



The Impact of Digital Auditing on Reducing Internal Control Risks at Jordanian Commercial Banks

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Abstract

This study aimed to identify the impact of digital auditing in reducing internal control risks in Jordanian banks listed on the Amman Stock Exchange. The study was applied to 13 Jordanian commercial banks listed on the Amman Stock Exchange at the end of the year 2021. The study's results showed a statistically significant impact of the aspects of digital auditing (data analysis, data mining, machine learning, and cloud computing) combined in reducing the internal control risks listed in the Amman Stock Exchange. Moreover, the study recommended that Jordanian commercial banks should enhance their use of technologies associated with digital auditing, especially those that rely on processing large volumes of data rapidly and accurately, such as data analytics and machine learning. This would contribute to improving the efficiency and effectiveness of the audit process, completing audit tasks with minimal cost, effort, and time, thereby enhancing audit quality and reducing potential audit risks.

Keywords: Digital Audit, internal control risks, Data Analysis, Data Mining, Cloud Computing, Jordanian Commercial Banks.

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1.Introduction:

In light of the rapid and ongoing advancements in digital technology, organizations across all sectors have faced increasing pressure to adopt digital solutions that enhance operational efficiency and decision-making. As noted by Al-Rhaifeh (2023) and Amour (2023), the shift towards digital auditing has become essential due to the increasing complexity of organizational environments and the growing need for effective internal control mechanisms.

Technological developments have brought about significant changes in the work environment. The introduction of advanced digital tools has enabled the acquisition of vast amounts of new data, enhanced information flow, improved productivity, fostered creativity, and provided practical solutions for organizational needs. To capitalize on these benefits, institutions must implement comprehensive digital transformation strategies across their operations, ensuring effective management while avoiding complex transitions that may introduce new risks.

The auditing profession must adapt to digital changes given its role in ensuring organizational continuity and accountability. Digital auditing—through tools such as data analysis, data mining, cloud computing, and machine learning—has improved audit quality, reduced costs, and increased operational efficiency (Kawar & Al-Ali, 2025).

Internal control systems (ICS) remain central to business operations, offering a framework for detecting deviations, errors, and irregularities. Key ICS components include risk assessment, communication systems, control environment, and monitoring activities (Osman, 2024). Proper implementation of these systems reduces internal control risks (ICRs), such as fraud and misstatements, which often arise from design flaws or poor execution of internal controls.

Given the strategic role of Jordanian commercial banks in the national economy—and their high-volume, complex financial operations—this sector provides a fertile ground for examining the impact of digital auditing on ICRs. Therefore, this study aims to identify the impact of digital auditing (specifically data analysis, data mining, cloud computing, and machine learning) on reducing internal control risks in Jordanian commercial banks. It seeks to fill the gap in literature

where prior studies have not comprehensively addressed the interplay between digital auditing tools and internal risk mitigation in this sector.

Accordingly, the main research question is:

What is the impact of digital auditing (data analysis, data mining, cloud computing, and machine learning) on reducing ICRs in Jordanian commercial banks?

This question is further divided into four sub-questions:

1. What is the impact of data analysis on reducing ICRs?
2. What is the impact of data mining on reducing ICRs?
3. What is the impact of cloud computing on reducing ICRs?
4. What is the impact of machine learning on reducing ICRs?

2. Study Significance:

This study is significant for demonstrating the impact of digital auditing on reducing ICRs in Jordanian commercial banks. The study's significance can be highlighted from two perspectives:

I. Scientific Significance: This study is deemed interesting because it relates to the efforts of researchers who have addressed the subject of this study or parts thereof in their research. It contributes to forming an additional body of knowledge in this field, as it can serve as a reference for future studies by raising issues and questions that could be considered.

II. Practical Significance): The scientific significance is summarised in the potential contribution of this study's results in assisting Jordanian commercial banks in achieving the desired development and progress in digital auditing and reducing control risks. The practical significance of the study lies in providing support to Jordanian commercial banks to pay greater attention to digital auditing, drawing the attention of stakeholders (senior management in Jordanian commercial banks, auditors, and professional organizations concerned with auditing) to the importance and role of digital auditing in reducing ICRs. This can be achieved by focusing on its main components.

3. Study Hypotheses:

Main Hypothesis:

Ho: There is no statistically significant impact at a significance level of ($\alpha \leq 0.05$) for digital auditing (data analysis, data mining, cloud computing and machine learning) represented by its aspects on reducing ICRs in Jordanian commercial banks.

Digital Auditing Concept:

Technological advancements have increased the focus on modern technologies in the auditing process. These technologies save time and effort in auditing, positively impacting its efficiency and effectiveness (Al-Sammarrae & Al-Shareeda, 2020).

Numerous accounting literature and studies have addressed the concept of digital auditing from various perspectives. (Barbari & Bouali 2017) stated that it involves auditors conducting audits using information technology methods.

The researcher views digital auditing as conducting the auditing process in all stages using modern methods and technologies. The current study addressed four aspects of digital auditing, presented as follows:

Digital Auditing Aspects:

I. Data analysis: In **digital auditing**, data analysis involves using various modern digital methods and techniques to examine and process vast amounts of data, uncovering necessary information that helps understand activities, and functions and forecast future events based on derived information. Data analysis also pertains to examining big data to discover patterns, unknown correlations, and other critical and essential information that traditional auditing tools could not previously analyze (Vanani and Majidian, 2019).

It depends on the nature and volume of the data to be analyzed.

