Role of Business Intelligence in Actuarial Accounting to Enhancing Predict Banking Risks

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Abstract:

This research examines the pivotal role of Business Intelligence (BI) in Actuarial Accounting (AA) within the banking sector, principally concentrating on its influence on generating risk forecasts. Thus employing a descriptive-analytic method, the research conducted a survey of commercial banks in Sudan, selecting two banks as a representative sample. The focused sampling technique was applied, expanding the sample size to 267 individuals in this study with a primary prominence on managers in relevant departments.

The outcomes reveal a compelling relationship between BI and AA dimensions, underscored by three key facets: the augmentation of Analytical Skills (AS), the development of Banking Sector Performance (EP), and the easing of Predicting Banking Risks (PBR). Notably, BI increases risk measurement methodologies, empowering actuary accountants to adeptly expect and address emerging risks within the banking sector. The study validates statistical significance in these relationships, shedding light on how BI not only contributes to the analytical capabilities of professionals but also substantially influences the overall performance of the banking sector, especially in the critical domain of risk forecasting. This research offers valuable insights into the interconnected dynamics of BI and AA, showcasing its practical implications for strategic decision-making and risk management in the banking industry.

Keywords: Business Intelligence, Actuarial Accounting, Banking Sector, Banking Risks

INTRODUCTION:

Following the huge revolution witnessed by the banking sector, which highlighted great technical progress and rapid growth, which makes these banking and financial industry institutions face mounting competition, through the flow of a large amount of data that requires careful analysis to reduce the seriousness of risks and to support those who require rational decisions. On the other hand, in light of these developments, the processes of analyzing, measuring, and anticipating financial and non-financial risks witnessed remarkable progress as a synonymous requirement to meet the needs of stakeholders and investors to help them reduce the intensity of financial and non-financial risks. Raising awareness of the importance and necessity of companies anticipating the financial risks they face to try to manage and control the risks. Meidell, A. and Kaarboe, K., 2017.

In this context we find that Many previous studies and scientific writings have categorized risks into many classifications, (Bushman, et al., El Bouchti, et al., 2018; Hopkin, 2018; Hull, 2018)

The most prominent of which were financial risks, (risks: credit, liquidity, market, interest rate, capital adequacy) and non- Financial risks, which was represented in (risks: operational, legal, business, strategic) and with suggests adding current and contemporary risks, which are cyber risks.

These risks have become a major challenge for institutions, and all of these institutions and banks are looking for solutions and methods to help them predict and deal with risks to reduce their severity. Actuarial science has emerged as one of the methods that these banks are looking to follow. In this study, we will discuss the role of actuarial sciences through actuarial accounting to understand the role that can be played in risk management.

Actuarial science in general and actuarial accounting in particular face several challenges in their attempt to model risk through mathematical and statistical methods, these challenges are getting more complicated day by day due to the amount of huge data that is constantly flowing, so actuarial accounting is constantly trying to improve its ability to predict the increasing risks in The financial and banking sectors in particular. On the other hand, we find that many technologies may help with high efficiency in processing and analyzing data related to the risks of the banking sector, which may be a good nucleus to support actuarial accounting to carry out its tasks. Business intelligence tools are one of these technologies that be used in the banking and financial industry to deal with big data to produce smarter management practices and business decisions. Therefore, we are trying to resort to the use of Actuaries ' techniques with the benefit of Business Intelligence (BI) technologies in an integrated framework to find out its ability to increase efficiency and mitigate risks.

Many studies (Sharma, 2019 MKhalid 2020, Khalid. et al, 2023) have found that a lot of financial entities are turning to the services of Actuaries, particularly in light of the global economy's intense competition as a result of economic and geopolitical fluctuations, cyber threats, and financial crises, which force these institutions to seek to face uncertainties. While (Jugu, 2015) indicated to the meeting point between accounting and actuarial sciences is financial mathematics, as actuarial accounting uses financial mathematics techniques and tools for addressing issues linked to financial risks or asset management, as well as how to deal with financial affairs and financing. In addition, it relies on financial reports based on Generally Accepted Accounting Principles (GAAP), according to which the financial impact is reported. (Odomirok et al, 2014).

