ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ
РЕСПУБЛИКИ КАЗАХСТАН

ҚазҰТЗУ ХАБАРШЫСЫ

ВЕСТНИК КазНИТУ

VESTNIK KazNRTU

№ 1 (131)

АЛМАТЫ 2019 ЯНВАРЬ

ISSN 1680-9211

Учредитель:

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Регистрация:

Министерство культуры, информации и общественного согласия
Республики Казахстан № 951 – Ж “25” 11. 1999 г.

Основан в августе 1994 г. Выходит 6 раз в год

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[14] Гост 7.25-2001 СИБИД. Информационно-поисковые языки. Термины и определения - М.: Изд-во стандартов,2001.-38 с. Воробьёв Г.Г. Документ: информационный анализ. М., 1973. С.

[15] Маннинг, К. Введение в информационный поиск / К. Маннинг. - М.: «Вильямс», 2011.- 200 с.

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Қосымша білім беру курстары бойынша ақпараттық іздеу жүйесінің маңыздылығы

Кілтті сөздер: қосымша білім беру, ақпараттық іздеу жүйесі, Батыс Қазақстан облысы, веб-қосымша.

UDK 004.89;004.93;004:85

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CORRELATION AND REGRESSION ANALYSIS FOR BIG DATA PROCESSING

Abstract. In this article, we looked at the concept of big data, as well as some of its various possibilities and problems. In this article, we discussed big data in general, as well as some of its general characteristics. After examining the importance of big data and its management in organizations and the value it can add, we discussed large data analytics as an option for managing data and extracting important information from such large amounts of data. Association rules, clustering and decision trees were covered. However, with a huge amount of data, performing typical analytics is not enough. Thus, in the article we discussed various technologies and made data prediction using correlation and regression analysis. This facilitates the storage of large data as well as parallel processing. We looked at the problems encountered when working with big data, and still need further research. Future research may include the use of big data analytics methods discussed in real business situations in organizations facing big data problems. In addition, the problems associated with the big data previously discussed can be examined or studied in more detail.

Key words: correlation, regression, big data, technologies, processing, analysis.

Introduction.

We cannot even imagine a world without data storage; a place where every detail about a person or organization, every transaction made, or every aspect that can be documented, is lost immediately after use. Thus, many organizations in the world will lose the ability to extract valuable information and knowledge, conduct detailed analysis, and provide new opportunities and benefits.

Data is an essential part of our lives, and the ability to store and access such data has become a crucial task which we cannot live without. Anything ranging from customer names and addresses, to products available, to purchases made, to employees hired, etc. has become essential for day to day continuity. Data is the building block upon which any organization thrives.

Currently, many companies compete with each other by increasing the volume of processing big data, as the consumers of their software grow every year. This leads to the fact that software development companies must improve the processing of big data. Today the processing of large data and ensuring the safety and storage of them in a safe place is very important for everyone, the solution of such a task must be fast and reliable[1].

Now imagine the extent of details and the surge of data and information provided nowadays through the advancements in technologies and the internet. With the increase in storage capabilities and methods of data collection, huge amounts of data have become easily available. Every second, more and more data is being created and needs to be stored and analyzed in order to extract value. Furthermore, data has become cheaper to store, so organizations need to get as much value as possible from the huge amounts of stored data. According to Gruenspecht, there has been a tremendous surge in the use of digital storage, as well as a drop in its price within the last twenty years. This has eliminated the requirement of clearing out previous data, increased the storage of metadata, or data about the data, as well as made backup storage a common practice against data loss. Additionally, companies and individuals possess more technologies and devices which create and capture more data in different categories. A single user nowadays, can own a desktop, laptop, smartphone, tablet, and more, where each device carries very large amounts of valuable data.

The term "Big Data" has recently been applied to datasets that grow so large that they become awkwardto work with using traditional on-hand database management tools. They are data sets whose size is beyond the ability of commonly used software tools and storage systems to capture, store, manage, as well as

process the data within a tolerable elapsed time. Big data also refers to databases which are measured in terabytes and above, and are too complex and large to be effectively used on conventional systems.