The researcher believes that data analysis is one of the most critical aspects of digital auditing. Its importance stems from the significance of the data itself, as the

data audited by the auditor reflects the financial events of the company being audited.

II. Data Mining: Data mining refers to modern digital techniques and methods to explore large volumes of integrated data to extract unexpected information or patterns. It involves analyzing data by integrating AI techniques and statistical processes (Al-Farsi, 2022).

The data objectives mining includes uncovering new knowledge, unknown patterns, rules, correlations, changes, anomalies, and significant structures within large databases.

The researcher views data mining as an advanced method of data analysis that involves searching and exploring to identify unknown patterns and significant relationships within databases. This is achieved through AI, statistical methods, and advanced database techniques.

III. Machine Learning: Machine learning is an analytical approach related to AI and modern technology, relying on advanced digital technical standards to focus on prediction and decision-making based on learning. Moreover, machine learning represents a shift from traditional learning to modern technical learning across various fields, accompanied by numerous benefits that have enhanced and expanded the scope of learning processes (Al Jarah et al, 2019).

Machine learning algorithms are classified into two types: supervised learning algorithms that require the user to provide large amounts of data to predict the desired output values and specify the accuracy of predictions during the training phase. Once the algorithm completes its learning process, it applies the acquired knowledge to new data. The other type is unsupervised learning algorithms, which do not require training with specific output values. Instead, they use a different approach called deep learning, which involves broader automated learning processes. Unsupervised learning algorithms handle more complex tasks than supervised learning systems (James et al, 2018).

The researcher believes that machine learning is a modern concept of AI, which relies on different algorithms for learning methods, to obtain information, predict it in the future, and apply learned lessons to new data to obtain new information, which leads to the development of learning methods.

IV. Cloud Computing: Cloud computing is one of the advanced concepts in business technology, offering services to users in the form of a digital cloud accessible via the Internet. It represents a modern technique for disseminating information online, where services are delivered in a technologically advanced manner that makes them measurable, allowing for pricing based on a pay-per-use model (Karima, 2021).

Cloud computing is an essential aspect of digital auditing, as auditors have come to rely on modern programs and technologies prepared in the digital cloud containing the information needed during the audit process (Sharma et al, 2017). Furthermore, it is easy to use and reduce costs associated with obtaining the information (Al-Shamrani & Al-Asmary, 2021).

Importance of Digital Auditing:

The importance of digital auditing lies in auditing various processes and activities within companies in a sophisticated manner based on modern methods and technologies. This approach may help to streamline the operations of companies in an appropriate and planned manner. The importance of digital auditing is also evident in its role in achieving an audit strategy, which includes the plans, methods, and procedures that auditors will rely on during the audit process (Barbari & Bouali 2017).

Digital auditing also contributes to achieving cost efficiency by reducing the cost of auditing services and increasing the profitability of audit firms. This is achieved through the use of auditing software in financial data auditing, enabling auditing services to be completed more quickly. It also enhances audit quality, as it allows

audit firms to carry out their tasks efficiently and effectively through the use of digital software. This software helps auditors gain deeper and quicker insights into the activities of the audited company, monitor its operations, and understand the sector it operates in.

The researcher believes that digital auditing is important as digital auditing provides a competitive advantage to audit firms by offering their services quickly and accurately. Furthermore, the importance of digital auditing lies in assisting the auditor during the auditing process by developing digital auditing software that helps the auditor access the needed data at any time.

The Concept of ICRs:

The concept of internal control has evolved as a result of the growth in the size of companies in the business world. Companies of all types have become increasingly concerned with internal control systems due to their significant importance in controlling various activities and operations at different levels within companies, which can lead to the achievement of company objectives in the appropriate and planned manner.

ICRs constitute a violation or threat to the achievement of company objectives, as these risks negatively affect various activities in different companies. Accounting literature and studies have addressed the concept of ICRs. (Nikolovoski et al, 2016) defined them as those errors that occur and the inability of the internal control system to detect or prevent them, which arise from the exposure of financial data to material misstatements without being detected or corrected by internal controls. (Hassan, 2017) defined them as the risks that may occur partially or individually in a specific balance or account item due to the ineffectiveness of the internal control system.

Based on the foregoing, the researcher concludes that ICRs refer to material misstatements or misstatements in the data or transactions, such that these

misstatements materially affect the remaining data and transactions and the inability of the internal control system to detect them.

The Importance of Assessing ICRs:

The assessing importance of ICRs is one of the most important elements related to internal control, as these risks "ICRs" threaten the achievement of the company's objectives and affect its operations. The importance of assessing these risks lies in discovering, identifying, evaluating, and overcoming these risks. It shall be noted here that the risks related to internal control are either internal or external risks that may prevent the achievement of the specified objectives at all levels of the organizational hierarchy, which requires management to take the necessary measures to prevent or mitigate these risks (Ali et al., 2018).

After reviewing the foregoing, the researcher concludes that the importance of assessing ICRs helps the company to identify sources of risk and deviations in its various activities, identify weaknesses in the internal control system, and reach appropriate methods to deal with those risks in the event of their occurrence, which helps the company's management make the appropriate decisions to prevent or mitigate those risks to the permissible limit.

The Relationship between Digital Auditing and Mitigating Control Risks

The auditor obtains this evidence to verify whether the internal control system is operating as required and by the company's activities and can monitor these activities at various levels. It also serves to verify whether this system can detect deviations and risks that have occurred or may occur and that this system is capable of mitigating these risks to an acceptable level so that these risks do not affect other activities (Manita et al, 2020).

