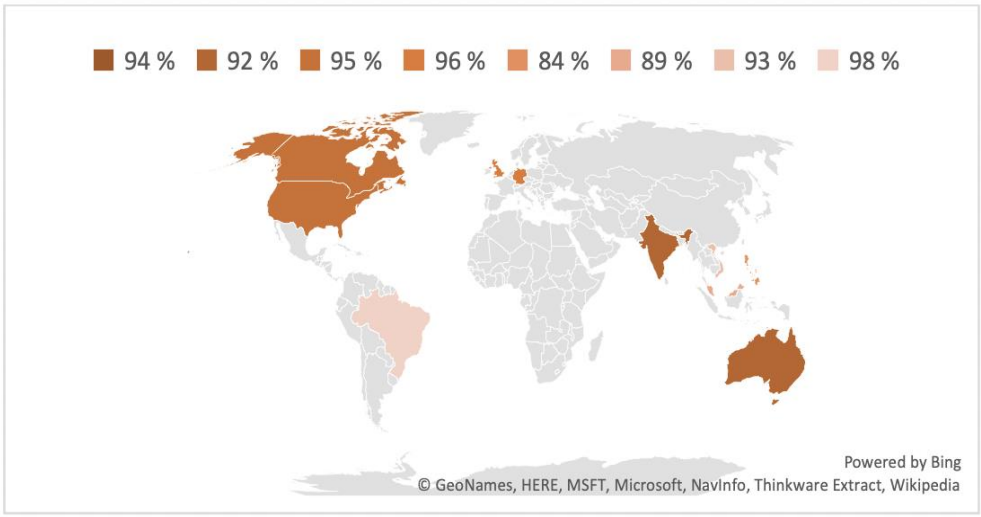

Figure 3 Predictive Analytics (own processing)

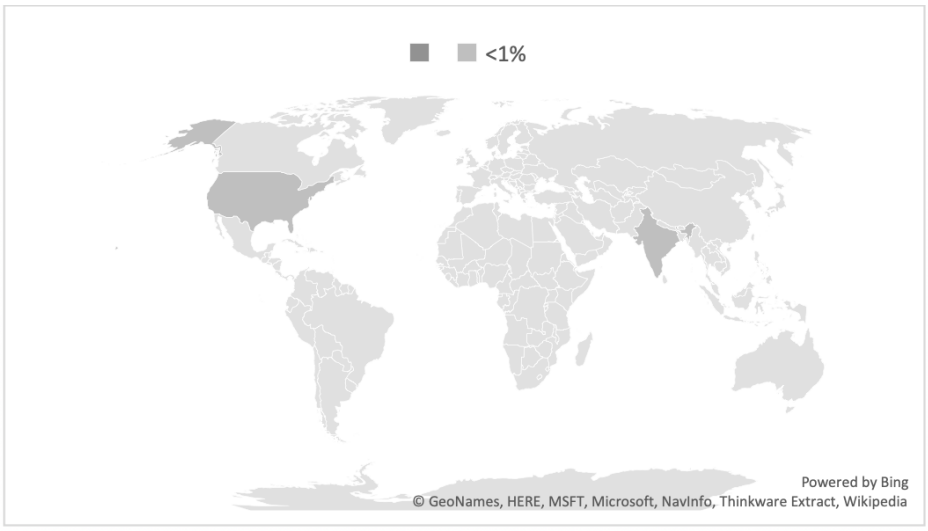

Figure 4 Diagnostic Analytics (own processing)

