ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 13, Issue 4, pp: (31-40), Month: October - December 2025, Available at: www.researchpublish.com

An Excel-Based Decision Support Model for Pawn Broking Businesses: A Case Study in Sri Lanka

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DOI: https://doi.org/10.5281/zenodo.17922799

Published Date: 13-December-2025

Abstract: **Pawn broking is one of the oldest and most stable financial services in Sri Lanka, offering short-term, collateral-backed credit primarily against gold jewellery. Despite its resilience, the sector faces growing uncertainty driven by fluctuations in gold prices, changing interest rate environments, and inconsistent repayment behaviours. These factors increase operational risk and make accurate forecasting difficult, especially for small and medium pawn-broking businesses that rely heavily on manual or semi-digital systems. This study introduces an Excel-based Decision Support Model (DSM) designed to simulate loan portfolio behaviour, assess exposure to price and rate volatility, and support more systematic decision-making. By integrating automated calculations, scenario analysis, and risk visualization tools, the DSM enhances the ability of pawn brokers to anticipate financial outcomes.**

Keywords: **Pawn broking, Decision Support System, Gold price volatility, Interest rate risk, Excel modelling.**

I. INTRODUCTION

Pawn broking plays a significant role in Sri Lanka's informal financial ecosystem. n Sri Lanka, pawn broking serves as a crucial financial service for individuals who lack access to formal banking facilities or require immediate liquidity without lengthy approval processes. The industry comprises licensed pawn brokers, cooperative societies, and specialized financial institutions that collectively process millions of transactions annually.Gold-backed pawn loans dominate this sector due to the cultural prevalence of gold ownership and its function as a store of value.

Despite its importance, the pawn-broking industry faces high exposure to market uncertainties:

- Volatile international gold prices directly impact loan-to-value ratios and collateral risk.
- Fluctuating interest rates affect pawnshop revenue and potential default risk.
- Loan portfolio composition varies significantly across seasons and economic cycles.

Small and medium pawn brokers often rely on manual bookkeeping, subjective valuation, and experience-based decision making. This limits their ability to forecast future risks or optimize loan pricing. Therefore, a low-cost, transparent, Excel-based decision support approach can fill a critical gap.

A. Research Problem

Despite the economic significance of pawn broking in Sri Lanka's microfinance landscape, there exists a notable gap in accessible, affordable decision support tools tailored to the specific operational requirements of small and medium-sized pawn brokers. Existing systems either involve expensive proprietary software beyond the reach of smaller operators or rudimentary manual methods that fail to incorporate sophisticated risk analysis and scenario planning capabilities.

The primary challenges facing Sri Lankan pawn brokers include accurately assessing exposure to gold price volatility, optimizing interest rate structures within regulatory constraints, managing diverse loan portfolios with varying maturities and collateral values, and making informed strategic decisions regarding capital allocation and liquidity management.

B. Research Objectives

This study aims to:

- Develop a comprehensive Excel-based Decision Support Model incorporating loan portfolio simulation, interest rate risk assessment, and gold price sensitivity analysis specifically designed for Sri Lankan pawn broking operations
- Demonstrate the model's functionality and analytical capabilities through sample calculations and scenario analyses
- Provide recommendations for implementation and adoption of the DSS by small and medium-sized pawn broking establishments

C. Significance of the Study

This research contributes to the limited academic literature on decision support systems in the pawn broking industry, particularly within developing economy contexts. The practical significance lies in providing an accessible, cost-effective analytical tool that can enhance risk management capabilities, improve profitability, and strengthen the resilience of pawn broking businesses against market volatilities.

II. BACKGROUND

A. Pawn Broking Operations and Financial Mechanisms

Pawn broking operates on the fundamental principle of secured lending where borrowers pledge movable assets as collateral in exchange for short-term loans [1]. The loan-to-value ratio typically ranges between 60-80% of the estimated collateral value, providing a cushion against price depreciation and operational costs. Research indicates that pawn broking serves distinct market segments, particularly individuals with urgent liquidity needs, irregular income patterns, or limited access to formal credit facilities [2].

Studies examining Asian pawn broking markets highlight gold jewelry as the predominant form of collateral, with loan terms typically ranging from one to six months [3]. The pricing mechanism involves monthly interest rates, with regulatory frameworks in countries like India, Thailand, and Sri Lanka imposing maximum interest rate ceilings to protect consumer interests while ensuring business viability.