Big data sizes are a constantly moving target, currently ranging from a few dozen terabytes to many petabytes of data in a single data set. Consequently, some of the difficulties related to big data include capture, storage, search, sharing, analytics, and visualizing. Today, enterprises are exploring large volumes of highly detailed data so as to discover facts they didn't know before. Business benefit can commonly be derived from analyzing larger and more complex data sets that require real time or near-real time capabilities, however, this leads to a need for new data architectures, analytical methods, and tools. In this section, we will discuss the characteristics of big data, as well the issues surround storing and analyzing such data[2].

Big data characteristics.

Big data is data whose scale, distribution, diversity, and/or timeliness require the use of new technical architectures, analytics, and tools in order to enable insights that unlock new sources of business value. Big data is characterized by three main features: volume, variety, and velocity. The volume of the data is its size, and how enormous it is. Velocity refers to the rate with which data is changing, or how often it is created. Finally, variety includes the different formats and types of data, as well as the different kinds of uses and ways of analyzing the data[3].

Importance of managing big data

There are five broad ways in which using big data can create value. First of all, big data can unlock significant value by making information transparent and usable at a much higher frequency. Second of all, as organizations create and store more and more transactional data in a digital form, they can collect more accurate and detailed performance information on everything from product inventories to sick days. This can therefore expose variability in the data and boost performance.

Third of all, big data allows a narrower segmentation of customers and therefore much more precisely tailored products or services to meet their needs and requirements. Fourth of all, sophisticated analytics performed on big data can substantially improve decision making. Finally, big data can also be used to improve the development of the next generation of products and services. For example, manufacturers are currently using data obtained from sensors which are embedded in products to create innovative after-sales service offerings such as proactive maintenance, which are preventive measures that take place before a failure occurs or is even noticed by the customer[4].

Big data analytics

Big data analytics is where advanced analytic techniques operate on big data sets. Analytics based on large data samples reveals and leverages business change. However, the larger the set of data, the more difficult it becomes to manage. Sophisticated analytics can substantially improve decision making, minimize risks, and unearth valuable insights from the data that would otherwise remain hidden. Sometimes decisions do not necessarily need to be automated, but rather augmented by analyzing huge, entire datasets using big data techniques and technologies instead of just smaller samples that individuals with spreadsheets can handle and understand [5]. Therefore, decision making may never be the same. Some organizations are already making better decisions by analyzing entire datasets from customers, employees, or even sensors embedded in products . In this section, we will discuss the data analytics lifecycle, followed by some advanced data analytics methods, as well as some possible tools and methods for big data analytics in particular [6].

Advanced data analytics methods

With the development of technology and the increase in the number of data coming into and out of organizations from daily organizations, the need has emerged for faster and more efficient ways to analyze such data. Having a pile of data on hand is not enough to make effective decisions at the right time. As recognized by world scientists, the data obtained should not only be accurate, consistent and sufficient for making fundamental decisions, but also should be integrated and subject-oriented, as well as unstable and variants with time. New tools and a razor algorithm have been developed for developers of solutions to automatically filter and analyze these diverse data pools[7].

Data analytics is the process of applying algorithms in order to analyze sets of data and extract useful and unknown patterns, relationships, and information . Furthermore, data analytics are used to extract previously unknown, useful, valid, and hidden patterns and information from large data sets, as well as to detect important relationships among the stored variables . Thus, analytics have had a significant impact on research

and technologies, since decision makers have become more and more interested in learning from previous data, thus gaining competitive advent age.

Nowadays, people don't just want to collect data, they want to understand the meaning and importance of the data, and use it to aid them in making decisions. Data analytics have gained a great amount of interest from organizations throughout the years, and have been used for many diverse applications. Some of the applications of data analytics include science, such as particle physics, remote sensing, and bioinformatics, while other applications focus on commerce, such as customer relationship management, consumer finance, and fraud detection[8].

Big Data Challenges

Several issues will have to be addressed in order to capture the full potential of big data. Policies related to privacy, security, intellectual property, and even liability all need to be addressed in a big data world. Organizations need to put the right talent and technology in place, as well as additionally structure workflows and incentives to optimize the use of big data. Access to data is critical, and companies will need to increasingly integrate information from multiple data sources, often from third parties or different locations. Furthermore, questions on how to store and analyze data with volume, variety, and velocity have arisen, and current research lacks the capability for providing an answer.

