

Decomposition of Google Trends Series for the Search of Patterns and Seasonality of Financial Risk Control Interest

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Abstract

In this paper, it is proposed to use the Google Trends service for the identification of interest in risk control trends through queries in different languages of users in the world and Ukraine for such risk control terms: "risk control", "forensic", "financial investigations" in different languages. The time series formation model was described and analyzed, taking into account the high asymmetry and seasonality of the development of forensic in the regions of Ukraine and the world. Google Trends have sufficient opportunities to determine users' level of interest in major trends in the financial investigations, which allows forming a statistical base for decision making for modeling and further development of this direction. The experimental modeling showed the seasonality for "forensic" and "risk control" popularity trends as well as the determination of the eastern and western in Ukraine in the relation of "forensic".

Keywords1

Risk Control, Forensic, Financial Investigations, Search Engine, Search Query, Google Trends, Analytics, Time Series, Correlation, Seasonality.

1. Introduction

Crisis phenomena in the world, the imperfection of the market economy have created favorable conditions for the distribution and activation of economic criminality, all more companies bear loss in the different spheres of their activity. The amount of financial machinations puts under a doubt the efficiency of threat estimation and implemented technologies for protection against economic crimes, as well as the application of the necessary measures to counteraction of fraud. Thus, according to research of the World Economic Crimes Review for 2020, approximately every second organization in the world (47%) for the last two years has faced various types of fraud. This is the second most important level of economic crime in the last 20 years, losses from fraud in fixed cases from 99 countries amounted to more than 42 billion dollars USA [1]. Client's fraud (35%), cybercrimes (34%), misappropriation of assets (31%), bribery and corruption (30%) are amongst the main fraud directions. It is explained by the inability of the existing model of the financial reporting to provide an effective financial supervision. The introduction of forensics as a tool for financial investigation of the enterprise will assist to the detection and prevention of economic crimes. "Forensic" term is interpreted as a complex comprehensive study of the financial and economic activities of the economic entity, the purpose of which is to identify various facts of fraud, financial machinations and other illegal actions, both by administrative vehicle and other employees, to create a system of

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measures to avoid them. Therefore, the request for this term may indicate the search for a service or its avoidance. This is an information tool for detecting or preventing economic crimes. Google Trends sorts by time and region, so it is possible to track peak interest in certain regions, as well as the time period, which may indicate both the interest of consumers in finding this service, and the interest of fraudsters in certain actions to avoid control procedures. This is especially important in international projects, in particular in the context of digitalization, where the chains of legalization can be long, and the constant interest, for example, in a particular request in a particular place may indicate the center of legalization risk. Additionally, the availability of comparative search statistics with similar or opposite topics can also be a certain indicator of measuring economic risk.

Risk control systems are created to activate the spread of the forensic process. To confirm the actualization of such an opinion in society, a search for approaches to the possible definition of patterns of interest by the theme of financial risk control has begun, analysis of the formed interest in this theme, opinions and public confidence in determination the essence of the linguistic and terminological list in this direction.

2. Analysis of publications

In modern conditions, domestic and foreign search engines not only accumulate and group information, provided by modern search tools. The researches of search query statistics have recently become widespread and special actuality [2, 3] and are powerful statistical and analytical systems. Google offers a large number of tools that can be used by the specialists in different directions. Domestic and foreign researchers use Google Trends mainly for the analysis of marketing information [4], but recently this analytical tool is used for the analysis of political processes [5], business and entrepreneurship [6]. A number of scientists conduct comparative researches of domestic and foreign tools, which complement each other in solving various problems related to social processes [5, 7]. Google Trends intellectual search and analytical system is used in the analysis of credit development [8], as well as for short-term forecasting of macroeconomic variables [9]. The success of the application of web-analytical tools Google Trends in socio-humanitarian and library research [10], as well as the estimation of interest in the topic of innovation through the Google search [11].

At the same time, to prevent economic risks, it is important to use Google's tools for determination interest in financial risk control through the introduction of forensic as a method of investigation intra-corporate cases of fraud and factoring risk management [12–17] and the financial investigations themselves [18–20]. The development of improvement mechanisms of the risk-oriented approach was researched in [21], which considers the field of financial monitoring. Meanwhile, the risk-oriented approach extends to other areas, in particular, funded pensions. This approach has a similar terminology with other areas of application (risk control, financial investigations, etc.).

There are no separate researches that analyze the capabilities of the Google Trends service to analyze users demand in search engines for linguistic terminology.

Thus, the presented experience of using Google Trends is progressive and actual to the possibility of solving the problem of analysis the level of users interest in the world and in particular in Ukraine, the topic of financial risk control.

The contribution of the research is the result of the Google Trends interest data processing using time series decomposition. It allows to establish the popularity development patterns and find the synchronous 52 weeks seasonality interest to the search of the "risk control" and "forensic" terms. At the same time the interest in searching for "forensic" nearly 10 times larger. The analysis of interest in other definitions ("financial investigations") and different geographic locations confirmed that the popularity level is stable but without significant seasonality.

3. The tools of the Google Trends search and analytical system in research

Google Trends is a service that allows to identify the interests of the target audience, analyse demand for goods or services, track current and past trends, popular events, as well as find out the

number of Google queries from different regions for certain keywords [22]. The main difference of Google Trends is that it provides users with qualitative rather than quantitative indicators, which is how popular this query relative to the total number of queries in Google. Google Trends not only tracks the popularity of news and products that users search for on the Internet, but also tracks the activity of the target audience, analyses the dynamics of search queries over time and identifies seasonal dependencies. One of useful functions of Google Trends is the possibility to get an idea about the popularity of request relative to the certain region of the world or country and to use them for the estimation of influence of geographical factor. The advantage of this service is not only the detection of the most proof popular queries on the whole but also getting the statistics for a certain period of time for a further analysis.

Google Trends provides statistical data about search requests performed in Google at a certain period with grouping by countries, categories, and search types (web, images, news, YouTube) [23]. Google scales data automatically to the [0; 100] range according to the highest search frequency available for the selected geographic region, time interval, category, and search type. Search frequency is itself a proportion of the search keywords being investigated to all searches on all topics on Google at that time and location [24]. So the graph reflects the overall popularity of the topic but not the absolute values. The data update instantly and graphs that include last time statistics may change slightly even when you preserve all initial conditions and just update the graph later in time.

A review of scientific papers proves that Google Trends is an effective tool not only for market research and collection of statistical information, but also for forecasting demand and making final decisions in business [13]. The most common area of Google Trends use is the analysis of marketing information for SEO-promotion. To do this, keywords and trends are identified based on them and data cyclical analysis is used. In addition, the Google Trends methodology is maximally used in the field of information technology [25]. Google Trends search queries are also used to forecast macroeconomic variables [16] and to identify financial indicators [6].

The efficiency of the Google Trends tools use by interested users of information on financial risk control has shown a growing interest in it. The strategic direction is to ensure greater access to open data, as there is a prospect of developing standards for open data in open information networks.

When planning areas of research in the field of financial risk control, a key term is defined – "forensic", with which the terms "risk control" and financial investigations are connected. Each query is monitored as the dynamics of popularity of these queries in Ukraine and worldwide grows over the past 5 years. For a more detailed analysis, the resulting data is exported in CSV format, which contains data tables.

In addition to statistics, search results were obtained across regions, which allow identifying strategic geographical centers that are actively promoting and developing the innovation sector in the field of finance. The results of the "forensic" search query in Ukrainian among the regions of Ukraine are shown in Figure 1[26]. The concentration of two centers of the western and especially the eastern regions is clearly visible, meanwhile almost disinterested center, which requires additional analysis and may indicate the lack of modern strategies application in this area. Among the regions with the highest share of query popularity, the following regions are clearly visible: Kharkiv, Kyiv, Odesa, Dnipro, Lviv and Donetsk.