According to Shigaev, A. I., & Ivashkevich, V. B. I. (2018),actuarial accounting targeted at decrease financial uncertainties in the future and creating information for the relevant assessment of economic value and future cash flows, protecting and expanding the economic worth of capital providers' (owners and creditors') investments in business entities. While Rafejameel (2016) noted the role that actuarial accounting plays in the process of enhancing the value of an entities through applying accounting and auditing skills and expertise in the field of Statistics and mathematics sciences to enhance financing services and assess current or expected financial risks. Also Shigaev, A. (2011) referred to actuarial accounting, as a provide stakeholders with information about the entity's future economic value in order to manage investment desirability and create market value for their entities.

As a result, we can say that actuarial accounting is one of the integrative sciences that combines the techniques and tools of actuarial sciences represented by mathematical and statistical methods, as well as the capabilities of analytical accounting in the areas of risk management and forecasting, with the goal of maximizing the value of the economic establishment and assisting it in

overcoming cases of uncertainty, and then providing information that assists in making sound decisions.

In contrast, the term business intelligence (BI) was widespread during the 1990s, and this term has been defined in many studies (Al-Okaily, M., & Al-Okaily, A.:2022 Al-Okaily, A., et.al.: 2022, Ajah, I. A., & Nweke, H. F.:2019**,** Turban, E.; Sharda, R.; Delen, D.: 2011) as one of the most important systems, practices, and applications used to analyze data to provide useful information and gain a competitive advantage to improve and develop processes to support decisions. While Aws, A. L., Ping, T. A., & Al-Okaily, M. (2021) have defined "business intelligence as the ability of businesses to think, plan, predict, solve problems, understand, devise new ways to improve business and decision-making processes appropriately, enable effective actions, and help create and achieve business goals".

Regarding the contributions of business intelligence in the banking sector, we discover that business intelligence assists management in developing products or services that are compatible with customer needs, determining competition and pricing strategy, improving revenue management, and increasing sales through data analysis. These analytics can also help to solve financial service difficulties to achieve the best results and improve decision-making - Al-Madadha, et.al. (2022). Furthermore, business intelligence tools are employed for forecasting and developments outside of the bank to provide alternative investment plans. Lim, E. P., Chen, H., & Chen, G. (2013)**.** It also assists banks in lowering continuing costs and expanding available knowledge and resources Moro, S., Cortez, P., & Rita, P. (2015)**.**

Despite the increasing research interest in business intelligence and the use of analytics in the banking sector, there is no study, as far as the researcher knows, that integrates actuarial accounting and business intelligence in the banking sector to enhance the process of risk management and forecasting as well. To know the role in which business intelligence can support actuarial accounting to enhance its ability to analyze data in the banking sector to deal with banking risks, in light of sharp economic fluctuations and increasing competition, and to identify how actuarial accounting can benefit from business intelligence tools to process big data. This study also aims to try to answer the following questions, about is there a relationship between actuarial accounting (AA) and business intelligence (BI)? Does business intelligence and its tools enhance the level of analytical skills (AS) in actuarial accounting in the banking sector to predict risks? Does the use of business intelligence (with) and its tools contribute to enhancing the performance (EP) of the banking sector to predict banking risks? Is there a statistically significant relationship between business intelligence and actuarial accounting to predict banking risks (PBR) and deal with them?

LITERATURE REVIEWS:

There hasn't been much research on integrating actuarial accounting and business intelligence in the banking sector to enhance the process of risk management, but there are many Literature Reviews that have dealt with the components of this study separately, some of which have focused on the role of actuarial accounting in the banking sector, and there are others studies that have dealt with the contributions of business intelligence in the banking sector. Several studies have pointed to the role of actuarial accounting in the banking sector, (Sinkis, Scott, 2013) a survey was carried out to better comprehend the rise of the actuarial profession in the banking sector with a focus on Australia's financial system, where the study revealed that actuaries work in a variety of banking

roles, with a with focus on the credit risk and Treasury modeling, The study showing that (29%) that actuaries are active an Investment Banking and Markets and all related department.

