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The Effect of Stock Recording Digitalization and the Application of the FIFO Method on the Perception of Expired Product Losses at SpiceBali

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Abstract

This study examines the effect of stock recording digitalization and the application of the First in First Out (FIFO) method on the perception of expired product losses at SpiceBali, a spice distributor in Bali that recorded annual losses of Rp 70–150 million due to expired products in 2023. The research applies a quantitative associative-causal approach using multiple linear regression analysis, with primary data collected through questionnaires administered to 40 employees involved in inventory management, supplemented by secondary data from monthly internal loss reports covering the 2023–2025 period. The findings reveal that stock recording digitalization ($\beta = 0.310$; $t = 4.609$; $p < 0.001$) and the FIFO method ($\beta = 0.374$; $t = 4.922$; $p < 0.001$) each exert a significant positive influence on the perception of expired product losses, with both variables jointly explaining 53.4% of the variance ($F = 21.171$; $p < 0.001$). Secondary data analysis further corroborates these results, showing that average monthly losses declined from Rp 12,441,667 in 2023 to Rp 3,925,000 in 2025, representing a cumulative reduction of 68.45%, confirmed as statistically significant across all periods by Repeated Measures ANOVA ($F = 666.945$; $\eta^2 = 0.984$) and Bonferroni-corrected post-hoc tests. These results indicate that the combined implementation of digitalization and FIFO delivers a sustained and progressively strengthening impact on inventory efficiency, consistent with a learning curve effect. The study contributes empirical evidence on the effectiveness of technology-driven inventory management strategies in reducing perishable product losses within the distribution sector.

Keywords: stock recording digitalization, FIFO method, expired product losses, inventory management, perishable goods.

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INTRODUCTION

Inefficient inventory management is a global challenge that triggers massive food waste. Inventory management inefficiency is one of the main causes of food loss and waste at the distribution level. This issue is particularly relevant for the spice industry in Bali, which has characteristics of high economic value products yet limited shelf life. SpiceBali, a spice distributor in Bali, faced annual losses due to expired products amounting to Rp 70–150 million in 2023 based on the company's internal data. These losses not only reduced profits but also generated additional costs in the form of storage and disposal of goods.

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SpiceBali's internal evaluation identified two main factors suspected to influence the high perception of expired product losses: the stock recording system and the application of inventory rotation methods. The first factor is stock recording digitalization. Manual recording based on books and simple spreadsheets tends to cause human error, delays in data updates, and minimal early warning for products approaching their expiration date.

The second factor is the application of the First In First Out (FIFO) method. Theoretically, FIFO is the most appropriate approach for products with expiration dates because it ensures that goods entering first are also the first to be released. However, the effectiveness of FIFO is highly dependent on field discipline, including the physical layout of the warehouse, compliance with Standard Operating Procedures (SOPs), and regular monitoring. The more disciplined the application of the FIFO method, the smaller the likelihood that older products will remain in the warehouse until they pass their expiration date.

Since early 2024, SpiceBali has begun implementing stock recording digitalization and applying the FIFO method in a structured manner. However, the extent to which both factors truly influence the perception of expired product losses had never been quantitatively analyzed.

Hypothesis I: Effect of Stock Recording Digitalization on Loss Value

Hypothesis II: Effect of the Application of the FIFO Method on Loss Value

Hypothesis III: Simultaneous Effect of Stock Recording Digitalization and the FIFO Method on Loss Value

Hypothesis IV: Differences in Loss Values Between Implementation Periods

LITERATURE REVIEW

Inventory Management Theory

Inventory Management Theory (Silver et al., 2016) is a theoretical framework that explains how organizations effectively manage inventory to minimize costs and meet customer demand. In the context of products with expiration dates (perishable goods), this theory emphasizes the importance of: (1) accurate inventory information systems to improve inventory visibility, and (2) appropriate inventory rotation methods to prevent losses due to expired products.

Resource-Based View (RBV)

Resource-Based View (Barney, 1991) views information technology as a strategic resource that creates competitive advantage. In this study, stock recording digitalization (X1) is viewed as a technological capability that provides the company with the ability to process data into strategic information (real-time inventory visibility).