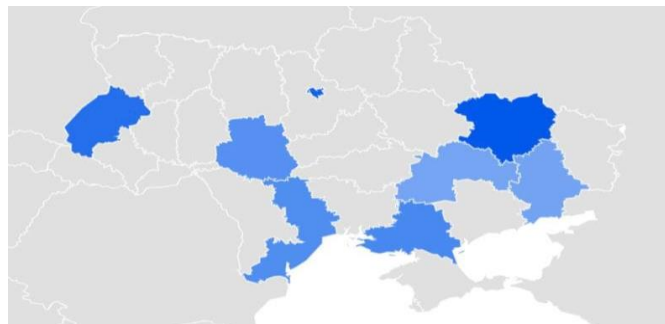


Figure 1: Results for "forensic" among the regions of Ukraine for 2016-2020 (image source: Google Trends)

4. Analysis of the level of interest in the term "risk control"

In order to explain and analyze such asymmetry in using a generic term "forensic" in technologies of risk control in finance in relation to the interest in Ukraine, investigated the frequency of the term "risk control" through the Google Trends search and analysis system, which was considered in various language submissions: Ukrainian, Russian, Polish, English. The results of the comparison revealed that the most popular query English – "risk control" (Figure 2), while there are insufficient data for processing and analysis in Ukrainian – "ризик-контроль", in comparison with in Russian "risk control" ("риск-контроль") and in Polish "risk control" ("kontrola ryzyka"), where the frequency of queries in English exceeds several times (Figure 3).

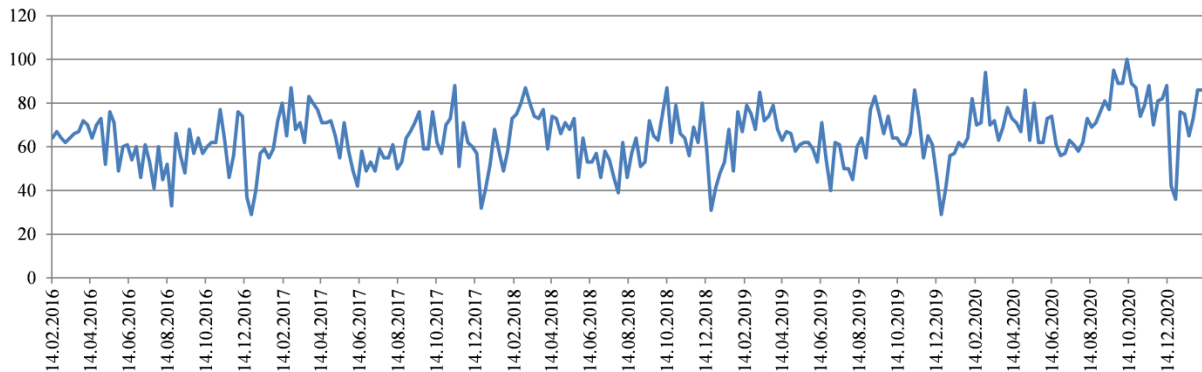


Figure 2: Request frequency for the term "risk control" in English

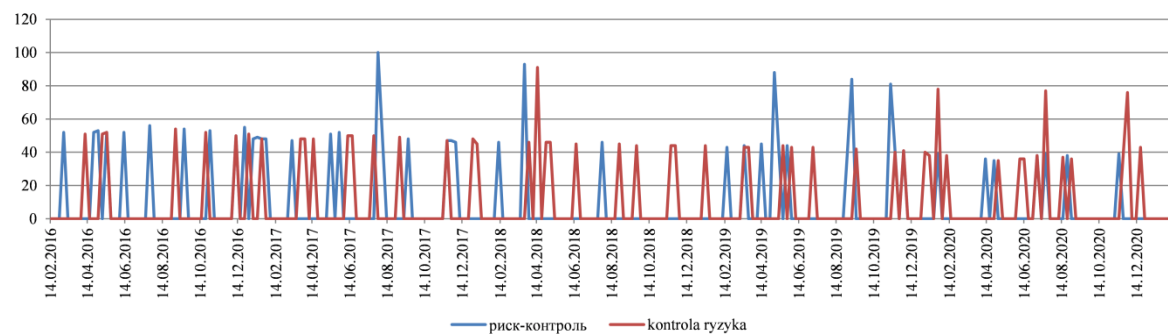


Figure 3: Request frequency for the term "risk control" in Russian and Polish

Analyzing the results from Figure 3, there is the some interest and additional comparative analysis can be conducted in the beginning of 2018, when there was a strong increase of interest in risk control in Russian and Polish at the same time.

Examining the results of the search for all countries "risk control" in English, was identified countries that are interested in this topic with the possibility of generating statistics of queries for analysis: most interested – Botswana, Zimbabwe, Ethiopia, Zambia, Tanzania, Australia, Singapore, least – France, Mexico, Brazil, Turkey, Japan, Poland and Russia. "Risk control" in English remains the prevailing term in the world.

According to the investigation, interest in the term "risk control" can be traced worldwide, in particular in North America, Western Europe and Africa. Analyzing the data for 2020, it should be noted a persistent trend to the increase of interest in the term "risk control" in English (Figure 2). The Table 1 shows the analysis results of the requests frequency of selected terms in different languages in the world and in Ukraine for 2016-2020.

As can be seen from Table 1, the tendency to search for the term "risk control" in English does not coincide worldwide and Ukraine in terms of Latin search for forensic, this indicates that forensic is

not identified only with risk control, but rather seen as a means of crisis management, so as forensic in Africa and Asia.

However, the number of results on the queries "financial investigations", "risk control", "financial investigations" In Ukrainian and Russian, especially in Ukraine, is too small, that even after reducing the analysis period – there is not enough analytics for data submission, so there was a transition to finding interest in the concepts forensic and financial investigations.

Table 1
Analysis of the requests frequency in the world and in Ukraine

The term in different languages	in Ukraine	In the world	Countries with the most requests
"Risk control"	NED	There is a trend	Botswana, Zimbabwe, Ethiopia, Zambia, Tanzania, Australia, Singapore, Ghana, Kenya, Jamaica and others (more than 50)
"Risk control" in Ukrainian ("ризик-контроль")	NED	NED	NED
"Risk control" in Russian ("риск-контроль")	NED	Peak values are traced in separate periods	Russia
"Risk control" in Polish ("Kontrolaryzyka")	NED	Peak values are traced in separate periods	Poland
"Forensic"	Peak values are traced	There is a trend	Zimbabwe, Singapore, South Africa, UAE, Jamaica, India, Ghana, Qatar, Kenya, Nigeria, USA, Canada, Great Britain, Australia, Sri Lanka.
"Forensic" in Russian ("форензик")	There is a weak trend with fluctuations	There is a trend with fluctuations and peak values	Russia, Ukraine
"Forensic" in Ukrainian ("форензік")	Peak values are traced in separate periods	There is a trend with peak values in some periods	Ukraine
"Financial investigations"	NED	There is a trend	Great Britain, USA
"Financial investigations" in Russian ("финансовые расследования")	NED	Peak values are traced	Russia
"Financial investigations" in Ukrainian ("фінансові розслідування")	NED	NED	-
"Financial investigations" in Polish ("dochodzenia finansowe")	NED	NED	-

NED: Not Enough Data

5. Estimation the search frequency of "forensic" and "financial investigations" terms

The study of the request frequency for the term "forensic" was considered in language submissions: forensic in Ukrainian, forensic in Russian, forensic in English. The most popular query is forensic in English, and the activity of the query was localized in such countries: Zimbabwe, Singapore, South Africa, UAE, Jamaica, India, Ghana, Qatar, Kenya, Nigeria, USA, Canada, UK, Australia, Sri Lanka. If considered within Ukraine, it is Vinnytsia, Kharkiv, Kyiv, Odesa, Dnipro, Lviv, Kherson and Donetsk regions, there is also a concentration of both western and eastern regions and the lack of interest of the center. It is shown in Figure 4 and Figure 5 the request frequency for the term "forensic" in English, "forensic" in Ukrainian and "forensic" in Russian worldwide.