Consequently, the biggest problem has become not only the sheer volume of data, but the fact that the type of data companies must deal with is changing. In order to accommodate for the change in data, the approaches for storing data have changed throughout the years. Data storage started with data warehouses, data marts, data cubes, and then moved on to master data management, data federation and other techniques such as in-memory databases. However, database suppliers are still struggling to cope with enormous amounts of data, and the emergence of interest in big data has led to a need for storing and managing such large amounts of data. Several consultants and organizations have tried coming up with solutions in order to be able to store and manage big data. Therefore, analytics recommends that organizations carefully study the following aspects regarding proposed solutions for big data before taking one:

• Can this solution deal with different data types, including text, image, video and sound?

• Can this solution deal with disparate data sources, both within and outside of the organization's environment?

• Will the solution create a new, massive data warehouse that will only make existing problems worse, or will it use metadata and pointers to minimize data replication and redundancy?

• How can, and will, the solution present findings back to the organization, and will this only be based on what has already happened, or can it predict with some degree of certainty what may happen in the future?

• How will the solution deal with back-up and restore of data? Is it inherently fault tolerant and can more resource easily be applied to the system as required?

Correlation regression analysis is one example that includes methods and analyzes of processing big amounts of data. This problem is solved by using an adequate regression model using the existing and new technology algorithms. The regression model is an equation in which the variable explained is represented as a function of the explanatory variables[9].

Statistical relationships between variables can be studied, methods of variance, correlation and regression analysis. The methods of analysis of variance establish the presence of influence given factor on the studied process. Correlation analysis allows you to evaluate the strength of such a relationship, and the methods of regression analysis, you can select a specific mathematical model and evaluate its adequacy. Correlation is a consistent change in features reflecting the fact that the variability of a single trait is in accordance with the variability of the other. Pair correlation studies the relationship between two random variables, multiple - between a large number of quantities[10]. The main task of the correlation analysis is to identify and evaluate connections between random variables, the main task of regression analysis - establishing the form and studying the relationship between random variables. (Figure-1)

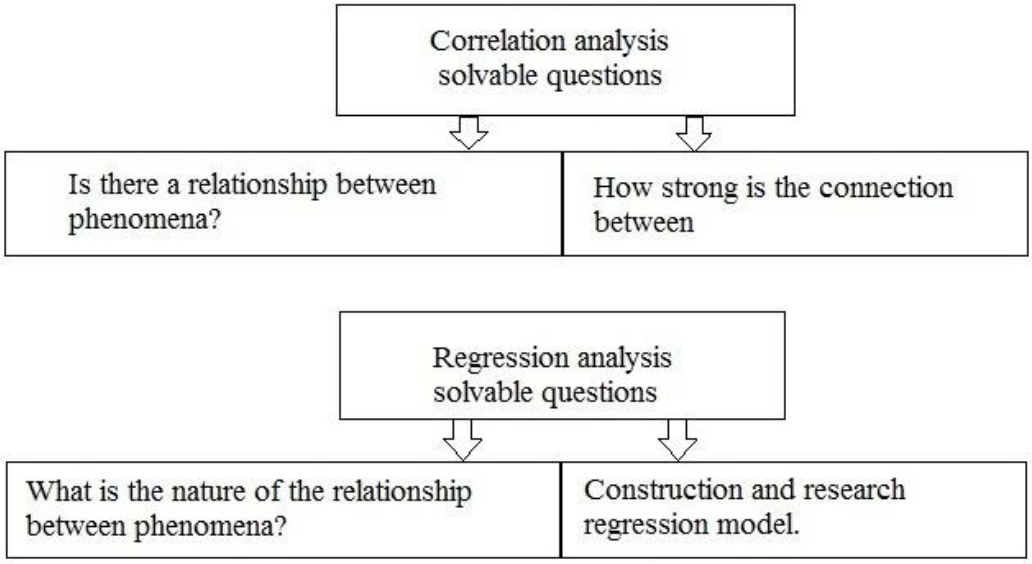

Figure-1.