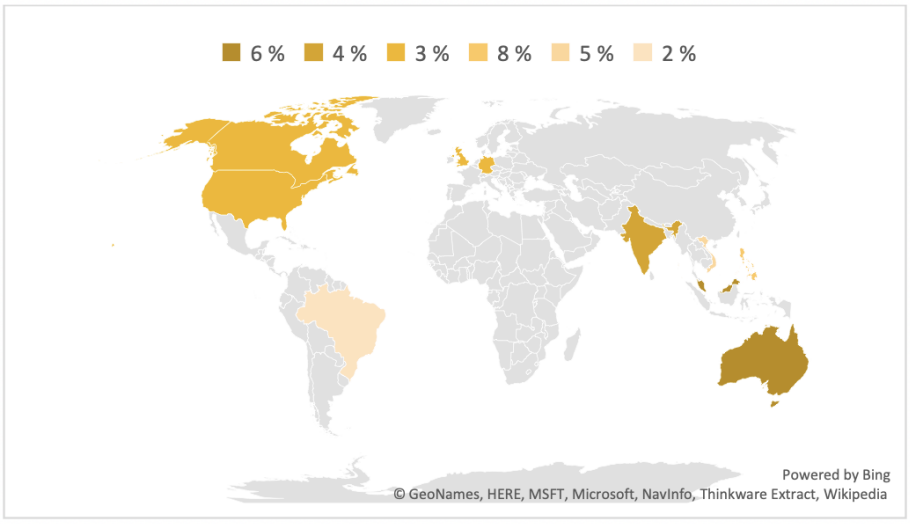

Figure 5 Prescriptive Analytic (own processing)

3.2 Results with Excluded Term 'Predictive analytics'

On the Figure 6, we can see overall results with excluded term predictive analytics. With exclusion, we've achieved much more precise results in terms of the ratio between descriptive, diagnostic, and prescriptive analytics. We can notice that trend line of prescriptive analytics has higher slope than test of two. This may also indicate future increase of popularity of the prescriptive analytics in the field of business and industry.