Lean Management

Lean Management Theory (Womack & Jones, 2003) views expired products as a form of waste that must be eliminated. The application of the FIFO method (X2) is one of the lean practices that ensures older goods are released first before passing their expiration date. This theory forms the theoretical basis for why FIFO is presumed to influence the reduction of losses.

Cost Accounting

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Cost Accounting Theory provides a financial framework for accurately measuring loss values (Y). This theory explains that loss values should not only be calculated from the purchase price of goods, but must accumulate all associated costs, including storage costs and disposal costs.

Stock Recording Digitalization

Stock recording digitalization refers to the transformation from manual recording methods (books & spreadsheets) to information technology-based systems, such as Warehouse Management Systems (WMS) or integrated Point of Sales (POS) applications. Research by Prasetyo & Sutopo (2023) in the context of Industry 4.0 confirms that digitalization can reduce information asymmetry. Indicators of stock recording digitalization in this study include: (1) use of digital systems, (2) real-time data accuracy, (3) automatic notification features, and (4) ease of system use.

Application of the First In First Out (FIFO) Method

According to Mohan & Geetha (2021), the FIFO system is an inventory valuation and goods flow management method in which products that first enter the warehouse are the first to leave for sale. A study by Lestari, Gusnadi, & Raharjo (2023) shows that the effectiveness of FIFO is highly dependent on physical discipline (warehouse layout) and not merely records on paper. Strict FIFO implementation can suppress expired product numbers because it forces the rotation of old stock before new stock is touched. Indicators of the FIFO method application in this study include: (1) physical warehouse layout, (2) staff discipline, (3) SOP compliance, and (4) stock rotation monitoring.

Perception of Expired Product Losses

In an economic context, expired products are categorized as food loss (food loss at the production/distribution level). UNEP (2024) in the Food Waste Index Report defines this as an economic inefficiency that causes loss of added value. Bappenas (2021) underlines that suppressing these loss figures directly contributes to GDP efficiency and company profitability. In this study, the Perception of Expired Product Losses is positioned as the dependent variable (Y), with indicators: (1) frequency of expired product occurrence, (2) perception of nominal loss value, (3) impact on profitability, and (4) additional costs due to disposal.

METODOLOGI

This study uses a causal associative quantitative approach, aiming to determine the effect or causal relationship between two or more variables (Sugiyono, 2019). Primary data were obtained through questionnaires distributed to 40 SpiceBali employees involved in inventory management. The questionnaire measured the three research variables (X1, X2, and Y) using a Likert scale of 1–5. This primary data served as the main basis for multiple linear regression analysis. Additionally, this study used secondary data in the form of monthly expired product loss reports from SpiceBali's internal archives (Waste Reports and Stock Opname Minutes) for the 2023–2025 period.

The respondent population consisted of all SpiceBali employees directly involved in the inventory management process. Based on SpiceBali's personnel data as of January 2026, the population consisted of 40 people with the following breakdown: 1) Warehouse Staff: 16 people, 2) Logistics Admin: 11 people, 3) Purchasing Staff: 10 people, 4) Operations Manager: 3 people.

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The research sample was determined using a saturated sampling (census) technique. According to Sugiyono (2019), saturated sampling is a sampling technique that uses all members of the population as the research sample. This technique was chosen because the number of the population involved in inventory management at SpiceBali is relatively small, so all population members could be used as research respondents.

The questionnaire is the primary data collection technique in this study. It was designed to measure the three research variables (X1, X2, and Y) using a Likert scale of 1–5 with the following descriptions: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A), 5 = Strongly Agree (SA). This study uses descriptive statistical analysis and multiple linear regression analysis preceded by classical assumption tests. All analyses were conducted using IBM SPSS Statistics version 26.