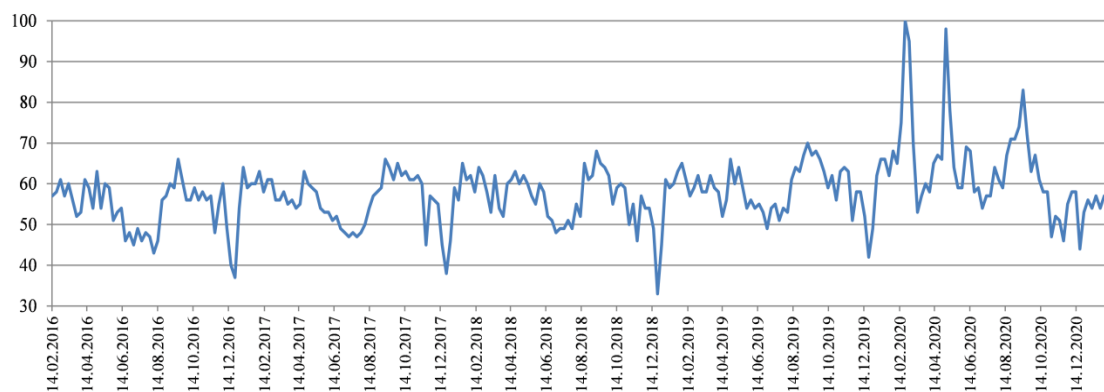


Figure 4: Request frequency for the term "forensic" worldwide

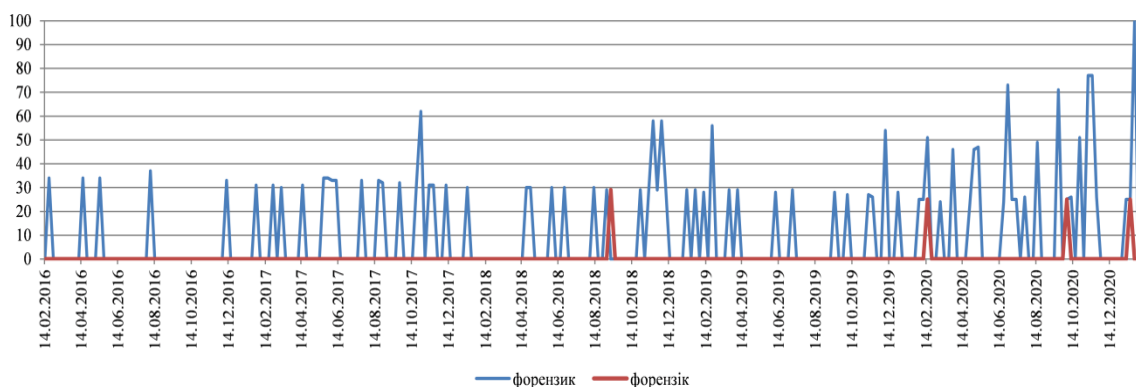


Figure 5: Request frequency for the term "forensic" in Ukrainian and in Russian worldwide

As can be seen from Figure 4, there is a persistent trend when searching for the term "forensic" in English, while queries for the term in Ukrainian and in Russian (Figure 5) have clearly defined peak values and seasonality. The same situation is observed in the analysis of the request frequency in Ukraine (Figure 6). Analysis of the popularity of inquiries in Ukraine and worldwide over the past year confirms the data obtained on the peak and seasonality.

As can be seen from Figure 6, the general interest in the term "forensic" in English in Ukraine is constant, meanwhile in Ukrainian and in Russian only in some peak periods, which requires additional measurements.

The study of the request frequency of the term "financial investigations" was considered in the language representations: "financial investigations", "financial investigations" in Ukrainian ("фінансові розслідування"), "financial investigations" in Russian ("финансовые расследования"), and "financial investigations" in Polish ("dochodzenia finansowe"). As can be seen from Table 1, only in English and in Russian there is available information for analysis.

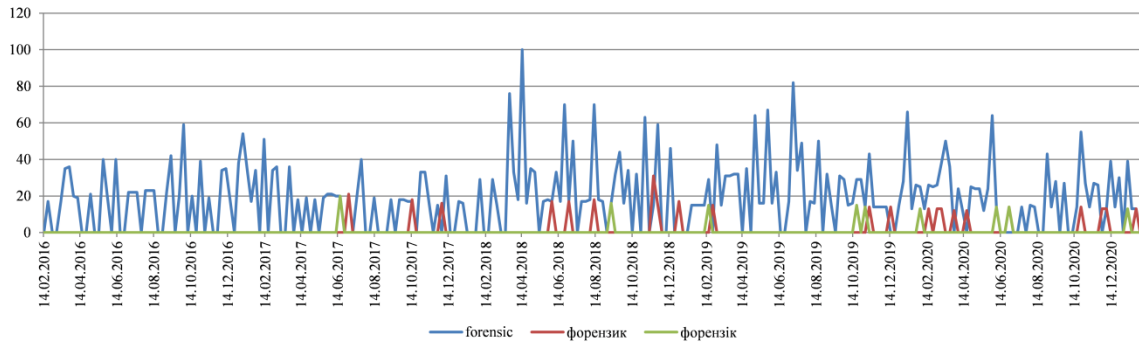


Figure 6: Request frequency for the term "forensic" in different languages in Ukraine

Analyzing Figure 7, it is possible to mark that by the requests in the world's leads "financial investigations" in English and "financial investigations" in Russian. In relation to requests in Russian, peak values are similarly traced in some periods, as in previous requests on forensic in both Russian and Ukrainian. Requests by the term "financial investigations" can be traced from the countries, such as the United States and the United Kingdom". Thus, there is no such diversity in the world as in term of "risk control". Analysis of requests for the last year has also shown interest in this term around the world, but, it should be noted, in contrast to the term "forensic", more pronounced peak values. It is not possible to analyze the interest in this term in Ukraine due to the lack of the required amount of data. Thus, the process of developing financial investigation technologies in Ukraine is just beginning.

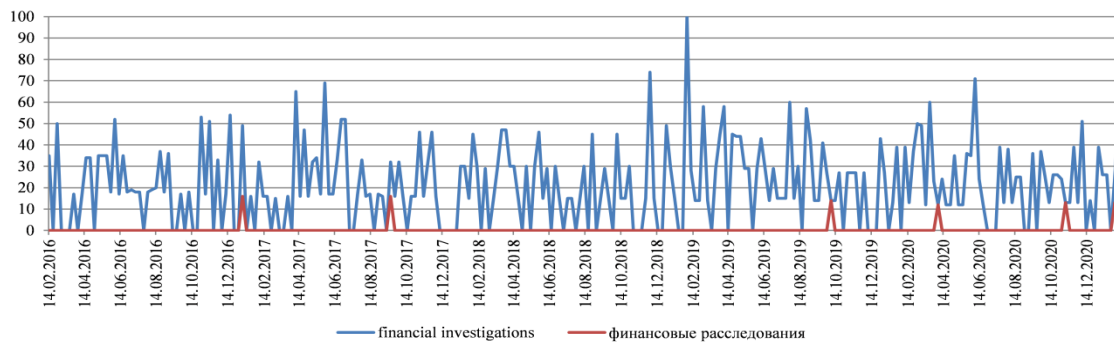


Figure 7: Request frequency for the term "financial investigations" in English and in Russian worldwide

The obtained data prove the interest in the concepts of "risk control", "forensic" and "financial investigations" both worldwide and in Ukraine represent their orientation for development in these areas. It should be noted the existing asymmetry of interest in terms both worldwide and in the regions of Ukraine, as well as the presence of clear peak values, which became the basis of the next task to build a model of time series.

