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Research on the security of the world in Nuclear weapons threatens

Renjie Wu*

School of Mathematics and Statistics, Yunnan University, Kunming, Yunnan, 650500, China
**Corresponding author: weilai@mail.ynu.edu.cn*

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Abstract: This article focuses on nuclear security, models the locations of nuclear bomb explosions. The conclusion is that although nuclear weapons cannot destroy the earth for the time being, their spread will threaten the survival of mankind. We found that there are now 10 countries in the world that have nuclear weapons. In terms of reductions, this makes the United States the country that has cut the number of nuclear weapons by the most over the past 20 years. In terms of number of additions, Pakistan led the way with 133 additional nuclear weapons. The five-year period from 1962 to 1966 saw the largest number of nuclear weapons tests, with 422. For question D, we construct two indicators: the increase in the number of nuclear weapons and the number of nuclear weapons tests. After the entropy weight method is used to determine the weight, TOPSIS evaluation model is established, and it is concluded that North Korea and Iran are the most active countries in the study of nuclear weapons. The United States changed its attitude from "not considering nuclear weapons" to "possessing nuclear weapons" in just seven years, the fastest change of attitude among nuclear powers. We call on all countries in the world to actively participate in the struggle for nuclear security and jointly safeguard the future of mankind and the planet.

1. Introduction

Since 1942, when mankind formally entered the atomic energy era with the achievement of a stable uranium fission chain reaction at the Chicago No. 1 reactor, the use of atomic energy has provided many conveniences to human life [1-2]. Nevertheless, three serious nuclear leakage accidents have occurred around the world, namely, the 1979 nuclear leakage accident in the United States, the 1986 Chernobyl accident in the former Soviet Union and the 2011 accident at the Fukushima Daiichi nuclear power plant in Japan [3]. These three nuclear accidents have caused irreparable damage to the human living environment. Nuclear leakage poses a great challenge to the natural environment in which human beings live [4]. Radioactive substances generated by nuclear accidents pose a great threat to the living environment of human beings in the course of their proliferation [5]. Although the probability of a nuclear leakage accident is very low, there is a consensus on the hazards and threats posed by nuclear leakage accidents to all mankind. Today, the world is facing a major change not seen in a century, and tensions in international relations have led to the nuclear issue becoming a bargaining chip in negotiations among countries. In the light of the current situation of nuclear technology in different countries around the world, the study of future security issues around the

world is crucial to the survival and development of all mankind [6-7].

Nuclear weapons have great destructive power and usually include hydrogen bombs, atomic bombs and neutron bombs. As a highly destructive weapon, the proliferation and misuse of nuclear weapons will inevitably threaten world peace and development. During the Second World War, nuclear weapons made their debut on the stage of history, and the tragic accidents in Nagasaki and Hiroshima in Japan triggered people's thinking about the safety of nuclear weapons [8]. Insofar as the "Tsar Bomb", the most powerful known, is concerned, its explosion shifted the Eurasian continent to the south by about 9 millimeters [9-10].

With the growing call for peace, more and more countries are joining the fight to maintain nuclear safety. Among them, one wonders whether nuclear weapons will destroy the Earth. Will the number of nuclear weapons increase or decrease in the next 100 or 200 years? And how many countries will become nuclear-weapon States?

2. The fundamental of data analysis

First, in the MATLAB environment, we visualized the number of countries considering, pursuing and possessing nuclear weapons globally, as shown in Table 1. As shown in Figure 1, as of 2022, there are a total of nine countries that possess nuclear weapons globally. Of these, South Africa renounced nuclear weapons and declared itself a non-nuclear state in 1991.

The data we study in this paper comes from: Nuclear Weapons - Our World in Data.