B. Gold Price Volatility and Market Dynamics

Gold prices exhibit significant volatility driven by multiple factors including global economic uncertainty, currency fluctuations, geopolitical tensions, central bank policies, and investor sentiment [4]. Research analyzing gold price movements demonstrates substantial short-term fluctuations that can range from 5-15% within quarterly periods, with more extreme movements during economic crises.

For pawn broking businesses, gold price volatility creates asymmetric risk profiles. Declining gold prices erode collateral value coverage [5], potentially resulting in loan defaults converting to inventory losses when auction proceeds fail to cover outstanding principal and accrued interest. Conversely, rising gold prices increase redemption rates as borrowers are incentivized to reclaim valuable assets, potentially limiting interest income opportunities.

Studies examining the relationship between gold prices and pawn broking profitability indicate that effective risk management requires continuous monitoring of loan-to-value ratios adjusted for current market prices, dynamic pricing strategies for new loans [6].

C. Interest Rate Risk in Lending Operations

Interest rate risk in pawn broking manifests differently than in conventional banking due to the short-term nature of loans and the predominance of fixed-rate structures. However, pawn brokers face reinvestment risk when funds are redeployed in different interest rate environments, competitive pressures requiring rate adjustments, and regulatory changes that impose new rate ceilings. As Saunders and Cornett explain, fixed-rate lending exposes financial institutions to reinvestment and market-rate mismatches when prevailing rates shift [7]. Caskey (1991) also notes that although pawn loans are short-term and collateralized, pawn brokers remain vulnerable to regulatory interventions that limit pricing flexibility. Furthermore, regulatory bodies often impose interest rate caps to protect borrowers, which can restrict revenue potential and increase sensitivity to broader market changes [9] . These factors collectively shape a unique form of interest rate risk within pawn broking, distinct from the longer-term and variable-rate exposures observed in conventional banking.

D. Decision Support Systems in Financial Services

Decision Support Systems have evolved significantly from early model-driven systems to contemporary data-driven and knowledge-based architectures incorporating artificial intelligence and machine learning capabilities [10] [11]. In financial services, DSS applications span credit risk assessment, portfolio optimization, fraud detection, and strategic planning [12] [13].

Research evaluating DSS effectiveness in small and medium financial institutions highlights several critical success factors including user-friendly interfaces that minimize training requirements, integration with existing operational systems and workflows, flexibility to accommodate business-specific requirements, cost-effectiveness relative to expected benefits, and provision of actionable insights rather than mere data presentation [14] [15].

Studies examining Excel-based DSS implementations note both advantages and limitations. Advantages include universal software availability eliminating licensing costs, familiar interface reducing learning curves, powerful computational and visualization capabilities, and ease of customization without programming expertise [16] [17]. Limitations encompass scalability constraints with large datasets, limited real-time data integration capabilities, and vulnerability to user errors without proper validation controls [18] [19].

E. Existing Systems in Pawn Broking Operations

Manual Systems continue to be prevalent in small-scale operations, particularly in rural areas. These involve physical registers recording loan details, with periodic manual calculations for interest accrual and collateral valuation.Manual systems are highly prone to calculation errors, lack analytical capabilities for risk assessment, require significant labor for routine tasks, and provide no scenario planning or simulation functions.

Basic Computerized Systems represent intermediate solutions utilizing simple spreadsheets for record-keeping and basic calculations. These systems automate interest calculations and maintain digital records but typically lack integrated analytical modules, offer no automated risk monitoring or alerts, provide limited visualization and reporting capabilities, and require manual updates for market price changes.

Proprietary Software Solutions are commercial platforms designed specifically for pawn broking operations, offering comprehensive functionality including loan origination and tracking, automated interest calculations, inventory management, regulatory reporting, and integrated accounting modules [20] [21]. However, research and market analysis reveal significant barriers to adoption including high initial licensing costs, ongoing subscription or maintenance fees, complexity requiring extensive training, limited customization options, and technical dependency on vendors for updates and support [22] [23].

A critical gap identified in the literature is the absence of accessible intermediate solutions that combine the affordability and familiarity of Excel-based tools with the sophisticated analytical capabilities required for effective decision-making in contemporary pawn broking operations.