Many studies have addressed the relationship between digital auditing and mitigating control risks, either directly or indirectly. A study by (Abu Aliweh, 2019) indicated the role of digital auditing in improving the quality of the outputs of the

internal control system, which concluded that there is a significant role for technical auditing in improving the quality and effectiveness of the outputs of the internal control system, which may reduce potential ICRs.

Based on the foregoing, the researcher concludes that the digital auditing process helps detect ICRs through the modern technical methods that the auditor has come to rely on, which have helped in obtaining the information that the auditor needs more quickly and related to the effectiveness of the internal control system and its ability to detect risks.

Previous Studies:

A Study by (Al-Rhaifeh, 2023) titled: "The Role of Information Technology Tools in Enhancing Internal Control in Jordanian Commercial Banks"

This study aimed to explore the role of information technology tools in enhancing internal control systems within Jordanian commercial banks. The study used a quantitative research approach, relying on surveys to collect data from employees in the banking sector. The research focused on understanding how tools such as software systems, data analytics, and cloud computing contribute to strengthening internal control frameworks. The study found that the integration of information technology tools significantly enhances the efficiency and effectiveness of internal control practices. The study recommended that banks invest further in advanced IT tools to improve risk management and operational efficiency.

A Study by (Amour, 2023) titled: "The Impact of Digital Transformation on Mitigating Institutional Risks: The Mediating Role of Internal Auditing in Jordanian Commercial Banks"

The study aimed to analyze the impact of digital transformation on reducing institutional risks in Jordanian commercial banks, with a focus on the mediating role of internal auditing. A mixed-methods approach was adopted, combining both quantitative analysis through surveys and qualitative interviews with internal auditors. The study found that digital transformation positively impacts the

reduction of institutional risks, with internal auditing playing a crucial mediating role in this process. The study recommended enhancing the digital skills of auditors and increasing the adoption of digital auditing tools to better manage institutional risks.

A Study by (Abu Amro, 2023) titled: "The Impact of Information Technology Auditing on the Effectiveness of Accounting Information Systems in Jordanian Commercial Banks"

This study examined the effect of information technology auditing on the effectiveness of accounting information systems in Jordanian commercial banks. The study followed a qualitative approach, using case studies and interviews with bank personnel to understand the relationship between IT auditing and accounting system performance. The study concluded that robust IT auditing significantly improves the effectiveness of accounting information systems by ensuring data integrity and system security. The study recommended that banks strengthen their IT auditing practices to align with modern technological developments, ensuring greater reliability and accuracy in their accounting systems.

A Study by (Osman, 2024) titled: "The Role of the Internal Control System in Reducing Risks Related to the Use of Blockchain Technology in Light of COSO Guidelines".

This study explores how the application of an internal control system based on the COSO framework can help mitigate risks associated with the use of blockchain technology in organizations. The research focuses on aligning COSO's five components—control environment, risk assessment, control activities, information and communication, and monitoring activities—with the challenges posed by blockchain adoption. By analyzing these components, the study provides insights into how internal control mechanisms can be adapted to ensure effective risk management in the context of emerging technologies. Conducted at the University of Mosul in 2024, this research contributes to the understanding of integrating

traditional control systems with modern technologies to enhance organizational governance and security.

A Study by (Khalil, 2024) titled: “The Impact of Using Artificial Intelligence Technologies on the Quality of External Auditing – A Survey Study”.

This study aims to investigate the impact of employing artificial intelligence (AI) technologies on the quality of the external auditing process. It focuses on identifying the most prominent AI technologies used in the field of auditing and analyzing their role in enhancing audit quality in terms of accuracy, efficiency, and risk detection. The researcher adopted a survey-based methodology by distributing questionnaires to a targeted sample of auditors and professionals in the auditing sector. The results indicate that AI technologies play a significant role in improving the quality of external audits, particularly in reducing human error, increasing the accuracy of financial analysis, and supporting auditors in making more informed decisions.

A Study by (Ismail, 2024) titled: “Enhancing the Effectiveness of Internal Control in Reducing Errors and Fraud through the Use of Audit Risk Indicators.”

This study examines how the use of audit risk indicators can enhance the effectiveness of internal control systems in detecting errors and fraud within organizations. The research highlights the importance of proactive risk signals in strengthening internal oversight mechanisms and preventing irregularities before they escalate. By focusing on the role of audit warning signs, the study provides a framework for improving early detection and response strategies in internal auditing. Conducted at the University of Mosul in 2024, the research offers practical implications for auditors and internal control professionals seeking to improve organizational integrity and transparency.

A Study by (Kawar & Al-Ali , 2025) titled: "The role of Digital Transformation Technologies in Enhancing the Efficiency of the Auditing process" Field study A Field Study in the Companies and Audit Offices Listed in the Securities and Exchange Commission in Damascus"

This research aims to understand the role of digital transformation technologies in enhancing the efficiency of the external auditing process. This is achieved by identifying its main pillars and the key technological means associated with digital transformation and their contribution to improving the efficiency of the auditing process. Subsequently, the study aims to define the efficiency of the auditing process and highlight its main elements. To achieve the study's objectives, a field study was conducted by designing a questionnaire that was distributed to the study's community and sample of audit offices and firms accredited by the Securities and Financial Markets Authority. A total of 90 questionnaires were distributed, and 70 sample were retrieved and deemed analyzable. The hypotheses were tested using the SPSS.VER26 program. The study concluded that digital transformation significantly enhances the efficiency of the external auditing process by reducing the time required to complete the external audit and lowering the costs associated with the external auditing process.