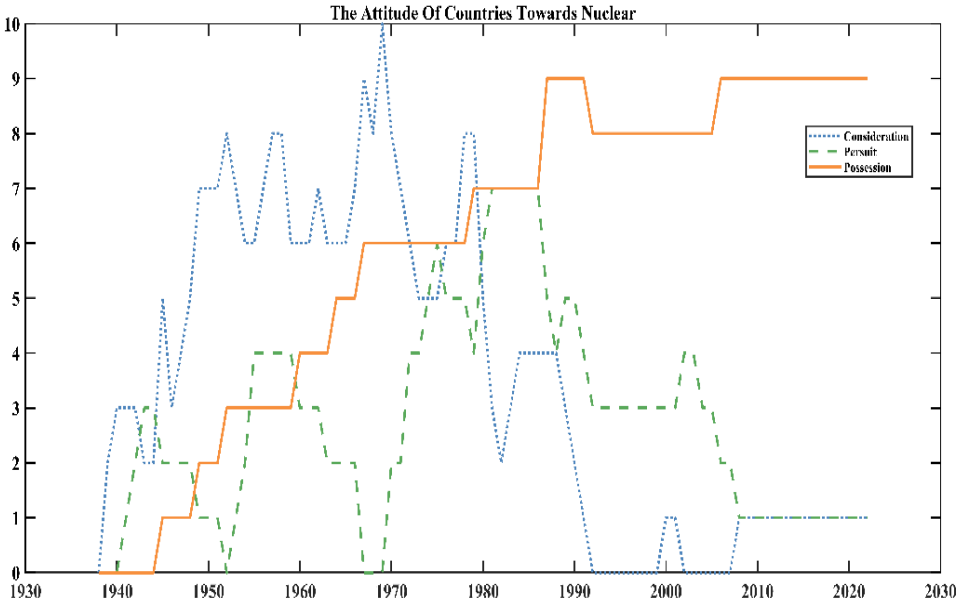

Figure 1: The Attitude of Countries towards Nuclear

Table 1: Countries with nuclear weapons in the world

China	France	India	Israel	North Korea
Pakistan	Russia	South Africa	United Kingdom	United States
Note: Green are the legitimate nuclear states, i.e., the five permanent members of the United Nations.				

We screened the data in Table 2 for the number of nuclear weapons in the 10 nuclear-armed states in 2003 and 2022, and the results are shown in Table 2.

In terms of reductions, according to table 2, the number of United States nuclear weapons will decrease from 10,027 in 2003 to 3,708 in 2022, a total reduction of 6,319, or 63.02 per cent, while

the number of Russian nuclear weapons will decrease from 9,076 in 2003 to 4,477 in 2022, a total reduction of 4,599, or 50.67 per cent. It is clear that the United States has made the largest reductions, both in terms of numbers and in terms of percentages.

Table 1: Number of nuclear weapons in the 10 nuclear-armed States, 2003 versus 2022

Country	2003_Stockpile	2022_Stockpile	Difference	Percent
China	235	350	115	32.86%
France	350	290	60	17.14%
India	28	160	132	82.50%
Israel	78	90	12	13.33%
North Korea	0	20	20	100.00%
Pakistan	32	165	133	80.61%
Russia	9076	4477	4599	50.67%
South Africa	0	0	0	0.00%
United Kingdom	280	180	100	35.71%
United States	10027	3708	6319	63.02%

In terms of increase, according to table 2, Pakistan has the largest increase in terms of number of nuclear weapons, from 32 in 2003 to 165 in 2022, a total increase of 133.

We used a summation function to calculate the number of nuclear weapons tests per year versus the number of nuclear weapons tests per five-year period. 1962 to 1966 had the highest number of nuclear weapons tests, totaling 422.

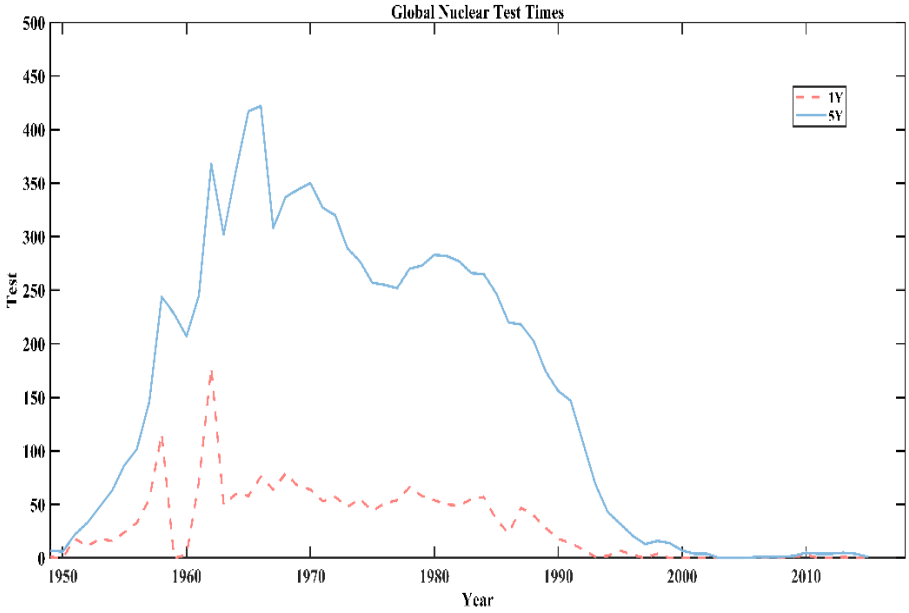

Figure 2: Global Nuclear Test Times

The blue curve in Figure 2 represents the sum of each five-year period and the red curve represents the sum of one year. For example, the data for 1949 are the sum of the data for 1945, 1946, 1947, 1948 and 1949.

We need to select some indicators from the available data to quantify "active". For the nuclear-armed states, we extracted data from Tables 2 and 3 and selected two indicators to quantify "active"; for the nuclear-threshold states, due to the lack of data on nuclear weapons experiments and stockpiles, we extracted data from Table 4 for analysis. Using Table 4, we screened for countries still considering or pursuing after 2013, yielding Iran always pursuing and Syria always considering. Based on Table

3, we conclude that among the nuclear threshold countries, Iran is the most active in nuclear weapons research.