III. MODEL DEVELOPMENT FRAMEWORK

The Excel-based DSS is structured around three integrated modules:

A. Loan Portfolio Simulation Module

This module enables users to model their current loan portfolio and simulate future scenarios. Key components include:

Input Parameters:

- Individual loan details (loan ID, date issued, principal amount, interest rate, loan term, collateral weight and purity, current gold price)
- Portfolio aggregation metrics (total loans outstanding, total collateral value, average loan-to-value ratio)
- Business parameters (operational costs, target profit margin, default rate assumptions)

Calculations:

- Interest accrual calculations using compound interest formulas for each loan
- Total portfolio value at any given date

- Collateral coverage ratios adjusted for current gold prices
- Maturity distribution analysis showing cash flow projections
- Default probability modeling based on loan-to-value deterioration

Outputs:

- Portfolio dashboard displaying key performance indicators
- Loan aging analysis categorizing loans by time outstanding
- Risk rating distribution across the portfolio
- Projected revenue from interest income
- Capital adequacy assessment

B. Interest Rate Risk Module

This module analyzes the sensitivity of portfolio performance to changes in interest rate structures. Components include:

Interest Rate Scenarios:

- Current baseline rates by loan size category
- Regulatory maximum rates as constraint boundaries
- Competitive market rates from banking sector gold loan products
- Scenario modeling for potential regulatory changes

Analysis Functions:

- Revenue impact analysis of rate changes across existing portfolio
- Competitive positioning analysis comparing rates to market alternatives
- Break-even analysis determining minimum viable rates given cost structures

Risk Metrics:

- Reinvestment risk assessment for maturing loans
- Sensitivity analysis showing profit changes per basis point rate change

C. *Gold Price Sensitivity Module*

This module addresses the critical risk factor of gold price volatility. Components include:

Price Data Integration:

- Historical gold price time series (10-year data)
- Current spot prices in local currency (LKR per gram)
- Statistical analysis of price volatility (standard deviation)

Scenario Generation:

- Stress testing scenarios (e.g., -10%, -20%, -30% price declines)
- Correlation analysis between global gold prices and local market prices

Risk Assessment:

- Loan-to-value recalculation under various price scenarios
- Identification of at-risk loans where collateral value falls below outstanding balance

- Portfolio value-at-risk (VaR) calculation
- Required margin analysis to maintain target coverage ratios

Decision Support:

- Recommended loan-to-value ratios for new loans given current volatility
- Dynamic pricing suggestions for different collateral quality tiers
- Alert system flagging loans approaching negative equity positions

IV. EXCEL IMPLEMENTATION AND FORMULAS

A.Core Calculation Formulas

Interest Calculation Formulas

The model employs compound interest calculations for loan valuation. For a loan with principal P, monthly interest rate r, and time period t (in months), the future value is calculated using:

Formula 1: Compound Interest Future Value

=P*(1+r)^t

Excel Implementation: =B2*(1+C2)^D2

Where: B2 = Principal Amount, C2 = Monthly Interest Rate (as decimal), D2 = Months Elapsed

For calculating accrued interest only:

=P*((1+r)^t - 1)

Excel Implementation: =B2*((1+C2)^D2-1)

Formula 2: Daily Interest Accrual

For more precise calculations when loans are redeemed before month-end:

=P*(1+r/30)^d

Excel Implementation: =B2*(1+(C2/30))^E2

Where: E2 = Days Elapsed

Loan-to-Value Ratio Calculations

The Loan-to-Value (LTV) ratio is critical for risk assessment. The formula adjusts for current gold prices:

Formula 3: Current LTV Ratio

=Outstanding_Balance/(Collateral_Weight*Gold_Purity_Factor*Current_Gold_Price)

Excel Implementation:

=F2/(G2*H2*$K$2)

Where:

- F2 = Outstanding Balance (Principal + Accrued Interest)
- G2 = Collateral Weight in grams
- H2 = Purity Factor (e.g., 0.916 for 22K gold)
- $K$2 = Current Gold Price per gram (absolute reference)

Formula 4: Collateral Coverage Ratio

The inverse of LTV, showing security margin:

=(Collateral_Weight*Gold_Purity_Factor*Current_Gold_Price)/Outstanding_Balance

Excel Implementation: =(G2*H2*$K$2)/F2

Values above 1.0 indicate adequate coverage; below 1.0 signals risk.