6. Time series decomposition

There are two ways to detect the seasonality in time series data [27]: knowing the natural seasonality like vacation periods, national holidays, etc., and statistical analysis of the data. The retrieving seasonality values from the time series is a part of the process that is often referred to as time series decomposition.

There are three common components in the time series data [28, 29]: T_t is the trend component (that reflects long-going progression), S_t is the seasonal component (part of time series that repeats itself at some interval), I_t is an irregular component, which often means noise, t is a period. Sometimes the fourth separate component C_t —cyclical—is also included.

Two time series formation models are typically used: $Y_t = T_t + S_t + I_t$ (additive) and $Y_t = T_t \times S_t \times I_t$ (multiplicative). Additive model is used when the variance of the time series doesn't change over different values of the time series. In our experiments we assume additive model.

The time series process consists of the steps depending on the components assumed to be present but always includes detrending and deseasonalization.

Estimation of the trend of time series is usually performed with centered moving average (w-MA) procedure, where w is the width of the moving window. The calculation of trend component values $T_t = \{m_t\}$, $t = \overline{1, \dots, N}$ is written as follows:

$$m_t = \frac{1}{w} \sum_{i=-\lfloor \frac{w}{2} \rfloor}^{\lfloor \frac{w}{2} \rfloor} Y_{t+i},$$

where N is the length of time series. The choice of w parameter may come from the expected seasonality lag, but not necessarily. Additionally, if the hypothetical length of the seasonality period is sufficient, the centered MA procedure will shorten the length of the initial time series by $w - 1$ (if w is odd). So, the selection of w mostly comes from practical considerations.

We propose to preserve first and last $\frac{w-1}{2}$ values of the trend series with the averaging of only available values of the initial time series at the beginning and end. For example, for 7-MA $\lfloor \frac{w}{2} \rfloor = \frac{w-1}{2} = 3$, first three values are calculated as $m_1 = \frac{1}{1+\lfloor \frac{w}{2} \rfloor} \sum_{i=0}^{\lfloor \frac{w}{2} \rfloor} Y_{t+i}$, $m_2 = \frac{1}{2+\lfloor \frac{w}{2} \rfloor} \sum_{i=-1}^{\lfloor \frac{w}{2} \rfloor} Y_{t+i}$, $m_3 = \frac{1}{3+\lfloor \frac{w}{2} \rfloor} \sum_{i=-2}^{\lfloor \frac{w}{2} \rfloor} Y_{t+i}$. Similar procedure is applied at the end of the series. This is shown in Figure 8.

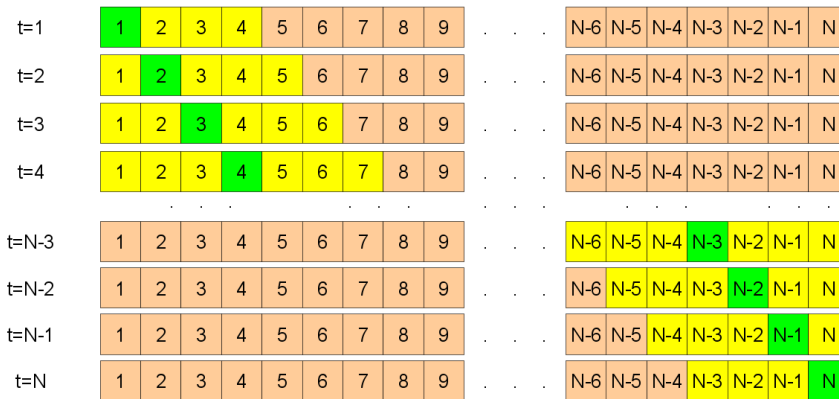


Figure 8: The processing of first and last time series values in 7-MA

The traditional way to estimate the seasonality is the building of the plot of autocorrelation function (ACF), which is sometimes called correlogram. Known correlation shows the linear relationship between two variables, autocorrelation shows the one between the signal and its lagged version. Autocorrelation values $A_l = \{a_l\}$ may be written as [29]:

$$a_l = \frac{\sum_{t=l+1}^N (Y_t - \bar{Y})(Y_{t-l} - \bar{Y})}{\sum_{t=1}^N (Y_t - \bar{Y})^2},$$

where $l = \overline{1, \dots, L}$ is the lag of the series, L is the maximum possible lag, \bar{Y} is the average of the series.

Making the decision on the ACF plot is based not only on absolute values of the coefficients but also on their significance. The typical approach includes the building of the confidence bands and analysis if the coefficients are bigger or less than band values. If data are random, ACF values should not exceed corresponding significance band values. The widths of the confidence bands are calculated according to [30]:

$$\frac{\pm Z_{1-\alpha/2}}{\sqrt{N}},$$

where N is the number of samples, Z is the cumulative distribution function of the standard normal distribution and α is the significance level (equals to 2.58 for the 99% significance level and 1.96 for 95%).

So, if the data are statistically independent, the coefficients of the ACF should fall inside the confidence bands (in our experiments it was set up to 99%).

7. Experiments

Let us investigate seasonality in different time series, provided by Google Trends service for different periods and geography of search queries.

The first definition we are looking at is the "forensic" term with the worldwide geography for the last 5 years (measurement interval in Google Trends is 1 week). The popularity time series, trend series (based on the 7-MA smoothing), and detrended series assuming additive time series model are shown in Figure 9.

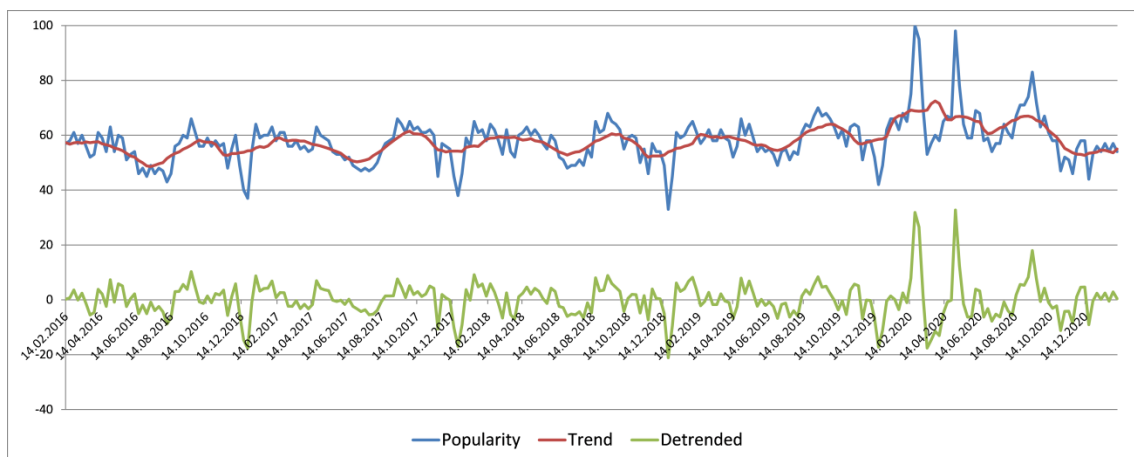


Figure 9: Popularity, trend and detrended series for the "forensic" term for the last 5 years

The bar chart of the ACF coefficients and significance bands are presented in Figure 10. There are different suggestions about the choice of the maximum lag value for ACF building, we have chosen 30% of the length of series to build (lag varied from 1 to 77 weeks inclusively).