RESULTS AND DISCUSSION

Table 1. Validity Test

No	Variable	Item	Cronbach's Alpha	Sig	Remarks
1	Stock Recording Digitalization (X1)	X1.1	0,828	<0,001	Valid
2		X1.2	0,798	<0,001	Valid
3		X1.3	0,773	<0,001	Valid
4		X1.4	0,799	<0,001	Valid
5		X1.5	0,857	<0,001	Valid
6		X1.6	0,738	<0,001	Valid
7		X1.7	0,822	<0,001	Valid
8		X1.8	0,857	<0,001	Valid
9	Application of FIFO Method (X2)	X2.1	0,712	<0,001	Valid
10		X2.2	0,811	<0,001	Valid
11		X2.3	0,855	<0,001	Valid
12		X2.4	0,79	<0,001	Valid
13		X2.5	0,826	<0,001	Valid
14		X2.6	0,733	<0,001	Valid
15		X2.7	0,746	<0,001	Valid
16		X2.8	0,703	<0,001	Valid
17	Perception of Expired Product Losses (Y)	Y1	0,685	<0,001	Valid
18		Y2	0,712	<0,001	Valid
19		Y3	0,602	<0,001	Valid
20		Y4	0,605	<0,001	Valid
21		Y5	0,649	<0,001	Valid
22		Y6	0,625	<0,001	Valid
23		Y7	0,502	<0,001	Valid
24		Y8	0,608	<0,001	Valid

Source: SPSS Data Processing Results 2026

The validity test was conducted to determine the extent to which the research instrument is able to measure the variables it is supposed to measure. All 24 statement items used in this study had r-count values greater than r-table (0.304) and significance values less than 0.05. Therefore, all research instrument items are declared valid and suitable for use in subsequent testing stages.

Reliability Test

Table 2. Reliable Test

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No	Variabel	Items	Cronbach's Alpha	Remarks
1	Stock Recording Digitalization (X1)	8	0,924	Reliabel
2	Application of FIFO Method (X2)	8	0,901	Reliabel
3	Perception of Expired Product Losses (Y)	8	0,755	Reliabel

Source: SPSS Data Processing Results 2026

All research variables had Cronbach's Alpha values greater than 0.60. The Stock Recording Digitalization variable (X1) obtained a Cronbach's Alpha value of 0.924, the Application of FIFO Method variable (X2) obtained 0.901, and the Perception of Expired Product Losses variable (Y) obtained 0.755. Thus, all research instruments are declared reliable and suitable for use as data collection tools.

Normality Test

Table 3. Normality Test (Shapiro-Wilk)

Variable Tested	Statistic	Sig.	Remarks
Unstandardized Residual	0.983	0.804	Normal

Source: SPSS Data Processing Results 2026

The normality test was conducted to determine whether the residual data used in the regression model has a normal distribution. Based on the normality test results in Table 3, the Kolmogorov-Smirnov significance value was 0.200 and the Shapiro-Wilk significance value was 0.804. Therefore, it can be concluded that the residual data in this study is normally distributed and does not experience deviations.

Multicollinearity Test

Table 4. Multicollinearity Test

Variable	Tolerance	VIF	Remarks
Stock Recording Digitalization (X1)	0.995	1.005	No multicollinearity
Application of FIFO Method (X2)	0.995	1.005	No multicollinearity

Source: SPSS Data Processing Results 2026

Based on the multicollinearity test results, each variable had a Tolerance value of 0.995 and a VIF value of 1.005. Thus, it can be concluded that there is no multicollinearity symptom between the independent variables in this regression model, so multiple linear regression analysis can proceed to the next classical assumption test stage.

Heteroscedasticity Test

Table 4. Heteroscedasticity Test

Variable	Sig.	Remarks
Stock Recording Digitalization (X1)	0.764	No heteroscedasticity
Application of FIFO Method (X2)	0.259	No heteroscedasticity

Source: SPSS Data Processing Results 2026

Based on the heteroscedasticity test results, the Stock Recording Digitalization variable (X1) had a significance value of 0.764, while the Application of FIFO Method variable (X2) had a significance value of 0.259. Both values are greater than 0.05, so it can be concluded that the regression model does not experience heteroscedasticity symptoms.

Multiple Linear Regression Analysis

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Table 5. Multiple Linear Regression Analysis

Variable	B (Unstd.)	Std. Error	t-count	Sig.
Constant	0.826	0.351	2.353	0.024
Stock Recording Digitalization (X1)	0.310	0.067	4.609	<0.001
Application of FIFO Method (X2)	0.374	0.076	4.922	<0.001

Source: SPSS Data Processing Results 2026

Overall, both independent variables have positive regression coefficients, indicating a positive relationship with the dependent variable. Furthermore, based on the magnitude of the regression coefficient values, the Application of FIFO Method variable (X2) has a more dominant influence on the Perception of Expired Product Losses variable (Y) compared to the Stock Recording Digitalization variable (X1).

