Big Data: An Approach for Detecting Terrorist Activities with People's Profiling

Oludare Isaac Abiodun[1], Aman Jantan[2], Abiodun Esther Omolara[3], Manmeet Mandy Mahinderjit Singh [4], Zakari Logun Abubakar[5], Abubakar Malah Umar[6]

***Abstract*— This research provides an empirical model approach to detecting terrorist. The modeling method is an empirical formula for measuring individual actor's level of involvement in terrorism crime. Terrorists are gaining ground virtually in the most nation of the world. This has become a global challenge as the attacks have recorded millions of deaths of innocent people, incapacitated people, and destroyed properties. In addition, the attacks rendered most communities and countries economically dormant and create a complex crisis among the people. In the research approach, the mathematical model developed is used to detect person's involvement in terrorism. Furthermore, the mathematical model result can be used to predict or calculate the outcome of the dependent parameter from the varying independents. In conclusion, the research objectives were achieved as there was a record of 0.26495 or 26.495% prediction on the overall test which determined the levels of optimization and improvement. Thus, we recommend that people's profiling analysis has a significant contribution to terrorist detecting if integrated into the system as a solution to terrorist attacks.**

***Index Terms*— Big data, Integration, Security, Optimization, Terrorist.**

I. Introduction

THERE are many identified problems, issues, and challenges in the terrorism studies that need to be addressed. In a review in 1988, Schmid and Jongman identified many key problems in research on terrorism [1]. These included concerns with the methodologies being used by researchers to collect data and with the level of analysis that was undertaken once data was available because the goal of any research must concern with the creation of new knowledge [1,2]. But, the level of this knowledge varies, as do the methods which are used to reach it. Another identified problem is that most books on terrorism affairs, and certainly almost all with an academic or research focus, begin with a discussion and explanation on how terrorism is defined [3]. Or, to be more accurate, some discuss the long-running and peculiar failure to reach an agreed definition [3]. An agreed definition enables the research world to develop shared approaches, methods, benchmarks and appropriate topics for study [3]. Without a standard definition, the focus of the field is fragmented, scattered, and an unrealistic range of activities, phenomena, and actors have been labeled as a terrorist. Ariel Merari stated that "Repeated occurrences of the same phenomenon are the basis of scientific research" [3]. However, in the case of terrorist there is hardly a pattern which enables generalizations [3]. Though, Hickman mentioned that "the definition of terrorism, international consensus has gradually emerged condemning terrorist acts as a violation of the "law of nations." Until recently, there has been uncertainty over whether terrorism can be considered a violation of the customary international law" [4].

Therefore, the problem is a clear one, there is no widely agreed definition of terrorism, perhaps this may be the reason why the solution to the subject is complex. Clearly, the heterogeneity of the terroristic phenomena causes difficulty in explanatory, descriptive, and predictive generalizations, which are the fundamental products of scientific research. Some countries such as Malaysia had originally attempted to define terrorism to include all attacks directed against civilians [3]. The government of the United Kingdom, for example, has a very explicit definition of terrorism which has been set out in its Terrorism Act 2000. Terrorism is defined there as: 'The use of serious violence against persons or property, or the threat to use such violence, to intimidate or coerce a government, the public, or any section of the public for political, religious or ideological ends'[3]. While the US's Federal Bureau of Investigation (FBI) which defines terrorism as: 'The unlawful use of force or violence against persons or property to intimidate or coerce a government or civilian population in furtherance of political or social objectives'. These similarities in phrases and tone can be a term to represent a growing international agreement on what constitutes terrorism.