As one can see, there is a statistically significant value at lag 52 that means the seasonality pattern of 52 weeks. Besides this, there are also other confident peaks at lags 1, 15-16, 53, 64, 74 intervals.

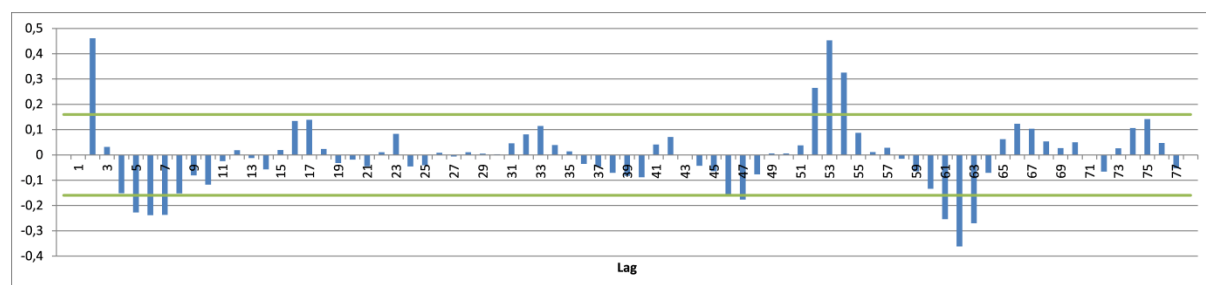


Figure 10: ACF plot for the "forensic" term for last 5 years and significance bands

The choice of moving average size window w influences the ACF values. The smoothing level is not enough to catch significant seasonality patterns for small window sizes like 3-MA (popularity series and corresponding trend series are shown in Figure 11). The ACF plot after this smoothing and detrending is shown in Figure 12, there we can see a lot of peaks with a small amplitude which are under the significant bands.

The bigger w allows to extract more exact long-going seasonality and more significant absolute correlation values (about 0.5). The smoothed with 15-MA trend line is shown in Figure 13. ACF plot shows that there is a clear 52 weeks seasonality interval (Figure 14).

So, the choice of the w depends on the form and length of the series, presence of noise in it and practical experience. In all experiments, we used such window size that is not big enough to make the trend almost linear but at the same time allows us to analyze ACF values confidently.

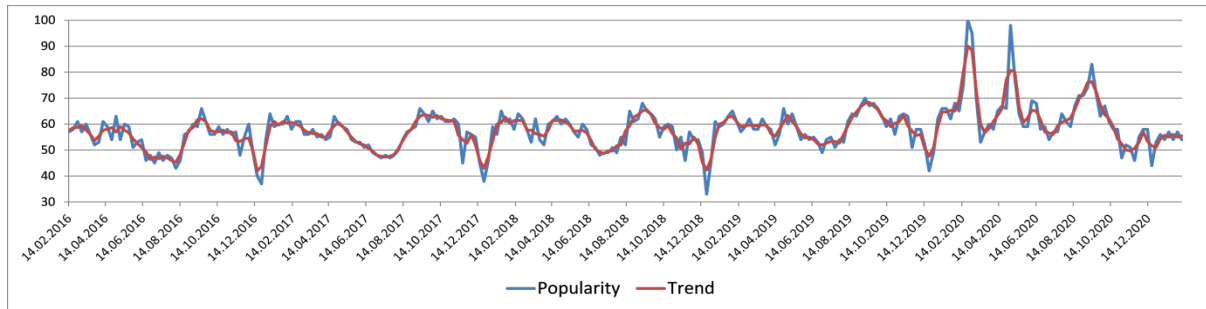


Figure 11: Popularity and trend series or the "forensic" term for the last 5 years (3-MA)

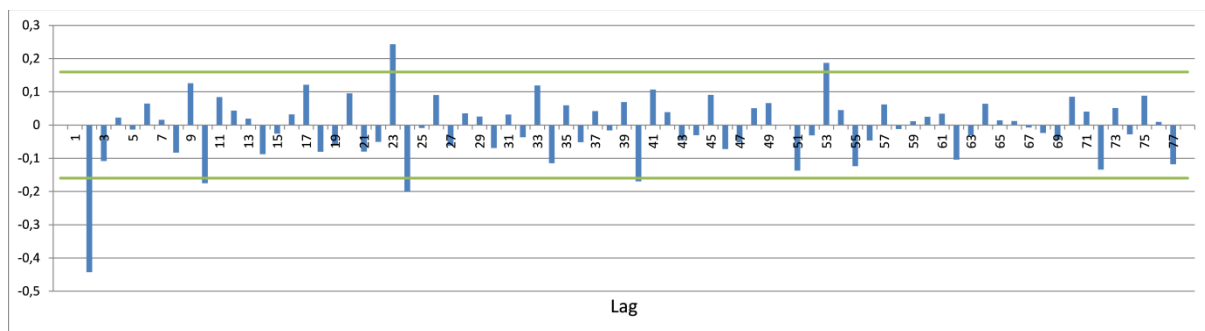


Figure 12: ACF plot for the "forensic" term for last 5 years and significance bands (3-MA)

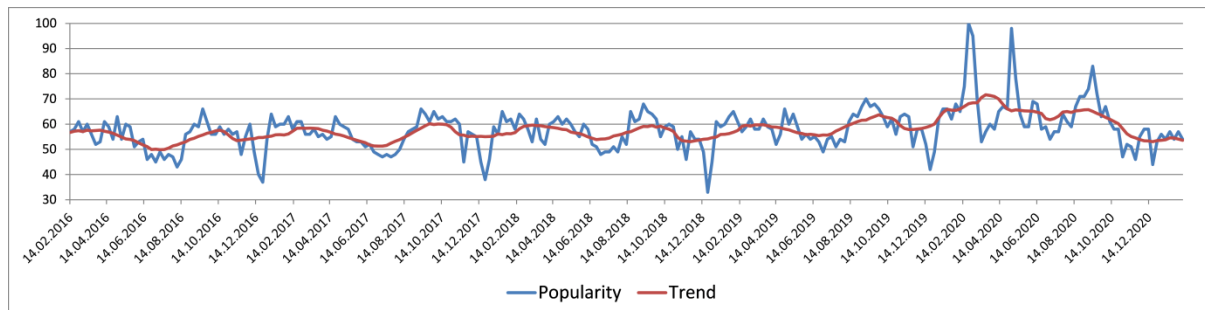


Figure 13: Popularity and trend series for the "forensic" term for the last 5 years (15-MA)

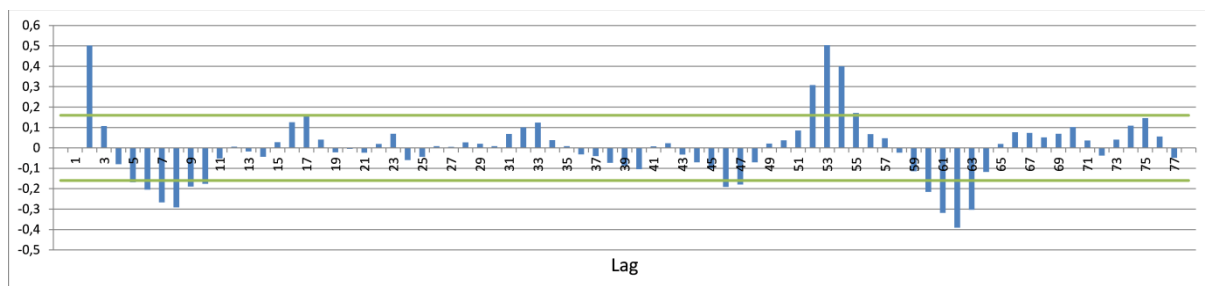


Figure 14: ACF plot for the "forensic" term for last 5 years and significance bands (15-MA)

The ACF plot for the "forensic" term interest in Ukraine for the last 5 years is shown in Figure 15. The corresponding original series and trend (based on the 7-MA) are shown in Appendix. There are no statistically significant results in 99% confidence bands but three of them are in 95% confidence intervals (lags 21, 42, 49). Increasing the MA window size (15, 21, 31 values were tested) change

neither the common situation nor the amplitude of the ACF coefficients, so with the 99% confidence, there is no seasonality in this time series.