While Sharma (2019) indicated in his study that actuaries are characterized by financial skills and open future horizons by using actuarial modeling techniques. They are also interested in researching and evaluating economic and financial risks and seeking to reduce their severity. And they play a crucial role in assessing the minimum capital requirements and the solvency ratio as defined by Basel III using actuarial modeling techniques. There are also many accountant actuaries employed in the banking sector in credit risk jobs and improving data analysis to achieve efficiency in some banking products such as credit cards, loans, deposits, finance, and liquidity. Their presence also boosts operational efficiency in this industry. As a result of their analytical talents and capacities. (Peabody, 1994). While the Khaled, (2020) study is concerned with the performance effectiveness of the actuarial accountants in reducing the risks of the banking industry, particularly during periods of economic volatility. In contrast, many studies have also found a link between accounting and actuarial sciences, particularly in the areas of financial reporting and risk assessment. According to Jugu (2015), Walker (2017), and Vyas (2019), many aspects are a meeting point between accounting and actuarial sciences, which are represented in financial reports and international reporting standards such as IAS 39: Financial Instruments: Recognition and Measurement, IFRS 9 Financial Instruments, and International Financial Reporting Standard in the banking sector. These standards, in turn, govern the work of actuarial accounting in the banking sector, which necessitates a variety of actuarial skills ranging from strong quantitative skills to risk management and project management, and these standards assist banks in shifting from the incurred loss model to the expected loss model, which is one of the primary goals of actuarial accounting. According to Luchik, Yevdoshchak, and Manachynska (2018), the implementation of general financial reporting requirements would be a solid starting point for the introduction of actuarial accounting for analytical and prediction and support the activities of the management of banks.

Actuarial accountants also contribute significantly to risk management. According to Gordon (2017), actuaries' cumulative experience provides them with a wide range of suitable skills, allowing them to examine the full range of risks that can impact of entity, taking into account financial and non-financial factors, and then providing useful informational content to decision-makers in a balanced and effective technique.

Regarding the contributions of business intelligence to banking risks in the banking industry, we find Wu. D., Chen, et al (2014), Yiu, LD, et al (2021), and Hair Jr. and GF (2007), indicated improvement in the effectiveness and efficiency of employing business intelligence to mitigate risks, which is reflected in company profitability. While Al-Madadha, A.et al. (2022) highlight the business intelligence tools employed in the banking industry, such as data mining, data warehousing, and decision support, In this regard, data analytics are used to estimate predictive hazards after analyzing large amounts of data, as well as to contribute to the achievement of outcomes that enable rational decision-making.

As for the study Alzeaideen, K. (2019) it pointed to the openness of the banking sector to adopt Data Mining and Data Warehouse Management, which can be considered one of the business intelligence technologies that enhances dealing with banking risks, the study also pointed to the possibility of designing many techniques of artificial intelligence and business intelligence and that

these models are a good addition to the factor with the influx of huge data and improves the efficiency of risk management.

Regarding the importance and nature of the relationship between actuarial accounting and business intelligence (BI) in the banking sector, we failed to discover any direct study, but we found a few studies that focused on actuarial accounting or actuarial science in general and their relationship with some tools that fall within the scope of business intelligence (BI). Lozano (2021), and Richman, R. (2018) indicated, an attempt to utilize machine learning techniques and artificial intelligence models to produce efficient and effective actuarial models, and these Models have demonstrated higher accuracy in the risk prediction process. While Hassani, H. Unger, S. Binky, and C (2020) discuss the impact of big data on the actuarial industry through data analytics and data mining, they conclude that there is an enormous benefit from the use of data analytics and the ability to access to data, that help companies operating in the fields of risk management and dealing with cases of uncertainty.