Apart from the methodologies being used by researchers to gather data and with the level of analysis and the difficulty of terrorism definition other identified problems of terrorism include frequent attacks. This frequent or sudden attacks takes people unaware and often led to pandemonium [5,6,7,31]. Another problem is the fatality of attack, in terms of death, injury and damages to properties [5,6,7,8]. Again, there is a problem of long-term effect on people and society, as the memory of the lost lives, and properties continue lingering [8], this lingering memory of the lost ones and properties does not give room for peace and forgiveness, rather it breeds retaliation and avenges. Also, is the problem of security of lives and properties. Terrorist activities portrait danger and a threat to national security, unity, and sovereignty. Frequent attack of terrorist's portrayal weak

Corresponding author: aman@usm.my[2], aioludare@gmail.com[1], styleest2011@gmail.com[3],manmeet@usm.my[4], zlabubakar@yahoo.com[5],amumar99@gmail.com[6]. Universiti Sains Malaysia[1,2,3,4], National Defence College, Nigeria[5], Nigerian Defence Academy, Kaduna[6]. This research was partially supported by the Fundamental Research Grant Scheme (FRGS) for ''content-based analysis framework for better email forensic and cyber investigation'' [203/PKOMP/6711426], SFRG Lab, School of Computer Sciences, USM. Penang, 11800, Malaysia.

governance and sign of incapability to protect lives and properties of the citizenry [9,10,6, 31]. More also, terrorism hampers economic growth and development of a community and a nation [9,10,6]. Another notable problem is the dynamism of terrorist activities, this dynamism is making the problem so complex to solve by the government security operatives and researchers to addressed empirically [5,6,7,31]. The dynamism of terrorist includes; the emerging threat from social media which is the most dangerous aspect of terrorism [11], nowadays women emerging as terrorists is a new phenomenon [11]. Others are terrorist activities on the internet that brings radicalization, the lone wolf of history attacks, deceptive statements, and posters, motives of attacks are not clear and unmitigated evil. In addition, sympathy statement from politician and community leaders loyal to the terrorist. Importantly, the widespread of terrorist activities is a big problem globally [11]. Furthermore, there is a problem of assessing an individual more effectively to prevent future attacks. An individual that may be supporting the terrorist and dangerously such an individual may be playing a big role either in government security organization or government civil office. That individual may be serving in police, army, navy, air force, defense units, and intelligence units of the government. The person may be holding a high portfolio in government, community, or controlling strategic position in a volatile organization in the society. Therefore, all these problems could serve as possible research areas for new researchers, but this work is focused on the problem of assessing an individual more effectively to prevent future attacks.

Observably, increasing research is being focused on other aspects of terrorism which are less obviously of growing importance. Of concern is the growing amount of research investigating the (potential) use of Biological, Chemical, Radiological and Nuclear weapons (CBRN) –often referred to as weapons of mass destruction (WMDs) - by terrorists [12]. Other big issues are data gathering and analysis challenges. More also is the issue of lack of funding for interested researchers.

In terms of research gaps, we can say that primarily much of what is written about terrorism and terrorists is repetitive, but it is strong in many other respects. Generally, research has been very good at exploring the impact of conventional terrorist violence on wider society, particularly in the western world in areas like Northern Ireland and Oklahoma City [3]. There has also been some success work done on the direct victims of hijackings, bombings, and other types of terrorist attacks [3]. But when it comes to the vitally main subject of the terrorists themselves, the quantity and quality of the achievement to date falls away totally. Yet, surprisingly little research work of scientific merit has been conducted on the perpetrators of terrorist violence.

Unfortunately, the activities of terrorist groups and the nature of their membership have by and large been studiously ignored by scientists. Although, there are identify gaps, problems, issues, and challenges in the terrorism studies that need urgent attention. Nevertheless, this research is focused on the problem of assessing an individual more effectively using people's profiling in preventing future attacks.