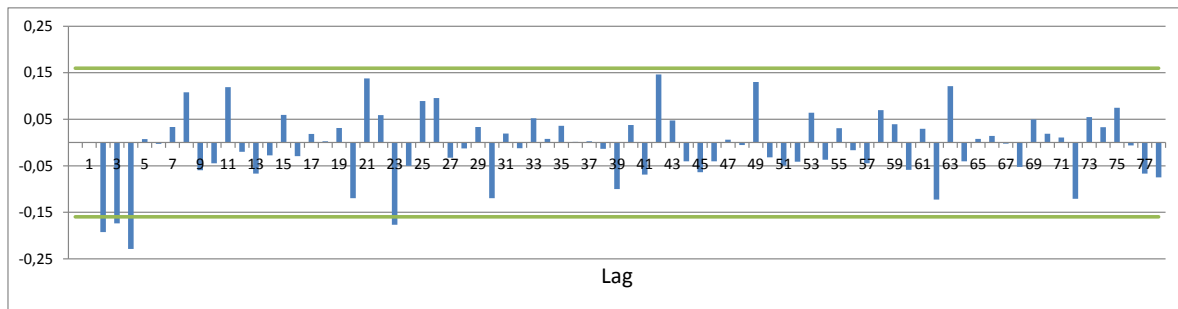


Figure 15: ACF plot for the "forensic" term for last 5 years in Ukraine and significance bands

The results of the processing of interest in "forensic" term for the last 1 year all over the world are shown in Figure 16 and Appendix. The size of moving averaging windows was set up to 7. There are no statistically significant results in 99% confidence bands for different w but 6 weeks seasonality detected for 95% for 7-MA (correlation value is 0.34). It seems there is no strong seasonality here.

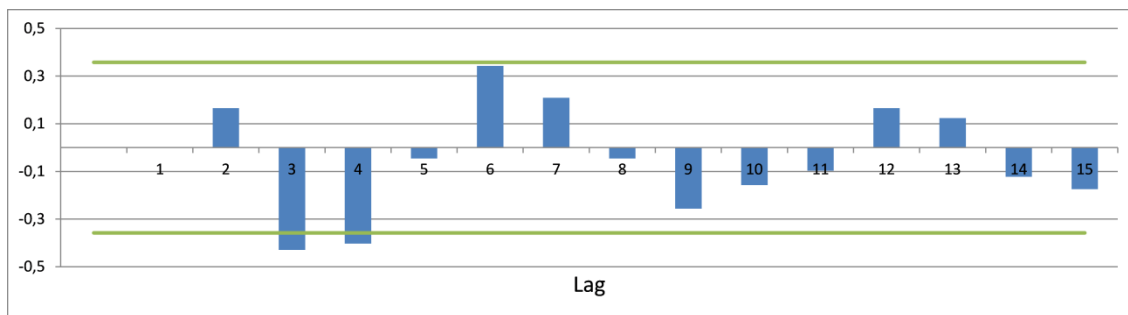


Figure 16: ACF plot for the "forensic" term for last year worldwide and significance bands

The results of the processing of popularity time series for the "forensic" term in Ukraine during the last 1 year are shown in Appendix and Figure 17. Series for the "forensic" term for the last 5 years in Ukraine. There are no statistically significant results in 99% confidence bands but 12 weeks seasonality is found with 95% confidence still with a small absolute correlation value. These results are stable for different w .

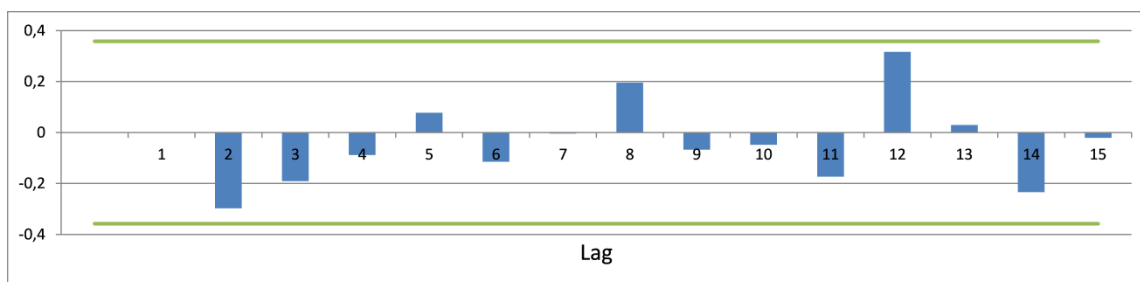


Figure 17: ACF plot for the "forensic" term for last year in Ukraine and significance bands

Looking at the interest in the "risk control" term for the last 5 years and 1 year worldwide we obtained the following results (15-MA), which are shown in Appendix and Figure 18. Series for the "forensic" term for the last 5 years in Ukraine. One can see clear 52 weeks seasonality here and corresponding correlation values become stronger for greater w .

Looking at the "risk control" term for only last year (Figure 19) we can conclude that the popularity is independent, the only ACF value at lag 5 gets outside of 95% bandwidth for 7-MA, and the same repeats for different w .

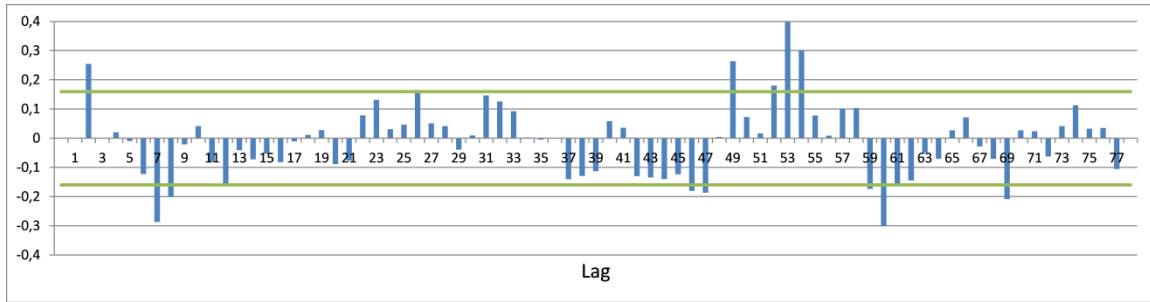


Figure 18: ACF plot for the "risk control" term for last 5 years worldwide and significance

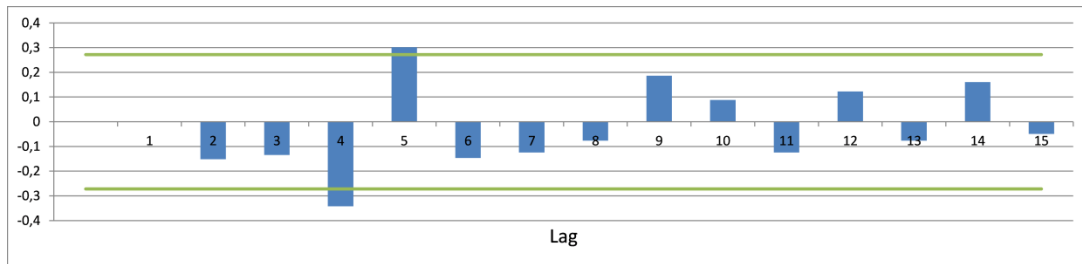


Figure 19: ACF plot for the "risk control" term for last year worldwide and significance bands

The last term we are looking at is the "financial investigations" all over the world for the last 5 years (Figure 20) and last year (Figure 21), initial data and corresponding trend series are presented in Appendix. Three ACF coefficients are greater than the 95% confidence interval (lags 28, 40, 62), there are no values greater than 99% confidence. Increasing the MA window size doesn't change the situation for both these time series, so the interest in the search of these definitions seems to be stable but without seasonality.