Meeting Point Between Business Intelligence BI and Actuarial Accounting AA

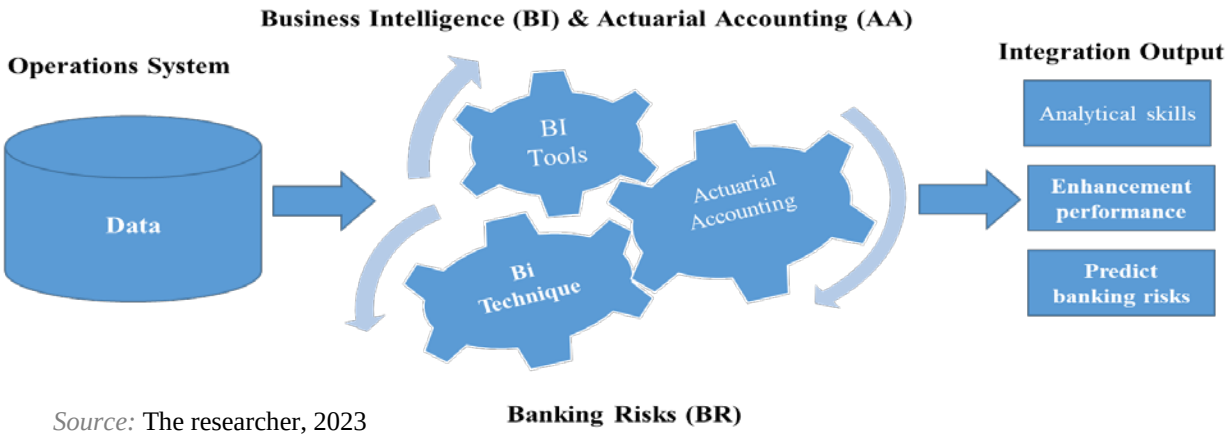
To reflect the points of convergence between business intelligence and actuarial accounting, the researcher worked to clarify the mechanism of work within a framework that approximates the points of view, so the researcher sought to reconcile the goals that actuarial accounting seeks to achieve, and the tools that business intelligence can provide to achieve these goals, through an interactive mechanism combining these two approaches, see Table 1 and Fig.

Table I: Meeting point of BI &AA

Business intelligence BI	Actuarial Accounting AA
➢ **Banking Business Intelligence Tools:** • Microsoft Power BI • Tableau • Domo • TIBCO Spotfire • SAP Business Intelligence • Oracle BI ➢ **Banking Business Intelligence Techniques:** ▪ Data visualization ▪ Data mining ▪ Data warehouse ▪ OLAP ▪ Prescriptive analytics ▪ Predictive analytics ▪ Predictive modelling ▪ Data analysis ▪ Performance management ▪ Benchmarking ▪ Cluster analysis ▪ Real-time business intelligence ▪ Cloud computing ▪ Visual analytics	➢ **Actuarial accounting objectives:** ▪ Capital optimization and profit maximization. ▪ Improve the enterprise's competitiveness. ▪ Reporting on solvency and risk assessment. ▪ Ability to manage and predict the risks. ➢ **Financial Risk In Banking Sector:** ▪ Credit risk. ▪ Liquidity risk. ▪ Interest rate risk. ▪ Market risk. ▪ Operational risk. ▪ Other risks (regulatory ,legal, reputation) ➢ **Risk measurement:** ▪ Asset and Liability Management (ALM) ▪ Value at Risk (VAR) ▪ Economic Capital (EC) ▪ Stress and Scenario Testing (SST).

Source: **The researcher, 2023**

Fig1: Meeting point of BI &AA



Source: The researcher, 2023

Table 1, Fig1 above reflect the points of convergence between BI and AA in the banking industry by focusing on the aims that actuarial accounting seeks to achieve, which are: Work on capital optimization and profit maximization. Improve the enterprise's competitiveness. - Take part in reporting on solvency and risk assessment. Developing the ability to manage and predict current and future risks, increasing capital through improving risk management. Actuarial accountants also work to address emerging banking risks such as credit risk, liquidity risk, interest rate risk, market risk, operational risk, and other risks.

On the other hand, to achieve the goals that actuarial accounting seeks to achieve in the field of risk management, it must use risk measurement tools such as Asset and Liability Management (ALM) Value at Risk (VAR) Economic Capital (EC) Stress and Scenario Testing (SST). Furthermore, these standards are heavily reliant on business intelligence tools and processes. M. Rajiv, K Sonjai, (2021).

While we find that BI systems and programs in the banking sector work to provide many tools and techniques that increase the ability and effectiveness of organizing access to data from various sources, such as customer data, products, services, operational activities, suppliers, and all sources on which the bank relies. Rahman, M. M. (2023) and Sundjaja, A. M. (2013), and this data requires a variety of techniques for handling and arranging it referred to by, Ana Misiuro, (2022)and Duygun-Fethi, M., & Pasiouras, F. (2009), and among these techniques, as shown in Table 1, as big data, we additionally find data management, data mining, data visualization, Data warehouse OLAP, Prescriptive analytics, Predictive Analytics, Predictive Modeling, Data analysis, visual analytics, and so on. As shown in Table 1, these strategies enable business intelligence systems to generate a plethora of tools, and these techniques and tools provide the appropriate mechanisms on which actuarial accounting relies to fulfill objectives, particularly in the areas of risk management and forecasting. The outputs of this interaction are the production reports about Enhancement Analytical Skills, Performance, and Predict Banking Risks and achieve the desired results.