Elements of correlation analysis. Let be $(x_1, y_1),...(x_n, y_n)$ sampling volume n, from observations of a random variable (ξ, η), having two-dimensional normal distribution. Depicting the elements of the sample points in the Cartesian coordinate system, we get the diagram scattering or correlation field. Sometimes by type of correlation Is there a relationship between phenomena? How strong is the connection between phenomena? What is the nature of the relationship between phenomena? Construction and research regression model. Fields can be made an assumption about the presence and nature of the relationship between random variables ξ and η.

The sample ? correlation coefficient is called the number

$$r_{sel.} = \frac{\frac{1}{n}\sum_{i=1}^{n} x_i y_i - \bar{x} \cdot \bar{y}}{\tilde{S}_x \tilde{S}_y}$$

It can be shown that $|r_{selektive}| \le 1$, Table-1 shows the possible forms of the correlation field in depending on the value of the sample correlation coefficient.

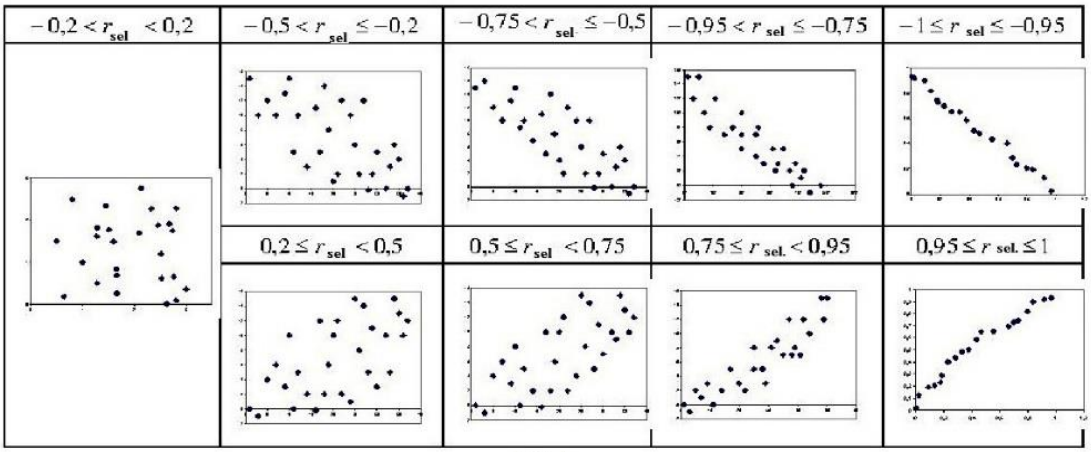

Table-1

In practice, the task of checking is of great interest hypotheses about the significance of the correlation between random quantities, i.e. the significance of the deviation of the correlation coefficient from zero.

Let be $r_{sel.}$ -selective correlation coefficient. With a given level of significance α hypothesis is tested $H_0 : r = 0$ about equality to zero theoretical correlation coefficient. If the null hypothesis is rejected, then talk about the significance of the correlation coefficient, and mean that random variables ξ and η correlated. If a the null hypothesis is accepted, then the correlation coefficient is insignificant, and random variables ξ and η uncorrelated. Criterion statistics is

$$t_{obs.} = r_{sel.}\sqrt{\frac{n-2}{1-r_{sel.}^2}}$$

Located, $t_{\frac{\alpha}{2};n-2} = t(100\frac{\alpha}{2}\%, n-2)$ - the value of the percentage point distribution of student with $(n-2)$ degrees of freedom. Decision making scheme is as follows:

- if $|t_{obs.}| = \left| r_{sel.}\sqrt{\frac{n-2}{1-r_{sel..}^2}} \right| < t_{\frac{\alpha}{2};n-2}$, then there is no reason to reject null hypothesis, correlation coefficient is not significant, ξ and η uncorrelated;

- if $|t_{obs.}| = \left| r_{sel.}\sqrt{\frac{n-2}{1-r_{sel..}^2}} \right| \geq t_{\frac{\alpha}{2};n-2}$ then the hypothesis is rejected, and correlation coefficient and significantly different from zero, ξ and η correlated [11].