II. BACKGROUND

Terrorism seems to be the most security challenge that is currently facing the world which require urgent attention of researchers for possible solution. There are many possible approaches to the multifaced problem of terrorist activities, such as the use of dialogue, arrest, detection, and gun which has not yield a positive result. Some affected countries seek for solution by their established army; while some seek for an alliance of forces in the neighboring country, other nations ask for regional and global collaboration to fight the ugly trend. The dynamism of terrorist violence is accompanied by deaths, injuries, loss of properties, financial loss, increase in poverty level, increase of illiteracy in the society, internal displacement, anger, violence, unemployment challenge, environmental damage, health problem, spread of disease, scarcity of water, homeless among the people poor development and security problem, migration and lot more. The survey of the global economic impact of terrorism in 2015 was broadly comparable to the previous year, costing the global economy US$89.6 billion [5]. Records have shown that there is a rise of global terrorism [5]. The unhealthy growth of terrorist activities between 2006 to 2016 shows that the attack by terrorist must have caused security challenge in many nations including developed parts of the world [5].

III. TERRORISM RESEARCH CLASSIFICATION

The current terrorism research classification can be the view from information and communication technology-based solution approach such as; internet, software, computer network, surveillance camera, social network analysis and satellite imagery. Others include a database, cloud computing, data mining, robot, CCTV, expert system, mobile phone, cryptography, digital-forensic and biometric. The framework classification for terrorism research can be explained as depicted in Fig. 1.

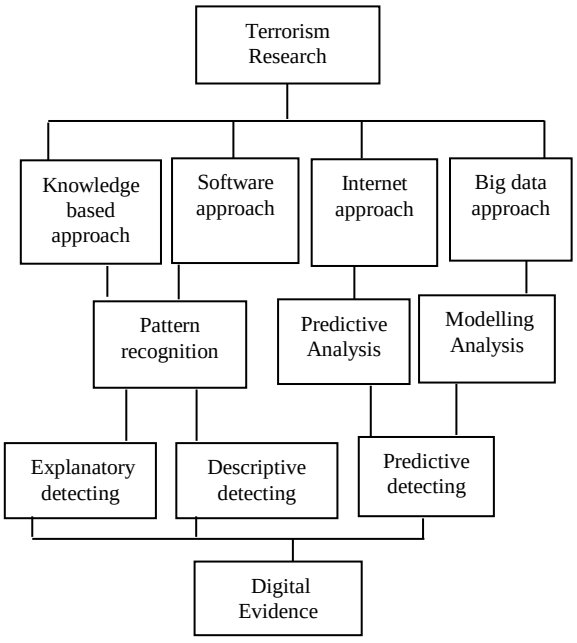

Fig. 1. Review Framework for Terrorism Research Classification

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In most of the data-collection strategies and data analysis techniques, there has only been a been a bit shift from literature review-based research. There has, however, been a much more likely increase in the use of explanatory, descriptive, inferential statistical analysis, mathematical equation, software, and technology. However, the use of inferential statistics on terrorism data could be more reliable and could provide an improvement in the study than the descriptive analysis approaches. Also, the application of software and technology can provide better digital information. Therefore, this work proposed an empirical formula and detecting techniques, because it could provide a better evidence against terrorist when compared to other methods currently in practice.

The motivation of the study which is due to the past and present socio-cultural, economic, and security implication in the society. The high rise in global terrorism has made this work very necessary in an attempt of finding a solution to the scourge. Over a decade terrorist's activities have become one of the social evil and human-made security challenge that threatens our generation as there has been an astronomical increase in the terrorist's attacks. Recent records have shown that there is a high rise in the number of terrorist's attack per year [5,6]. Therefore, the study proposes the use of people's profiling analysis for assessing an individual more effectively to prevent future attacks.

IV. LITERATURE REVIEW

Though, the terrorism literature is composed mainly of studies which rely on relatively weak research methods. However, this is not meant to be an overly harsh criticism. Many white papers, journal articles, and business reports propose ways government can use big data to help them serve their citizens and overcome national challenges such as rising health care costs, job creation, natural disasters, and terrorism [13]. While the term big data may seem to reference the volume of data, that isn't always the case.