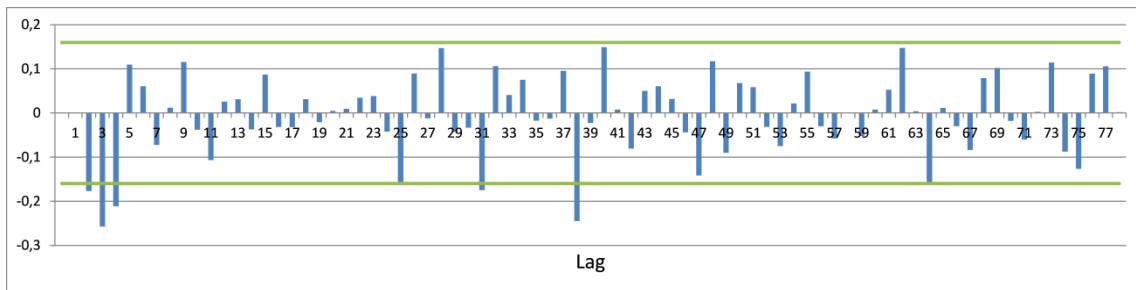


Figure 20: ACF plot for the "financial investigations" term for last 5 years worldwide and significance bands

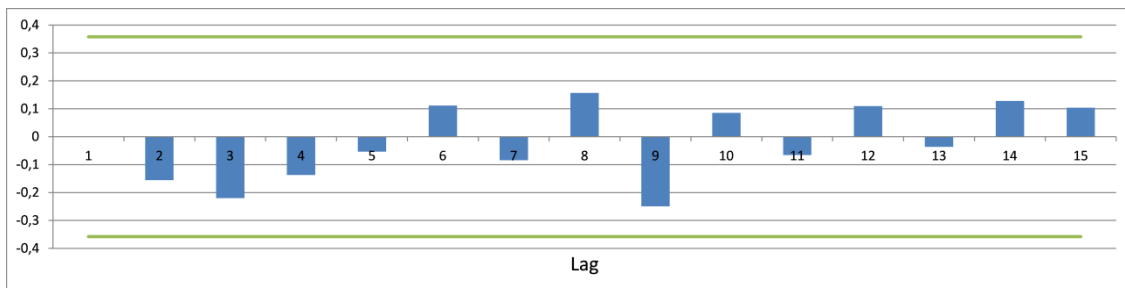


Figure 21: ACF plot for the "financial investigations" term for last year worldwide and significance bands

As it has been shown earlier, the popularity of both "forensic" and "risk control" terms for the last 5 years worldwide has 52 weeks of seasonality. It worth noting that the interest in these term searching is synchronous (correlation coefficient is 0.61) besides the fact that the popularity of the

"forensic" is nearly 10 times larger. The corresponding trends smoothed with 15-MA for the popularity of "forensic", "risk control" and scaled "risk control" time series are shown in Figure 22.

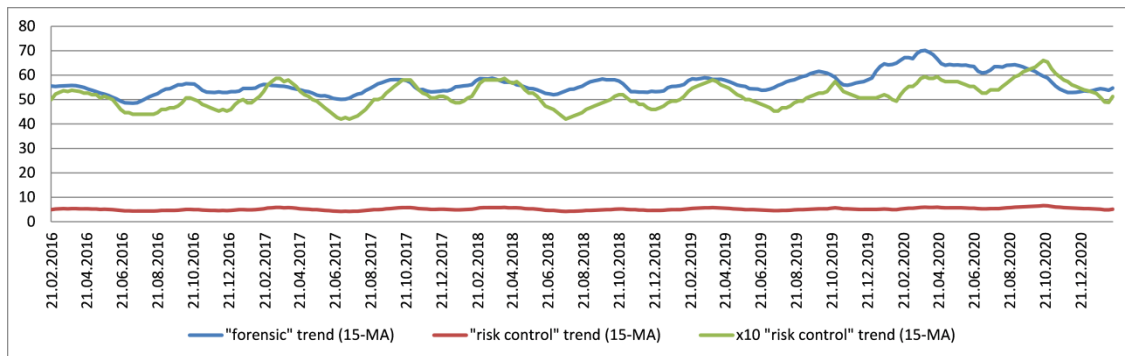


Figure 22: The comparison of trends for the interest of "forensic" and "risk control" terms

8. Conclusions

The research has shown that Google Trends has ample opportunity to determine the level of user interest in the main trends of the financial risk control. It is noted the low interest of society in the term "financial investigations", which indicates negative trends. Among searchers, the concepts of "forensic" and "risk control" are not identified, which is more seen as a means of crisis management. There is also a persistent trend to the increase of interest in the term "risk control" in English worldwide, in particular in North America, Western Europe and Africa in 2020. Some interest and additional comparative analysis can be conducted in the beginning of 2018, when there was a strong increase of interest in "risk control" in Russian and Polish at the same time. The significant predominance of the search for the term "risk control" in English in Ukraine and worldwide requires an additional study. The same situation is observed when analyzing the requests frequency in Ukraine. The analysis of the requests popularity in Ukraine and worldwide over the past year confirms the data obtained about peak and seasonality. The analysis of the requests of the term "financial investigations" over the past year has also shown interest worldwide, but, it should be noted, unlike the term "forensic", more pronounced peak values. It is not possible to analyze the interest in this term in Ukraine due to the lack of the required amount of data. So, the process of development of financial investigation technologies in Ukraine only begins.

The analysis of the popularity time series for the seasonality allowed to find 52 weeks seasons for the "forensic" and "risk control" terms in the scope of last 5 years worldwide. The interest in these definitions is also somewhat synchronous in time. There is no confident seasonality for the interest in other terms being investigated.

The advantage of Google search services is the ability to measure interest in regions and cities, which allows to identify strategic geographic centers that actively promote and develop the innovation sector in the field of financial risk control, as evidenced by a certain asymmetry west-east interest in forensic and needs to search of measures to equalize the development of financial risk control throughout Ukraine, in particular, the center.

The obtained data prove the interest in the concepts of "risk control", "forensic" and "financial investigations" both worldwide and in Ukraine representing their orientation for development in these areas. It should be noted the existing asymmetry of interest in terms both worldwide and in the regions of Ukraine, as well as the presence of clear peak values, which became the basis of the next task to build a model of time series.

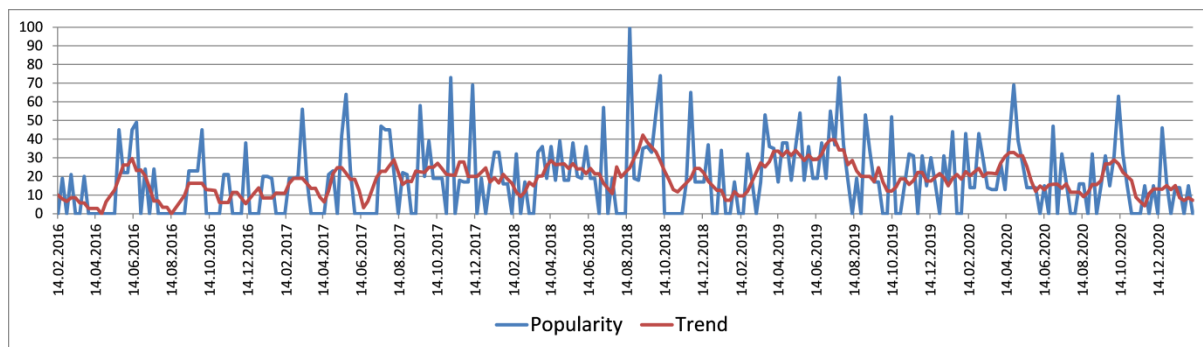
It is difficult to define the affinity of countries by geographical location, which needs additional analysis. It determines the direction of further research –the estimation of the relationship between regions of the world and the greatest interest in the topic of risk control. Other interesting topic for future research relates to analysis and comparison of search statistics provided by competitors for Google Trends.