Statement of the problem of correlation analysis.

Assuming that $(x_1, y_1),...(x_n, y_n)$ - selection of observations of random variable (ξ, η) having a two-dimensional normal distribution, calculate the sample coefficient correlations and at a given level of significance $\alpha = 0.05$ check the hypothesis of zero theoretical correlation coefficient.

x_i	1,37	0,11	1,56	-0,11	0,23	-0,76	-0,13	-0,64	-0,46	-0,88
y_i	0,08	0,64	1,59	1,75	0,74	0,89	1,44	0,72	1,26	0,03

-0,56	1,28	1,16	-0,30	-0,31	1,13	-0,17	0,60	-1,16	2,65	1,55
0,92	0,51	0,52	0,43	1,06	0,47	0,11	1,27	1,33	0,32	1,48

0,29	-2,16	-0,77	0,93	0,01	-1,56	1,59	-1,13	-1,74
1,61	1,47	0,98	0,54	0,59	0,34	0,17	0,20	0,27

Selective correlation coefficient:

$$r_{sel.} = \frac{\frac{1}{n}\sum_{i=1}^{n} x_i y_i - \bar{x}\cdot\bar{y}}{\tilde{S}_x \tilde{S}_y} \approx \frac{\frac{1}{30}\cdot 1{,}37\cdot 0{,}08 + \ldots + (-1{,}74)\cdot 0{,}27 - 0{,}05\cdot 0{,}79}{1{,}12\cdot 0{,}52} \approx 0{,}08$$

Hypothesis is tested $H_0 : r = 0.$

Criterion statistics is:

$$|t_{obs.}| = \left| r_{sel.}\sqrt{\frac{n-2}{1-r_{sel..}^2}} \right| \approx 0{,}08\cdot\sqrt{\frac{30-2}{1-(-0{,}08)^2}} \approx -0{,}4.$$

Find the value of the percentage distribution point of student $t_{\frac{0{,}05}{2};30-2} = t(2{,}5\%,\ 28) \approx 2{,}048.$ Insofar as, $|t_{obs.}| \approx |-0{,}4| < t_{0{,}025;28} \approx 2{,}048$, then there is no reason to reject null hypothesis H_0 and the correlation coefficient is not significant, ξ and η uncorrelated;

Linear regression analysis. Often it is necessary to determine how does the observed random variable depend on one or several other quantities. Regression analysis - the math section statistics, studying the relationship between the dependent variable and one or several independent variables.

Observed values $(x_1, y_1),\ldots(x_n, y_n)$ two-dimensional random magnitudes ξ, η. The dependence of the random variable η is investigated, from random variable ξ.

In the general case, the regression model is:

$$y = f(x, \beta_0, \beta_1, \beta_k)$$

Options $\beta_0, \beta_1, \beta_k$ -called regression coefficients. One of the objectives of the regression analysis is to estimate the coefficients regression. For estimating regression coefficients, as a rule, the least squares method is used: as estimates accepted values of parameters that minimize the amount squared deviations of observed values y_i from $\tilde{y}_i = f(x_i, \beta_0, \beta_1, \beta_k)$, $(i = 1,\ldots n)$ i.e. the least squares method is based on minimization sums of squares:

$$\sum_{i=1}^{n} \varepsilon_i^2 = \sum_{i=1}^{n} y_i - \tilde{y}_i^{\,2} \to \min$$

If we assume that the relationship between variables is linear, then the corresponding regression model is:

$$y = \beta_0 + \beta_1 x,$$

where β_0 and β_1 - linear regression coefficients. For a linear regression model, the minimization problem is:

$$\sum_{i=1}^{n} \varepsilon_i^2 = \sum_{i=1}^{n} y_i - \beta_0 - \beta_1 x_i^{\,2} \to \min$$