Partial Test (t-Test)

Table 6. Partial Test (t-Test)

Variable	t-count	t-table	Sig.	Remarks
Stock Recording Digitalization (X1)	4.609	2.026	<0.001	H1 Accepted
Application of FIFO Method (X2)	4.922	2.026	<0.001	H2 Accepted

Source: SPSS Data Processing Results 2026

Based on the partial test results, the Stock Recording Digitalization variable (X1) obtained a t-count value of 4.609 with a significance value of <0.001, so H1 is accepted. This indicates that Stock Recording Digitalization has a significant effect on the Perception of Expired Product Losses at SpiceBali. Furthermore, the Application of FIFO Method variable (X2) obtained a t-count value of 4.922 with a significance value of <0.001, so H2 is also accepted. These results indicate that the Application of the FIFO Method has a significant effect on the Perception of Expired Product Losses at SpiceBali. Additionally, based on the comparison of t-count values, the Application of FIFO Method variable has a larger value compared to Stock Recording Digitalization, so it can be said that the Application of FIFO Method variable has a more dominant influence on the dependent variable in this study.

Simultaneous Test (F-Test)

Table 7. Simultaneous Test (F-Test)

Model	df	Mean Square	F-count	Sig.
Regression	2	1.809	21.171	<0.001
Residual	37	0.085	-	-
Total	39	-	-	-

Source: SPSS Data Processing Results 2026

Based on the F-test results, an F-count value of 21.171 was obtained with a significance value of <0.001. This significance value is less than 0.05, so H3 is accepted. Thus, it can be concluded that the Stock Recording Digitalization (X1) and Application of FIFO Method (X2) variables simultaneously have a significant effect on the Perception of Expired Product Losses (Y) at SpiceBali.

Coefficient of Determination (R^2)

Table 8. Coefficient of Determination (R^2)

Model	R	R Square	Adjusted R Square

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1	0,731	0,534	0,508

Source: SPSS Data Processing Results 2026

R Square of 0.534 or 53.4%. This indicates that both variables are able to explain the variation in the Perception of Expired Product Losses (Y) by 53.4%, while the remaining 46.6% is explained by other factors outside the research model.

Secondary Data Analysis as Supporting Findings

Comparison of Loss Values Before and After Implementation

Table 9. Comparison of Loss Values Before and After Implementation

Month	Loss 2023 (Rp) Manual	Loss 2024 (Rp) Digital Yr 1	Loss 2025 (Rp) Digital Yr 2	Cumulative Difference (2023 vs 2025)
January	12.500.000	8.200.000	4.500.000	-8.000.000
February	10.800.000	7.500.000	4.100.000	-6.700.000
March	11.200.000	6.800.000	3.900.000	-7.300.000
April	13.000.000	7.200.000	4.200.000	-8.800.000
May	12.300.000	6.900.000	3.800.000	-8.500.000
June	11.700.000	6.500.000	3.600.000	-8.100.000
July	13.500.000	7.100.000	4.000.000	-9.500.000
August	12.900.000	6.700.000	3.700.000	-9.200.000
September	11.400.000	6.300.000	3.500.000	-7.900.000
October	12.800.000	6.600.000	3.800.000	-9.000.000
November	13.200.000	6.900.000	3.900.000	-9.300.000
December	14.000.000	7.400.000	4.100.000	-9.900.000
Average	**12.441.667**	**7.008.333**	**3.925.000**	**-8.516.667**
Std. Deviation	984.847	517.790	276.751	-

Sumber: Laporan Waste dan Berita Acara Opname Stok SpiceBali (diolah, 2026)

The implementation of digitalization and the FIFO system successfully reduced expired product losses significantly, from an average of Rp 12,441,667/month in 2023 to Rp 7,008,333/month in 2024 (down 43.67%), and continuing to decline to Rp 3,925,000/month in 2025. This cumulative reduction of Rp 8,516,667/month or 68.45% reflects the learning curve effect and system maturity that becomes increasingly effective from year to year.