9. References

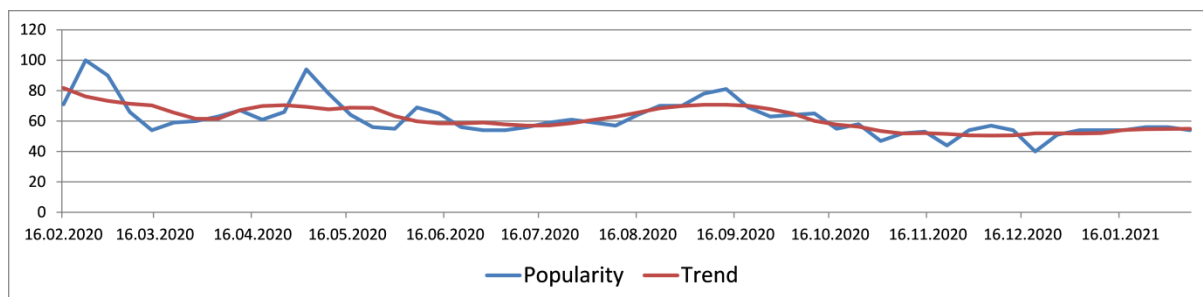
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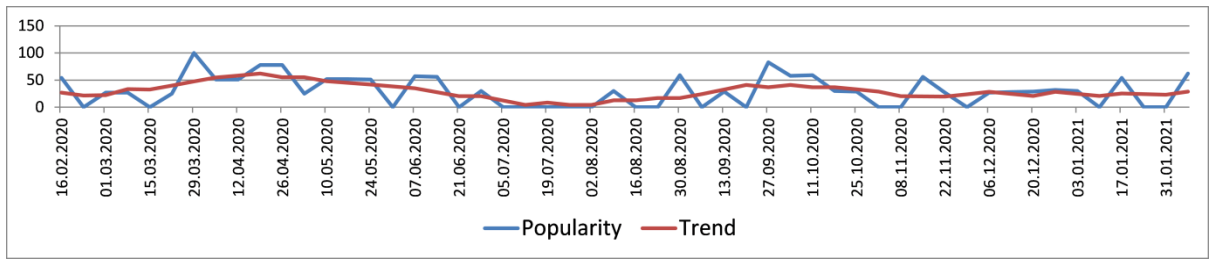
A. Initial popularities and trends for different terms



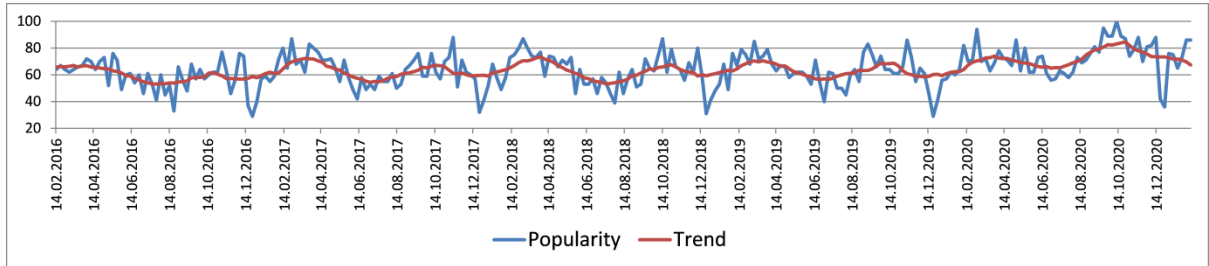
Series for the "forensic" term for the last 5 years in Ukraine



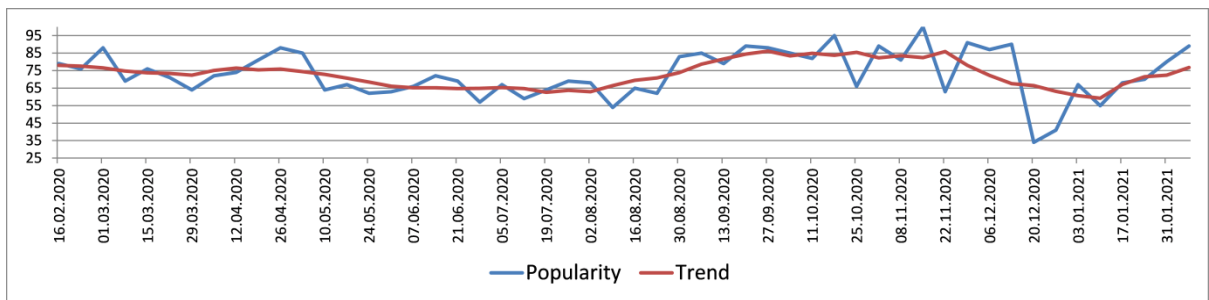
Series for the "forensic" term for the last year worldwide



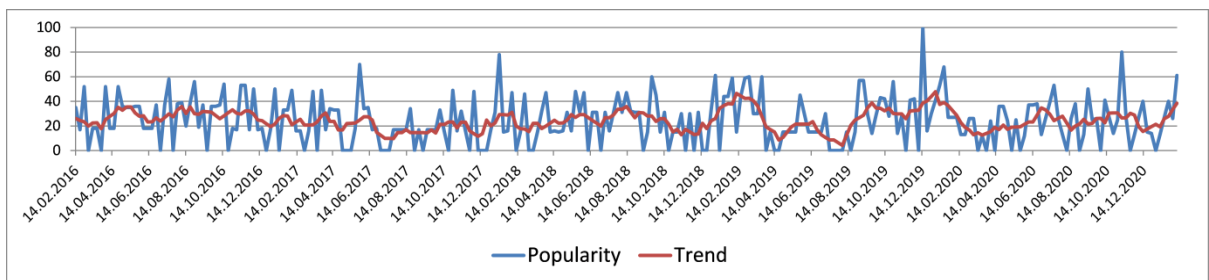
Series for the "forensic" term for the last year in Ukraine



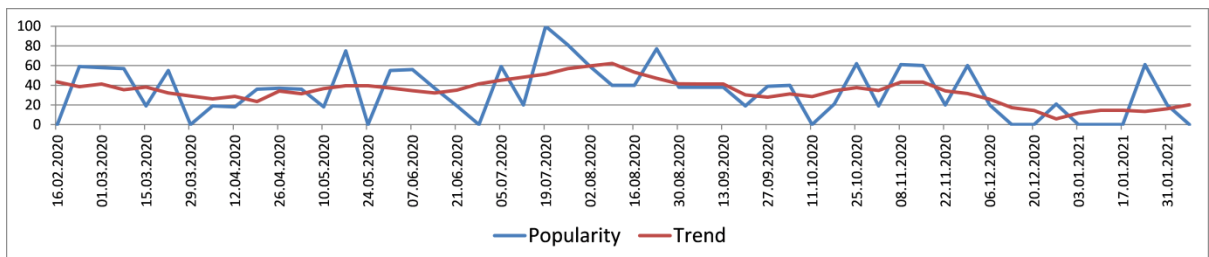
Series for the "risk control" term for the last 5 years worldwide



Series for the "risk control" term for the last year worldwide



Series for the "financial investigations" term for the last 5 years worldwide



Series for the "financial investigations" term for the last year worldwide