RESEARCH METHODOLOGY:

The analytical descriptive approach and many other statistical tools were utilized on the intended population of managers who participated in the study, and the following methodology and tools were used to accomplish the study's objective:

A- Design of the study sample:

The study sample consists of the Sudanese banking sector, focusing on commercial Banks that are at the forefront of using business intelligence on a large scale. After communicating with a number of banks management, the response was limited due to the raging war situation in Sudan, and following the initial scan, two commercial banks were selected as being among the pioneers in the field of hiring actuarial experts, as they have precedence and leadership in the field of developing and using business intelligence tools and techniques. The Bank of Khartoum, which has 150 branches, and Al Baraka Bank, 26 branches, were chosen with a wide spread in Sudan. The focus was on the study sample through the intentional sample, and the target was the branch managers, heads of departments and actuaries see (Table 2). The organized survey was conducted for research purposes, and 350 questionnaires were sent to the target group, and the respondents were 267, at a rate of 76.3% of the target sample.

(Table 2) shows the intended sample of the study through the demographic data of the study.

:Table 2: Demographic Statistic

Demographic Factors	Count	Percentage
Education		
Bachelor's degree	78	29.2
Higher Diploma	33	12.4
Master's degree	64	24.0
PhD	79	29.6
Other	13	4.9
Total	**267**	**100.0**
Job Positions		
Banking actuary	2	.7
Risk Management manager	92	34.5
Finance and Investment manager	51	19.1
Head of IT department.	62	23.2
Financial control manager	60	22.5
Total	**267**	**100.0**
Operating years (Bank Age)		
5. - 10	18	6.7
10. - 15	24	9.0
15 - 20	68	25.5
20 - 25	98	36.7
MOER THAN 25	59	22.1
Total	267	100.0

Source: Survey data

B- Data Collection Methods:

The data was gathered using a questionnaire designed specifically for this study, as it is one of the least expensive and easiest-to-use approaches, in addition to the scarcity of accurate actuarial data and the difficulty of obtaining them. Its axes were based on previous studies and the theoretical framework. The questionnaire included four main axes that included 24 items covering the dimensions and hypotheses of the study, see (Table 3). All items were measured using a five-point (Likert, 1932) Mohammed E. M. E, et al (2022) scale from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was sent to the intended sample. The survey was available for a period of three weeks starting from June 2023, via Email, WhatsApp, and Messenger.

C- Hypotheses:

- ✓ ***H1:*** There is a statistically significant relationship between business intelligence (BI) and actuarial accounting (AA) at the level of analytical skills to predict bank risks (AS).

- ✓ ***H2: There*** is a statistically significant relationship between business intelligence (BI) and actuarial accounting (AA) at the level of enhancement in the performance of the banking sector to predict banking risks. (EP)
- ✓ ***H3***: There is a statistically significant relationship between business intelligence (BI) and actuarial accounting (AA) to predict banking risks (PBR) and deal with them?

RESULTS AND DISCUSSION:

a) Measurement Sample Testing:

For Reliability and validity of obtained sampling Cronbach's Alpha for all factors scale is used. and it was 0.930 which exceeded the minimum standard of 0.7 recommended by Nunnally, 1978, and Peterson 1994 for scale reliability. And then, confirmatory factor analysis was conducted in order to verify the characteristic of convergent validity of the measurement items (Anderson and Gerbin, 1998; Bagozzi and Foxall, 1996), Suleiman, et.al (2021) (Table 3).

Table: 3: Variables and Reliability

Type	Variables	Dimension	Items	Cronbach's Alpha	
Independent	**Business Intelligence (BI)**	Business Intelligence (BI)	**8**	**0.921**	**0.930**
Dependent	**Actuarial Accounting**	Analytical Skills (AS)	**8**	**0.897**	
		Enhancement Performance (EP)	**4**	**0.907**	
		Predict Banking Risks (PBR)	**4**	**0.923**	

