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Analysis of public awareness on global warming: Forecasting using Google Trends and FB prophet

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Abstract

Global warming is a world problem that must be solved jointly by all countries in the world. Public awareness of global warming shows a decreasing trend over time, as shown in the global community's search results for the keyword global warming which tends to decrease in number. So, research must be carried out to find out the causes of the decline in global public awareness of this issue. This research aims to predict several keywords related to global warming and try to find the reasons why world public awareness tends to continue to decline. This research uses Google Trends to retrieve the dataset and uses the FB prophet model as a forecasting algorithm in machine learning. The research results show that the trend in people's searches for the keyword "global warming" will tend to decline over the next year. Another finding is that there are contradictory keywords on Google Trends that tend to increase, namely "evidence of global warming" and "why climate change is fake". The MAPE (Mean Average Percentage Error) score for the two contradictory keywords is 0.16 and 0.15. Another finding is, if the search dataset on Google Trends has a high fluctuating number of searches, additional columns can be added to the dataset by using the max function to combine several related keywords to retrieve the highest number of searches. Added max column can increase MAPE score in forecasting results. The MAPE score in the max column is 0.159. Another finding was that contradictory keywords on Google Trends came from South Africa, America, Australia, the Philippines, England, Canada, Vietnam, and India.

Keywords

Public awareness, Global warming, Google Trends, FB prophet

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Introduction

Global warming is a problem for countries around the world that must be addressed together. The fact that is happening now is that the earth's temperature has increased by one degree Celsius compared to the earth's temperature a hundred years ago. An increase in the earth's temperature by one degree has an impact on several things, namely increasing sea surface temperatures, melting of polar ice, changes in weather patterns, loss of biodiversity, increasing the risk of natural disasters, increasing the

spread of disease, causing crop failures which result in increased hunger. So, research on global warming is very important to ensure that public awareness will always be maintained for the continuity of human life in the future [1–3].

The problem that occurs is that global public awareness of this issue tends to decrease. Even though in 1988 the IPCC Organization was formed by the UN to research climate change, many similar organizations have even been established such as the Intergovernmental Panel on Climate Change (IPCC), World Wildlife Fund (WWF), Environmental Defense Fund (EDF), Natural Resources Defense Council (NRDC), Sierra Club, Greenpeace, Friends of the Earth, Conservation International. The IPCC issued its first report in 1988 concluding that the main cause of global warming was the burning of fossil fuels. However, in fact, until now, human civilization has not been able to free itself from dependence on fossil energy. Data from research also shows that general public awareness also tends to decrease, as can be seen from data on Google searches about this issue which also tends to decrease. So, it is necessary to conduct research on what causes public awareness to always tend to decrease [4].

There have been several studies that have attempted to examine the use of Google as a tool for environmental predictions. The first research from Nghiem [5] which examined the use of Google trends as a tool to predict patterns of public awareness about environmental conservation, this research concluded that there was a downward trend. The second research from Mccalum [6] concluded that there was a trend of decreasing public awareness of environmental conservation as seen from data on Google Trends. The third research was from Pretorius [7] which examined forecasting public awareness in South Africa about drought via Google Trends. The fourth study from [8] examined the decline in public awareness about drought in California through Google Trends. The fifth research from [9] uses the RNN algorithm to predict societal trends that support environmental conservation. Of the five studies, none has examined the causes of the decline in public awareness of global warming using Google Trends and the FB Prophet model.

This research aims to find out what causes public awareness about the issue of global warming to continue to decline. This can be achieved by using the FB Prophet machine learning model and using datasets from Google Trends. It is hoped that with this research the exact causes of these problems can be identified so that it can be useful for decision-makers at the country and world level as a basis for making decisions.