Big Data Integration

The term big data refer to the technology which includes the tools and processes, that an organization requires to handle the large amounts of data and storage facilities. The term is believed to have originated with web search companies who needed to query very large distributed aggregations of loosely-structured data [14]. Distribution of data and workload over multiple servers was the key to handle massive data volume efficiently [15]. An example of big data might be petabytes (1,024 terabytes) or exabytes (1,024 petabytes) of data consisting of billions to trillions of records of millions of people from different sources (for example contact center, web, sales, mobile data, customer social media, and so on). The data is typically loosely structured data that is often incomplete and inaccessible [14].

Data is distinct pieces of information, usually formatted in a special way. Data can exist in a variety of forms as numbers or text on pieces of paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind. In many occasion, people have used the word data to mean computer information that is transmitted or stored. But, data is the plural of *datum*, a single piece of information. In practice, however, people use data as both the singular and plural form of the word, and as a mass noun (like "sand") [14]. The integration of this huge data sets is quite complex. There are several challenges one can face during this integration such as analysis, data curation, capture, sharing, search, visualization, information privacy, and storage. There are several challenges one can face during this integration such as analysis, data curation, capture, sharing, search, visualization, information privacy, and storage. The core elements of the big data platform are to handle the data in new ways as compared to the traditional relational database. Accuracy in managing big data will lead to more confident decision making. In today's terrorist challenge, there is a need for modern big data integration platform, from the local level to state level and up to national level. Fig. 2 is an illustration of a Big data integration platform.

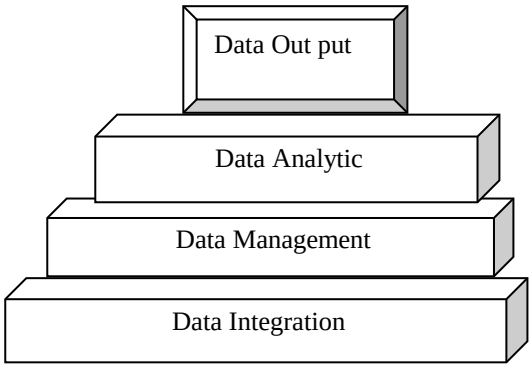

Fig 2. Big Data Integration Platform

Definition: Integration – this is inclusion or incorporation or use of supportive material or tools that could enhance performance as applied in the context.

Terrorism Research Existing Approaches

Recently, a new approach to studies of terrorism has appeared in the form of security and critical studies. Some authors in their paper aim to clarify the main differences between orthodox terrorism studies and critical studies.

Likewise, many information-searching and analytical approaches have been adopted in the academia and industries. The following sections review some of these techniques in relation to the counterterrorism domain.

1. *Paragon Network Analysis (PNA) Approaches*

Paragon Network Analysis is a software approach to terrorism network analysis in a way of providing a solution to the terrorist problem. The algorithms are embodied in the form of the Paragon Network Analysis (PNA) software [16]. The method is more robust to missing or erroneous data than earlier techniques, especially those based on traditional centrality measures [17] or on subgroup connectivity [18].

Unlike many existing methods, the PNA algorithms directly incorporate time-dependent data about communication events to characterize the dynamical evolution of a network. The time ordering of events is used explicitly in formalism (Steve Kramer. 2007)[19]. The initial tests indicated that PNA algorithms can track the changes in a terrorist cell as it transitions from a covert "sleeper" state to an active state [20]. Therefore, the software could aid the intelligence community by warning of impending attacks from covert cells going into action. The technique promises to be scalable to large networks [19]. Unlike centrality-based approaches that typically must solve the computationally expensive "all pairs, shortest distance" problem [21] says this method uses a purely local analysis that is highly parallelizable. Its basic computation time scales as O (n k2), where n is the number of nodes and k is the average degree for the network. Moreover, the software can effectively analyze streaming communications or transaction data.