Source: Survey data, SPSS V23 -2023

For checking sampling adequacy, Kaiser-Meyer-Oklin (KMO) and Bartlett's test of Spherity were performed. The value of KMO (0.922) and Bartlett's test of Spherity ($\chi 2$ = 7645.608, df = 276 and $p \leq 0.000$) represented the adequacy of sampling for further analysis. The data was analyzed using principal axis factoring and promax with Kaiser Normalization rotation method. Four factors were identified. These four factors were labeled as BI-AS-EP-PBR.

b) Confirmatory Factor Analysis:

Table 4: Rotated Component Matrix

	Component			
	1	2	3	4
Q23	.897			
Q8	.893			
Q7	.892			
Q4	.884			
Q15	.880			
Q24	.561	.462		
Q12	.451	.424		
Q3	.419	.416		.402
Q10		.736		.345
Q6		.723		.381
Q19		.711		.339
Q2		.651	.371	
Q1		.634		
Q20		.633		.338
Q22	.499	.573		
Q21	.414	.570	.325	
Q5	.444		.758	
Q17			.729	.487
Q9	.527		.718	

Q13	.370	.356	.507	
Q18			.354	.713
Q14				.701
Q11	.307	.548		.551
Q16		.388	.543	.545

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

"Confirmatory factor analysis" was executed using AMOS to examine the discriminant validity of the variables of this study. Factor analysis was performed with 1 as the Eigen value to improve the strength of the factors. Then, four factors were extracted when the rotation converged in their iterations. The four factors were BI, AS, EP, and PBR. Table 4 shows the Rotated Component Matrix of factors by Rotation Method: Varimax with Kaiser Normalization., which shows the saturation of the factors and the extent of the correlation of the variables after the development process, which Rotation converged in 8 iterations, also the table showed that there is independence in the correlation between the variables, which indicates the validity of the analysis.

c) Descriptive Statistics:

For the Descriptive Statistics of this study and for the Reliability of the Main Variables, we used the mean, standard deviation, and correlation among the variables. See Table (5).
The means calculated for the study variables are: "BI" (M =4.0144, S.D = .58802), "AS" (M = 3.9938, S.D = .60694), "EP" (M =3.8820, S.D =.65219), "PBR" (M = 4.1117, S.D =.51613), we find the Means of all of the study's variables and the direction of the study sample answers tend to be high, a (Mean 3). Correlation analysis was piloted to report the association between the variables. Also, when we look at the correlation existing between independent variables and dependent variables, we find that all study variables are significantly associated with each other.

Table 5: Means, Standard deviations, Correlations, and Reliabilities

Variables	Mean	SD	BI	AS	EP	PBR
BI	4.0144	.58802	1			
AS	3.9938	.60694	.910**	1		
EP	3.8820	.65219	.780**	.787**	1	
PBR	4.1117	.51613	.840**	.852**	.706**	1

****. Correlation is significant at the 0.01 level (2-tailed).**
Source: Survey data, SPSS V23 -2023

d) Testing of Hypotheses and Finds:

Simple regression has been used in this study hypotheses to test the relationship levels (weak and strong), type of relationship (negative and positive), significant level, standardized coefficient (βeta) value, un-standardized coefficient (β), Adjusted R Square (R2) Change R Square, Durbin-Watson (D.W), and F-Test value.

Table 6: Test of Simple Regression between BI - And AA- Dimensions

Variables	BI							
	βeta	Sig	R Square (R2)	Adjusted R Square (R2)	Change R Square (R2)	Durbin-Watson	F-value	Sig
AS	.910	.000	.910	.827	.827	1.871	1271.073	.000
EP	.780	.000	.780	.608	.607	2.021	411.573	.000
PBR	.840	.000	.840	.705	.704	2.021	633.927	.000

Source: Survey data, SPSS V23 -2023

Table (6) showed the test and results of simple regression of the relationship between BI and AA Dimension: there is positive and significant relationship between BI and AA dimensions, on the

standardized coefficient level, as the table show that all (βeta) factors are significant on (Sig 0.000), and that reflect there is positive and significant relationship between BI and AA Dimensions. also the Table (6) showed the test and results of simple regression of (R2) Adjusted R Square (R2) ,It swings between 0.70 to 0.90 as the all variables and Dimensions that mean the impact and the change in the BI variables was explained by AA dimensions variables around (70% - 80%) percentage and the remain of percentage returned to other factor as result on random mistake, also the table showed F-test values that the simple regression model is Significant (0.000), additionally the Durbin-Watson (D.W) was used and Significant at the (0.05) level are swings between (1.8 - 2.1) it explain that there is no-relationship between mistake random of using Durbin-Watson, the result of regression showed that (all factors) are Significant, according to showed results the model approve .