Methods

This research uses an experimental approach using the IPO (Input Process Output) framework in its methodology. At the input stage, the dataset obtained from Google Trends consists of D1 (Main & Related Keyword) and D2 (Main & Related Contradictory Keyword). The next stage is a process where a machine learning process is carried out using the Prophet FB model to predict data for the next 1 year. The programming language used is Python using the Sklearn library. At this stage, forecasting results are

also validated using R2 and MAPE (Mean Average Percentage Error) and keyword validation using the Pearson Correlation score. At this stage, the dataset is also adjusted by adding the max column which is obtained by calculating the largest number in each row. The purpose of adding this column is to fill in the lack of data for several keywords, namely by filling in the max column, so all keywords can be combined into one, by taking the largest number. The results of using the max column will compare the score against other keyword columns to assess which one has the best results. The final stage is the output where a search forecast for global warming and related keywords is produced for the next 1 year, as well as a forecast for conflicting keywords for the next 1 year. Another output is the formulation of dataset customization using the max function. The research flow can be seen in Figure 1.

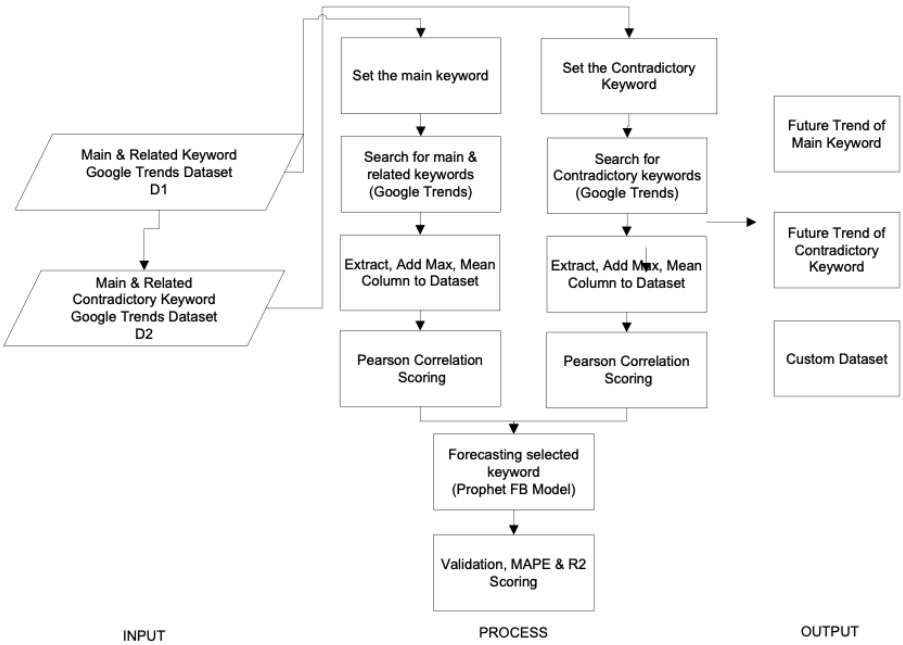


Figure 1. Research flow diagram

Results and Discussion

This stage is the initial stage to determine the main keywords that will be used as a basis and reference for searching for other keywords. The basic keyword used is "global warming" which was obtained from other related research literature studies. After determining the basic keywords, then look for other related keywords via Google Trends. The aim of searching for related keywords is to find other keywords that are better in terms of search quantity and to capture all keywords that have the potential to mutually reinforce the keyword "global warming". Of all the related keywords, the Pearson Correlation score was assessed against the basic keyword "global warming". The results of the Pearson Correlation score can be seen in Table 1.

After assessing the Pearson Correlation score for 12 related keywords and the main keyword "global warming". three main keywords were selected and determined. namely "global warming". "pollution" and "global climate change" based on the highest score from the Pearson Correlation. After determining the three main keywords. a

graph is created to see the trend of these three keywords. The results are shown in Figure 2. From Figure 2 it can be concluded that the predicted results of the three searches for three keywords are as follows: predictions for the keyword "global warming" will tend to decrease until 2024. while the other 2 keywords. namely "pollution" and "changes in global advertising" will tend to increase. Here it can be concluded that there has been a shift in the use of keywords by the public. where the keywords "pollution" and "global advertising changes" will be used more often by the public than the keyword "global warming".