What Distinguishes the Current Study from Previous Studies:

The current study on the "Impact of Digital Auditing on Reducing Internal Control Risks in Jordanian Commercial Banks" distinguishes itself from previous research in several keyways. First, while previous studies have focused on the broader impacts of digital auditing or its effects on different variables, the current study specifically examines its direct impact on internal control risks (ICRs) in Jordanian commercial banks. For instance, the study by (Tasnime, 2023) focused on how information technology tools enhance internal control effectiveness in Jordanian banks but did not explore ICRs as a specific outcome. Meanwhile, (Doaa, 2023) analyzed the role

of digital transformation in reducing institutional risks with an emphasis on the intermediary role of internal auditing but did not directly link digital auditing tools to ICRs. Moreover, the current study incorporates four key digital auditing tools (data analysis, data mining, cloud computing, and machine learning) as independent variables to examine their specific contributions to mitigating ICRs, which differentiates it from studies like (Eman, 2023), which focused on the effectiveness of IT audits on accounting information systems rather than on internal control risk reduction specifically.

In addition, recent studies have investigated emerging technologies in audit and internal control contexts but from different perspectives. For example, the study by (Khalil, 2024) examined the impact of using artificial intelligence technologies on the quality of external auditing, highlighting their role in increasing audit accuracy and efficiency but without addressing their relationship to internal control risks. Similarly, (Osman, 2024) explored how the COSO-based internal control system can mitigate blockchain-related risks, yet the focus was on blockchain rather than digital auditing tools per se. The study by (Ismail, 2024) emphasized enhancing internal control effectiveness through audit risk indicators, concentrating more on fraud and error detection mechanisms rather than digital audit tools. Furthermore, (Kawar & Al-Ali, 2025) analyzed how digital transformation technologies improve audit efficiency in Syria, but their scope was limited to audit performance outcomes rather than risk mitigation.

This focus on digital auditing tools and their direct link to internal control risks is what sets the current study apart, offering a targeted analysis within the Jordanian banking sector using a structured, multi-variable model to test the influence of specific digital tools on ICRs.

Research Methodology:

The study adopted a descriptive-analytical approach to clarify the relationship between the study variables (digital auditing and reducing ICRs) to determine the extent of their impact on the research problem, and to reveal their trends to reach the best solutions that explain and clarify the relationship between the variables.

Study Population and Sample:

The study population consists of managers, deputy managers, and directors and heads of internal audit, internal control, and information technology departments using digital auditing in Jordanian commercial banks, totaling 13 banks. Given the small size of the study population, a complete enumeration method was adopted in determining the study sample, which included all elements of the study population, namely 13 Jordanian commercial banks.

Study Variables and Operational Definitions:

Table 1 below presents the main variables of the study, their dimensions, theoretical and operational definitions, how each was measured, and the references used in developing the instrument.

Variable/ Dimension	Measurement Method	Theoretical Definition	Reference	Operational Definition
Digital Auditing	Measured using a structured questionnaire with 22 items across three dimensions. A 5-point Likert scale was used, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree)	Digital auditing uses modern technologies, especially AI, to improve audit accuracy and efficiency by automating tasks like planning and reporting within digital environments.	(Al-Fadli & Al-Amiri, 2025)	Refers to verifying the efficiency and effectiveness of information systems and data, as well as the performance quality of operational activities and financial transactions under audit
Data Analysis	Measured using 8 items in the questionnaire rated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).	Data analysis is the process of examining, transforming, and modeling data to extract meaningful insights that support decision-making. It involves techniques like classification and pattern recognition to improve accuracy and understanding.	Koschmider et al. (2024)	The process of examining and auditing data to improve accuracy, storage, and restructuring to derive information for decision-making.
Data mining	Measured using 7 items on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).	Data mining is the process of efficiently analyzing large and complex datasets to discover hidden patterns, trends, and useful information, often complementing machine learning	Koschmider et al. (2024)	The discovery and extraction of new data and information to generate predictive knowledge, aiding Jordanian commercial banks in modeling.

		techniques.		
Cloud computing	Measured using 7 items on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).	Cloud computing is the on-demand delivery of IT services (like storage, servers, and software) over the internet, offering flexibility, scalability, and cost efficiency. It allows organizations to use virtual resources via public, private, hybrid, or multi-cloud models, and is increasingly integrated with AI, ML, and edge computing for real-time processing and automation.	Ware, B., Mercy, R., & Mabel, E. (2025)	A network of large servers located in data centers, connected via the internet, enabling access anytime and anywhere to provide services.
Machine learning	Measured using 7 items on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).	Machine learning is a branch of artificial intelligence that focuses on developing algorithms and models capable of learning from data and improving their performance automatically without explicit programming. In the context of knowledge graphs, machine learning is used to understand complex relationships between entities, enabling models to provide interpretable explanations for their	Anders, C. J. (2024)	A set of activities that improve performance based on consumed data. It evolves rapidly and plays an effective, seamless, and secure role.

		decisions and contributing to the development of more transparent and explainable AI systems.		
Reducing Internal Control Risks	is measured using a 5-point Likert scale through 15 statements reflecting the internal control system's ability to identify, address, and mitigate risks, detect control weaknesses, apply modern evaluation tools, and support informed management decisions. Responses range from 1 (Strongly Disagree) to 5 (Strongly Agree).	Reducing Internal Control Risks to the potential for weaknesses or failures within an organization's internal control systems that could hinder the detection or prevention of fraud.	Harahap, A. J. S., & Erlina. (2024)	These statements relate to the ability of internal control systems to reduce risks (detection and control).