DISCUSSION:

This study aimed to investigate the role of business intelligence (BI) in actuarial accounting in the banking sector, particularly, in predicting banking risks, the study pointed to the support that business intelligence tools and techniques can provide to actuarial accounting for the effectiveness and efficiency of risk forecasting, and the study focused on the dimensions of the impact of business intelligence on the analytical skills (AS) of the actuarial accountant in the banking environment, and the study found that business intelligence enhances the analytical skills of an actuary through the use of business intelligence techniques such as increasing His competence in dealing with big data, as well as data mining and extraction, as well as his ability in data modeling, due to the actuarial accountant's analytical potential gained from actuarial accounting.

The study's findings also revealed a statistically significant relationship between business intelligence (BI) tools and techniques, and actuarial accounting (AA) at the level of enhancing banking sector performance (EP) in order to predict banking risks, through the support that tools and techniques can provide by (BI) to actuarial accountant's to help it choose the best investment tools, maximize profits and also strengthens his function in enhancing key performance indicators and his ability to undertake an adequate examination of capital adequacy to survive financial crises.

The study also found a positive relationship between business intelligence (BI) and actuarial accounting (AA) to predict and deal with banking risks (PBR) considering business intelligence tools assist the actuary accountant in accessing predictive analyses and studying uncertainties to deal with current and expected banking risks. , by enhancing his skills acquired from mathematics, statistics, and economics, which enable him to cope with predicting instances smoothly, especially in light of uncertainty. And then assist it in preparing financial solvency reports and assessing emerging risks such as credit risk, liquidity, interest rates, market, quantitative operational risks, and other risks. It also reassures stakeholders about the bank's ability to overcome financial crises and assists them in making decisions based on professionally analyzed data, increasing the likelihood that such decisions will be rational and improving operational efficiency, which improves dealing with banking risks.

Accordingly, we find the study recommended working on developing and addressing the structural construction in the Sudanese banking sector, as well as seeking to strengthen the banking technological structure through improving the tools and techniques of business intelligence as a basic pillar of banking development, and that this should not be done in isolation from actuarial accounting. The study also emphasizes the importance of providing a larger space for the development of actuarial work integrated with business intelligence systems to enhance bank operational efficiency and increase analytical capabilities that assist banks in dealing with current and

potential risks and predicting them in light of economic fluctuations in the world of finance and business.

The study additionally recommends that the banking sector encourage and facilitate the combined use of actuarial accounting and business intelligence techniques through ongoing training and development, as this will provide a sound analytical foundation in this field.

CONTRIBUTIONS

This study contributes to the literature on actuarial accounting and business intelligence in the banking area, particularly in the context of forecasting banking risks. This study is considered original because it was conducted on a sample of commercial banks in Sudan, a country that faces numerous challenges due to geopolitical complications. According to the researcher's knowledge, there are no studies dealing with the integration or assessing the relationship between actuarial accounting and business intelligence at the state level, and the study attempts to fill a research gap in the literature. The study's findings indicated the advantages that business intelligence techniques and approaches may bring for actuarial accounting in order to improve capabilities. And to effectively deal with banking risks.

CONCLUSION

Based on the analysis of the study's findings and testing the hypotheses' validity, the study concluded that business intelligence (BI) enhances the analytical skills of the actuary accountant in the field of banking risks by allowing him to deal with huge quantities of analytical data and data models to handle administrative and financial operations. The study also concluded that business intelligence (BI) enhances the role of actuarial accounting in improving banking sector performance in dealing with banking risks by conducting appropriate analysis of capital adequacy to withstand financial crises and assisting in choosing the best investment tools to maximize profits. It also assists in the enhancement of key performance indicators, hence increasing the bank's competitiveness.

The survey results also confirmed that business intelligence (BI) and its tools assist actuarial accounting (AA) predict banking risks (PBR) by improving risk measurement methods and enhancing the actuary accountant's ability to predict and address emerging banking risks such as credit risk, liquidity risk, interest rate risk, market risk, and operational risk. It also supports the preparation of reports on financial solvency and risk assessment, which reassure stakeholders of the bank's ability to overcome financial crises.

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