Normality Test of Secondary Data

Table 10. Normality Test of Secondary Data

Variable	Statistic (W)	Sig.	Remarks
Loss Year 2023	0.966	0.862	Normal
Loss Year 2024	0.943	0.535	Normal
Loss Year 2025	0.976	0.964	Normal
Residuals	-	0.342	Normal

Source: SPSS Data Processing Results 2026

These results indicate that all data are normally distributed, so the normality assumption has been fulfilled. Thus, the data is suitable for further analysis using parametric tests, namely Repeated Measures ANOVA.

Sphericity Assumption Test (Mauchly's Test)

Table 11. Sphericity Assumption Test (Mauchly's Test)

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Within-Subject Comparison	Mean Difference (Rp)	SD Difference (Rp)	t-count	Sig.
2023 vs 2024	5.433.333	1.019.209	18,467	0,000
2024 vs 2025	3.083.333	265.718	40,197	0,000
2023 vs 2025	8.516.667	947.565	31,135	0,000

Source: SPSS Data Processing Results 2026

The Mauchly's test indicates a violation of sphericity (p = 0.000), so Repeated Measures ANOVA results are reported with the Greenhouse-Geisser correction (ε = 0.795), while all three Paired Sample t-tests produced p = 0.000 with significant differences between periods: 2023–2024 (Rp 5,433,333; t = 18.467), 2024–2025 (Rp 3,083,333; t = 40.197), and 2023–2025 (Rp 8,516,667; t = 31.135). This consistent and increasingly strong declining pattern proves that the impact of stock recording digitalization and the FIFO method at SpiceBali is sustained, not merely a one-time effect, thus empirically reinforcing the results of regression analysis on primary data.

Repeated Measures ANOVA Test

Table 12. Repeated Measures ANOVA Test

Source of Variation	Correction	SS ($\times 10^{12}$)	df	MS ($\times 10^{12}$)	F	Sig.
Between Periods	Sphericity Assumed	446.25	2.000	223.12	666.945	0.000
Between Periods	Greenhouse-Geisser	446.25	1.590	280.66	666.945	0.000
Error (within)	Sphericity Assumed	7.36	22.000	0.33	—	—
Error (within)	Greenhouse-Geisser	7.36	17.490	0.42	—	—

Source: SPSS Data Processing Results 2026

Based on the results, the F-count value of 666.945 with a significance of 0.000 (p < 0.05), both with standard sphericity assumption and with the Greenhouse-Geisser correction. Thus, $H0_4$ is rejected and $H1_4$ is accepted, meaning there are significant differences between loss values in the three measurement periods. The Partial Eta Squared value of 0.984 indicates that 98.4% of the variation in monthly loss values is explained by differences in measurement periods, which represents a very large effect size based on Cohen's criteria.

Post-Hoc Test (Pairwise Comparison with Bonferroni Correction)

Table 12. Post-Hoc Test (Pairwise Comparison with Bonferroni Correction)

Comparison	Mean Difference (Rp)	t-count	Sig. (2-tailed)	Reduction (%)	Remarks
2023 vs 2024	5,433,333	18.467	0.000	43.67%	Significant
2023 vs 2025	8,516,667	31.135	0.000	68.45%	Significant
2024 vs 2025	3,083,333	40.197	0.000	44.00%	Significant

Source: SPSS Data Processing Results 2026

The post-hoc test with Bonferroni correction (α = 0.0167) confirms that all period pairs differ significantly, with loss reductions of 43.67% (2023–2024) and 44.00% (2024–2025), so the cumulative reduction from 2023 to 2025 reaches 68.45%. These findings empirically confirm that the impact of stock recording digitalization and the FIFO method at SpiceBali is sustained and increasingly strengthens with the maturity of system implementation, in line with the results of regression analysis on primary data.