Table 2: Iranian research in nuclear weapons research

Country	Abbreviation	Year	Status
Iran	IRN	2013	2
Iran	IRN	2014	2
Iran	IRN	2015	2
Iran	IRN	2016	2
Iran	IRN	2017	2
Iran	IRN	2018	2
Iran	IRN	2019	2
Iran	IRN	2020	2
Iran	IRN	2021	2
Iran	IRN	2022	2

Table 3: Quantifying Active Indicators

Country	China	France	India	Israel	North Korea	Pakistan	Russia	South Africa	United Kingdom	United States
Tests	0	0	0	0	4	0	0	0	0	0
Stockpiles	100	0	50	10	20	50	0	0	0	0

Note: The red highlight indicates a decrease in the number of nuclear weapons in the country compared to 2013, which we have recorded as zero to avoid negative numbers.

3. Data Analysis

3.1 The establishment of data analysis

Considering that different indicators have different levels of possible influence, and in order to avoid subjectivity, we used the entropy weighting method for objective weighting.

Step 1. We determine whether there are any negative numbers in the input matrix, and if so, normalise to a non-negative interval.

Step 2. We calculate the weight of the ith sample under the jth indicator and consider it as the probability used in the relative entropy calculation.

Step 3. We calculate the information entropy for each indicator, then calculate the information utility value, and finally normalise to obtain the indicator weights.

As can be seen in Table 5, the results of the entropy weighting method show that the weight of the number of nuclear weapon tests is 71.247 per cent and the weight of the increase in the number of nuclear weapons is 28.753 per cent, with the largest weight (71.247 per cent) being given to the number of nuclear weapon tests.

Table 5: Quantifying Active Indicators

Item	Information Entropy Value E	Information Utility Value D	Weighting (%)
Tests	0.001	0.999	71.247
Stockpiles	0.597	0.403	28.753

3.2 Steps in modelling

We assume that there are nth evaluation objects and m evaluation indicators (which have been normalized) forming a matrix as follows

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \tag{1}$$

Then, we assume for its normalized matrix denoted Z, each element in Z

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} {x_{ij}}^2}} \tag{2}$$

We assume that there are nth evaluation objects and m evaluation indicators (which have been normalized) forming a matrix as follows

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix} \tag{3}$$

We define maximum value

$$\begin{aligned} Z^+ &= (Z_1{}^+, Z_2{}^+, \cdots, Z_m{}^+) \\ &= (\max\{z_{11}, z_{21}, \cdots, z_{n1}\}, \max\{z_{12}, z_{22}, \cdots z_{n2}\}, \cdots, \max\{z_{1m}, z_{2m}, \cdots, z_{nm}\}) \end{aligned} \tag{4}$$

We define minimum value

$$\begin{aligned} Z^- &= (Z_1{}^-, Z_2{}^-, \cdots, Z_m{}^-) \\ &= (\min\{z_{11}, z_{21}, \cdots, z_{n1}\}, \min\{z_{12}, z_{22}, \cdots z_{n2}\}, \cdots, \min\{z_{1m}, z_{2m}, \cdots, z_{nm}\}) \end{aligned} \tag{5}$$

We define the distance between the i-th evaluation object and the maximum value

$$D_i{}^+ = \sqrt{\sum_{j=1}^{m} (Z_j{}^+ - z_{ij})^2} \tag{6}$$

We define the distance between the i-th evaluation object and the minimum value

$$D_i{}^- = \sqrt{\sum_{j=1}^{m} (Z_j{}^- - z_{ij})^2} \tag{7}$$

Finally, the score of the ith evaluation object can be derived

$$S_i = \frac{D_i{}^-}{D_i{}^+ + D_i{}^-} \tag{8}$$

3.3 Analysis of calculation results

According to the above steps, the established TOPSIS model was solved in MATLAB environment, and the specific results are shown in Table 6. Among them, North Korea ranks first with a total score of 0.71. This indicates that North Korea has been the most active in nuclear weapons research among nuclear-armed countries in the past decade, and Iran has been the most active in nuclear weapons research among nuclear threshold countries.

Table 6: Summary assessment of the 10 nuclear-armed states

Index value	Positive ideal solution distance(D+)	Negative ideal solution distance(D-)	Overall Score Index	Sort by
China	0.84405627	0.43070275	0.33786994	2
France	0.94759477	0	0	5
India	0.8710954	0.21535138	0.19821622	3
Israel	0.92881103	0.04307028	0.04431639	4
North Korea	0.3445622	0.84844044	0.71118069	1
Pakistan	0.8710954	0.21535138	0.19821622	3
Russia	0.94759477	0	0	5
South Africa	0.94759477	0	0	5
United Kingdom	0.94759477	0	0	5
United States	0.94759477	0	0	5

4. Conclusions

By focusing on global nuclear security, this paper analyses the ten countries that currently possess nuclear weapons in the world through modelling, and analyses the current stage of world peace and security through data analysis of the number of nuclear weapons in some of these countries at the current stage and the process of change over the past 20 years. And through the establishment of topsis evaluation analysis, the world's most active countries in the research of nuclear weapons are analysed to make corresponding strategic recommendations for world peace and security.

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