Unit of Analysis:

The study targeted employees of upper management (represented by managers and their deputies), in addition to middle management (directors and heads of internal audit, and internal control departments, in addition to IT department managers) in Jordanian commercial banks. The researcher contacted the Jordanian commercial banks, which cooperated in distributing the study questionnaires to the targeted employees. A total of 130 electronic questionnaires were distributed to the relevant individuals, and 118 questionnaires were retrieved electronically. After auditing and reviewing the questionnaires, 9 questionnaires were excluded due to incomplete answers, leaving 109 valid questionnaires for analysis, representing 83.8% of the total distributed questionnaires.

Sources of Data and Information:

Primary Sources: These represent the sources that the researcher relied on to achieve her objectives and address the practical aspect of the current study. These sources were represented by the questionnaire that was prepared by referring to

secondary sources, and that is consistent with the dimensions and variables of the study model, in addition to considering the opinions of experts. The questionnaire was distributed to the members of the study sample to obtain data that reflected their opinions and attitudes regarding issues related to digital auditing and reducing ICRs in Jordanian commercial banks. When preparing the questionnaire, the suitability, accuracy, sequence, and coherence of the paragraphs and the absence of obstacles during answering were considered.

Testing the Validity of the Study Tool:

Testing the study tool aims to verify the ability of the questionnaire to achieve the objectives for which it was designed, and the possibility of using it to collect data related to the study topic, through conducting several tests, including:

Content Validity: The content validity test aims to verify the accuracy of the linguistic formulation of the study tool, the clarity of its meanings, the coherence of its paragraphs and objectivity, and its belonging to the dimensions it expresses, in a way that ensures the achievement of the study objectives. Therefore, the researcher presented the questionnaire to a group of faculty members specializing in the study fields in Jordanian public and private universities, totaling 13. final form. Based on this, the study tool is considered valid to measure what it was designed for.

Reliability Test of the Study Tool: Cronbach's Alpha Coefficient of internal consistency measure was applied. This measure indicates that the result is statistically acceptable if the value of Cronbach's alpha coefficient ranges between (0.70) or more. The closer the value of the coefficient is to the value (100%), the higher the degree of stability of the study tool (Sekaran & Bougie, 2016). Table 1 shows the results of the reliability test of the study tool.

Table 2: Results of the Reliability Test of the Study Tool

Variable/ Dimension	Data Analysis	Data Mining	Cloud Computing	Machin e Learning	Digital Auditin g	Reducing ICRs	Overall Index
Cronbach Alpha	0.780	0.757	0.831	0.822	0.912	0.907	0.944
Variable/ Dimension Type	Independent					Dependent	

The results in the table above show that the study tool has high-reliability coefficients and its ability to achieve the goals and objectives of the study, and thus the possibility of relying on it to conduct statistical analysis, as the values of the Cronbach's alpha coefficient ranged between (0.757-0.912), and the coefficient value for the study tool as a whole reached (0.944), and both are greater than the value (0.70).

Testing the Suitability of the Study Model for the Statistical Methods Used:

It aims to ensure the suitability of the study data and its validity for conducting scientific statistical tests and regression analysis. To achieve this, several tests were conducted, including the multiple linear correlation test, the variance inflation factor test, and the tolerance test, as follows:

Multiple Linear Correlation Test: It is necessary to ensure that the data is free from the problem of multicollinearity and the independence of variables to be achieved. The problem appears when there is a high linear correlation (complete or near complete) between two or more independent variables, which negatively affects the accuracy of measurements as it inflates the value of the determination coefficient R^2 so that its value exceeds the actual value (Gujarati, 2004).

It was verified that there was no problem of multicollinearity by calculating Pearson's correlation coefficient for the study variables, as shown in Table 2.

Table 3: Correlation Matrix of Pearson Correlation Coefficient Values

Variables	Data Analysis	Data Mining	Cloud Computing	Machine Learning
Data Analysis	1			
Data Mining	0.622**	1		
Cloud Computing	0.588**	0.628**	1	
Machine Learning	0.418**	0.426**	0.522**	1
(**) at a significance level of 0.01				

The results in the table above show that the data is free from the problem of multicollinearity, as the values of Pearson's correlation coefficient for the dimensions of the independent variable (digital auditing) ranged between (0.418-0.628) which is less than (0.80).

Multiple Linear Correlation Test Using Variance Inflation Factor and Tolerance:

The (VIF) indicates the absence of multicollinearity when the values of the coefficient range between (1.0-10.0), while the tolerance indicates the absence of multicollinearity when the values of the coefficient range between (0.1-1.0) (Gujarati, 2004). Table 3 shows the results of the variance inflation factor and tolerance test for the modified variable and the dimensions of the independent variable.

Table 4: Variance Inflation Factor and Tolerance

Dimensions	Variance Inflation Factor (VIF)	Tolerance
Data Analysis	1.845	0.542
Data Mining	1.983	0.504
Cloud Computing	2.049	0.488
Machine Learning	1.424	0.702

The results in the table above show that the data is free from the problem of multicollinearity, as the values of the Variance Inflation Factor (VIF) ranged between

(1.424-2.049) which is between (1-10) and the values of tolerance ranged between (0.488-0.702) which is between (0.1-1).