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2. *An Advanced Knowledge Discovery Approach to Addressing Terrorism Threats*

Many information-searching and analytical approaches have been adopted in the academia and industries. The following sections review some of these techniques in relation to the counterterrorism domain. The advanced knowledge discovery approach is to address terrorism threats. Some of the researchers [22] experimented with an approach in a project called Terrorism Knowledge Discovery Project that consists of several custom-built knowledge portals(testbeds): Terrorism Knowledge Portal, Terrorism Expert Finder, Dark Web (consisting of Internet-based terrorist multilingual resources). In addition to analyzing terrorism research, there was a focus on the information access and methodological problems in analyzing terrorist groups/victims [22] once completed, the system can also become a major learning resource and tool that the general community can use to heighten their awareness and understanding of global terrorism phenomenon, to learn how best they can respond to terrorism and, eventually, to garner significant grass root support for the government's efforts to keep America safe. Furthermore, they proposed to develop a Dark Web Portal that could help researchers locate, collect, and analyze Dark Web data. Table I presents the summary of methodologies for analyzing the terrorism knowledge domains used in the project.

TABLE I
SUMMARY OF METHODOLOGIES FOR ANALYZING THE TERRORISM KNOWLEDGE DOMAINS

Unit of Analysis	**Methodology**	**Research question associated with**
Authors	Citation analysis, Co-authorship analysis, Content analysis, Factor analysis, Multidimensional scaling, Social network analysis	Communities of practices, Intellectual structure & history of terrorism, Levels & types of collaboration Pathfinder network for visualization Social structure of terrorism
Documents	Co-citation analysis, Content analysis, Various clustering methods	Development of paradigms
Journals	Co-citation analysis, Bradford distribution	Diffusion between fields, Sociology of science
Words	Content analysis, Relational extraction, Semantic analysis	Cognitive structure of terrorism Convergence in ideas Topical classification
Indicators such as economic activity level indicators (counts of papers, patents, & citations)	Combination of methodologies	Impact of scientific outputs & funding, Impact of scientific outputs on policy

3. General-Purpose and Meta-Search Engines

Many different search engines are available on the Internet. Each has its own performance characteristics primarily defined by its algorithm for indexing, ranking and visualizing Web documents. For example, AltaVista and Google allow users to submit queries and retrieve Web pages in a ranked order, while Yahoo! groups Web sites into categories, creating a hierarchical directory of a subset of the Internet. Internet spiders (crawlers), have been used as the main program in the backend of most search engines. These are programs that collect Internet pages and explore outgoing links in each page to continue the process. An example includes the World Wide Web Worm [23].

Most prevailing search engines, such as Google, are keyword-based. Although their search speeds are fast, their results are often overwhelming and imprecise. Low precision and low recall rates make it difficult to obtain specialized, domain-specific information from these search engines.

4. Chatterbot Techniques

The idea behind chatterbot techniques is to create an intimate atmosphere where individuals can converse with a natural language program (a chatterbot) and receive meaningful and immediate responses to their queries related to a certain domain without having to search the Internet for the answers themselves. Most chatterbot techniques rely on pattern matching algorithms which takes inputs from the user, parses and matches the input to one of the questions in their question/answer script, then picks out the appropriate response dictated by the script, and displays it to the user. Examples include: Previous studies on chatterbot have shown the potential of using chatterbot to provide people with easy access to domain-specific knowledge [24,25]. We believe that chatterbot techniques can be used to provide the public with necessary knowledge of the global terrorism phenomena.

5. Geographical Approaches

It was not until the early 2000s that terrorism scholars began to adopt geographical perspectives, precisely when improved GIS technology was making geography popular again and terrorism studies seemed mature enough to welcome such approaches, though surely the events of 9/11 played a major role [26].

As geographical perspectives became more common among terrorism researchers, there was less focus on debating counterterrorism policies, and more on empirically describing and explaining terrorist violence or terrorist actors. The shift in research focus shows that while geographers have been responsible for most of the publications in the critical and applied literature, non-geographers have been the main contributors to the empirically based literature. It is mostly this empirical literature that can contribute to the growth in quality of studies on terrorist [26].