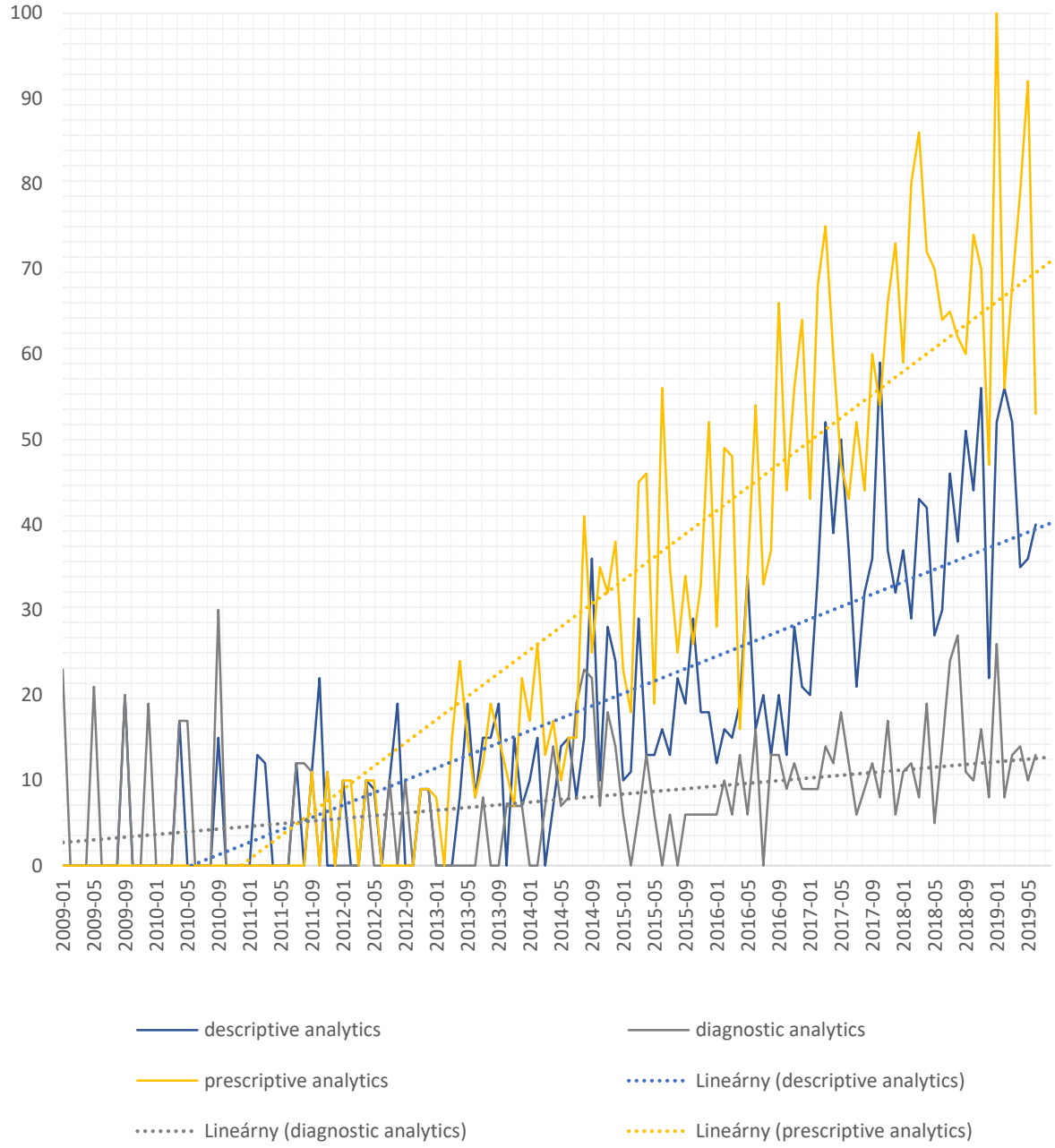

Figure 2 Results with Excluded Term 'Predictive analytics' (own processing)

3.3 Results with Excluded Term 'Predictive analytics' by Region

As we can see on the Figure 7, search query *descriptive analytics* is quite often in region of Philippines (51%), followed by Malaysia and India (42%), Canada (37%), Australia (33%), and USA (32%). Lowest value acquired Germany (28%).

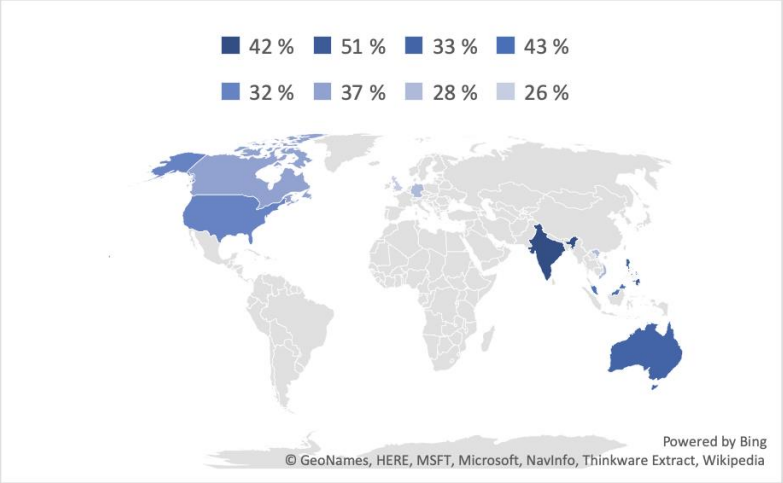

Figure 7 Descriptive Analytic with Excluded Term 'Predictive Analytics' (own processing)

Prescriptive analytics became highly popular within the regions. Highest values acquired Brazil (100%) of searched queries in the time, followed by UK (74%) and Germany (72%). We can forecast that in those countries, demand for prescriptive analytics will increase. Other countries are presented in the figure groped by colour.

In terms of the diagnostic analytics, we did not hoard enough of data to graphically represent the *diagnostic analytics* on the map. Therefore, we can say that demand for diagnostic analytics will increase over period of time, but for now it acquires low values.