Autocorrelation Test: The autocorrelation test aims to verify the randomness of a process in statistics by examining the correlation between processes at multiple points. This problem was verified through the most used test in this field, which is conducting the Durbin-Watson test (D-W). The value of the D-W coefficient ranges between (0-4). When the data is free from the problem of autocorrelation, the value of the D-W coefficient reaches the value (2) or is close to it (Gujarati, 2004). Table 4 shows the results of the Durbin-Watson (D-W) test for the study hypotheses.

Table 5: Results of the Durbin-Watson Test for the Study Hypotheses

Hypothesis	D-W Coefficient Value	Result
Ho1	2.262	No autocorrelation
Ho1-1	2.284	No autocorrelation
Ho1-2	2.145	No autocorrelation
Ho1-3	2.225	No autocorrelation
Ho1-4	2.145	No autocorrelation

The results in the table show that the values of the Durbin-Watson (D-W) coefficient ranged between (2.145-2.284) which means, as explained earlier, that the data is free from the problem of autocorrelation as the value approaches (2).

Demographic Data:

This section of the study presents a detailed description of the demographic data of the study sample in Jordanian commercial banks. These variables included age, years of experience, academic degree, specialization, and the number of professional certificates. Descriptive statistical methods were used, including frequencies and percentages. The following is a description of the characteristics of the study sample members according to demographic data.

Table 6: Description of the Characteristics of the Study Sample

Variable	Category	Frequency	Percentage (%)
Age	<35 years	45	41.3%
	35-44 years	47	43.1%
	45-54 years	13	11.9%
	55 years and above	4	3.7%
	Total	109	100%
Years of Experience	<5 years	20	18.3%
	5-9 years	36	33.0%
	10-14 years	26	23.9%
	15 years and above	27	24.8%
	Total	109	100%
Academic Degree	Diploma	5	4.6%
	Bachelor's Degree	69	63.3%
	Master's Degree	25	22.9%
	Doctoral Degree	10	9.2%
	Total	109	100%
Specialization	Accounting	64	58.7%
	Information Systems	6	5.5%
	Financial and Banking Sciences	16	14.7%
	Business Administration	23	21.1%
	Total	109	100%
Number of Professional Certificates	1 Certificate	42	38.6%
	2 Certificates	19	17.4%
	3 Certificates	12	11.0%
	4 Certificates	2	1.8%
	5 Certificates	11	10.1%
	More than 5 Certificates	5	4.6%
	None	18	16.5%
	Total	109	100%

The results of the table above show that the largest proportion of the study sample was in the age group (35 years - less than 45 years), with 47 employees, constituting 43.1% of the total sample. The researcher believes that the high proportion of this age group is due to the suitability of this age group for practicing the profession of digital auditing. It is noted that the largest proportion of the study sample had experience of (5 years - less than 10 years) with 36 employees, constituting 33.0% of the total sample. The researcher believes that the high proportion is due to the need for Jordanian commercial banks for employees with sufficient and appropriate qualifications and experience for their age groups. It is also noted that more than half of the study sample holds a (Bachelor's) degree, with 69 employees, constituting 63.3% of the total sample. The members of the study sample who hold higher academic qualifications (intermediate diploma, master's, and doctorate) constituted 36.7%. The researcher believes that employees of Jordanian commercial banks have varying qualifications that are suitable for answering the questionnaire items. More than half of the study sample are accountants, with 64 employees constituting 58.7% of the total sample. The researcher believes that the high percentage of accountants is due to the need for Jordanian commercial banks for this specialty, as it is highly compatible with the nature of the activities and work, they perform, in addition to its compatibility with the job title. Those who hold one professional certificate numbered 42 and constituted 38.6% of the total sample. The number of those who hold two to more than five certificates also varied, indicating that the study sample represented many groups who hold professional certificates that qualify them to answer the questionnaire.

Descriptive analysis of Study Variables:

This part of the study aims to describe the dimensions and variables of the study model by analyzing the responses of the study sample members to the items that measure these dimensions and variables. Descriptive statistical methods were used,

including means, standard deviations, rank, and relative importance. The results are shown in Table 6.

Table 7: Description of Variables and Dimensions of the Study

No.	Variable/ Dimension	Mean	Standard Deviation	Rank	Relative Importance
1	Data Analysis	4.212	0.452	1	High
2	Data Mining	4.046	0.483	2	High
3	Cloud Computing	4.046	0.575	2	High
4	Machine Learning	3.928	0.540	3	High
	Digital Auditing	4.058	0.414	-	High
	Reducing ICRs	4.058	0.476	-	High

The results of Table 6 show a high level of relative importance for the digital auditing variable in Jordanian commercial banks, with a mean of (4.058) and a standard deviation of (0.414). The dimension of data analysis ranked first with a mean of (4.212) and a standard deviation of (0.452) and a high relative importance, indicating the importance of analyzing, examining, and evaluating data, as data represents the inputs that are processed to reach the necessary information. Meanwhile, the dimension of machine learning ranked third and last with a mean of (3.928) and a standard deviation of (0.540) and a high relative importance, which may indicate that machine learning methods require more expertise and qualifications to know how to deal with them. The results of the table above show a high relative importance of the variable (reducing ICRs) in Jordanian commercial banks, with a mean of (4.058) and a standard deviation of (0.476). This may indicate that employees in Jordanian commercial banks at various levels apply the necessary systems and laws for the conduct of work, as the employees' adherence to the prevailing policies and legislation during the performance of their work helps to discover errors that may occur.