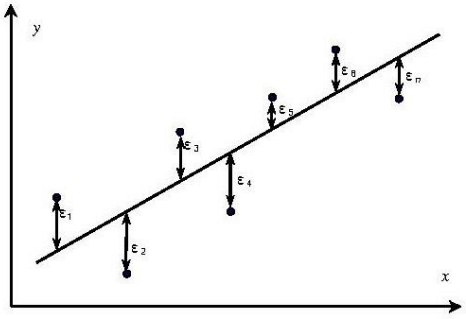

Figure-2

Figure -2 shows deviations $\varepsilon_i = y_i - \tilde{y}_i, i = 1,...n.$

A necessary condition for the minimum of the function of two variables β_0 and β_1 is the equality of its partial derivatives by β_0 and β_1 zero:

$$\begin{cases} \sum_{i=1}^{n} x_i (y_i - \beta_1 x_i - \beta_0) = 0, \\ \sum_{i=1}^{n} (y_i - \beta_1 x_i - \beta_0) = 0. \end{cases}$$

The solution of the system gives the desired estimates of the linear coefficients regressions:

$$b_0 = \tilde{y} - r_{sel.} \frac{S_y}{S_x} \bar{x};$$

$$b_1 = r_{sel.} \frac{S_y}{S_x}.$$

here b_0 and b_1 - ratings β_0 and β_1 respectively[12].

Conclusion

In the article we solved the problem of correlation analysis by iteration and found the sample correlation coefficient. Considered creation of a regression model as an iterative process. In the article carried the methods of desigion concrete tasks, developes and solves a linear regression equation.This process is aimed at finding effective independent variables, to explain the dependent variables that we are trying to model by starting a regression tool.

In the article we tried solve very inportant problem of processing large amount data, becouse analyzing large amounts of data requires technology and means of implementing high-performance computing. Main factors problems are, first of all, complexity and in the second - physical volume information collection. Large amounts of data cause problems in the formation of information resources from such data[13].

REFERENCES

[1] K.Nurlybayeva,G.Balakayeva. Algorithmic Scoring Models,Applied Mathematical Sciences,Vol.7,no.12,2013 P.571-586.

[2] Lynch C.Bigdata: How do your data grow? // Nature. 2008. Vol. 455. Iss. 7209. P. 28–29.

[3] N. Elgendy and A.Elragal Advances in Data Mining Applications and Theoretical Aspects 14 th Industrial Conference, ICDM 2014 St.Peterburg, Russia, July 16-20,2014 Proceedings, P. 214-225.

[4] Tsvetkov V. Ya. Information Management of Mobile Object // European Journal of Economic Studies, 2012, Vol.(1), №1. P. 40-4

[5] Tsvetkov V. Ya.Information field // Life Science Journal. 2014. Vol. 11. Iss. 5. P. 551–554.

[6] Herodotou H. et al.Starfish: A Self-tuning System for Big Data Analytics // CIDR. 2011. Vol. 11. P. 261–272.

[7] IBM big data platform – Bringing big data to the Enterprise. https://www.ibm.com/software/data/bigdata.

[8] Tsvetkov V. Ya., Lobanov A. A.Big Data as Information Barrier // European researcher. Series A. 2014. Vol. 78. Iss. 7-1. P.1237–1242.

[9] Steven C.Chapra. Second Edition Applied Numerical Methods with Matlab for Engineers and Scientists. Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. Copyright © 2012 by The McGraw-Hill Companies, Inc. All rights reserved. Previous editions © 2008 and 2005-320p.

[10] C.Ong, J.Huang, G.Tzeng, Building credit scoring models using genetic programming, Expert Systems with Applications 29, 2005 P.41-47

[11] John O.Rawlings, Sastry G.Pantula,David A.Dickey. Applied Regression Analysis: A research Tool,Second Edition.Springer Verlag,NewYork, Berlin,Heidelberg SPIN 10660129.1998-24-25p.

[12] Daniel Zelterman. Applied Linear Models with SAS. Published in the USA by Cambridge University Press, New York. 2010 P.62-64.

[13] G.T.Balakayeva, D.K.Darkenbayev, Chris Phillips. Investigation of technologies of processing of big data. International Journal of Mathematics and Physics 8, №2, 13(2017) ISSN 2218-7987 P.13-18.

Балакаева Г.Т., Даркенбаев Д.К.