6. Safety Modelling Approach

According to M. D. Cooper on agent-based modeling. "Modern society is characterized by a high complexity and change. A high complexity of the social dynamics results from many diverse local interactions among humans. Humans interact at diverse levels in different socio-technical contexts (teams, groups, organizations etc.). Traditionally, the interaction among humans has been modeled by abstracting from single interaction processes and by taking an aggregate view of the social dynamics. The relatively new agent-based modeling approaches to complex systems consider the local perspective of a possibly large number of separate agents and their specific behaviors (i.e., interactions) in a system. Then, the global behavior of the system emerges from the local distributed interactions among agents that form a part of this system" [27]. The concept of an agent is used to model both humans as well as hardware and software components of socio-technical systems.

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V. PROPOSED METHOD

In this research approach, ordinary least square (OLS) modeling was considered because the modeling technique has minimal error prediction among other reasons. The method of *Least Squares* is a procedure to determine the best fit line to data; the proof uses simple calculus and linear algebra. The basic problem is to find the best fit straight-line y = ax + b given that, for n∈{1, . . . , N}, the pairs (x_n, y_n) are observed.

The method easily generalizes to finding the best fit of the form; $y = a_1 f_1(x) + \ldots + c_1 f_k(x)$;……equation (1)

It is not necessary for the functions f_k to be linearly in x, all that is needed is that y is to be a linear combination of these functions. In this study, we considered x = 42, that is the test was conducted on forty-two (42) people profiling. Therefore, when x = 42, equation (1) becomes;

$y = a_o + a_1x_1+a_2x_2+a_3x_3+\ldots+a_{42}x_{42} + \epsilon_{k.}$, where a_0 is a constant parameter and ε_K is taking as an error in the experiment.

Physics Research Approach - Linear regression analysis (least squares) is used as data fitting techniques. Application is made to two experiments: (a) Fletcher's trolley and (b) Hooke's law [28].

(a) Using Fletcher's trolley: Newton's second law which states that "the rate of change of momentum of a body is proportional to the force causing it and takes place in the direction of that force".
i.e. (mv - mu) / t ∞ F or m(v - u) / t ∞ F ……..equation (2)

which gives ma ∞ F. i.e to show that the acceleration of a body is proportional to the applied force and inversely proportional to the mass of the body.

(b) Hooke's law: in simple terms says that strain is directly proportional to stress. Mathematically, Hooke's law states that; F = -KX ……...equation (3)

where, ***x*** is the displacement of the spring's end from its equilibrium position (a distance, in SI units: meters);
F is the restoring force exerted by the spring on that end (in SI units: N or kg·m/s^2); and, *k* is a constant called the *rate* or *spring constant* (in SI units: N/m or kg/s^2). Least squares will extract information from raw data in a very precise way. Let consider a simple example drawn from physics, a spring should obey Hooke's law which states that the extension of a spring is proportional to the force, *F*, applied to it.

(i) Research Design: In the conceptual framework approach to this research, values of numbers were assigned to each variable to form a dataset. According to Sarah Bouslaugh and Paul Andrew Watters [29], "Before someone can use statistics to analyze a problem, one must convert information about the problem into data. That is, one must establish or adopt a system of assigning values, most often numbers, to the objects or concepts that are central to the problem in question. This is not an esoteric process but something people do every day" [29].

(ii) Data Collection: To obtain a dataset from each variable of people's profiling such as name, passport photograph, biometric, bank details, residential address, nationality, work address, past education, religion, marital status, telephone number, etc.

(iii) Data Analysis Techniques: In each of the different design model of people's profiling, a regression analysis technique was applied using statistical software.