4. Testing the Study Hypotheses:

This part of the study presents the results of testing the study hypotheses. The main hypotheses were subjected to multiple and stepwise linear regression analysis, while the sub-hypotheses were subjected to simple linear regression analysis. The following are the results of testing the study hypotheses.

Results of Testing the Main Hypothesis: It aims to identify the effect of digital auditing with its dimensions (data analysis, data mining, cloud computing, and machine learning) in reducing ICRs in Jordanian commercial banks. This hypothesis states that: "There is no statistically significant effect at a significance level ($\alpha \leq 0.05$) of digital auditing, as indicated by its reducing ICRs in Jordanian commercial banks." To test this hypothesis, multiple linear regression analysis was used, and the results are shown in Table 7.

Table 8: Results of Testing the Main Hypothesis

Dependent Variable	Model Summary				ANOVA		
	R (Correlation Coefficient)	R ² (Determination Coefficient)	Adjusted R ²	Standard Error of Model	Degrees of Freedom	Calculated F-Value	Sig F*
Reducing ICRs	0.747	0.558	0.541	0.323	4	32.771	0.000
Statistical Significance at the ($\alpha \leq 0.05$) Level							

The results in the table above show a strong and positive correlation between digital auditing with its combined dimensions and reducing ICRs. The correlation coefficient (R) was 0.747, and the Determination Coefficient (R²) was 0.558, indicating that the digital auditing variable explained 55.8% of the variation in reducing ICRs, and the remaining 2.44% is attributed to other factors. The adjusted R² value was 0.541, and the difference between it and the Determination Coefficient was 0.017, which is a very small value, indicating the ability of the accepted model

variables to predict the values of the variable of reducing ICRs. The table also shows the significance of the model, as the calculated F value was 32.771 and the significance level (Sig F = 0.000) was less than 0.05, indicating a statistically significant effect of the digital auditing variable in reducing ICRs at ($\alpha \leq 0.05$) significance level and with 4 degrees of freedom.

Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted, which states that: "There is a statistically significant effect at 1 a significance level ($\alpha \leq 0.05$) of digital auditing, as indicated by its dimensions in reducing ICRs in Jordanian commercial banks." Table 8 shows the regression coefficients for the main hypothesis.

Table 9: Regression Coefficients for the Main Hypothesis Ho1

Regression Coefficients					
Independent Variable	B (Coefficients)	Standard Error	Beta Value	Calculated T Value	Sig T* Significance Level
Data Analysis	0.355	0.093	0.337	3.803	0.000
Data Mining	0.044	0.091	0.044	0.484	0.629
Cloud Computing	0.209	0.077	0.253	2.707	0.008
Machine Learning	0.249	0.069	0.283	3.638	0.000
*Significant at ($\alpha \leq 0.05$) significance level					

The results in the table above show the values of the regression coefficients for the digital auditing variable. It appears that the value of B for the dimension (data analysis) reached 0.355, and the calculated T value for this variable was 3.803 with a significance level (SigT = 0.000), which is less than 0.05, indicating a significant positive effect of the data analysis dimension in reducing ICRs. The table also shows that the value of B for the dimension (data mining) reached 0.044, and the calculated

T value for this variable was 0.484 with a significance level ($\text{SigT} = 0.629$), which is greater than 0.05, indicating no significant effect of the data mining dimension in reducing ICRs. The Table also shows that the value of B for the dimension (cloud computing) reached 0.209, and the calculated T value for this variable was 2.707 with a significance level ($\text{SigT} = 0.008$), which is less than 0.05, indicating a significant positive effect of the cloud computing dimension in reducing ICRs. Finally, the Table shows that the value of B for the dimension (machine learning) reached 0.249, and the calculated T value for this variable was 3.638 with a significance level ($\text{SigT} = 0.000$), which is less than 0.05, indicating a significant positive effect of the machine learning dimension in reducing ICRs. Stepwise linear regression was used to determine the impact of digital auditing, which has shown greater importance in reducing ICRs, and the results are shown in Table 9.

Table 10: Ranking of Digital Auditing Impact on Mitigating ICRs

Mo del	Reduci ng ICRs	B (Coeffici ents)	Calcul ated T- value	Sig. T* Signific ance level	R (Correl ation Coeffici ent)	R² (Determi nation Coefficien t)	Calcul ated F- value	Sig. F* Signific ance level
First	Data Analysi s	0.665	8.426	0.000	0.632	0.399	71.001	0.000
Seco nd	Data Analysi s	0.499	6.373	0.000	0.718	0.516	56.493	0.000
	Machi ne Learni ng	0.332	5.063	0.000				
First	Data Analysi s	0.372	4.341	0.000	0.746	0.557	43.538	0.000
	Machi ne Learni ng	0.253	3.712	0.000				
	Cloud Compu ting	0.223	3.103	0.002				
*Significant at (α≤0.05) significance level								

The results presented in the table above demonstrate the ranking of digital auditing dimensions in terms of their significance and impact on mitigating ICRs within Jordanian commercial banks. "Data Analysis" emerged as the primary dimension, accounting for 39.9% of the variation in reducing these risks.