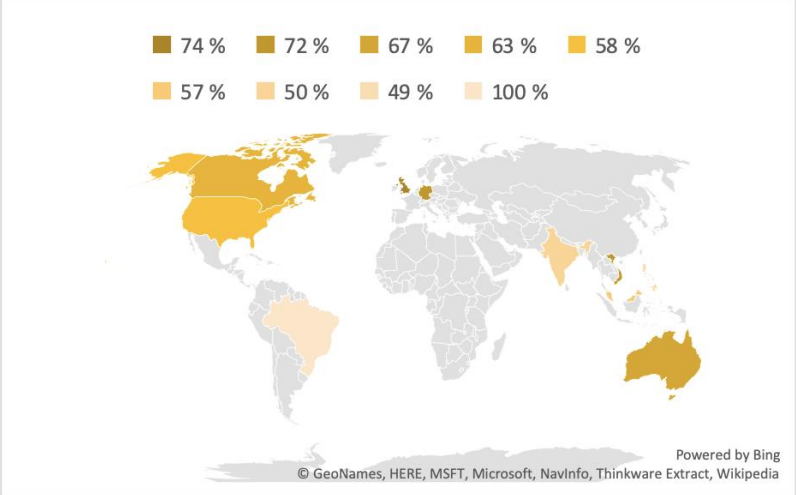

Figure 8 Prescriptive Analytic with Excluded Term 'Predictive Analytics' (own processing)

4 Discussion

To conclude, we presented in this paper our research on trend analysis of analytics directions in the field of business analytics within time period of 2009-2019**.** We have discovered, predictive analytics is widely popular query across the Internet, especially in countries such as United States and Canada, also Brazil, India, and Australia. Prescriptive

analytics have shown us queries with high demands in Brazil, UK and in Germany with value over 70%.

Increasing trend line tell us, that the demand for these types of analytics will increase over time. With the application of machine learning in artificial intelligence, this kind of applied statistics and analytics will lead in the business and industry, to serve high-efficient processes.

References

Baesens, B. (2012) 'Descriptive Analytics', *Analytics in a Big Data World*, pp. 87–104. doi: 10.1002/9781119204183.ch4.

Davenport, T. H. (2015) *Era 4.0: The Scary Age of Automated Networks*, *The Wall Street Journal*. Available at: https://blogs.wsj.com/cio/2015/04/01/era-4-0-the-scary-age-of-automated-networks/ (Accessed: 4 June 2019).

Ghosh, P. (2018a) *Fundamentals of Descriptive Analytics*, *06.07.2017*. Available at: https://www.dataversity.net/fundamentals-descriptive-analytics/ (Accessed: 6 June 2019).

Ghosh, P. (2018b) *Fundamentals of Descriptive Analytics*, *06.07.2017*. Available at: https://www.dataversity.net/fundamentals-descriptive-analytics/ (Accessed: 3 June 2019).

Holsapple, C., Lee-Post, A. and Pakath, R. (2014) 'A unified foundation for business analytics', *Decision Support Systems*. North-Holland, 64, pp. 130–141. doi: 10.1016/j.dss.2014.05.013.

Mason, N. (2015) *The Future of Analytics Is Prescriptive, Not Predictive*. Available at: https://www.clickz.com/the-future-of-analytics-is-prescriptive-not-predictive/25212/ (Accessed: 3 June 2019).

MathWorks.com (2018) *What Is Predictive Analytics*. Available at: https://www.mathworks.com/discovery/predictive-analytics.html (Accessed: 3 June 2019).

Olson, D. L. and Wu, D. (2017) *Predictive Data Mining Models*. doi: 10.1007/978-981-10-2543-3.

Šikšnys, L. and Pedersen, T. B. (2016) 'Prescriptive Analytics', in *Encyclopedia of Database Systems*, pp. 1–2. doi: 10.1007/978-1-4899-7993-3_80624-1.

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