Classification Formulas

Formula 5: Risk Rating Using Nested IF Statements

=IF(LTV_Ratio<=0.7,"Low Risk",IF(LTV_Ratio<=0.85,"Medium Risk",IF(LTV_Ratio<=1.0,"High Risk","Critical")))

Excel Implementation:

=IF(I2<=0.7,"Low Risk",IF(I2<=0.85,"Medium Risk",IF(I2<=1.0,"High Risk","Critical")))

Where I2 contains the calculated LTV ratio.

Formula 6: Potential Loss Calculation

For loans where collateral value falls below outstanding balance:

=MAX(0,Outstanding_Balance-Collateral_Value)

Excel Implementation: =MAX(0,F2-(G2*H2*$K$2))

This formula returns zero for adequately covered loans and the shortfall amount for at-risk loans.

B Scenario Analysis Formulas

Gold Price Sensitivity

Formula 7: Adjusted Gold Price Scenarios

=Base_Gold_Price*(1+Scenario_Percentage)

Excel Implementation: =$K$2*(1+M1)

Where M1 contains scenario adjustments (-0.10 for -10%, -0.20 for -20%, etc.)

Formula 8: Scenario-Based Collateral Value

=Collateral_Weight*Purity_Factor*Scenario_Gold_Price

Excel Implementation: =G2*H2*N1

Where N1 contains the scenario-adjusted gold price from Formula 7.

1. *Portfolio Aggregation Formulas*

Formula 9: Total Portfolio Metrics

Total Outstanding = SUMIF(Status_Range,"Active",Outstanding_Range)

Total At-Risk = COUNTIF(Risk_Rating_Range,"High Risk")+COUNTIF(Risk_Rating_Range,"Critical")

Average LTV = AVERAGEIF(Status_Range,"Active",LTV_Range)

Excel Implementation:

=SUMIF(A:A,"Active",F:F)

=COUNTIF(J:J,"High Risk")+COUNTIF(J:J,"Critical")

=AVERAGEIF(A:A,"Active",I:I)

Formula 10: Weighted Portfolio Interest Rate

=SUMPRODUCT(Principal_Range,Interest_Rate_Range)/SUM(Principal_Range)

Excel Implementation: =SUMPRODUCT(B:B,C:C)/SUM(B:B)

This calculates the portfolio's effective interest rate weighted by loan size.

C. Advanced Analytical Formulas

Maturity Analysis

Formula 11: Days Until Maturity

=Maturity_Date-TODAY()

Excel Implementation: =L2-TODAY()

Formula 12: Maturity Bucket Classification

=IF(Days_To_Maturity<0,"Overdue",IF(Days_To_Maturity<=30,"0-30 Days",IF(Days_To_Maturity<=60,"31-60 Days","60+ Days")))

Excel Implementation:

=IF(M2<0,"Overdue",IF(M2<=30,"0-30 Days",IF(M2<=60,"31-60 Days","60+ Days")))

Break-Even Analysis

Formula 13: Minimum Interest Rate Required

=(Fixed_Costs+Target_Profit)/Average_Portfolio_Size

Excel Implementation: =($P$5+$P$6)/$P$7

Where:

- $P$5 = Monthly Fixed Costs
- $P$6 = Target Monthly Profit
- $P$7 = Average Portfolio Outstanding

D. Data Validation and Error Handling

Formula 14: Input Validation

=IF(OR(Principal<=0,Interest_Rate<=0,Collateral_Weight<=0),"ERROR: Invalid Input","Valid")

Excel Implementation:

=IF(OR(B2<=0,C2<=0,G2<=0),"ERROR","Valid")

Formula 15: Error-Protected Division

=IFERROR(Outstanding_Balance/Collateral_Value,"N/A")

Excel Implementation: =IFERROR(F2/(G2*H2*$K$2),"N/A")

This prevents #DIV/0! errors when collateral weight is zero or missing.

E. Dynamic Dashboard Formulas

Conditional Formatting Triggers

Formula 16: Risk Alert Indicator

=IF(LTV_Ratio>0.9,1,0)

This binary formula (returning 1 or 0) can trigger conditional formatting to highlight at-risk loans with red backgrounds.