Subsequently, "Machine Learning" was introduced in the second model, increasing the explained variance to 51.6%. Finally, "Cloud Computing" was added in the third model, further elevating the explained variance to 55.7%. The table indicates that the influence of digital auditing was statistically at ($\alpha \leq 0.05$) significance level.

Discussion of the Main Hypothesis Results in Light of Previous Studies:

The findings of the study revealed a statistically significant effect of digital auditing, with its dimensions (data analysis, data mining, cloud computing, and machine learning), in reducing internal control risks (ICRs) in Jordanian commercial banks. The coefficient of determination (R^2) reached 55.8%, indicating that these dimensions explain a significant portion of the variation in internal control risk levels.

This result is consistent with the findings of Al-Rhaifeh (2023), which confirmed that the use of IT tools—such as data analytics and cloud computing—significantly enhances the efficiency and effectiveness of internal control systems, thereby reducing opportunities for error or manipulation. Similarly, the results align with Amour (2023), who found that digital transformation positively affects the mitigation of institutional risks, with internal auditing playing a crucial mediating role, thus strengthening internal control mechanisms.

Moreover, Abu Amro (2023) emphasized that IT auditing improves the effectiveness of accounting information systems by ensuring data accuracy and system reliability—an outcome that supports the current study's finding of a significant impact of data analysis and machine learning in reducing ICRs. These results also correspond to Khalil (2024), whose study demonstrated that artificial intelligence technologies significantly improve the quality of external audits by enhancing analytical precision and reducing human errors.

In addition, Ismail (2024) provided evidence that audit risk indicators enhance the ability of internal control systems to detect errors and fraud early, which reinforces the importance of digital tools such as data analytics in building preventive control

systems. Finally, the findings are further supported by Kavar & Al-Ali (2025), who concluded that digital transformation technologies improve the efficiency of external auditing processes by reducing both time and cost, thereby confirming the effectiveness of modern technological infrastructure in audit environments.

Accordingly, the current study's findings are consistent with those of previous research, which strengthens their validity and underscores the importance of adopting digital auditing tools in the Jordanian banking sector as a means of reducing internal control risks.

Conclusion and Recommendations:

Key Findings:

The study concluded that digital auditing, through its various dimensions such as data analysis, data mining, cloud computing, and machine learning, plays a pivotal role in reducing internal control risks in Jordanian commercial banks. The statistical analysis results showed a significant positive effect of these dimensions on reducing risks, with data analysis and machine learning having the greatest impact on improving the effectiveness of internal control.

Theoretical Contribution:

This study is one of the pioneering studies examining the effect of digital auditing on internal control in the Jordanian banking sector. Additionally, the study contributes to enriching the literature on technological auditing by integrating the four dimensions of digital auditing and providing a comprehensive model to understand how these technologies influence the effectiveness of internal control.

Practical Recommendations for Beneficiary Entities:

The study recommends that Jordanian banks invest in digital auditing technologies, particularly in the areas of data analysis and machine learning, due to their positive impact on risk reduction and the enhancement of internal control efficiency. It is also advised to train internal auditors in the use of modern digital

tools to ensure a swift and effective response to risks. Furthermore, it is crucial for banks to enhance their use of cloud computing for data storage and analysis, as this contributes to greater security and speed in processing information.

5. Study Limitations:

The main limitations of this study include its focus on Jordanian commercial banks, which may limit the generalizability of the results to other financial sectors. Additionally, the sample of the study did not cover all types of banks, but rather a selected group. The study period was also limited, which may affect the ability to analyze long-term impacts.

Recommendations for Future Researchers:

Future researchers are advised to expand the scope of the research to include other financial sectors, such as insurance and investment, to examine the effect of digital auditing on internal control in these sectors. Comparative studies between banks in different countries could also be conducted to explore the impact of different regulatory environments on the effectiveness of digital auditing. Additionally, researchers may examine the long-term effects of digital auditing technologies on improving auditing processes and reducing risks in financial institutions.

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أثر التدقيق الرقمي على الحد من مخاطر الرقابة الداخلية في البنوك التجارية الأردنية

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هدفت هذه الدراسة إلى التعرف على أثر التدقيق الرقمي في الحد من مخاطر الرقابة الداخلية في البنوك الأردنية، وتم اختبار فرضيات الدراسة باستخدام تحليل الانحدار المتعدد وتحليل الانحدار البسيط، ولتحقيق هذا الهدف طبقت الدراسة على البنوك التجارية الأردنية عددها (13) بنكا في نهاية عام (2021)، وأظهرت نتائج الدراسة وجود أثر ذو دلالة إحصائية لأبعاد التدقيق الرقمي (تحليل البيانات، تنقيب البيانات، التعلم الآلي، الحوسبة السحابية) في الحد من مخاطر الرقابة الداخلية، وأوصت الدراسة اهتمام البنوك التجارية الأردنية بزيادة سرعة توليد البيانات الضخمة بمعدل أسرع من البيانات التقليدية، وذلك لتحسين كفاءة وفاعلية عملية التدقيق وإنجاز مهام التدقيق بأقل كلفة وجهد ووقت مما يساعد على زيادة جودة خدمات التدقيق وتقليل المخاطر التي يمكن أن تتعرض لها في عملية التدقيق.

الكلمات المفتاحية: التدقيق الرقمي، مخاطر الرقابة الداخلية، تحليل البيانات، تنقيب البيانات، الحوسبة السحابية، التعلم الآلي، البنوك التجارية الأردنية.

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