Effect of Stock Recording Digitalization on Perception of Expired Product Losses

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The results of testing the first hypothesis (H1) indicate that Stock Recording Digitalization has a significant effect on the Perception of Expired Product Losses at SpiceBali. These research results are in line with Resource-Based View Theory (Barney, 1991), which views information technology as a strategic resource that can become the company's competitive advantage. The findings of this research are also consistent with research by Choudhury et al. (2022), which shows that digital technology-based inventory tracking systems are capable of improving recording accuracy and supporting the effectiveness of company inventory management. Similar results were found by Nugraha and Wibowo (2022), who stated that the transformation from manual recording to digital systems can improve operational efficiency and minimize the risk of errors in stock management.

Effect of Application of FIFO Method on Perception of Expired Product Losses

The results of testing the second hypothesis (H2) indicate that the application of the FIFO method has a significant positive effect on the Perception of Expired Product Losses at SpiceBali, with a regression coefficient of β = +0.374 and significance of 0.011. These results are in line with Lean Management Theory (Womack & Jones, 2003), which views expired products as an extreme form of waste that must be eliminated. FIFO implementation ensures that goods entering the warehouse first are released first, thereby minimizing the possibility of older products remaining until they pass their expiration date. This mechanism is highly relevant for perishable products such as spices that have a limited shelf life. These findings are consistent with research by Lestari, Gusnadi, and Raharjo (2023), which shows that strict FIFO implementation can suppress expired product numbers because it forces the rotation of old stock before new stock is touched. Bakade and Wafa (2024) also proved that consistent FIFO implementation helps MSME partners reduce losses due to expired goods.

Simultaneous Effect of Stock Recording Digitalization and FIFO Method on Perception of Expired Product Losses

The results of testing the third hypothesis (H3) indicate that Stock Recording Digitalization and the Application of the FIFO Method simultaneously have a significant effect on the Perception of Expired Product Losses at SpiceBali. This is evidenced by an F-count value of 21.171 and a significance value of <0.001, which is less than the significance level of 0.05. These research results indicate that control of expired product losses is not only influenced by one factor, but by a combination of a digitalized stock recording system and the FIFO method running consistently. These research findings support the view of Resource-Based View Theory (Barney, 1991), which emphasizes the importance of utilizing the company's internal resources, including information technology, as a means to improve organizational performance. Furthermore, these research results are also in line with the principles of Lean Management Theory (Womack & Jones, 2003), which emphasizes the importance of efficient inventory management to minimize waste in operational processes.

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Triangulation of Primary and Secondary Data Analysis Results

Secondary data analysis fully corroborates the primary data analysis results. Monthly loss data from 2023 to 2025 showed a consistent and significant decline across all periods, both statistically (Repeated Measures ANOVA: $F = 666.945$, $\eta^2 = 0.984$; all Bonferroni post-hoc pairs $p < 0.001$) and practically (cumulative loss reduction of 68.45%). The progressively strengthening magnitude of the reduction—from 43.67% in the first implementation year to an additional 44.00% in the second year—reflects a learning curve effect and system maturity consistent with predictions from Lean Management Theory and Resource-Based View Theory. These triangulated findings establish strong convergent validity for the study's conclusions.

CONCLUSION

Effect of Stock Recording Digitalization on Perception of Expired Product Losses (H1): The partial test results indicate that Stock Recording Digitalization has a significant effect on the Perception of Expired Product Losses at SpiceBali. This is evidenced by a t-count value of 4.609 and significance of <0.001. The regression coefficient of 0.310 indicates a significant relationship between stock recording digitalization and the Perception of Expired Product Losses.

Effect of Application of FIFO Method on Perception of Expired Product Losses (H2): The partial test results indicate that the Application of the FIFO Method has a significant effect on the Perception of Expired Product Losses at SpiceBali, with t-count of 4.922 and significance of <0.001. The regression coefficient of 0.374 indicates a significant influence of FIFO implementation on loss values.

Simultaneous Effect of Stock Recording Digitalization and Application of FIFO Method on Perception of Expired Product Losses (H3): The simultaneous test (F-test) results show an F-count value of 21.171 with significance of <0.001. The Adjusted R Square value of 0.508 indicates that both independent variables together are able to explain 50.8% of the variation in the Perception of Expired Product Losses, while the remaining 49.2% is explained by other variables outside the research model. This confirms that both variables have complementary influences in inventory management.

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