VI. EXPERIMENTAL RESULTS AND DISCUSSION

The result of the test is a generalised empirical expression, Ỳ, for detecting individuals as a function of the stipulated input parameters, Xi: i = 1,2,3,…,15, was obtained as model equation from the given original equation,

$Y = a_o + a_1x_1+a_2x_2+a_3x_3+\ldots+a_{42}x_{42} + \epsilon_k$……equation (1)

1. Model Equation

$$\grave{Y} = 0.3159 - 0.0472x_1+0.0071x_2+0.0001x_3+0.0002x_4-2.0757x_5-0.1133x_6+0.0105x_7-0.0018x_8+2.61173x_9+0.0454x_{10}+0.0075x_{11}+0.0455x_{12}+0.0319x_{13}-0.4660x_{14}-0.0001x_{15}+0.0083x_{16}+0.0003x_{17}-0.0554x_{18}+1.0857x_{19}-0.6780x_{20}-0.0471x_{21}+0.0070x_{22}+0.0012x_{23}+0.0003x_{24}-2.0257x_{25}-0.1134x_{26}+0.0106x_{27}-0.0019x_{28}+1.91172x_{29}+0.0461x_{30}-0.1133x_{31}+0.0105x_{32}-0.0018x_{33}+0.1715x_{34}+0.0454x_{35}+0.0075x_{36}+0.0455x_{37}+0.0319x_{38}-0.4660x_{39}-0.0001x_{40}+0.0083x_{41}+0.0003x_{42}$$ .....equation (4)

- Equation (4), is referred to as the model equation or equation of the model
  where, 0.3159 is constant, the Xi's represent parameters or independent variables of each person's profiling.
- Equation (4) is an important design empirical equation which can be used to predict or determine the degree or value of the individual's in the generalized empirical expression, Ỳ, from given values of Xi, which are the independent variables.
- Equation (4) can also be used to determine the contribution of each person's profiling, Xi, to the given value of Ỳ.
- Furthermore, the sum of the calculated value of the model, Ỳ, from given values of Xi, is given as 0.26495.

Therefore, Ỳ is predicted at; 0.26495, that means Ỳ, is significant and acceptable for generalized detecting prediction of individual's detecting prediction.

2. Summary of F-test Statistical Data

The coefficient of determination, R^2, of the model is presented in Table II, which indicates goodness-of-fit of the regression and shows the percentage of the variation in Y that could be accounted for by the fifteen (15) X variables. In this work, it is observed that 76.81°% of prediction, Ỳ, could be accounted for by these fifteen (15) input

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parameters, X; while, perhaps 23.19°% could be explained by other factors. The errors are being minimised at 4.741936 x 10^{-3}, while the absolute percentage error obtained is 1.412.

Table II show is the summary of the F-test statistics on people's profiling detecting prediction.

TABLE II
SUMMARY OF F-TEST STATISTICS ON PEOPLE'S PROFILING DETECTING PREDICTION

Parameter	Value
Dependent Variable	Ỳ (Safety Factor)
15(design input components)	X(Independent Variables)
Coefficient of Determination, (R^2)	0.7681
Coefficient of Variation	0.0508
Mean Square Error, MSE	4.741936 x 10^{-3}
Square Root of MSE	6.235621 x 10^{-2}
Average Absolute % Error	1.412
Number of observations, n	15

In making decisions involving validity Andrew Siegel has showed that R^2 can be used in testing the validity of a model [30]. Since the model (equation (4)) produced R^2 of 0.7681 or 77% it mean that R^2 = 0.7681 is greater than the benchmark scale or threshold value of R^2 = 0.673 or 67.3°% for n=15 and k = 1,2,3,…,15, this stand at the acceptable level of validity. Thus, this model equation is significant at the given significant level of 5°%.

VII. CONCLUSION

In conclusion, the research objectives were achieved as there was a record of 0.26495 or 20.294% prediction on the overall test which signifies the level of improvement or achievement. This means that Big data tools have a significant contribution to optimised security management if been integrated into the system as a solution to terrorism problem as it will be more efficient, effective, reliable and productive. The linear regression model has shown a better result when relatively compared to any other approaches in the recent study literature such as Advanced Knowledge Discovery Approach, Paragon Network Analysis (PNA) Approaches, Geographical, General-Purpose and Meta-Search Engines, Chatterbot techniques and Machine Learning Algorithms, as none has been able to achieve a significant level of improvement up to 26%.

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