Table 1. Pearson correlation score of main keywords

No	Keyword	Description	Score	Status
1	global warming	Main keyword	1	Selected Keyword
2	el nino	Related keyword	-0.15	
3	pollution	Related keyword	0.3	Selected Keyword
4	climate change	Related keyword	-0.45	
5	sea level rise	Related keyword	0	
6	climate	Related keyword	0.3	
7	la nino	Related keyword	0	
8	pollution air	Related keyword	0.19	
9	climate change is	Related keyword	-0.18	
10	global climate change	Related keyword	0.5	Selected Keyword
11	el nina	Related keyword	-0.32	
12	the pollution	Related keyword	-0.14	
13	map sea level rise	Related keyword	-0.11	

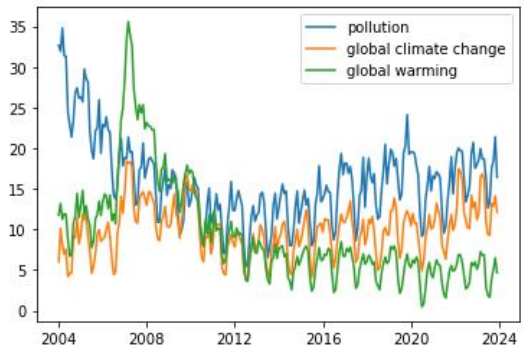


Figure 2. Future trend of the three main keywords

Table 2. Pearson correlation score of contradictory keywords

No	Keyword	Description	Score	Status
1	is global warming real	Contradictory Keyword	0.5	
2	is global warming fake	Contradictory Keyword	0.43	
3	fake climate change	Contradictory Keyword	-0.36	
4	global warming evidence	Contradictory Keyword	0.9	Selected Keyword
5	is climate change fake	Contradictory Keyword	-0.3	
6	global warming is not real	Contradictory Keyword	0.54	
7	why is global warming fake	Contradictory Keyword	8.79	Selected Keyword
8	evidence of global warming	Contradictory Keyword	0.78	
9	why climate change is fake	Contradictory Keyword	-0.02	

The next stage is to find out the reason why the keyword "global warming" has decreased since 2007. So, a keyword search is carried out that contradicts to the three main keywords via Google Trends. At this stage nine contradictory keywords were

determined. then a Pearson Correlation score test was carried out by searching for the largest score for the keyword "global warming". with the aim of finding out which keywords had a truly negative correlation to the basic keywords. The results of the Pearson Correlation score can be seen in Table 2.

From Table 2, two contradicted keywords were determined. namely "evidence of global warming" and "why global warming is fake". Two keywords are set as contradictory keywords to be selected. After determining the contradictory keywords. a forecasting process is carried out using machine learning with the FB prophet model as the algorithm using the Python programming language and the Sklearn library. The next stage is to validate the model to assess how accurate the forecasting results are for each keyword using the R^2 score. The results of the R^2 score for nine keywords and the additional max column can be seen in Table 3.

Table 3. R^2 Score of contradictory keywords

No	Keyword	Status	Score	Description
1	is global warming real	Contradictory Keyword	0.843545483098585	
2	is global warming fake	Contradictory Keyword	0.8377802757990314	
3	fake climate change	Contradictory Keyword	0.8337255588268547	
4	global warming evidence	Contradictory Keyword	0.9174325750080519	Selected
5	is climate change fake	Contradictory Keyword	0.7629048056876142	
6	global warming is not real	Contradictory Keyword	0.8246419093251496	
7	why is global warming fake	Contradictory Keyword	0.7269747695385231	
8	evidence of global warming	Contradictory Keyword	0.8147202075127656	
9	why climate change is fake	Contradictory Keyword	0.8755474930153578	Selected
10	max	Contradictory Keyword	0.8648254658107191	Selected