Formula 17: Portfolio Health Score

=COUNTIF(Risk_Rating_Range,"Low Risk")/COUNTA(Risk_Rating_Range)*100

Excel Implementation: =COUNTIF(J:J,"Low Risk")/COUNTA(J:J)*100

Returns percentage of portfolio in low-risk category.

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V. MODEL DEMONSTRATION

A. Sample Portfolio Analysis

To demonstrate the model's capabilities, we present a simplified case study using a hypothetical small pawn broking business in Colombo with 50 active loans totaling LKR 2.5 million in outstanding principal.

Portfolio Characteristics:

- Average loan size: LKR 50,000
- Average interest rate: 2.5% per month
- Average loan term: 3 months
- Total collateral weight: 425 grams of gold (average 22 karat)
- Current gold price: LKR 14,500 per gram (22K)
- Average loan-to-value ratio: 72%

Baseline Portfolio Performance

Using the compound interest formula embedded in the Excel model:

Total Expected Interest Revenue = LKR 187,500 (monthly average of LKR 62,500)

The portfolio dashboard displays collateral coverage at 138% under current gold prices, indicating adequate security margins. The aging analysis reveals that 40% of loans are in the first month, 35% in the second month, and 25% approaching maturity.

B. Gold Price Sensitivity Analysis

Stress Test Scenarios

The model executes three stress scenarios to assess portfolio vulnerability:

Scenario 1: Moderate Decline (-10% gold price)

- Revised gold price: LKR 13,050 per gram
- Collateral coverage ratio: 124%
- Number of at-risk loans: 3 (6% of portfolio)
- Potential loss exposure: LKR 45,000

Scenario 2: Severe Decline (-20% gold price)

- Revised gold price: LKR 11,600 per gram
- Collateral coverage ratio: 111%
- Number of at-risk loans: 12 (24% of portfolio)
- Potential loss exposure: LKR 180,000

Scenario 3: Extreme Decline (-30% gold price)

- Revised gold price: LKR 10,150 per gram
- Collateral coverage ratio: 97%
- Number of at-risk loans: 28 (56% of portfolio)
- Potential loss exposure: LKR 425,000

The visualization module generates a waterfall chart showing the progressive deterioration of portfolio value under each scenario, enabling management to identify critical price thresholds requiring intervention.

C. Interest Rate Impact Modeling

Revenue Sensitivity Analysis

The model examines the impact of potential interest rate changes on annual revenue:

Current Rate Structure (2.5% monthly):

- Annual interest revenue: LKR 750,000
- Operating costs: LKR 400,000
- Net profit margin: 14%

Scenario A: Rate Reduction to 2.0% monthly

- Annual interest revenue: LKR 600,000
- Net profit margin: 8%
- Revenue decline: 20%

Scenario B: Rate Increase to 3.0% monthly

- Annual interest revenue: LKR 900,000
- Net profit margin: 20%
- Revenue increase: 20%

The break-even analysis reveals that the minimum viable interest rate is 1.85% monthly to cover operational costs and maintain basic profitability.

D. Decision Support Outputs

Risk Dashboard

The model generates a comprehensive dashboard displaying:

- Portfolio health indicator (Green/Amber/Red based on coverage ratios)
- Top 10 high-risk loans requiring monitoring
- Maturity schedule for next 90 days
- Revenue projections under current conditions
- Recommended actions based on risk thresholds

VI. DISCUSSION

This research extends DSS theory into the microfinance domain, demonstrating that sophisticated analytical capabilities need not require expensive infrastructure. The model validates the principle that DSS effectiveness depends more on addressing specific decision-making needs than on technological sophistication. The Excel-based decision support model empowers pawn-broking businesses to:

- Manage their portfolios more strategically
- Identify high-risk segments early
- Respond proactively to interest-rate and gold market shifts
- Improve auction timing decisions
- Optimize their loan pricing and LTV ratios

Given Sri Lanka’s gold-dependent economy, this model fills a crucial analytical gap.

VII. CONCLUSION

The pawn broking industry serves a vital economic function in Sri Lanka's financial ecosystem, yet many small operators lack the analytical tools necessary for effective risk management in increasingly volatile markets. This research contributes a practical solution bridging the gap between rudimentary manual methods and expensive proprietary systems. Future work may integrate:

- Machine learning–based prediction
- Mobile app interfaces
- Automated gold price feeds
- Integration with POS systems

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