Үлкен көлемді деректерді өңдеу үшін корреляциялық және регрессиялық талдау жасау

Түйіндеме. Мақалада біз үлкен көлемді деректер тұжырымдамасын және оның түрлі мүмкіндіктері мен туындайтын қиындықтарды қарастырдық. Сонымен қатар біз мақалада үлкен көлемді деректерді толығымен талқылап, оның ортақ сипаттамаларына тоқталдық. Үлкен көлемді деректердің маңыздылығын зерттей келе және оның ұйымдарда басқарудың құндылығын ескеріп, біз үлкен көлемді деректерден маңызды ақпаратты алу және оны басқаруға талдау жасадық. Сондай-ақ, ұйымдар ережелері мен кластерлеу, шешу жолдары да талқыланды. Алайда, үлкен көлемді деректермен қарапайым талдау жеткіліксіз, сондықтан біз мақалада түрлі технологияларға жүгініп, деректерге корреляциялық және регрессиялық талдаулар мен болжамдар жасадық. Бұл үлкен көлемді деректерді болжап, сақтауға және параллелді өңдеуге мүмкіндік береді. Өңдеу кезіндегі туындайтын қиындықтарға тоқталып және алдағы уақытта үлкен көлемді деректермен жұмыс жасауды зерттеуді жалғастыруды қажет етеміз. Болашақ зерттеулеріміз үлкен көлемді деректерге талдау жасаудан, нақты бизнес саласындағы талқыланатын мәселелер мен үлкен көлемді деректермен кездесетін ұйымдардың қиындықтарын зерттеуден тұруы мүмкін. Алдағы уақытта осыған дейін үлкен көлемді деректермен байланысты талқыланған мәселелер кеңінен зерттеліп, толығымен қарастырылатын болады.

Кілттік сөздер: корреляция, регрессия, үлкен көлемді деректер, технологиялар, өңдеу, талдау

Балакаева Г.Т, Даркенбаев Д.К.

Корреляционно-регрессионный анализ для обработки больших данных

Резюме. В статье мы рассмотрели концепцию больших данных, а также некоторые ее различные возможности и проблемы. В статье мы обсудили большие данные в целом, а также некоторые из его общих характеристик. Изучив важность больших данных и их управления в организациях и ценность, которую он может добавить, мы обсудили большую аналитику данных как опцию для управления данными и извлечения важной информации из таких больших объемов данных. Были охвачены правила ассоциации, кластеризация и деревья решений. Однако, с огромным количеством данных, выполнить типичную аналитику недостаточно. Таким образом, в статье мы обсудили различные технологий и сделали прогноз данных с помощью корреляционно-регрессионного анализа. Это облегчает хранение больших данных, а также параллельную обработку. Рассмотрели проблемы, возникающие при работе с большими данными, и все еще нуждаемся в дальнейших исследованиях. Будущие исследования могут включать применение методов большой аналитики данных, обсуждаемых в реальных бизнес ситуациях, в организациях, сталкивающихся с большими проблемами с данными. Кроме того, проблемы, связанные с большими данными, ранее обсуждавшимися, могут быть рассмотрены или изучены более подробно.

Ключевые слова: корреляция, регрессия, большие данные, технологии, обработка, анализ

УДК 004.051

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DEVELOPMENT OF A SIMULATION MODEL FOR ASSESSING THE RISK OF INTRODUCING IT PROJECTS IN THE ENTERPRISE

Abstract. This article discusses the problem of assessing the risks arising from the implementation of IT projects in enterprises. A simulation model is proposed that implements the risk assessment of the implementation of IT projects in an enterprise, based on the most significant economic indicators and the Monte Carlo method.

Key words: IT project; simulation model; risk assessment; implementation efficiency.

CONTENTS

Earth Sciences

Technical Sciences

Physics and Mathematic Sciences

Chemistry and Metallurgy Sciences

Редакторы:
Н.Ф. Федосенко
Верстка на компьютере:
Л. Касжанова

Подписано в печать 25.01.2019 г.
Формат 60х84 $^{1}/_{8}$. Усл. п.л 37,4.
Тираж 500 экз. Заказ № 223.

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