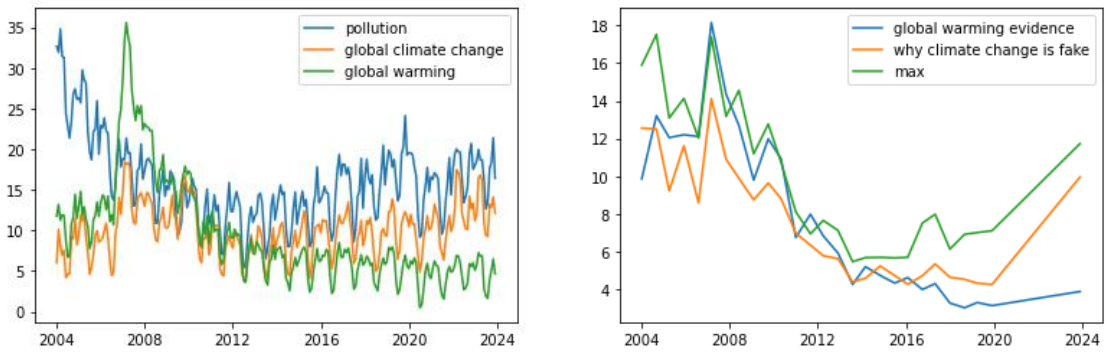
From Table 3 it can be concluded that the three keywords "global warming evidence". "Why climate change is fake" and the "max" column get the highest R2 scores. After getting an R2 score on all three contradictory keywords. So, the next stage is to test the deviation of the forecast results from the original value using the MAPE score. The results of the average MAPE score for nine contradictory keywords and one additional max column can be seen in Table 4.

Table 4. Mean value of MAPE score of contradictory keyword

No	Keyword	Status	Score	Description
1	max	Contradictory Keyword	0.15924024092636188	Selected
2	is global warming real	Contradictory Keyword	1340817769688323.2	
3	is global warming fake	Contradictory Keyword	837157179404326.5	
4	fake climate change	Contradictory Keyword	9352252446690841	
5	global warming evidence	Contradictory Keyword	0.16740005172836164	Selected
6	is climate change fake	Contradictory Keyword	0.15924529640015425	Selected
7	global warming is not real	Contradictory Keyword	22685462514157900	
8	why is global warming fake	Contradictory Keyword	21873354573299512	
9	evidence of global warming	Contradictory Keyword	19282203469115462	
10	why climate change is fake	Contradictory Keyword	7218080224602600	

From Table 4 it can be concluded that the keywords "global warming evidence". "is climate change fake" and the additional column max has the highest average MAPE scores. Next. a forecast graph is made until 2024 for three main keywords. namely

"pollution". "global climate change" and "global warming" and a forecast graph is made for two contradictory keywords. namely "evidence of global warming" and "why climate change is fake" as well as an additional column "max". The results of this graph can be seen in Figure 3.



(a) Global Warming keyword (b) Contradictory keyword

Figure 3. Future trend of (a) vs (b)

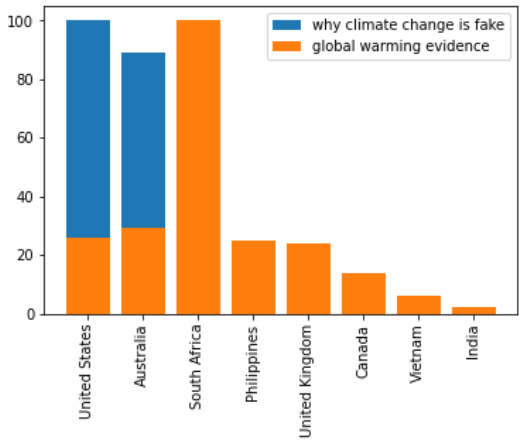


Figure 4. Origin of contradictory keyword

Conclusion

From Figure 3 it can be concluded that the graph for contradictory keywords. namely "evidence of global warming" and "why climate change is fake" is very negatively related to the keyword "global warming". So, it can be concluded that the reason why public awareness of global warming is increasingly showing a downward trend is the world community's mistrust of the fact that global warming is occurring. This is proven by the contradictory keyword search trend showing that the trend continues to increase after 2012. So, it can be used as a reference for decision-makers at world and country levels to educate the public about the facts of global warming. Apart from that. it is necessary to increase resistance to hoaxes about global warming. Another finding was that contradictory keywords came from South Africa. United States. Australia. The Philippines. United Kingdom. Canada. Vietnam. Sweden. India and Brazil.

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