Early Risk Signal System (ERSS)

Solution Architecture & Strategic Approach

Submitted by: Sourav Sarania (CU.17)

Project: Credit Card Delinquency Watch

1. Executive Summary

The Challenge: Financial institutions traditionally rely on "Lag Indicators" (e.g., missed payments or Day Past Due counters) to identify credit risk. By the time these indicators trigger, the customer is already in financial distress, making recovery difficult and leading to high "Roll Rates" (progression from delinquency to default).

The Solution: We have developed the **Early Risk Signal System (ERSS)**, a microservice-based decision engine that shifts the focus to **Lead Indicators**. By analyzing subtle behavioral shifts—specifically the correlation between reduced spending and liquidity seeking—our system identifies high-risk customers **30 days before** a payment is missed.

Key Outcome: A lightweight, transparent, and automated system that categorizes customers into actionable risk tiers (Red/Amber/Green), enabling proactive intervention rather than reactive collections.

2. Data Diagnosis & Behavioral Insights

Our analysis of the provided dataset revealed two distinct "Risk Personas" that standard models often overlook. These personas drove the logic behind our risk engine.

Persona A: The "Silent Quitter" (High Risk)

- **Behavior:** These customers realize they are running out of money. They instinctively stop using their credit card for discretionary spending (to save cash for rent/utilities) but are forced to use the card for cash withdrawals.
- **The Data Signal:** A sudden drop in Recent Spend Change % (worse than -20%) combined with Cash Withdrawal % (> 8%).
- **Validation:** In the sample data, Customer **C015** exhibited a -23% spending drop and 9% cash withdrawal. Despite having no prior missed payments, they transitioned to **DPD Bucket 2** (30-60 days past due) the very next month.

Persona B: The "Debt Trap" Revolver (Medium-High Risk)

- **Behavior:** These customers are treading water. They pay only the minimum amount due to avoid immediate penalties, but their principal balance remains high.
- **The Data Signal:** Avg Payment Ratio < 40% combined with Min Due Paid Frequency > 50%.

3. The Logical Framework (The "Balanced Formula")

We prioritized a **"White-Box" Rule-Based Model** over complex AI "Black Boxes." This ensures the logic is computationally lightweight (suitable for real-time processing) and fully explainable to regulatory bodies and operations teams.

The API utilizes the following tiered logic to assign risk flags:

🔴 RED FLAG (Immediate Intervention)

- **Trigger Condition:**
  - **Scenario 1 (Liquidity Crisis):** Spend Change < -20% **AND** Cash Withdrawal > 8%
  - **Scenario 2 (Chronic Revolver):** Payment Ratio < 40% **AND** Min Due Frequency > 50%
- **Operational Meaning:** The customer is actively managing a cash shortage. Default is imminent.

🟡 AMBER FLAG (Watchlist)

- **Trigger Condition:**
  - Cash Withdrawal > 15% **OR** Utilisation > 80%
- **Operational Meaning:** The customer is heavily leveraged or relying on expensive credit. They are stressed but solvent.

🟢 GREEN FLAG (Healthy)

- **Trigger Condition:**
  - Does not meet Red or Amber criteria.
- **Operational Meaning:** Standard usage patterns; no action required.

4. Technical Architecture

The solution is architected as a **Stateless Microservice** to ensure seamless integration with existing banking infrastructure.

- **Core Engine:** Built with **Java 25** and **Spring Boot 4**. It processes transaction files in memory without retaining sensitive data (Privacy-First).
- **Deployment:** The application is **Dockerized**. This allows the bank to deploy the logic implementation as a standard container on any infrastructure (On-Premise, AWS, Azure, or Kubernetes) without dependency conflicts.
- **Interface:** A simple REST API endpoint (POST /analyze) accepts daily batch CSV files from the Core Banking System.

5. Strategic Interventions

To minimize Roll Rates, the flags generated by the API are mapped to specific business actions:

Risk Level	Recommended Action	Goal
RED	**Loss Mitigation:** Immediately freeze "Instant Loan" offers and Credit Limit Increases. Proactively call the customer to offer an EMI Restructuring Plan.	Secure the principal amount before default occurs.
AMBER	**Nudge Strategy:** Send automated App Notifications highlighting the interest costs of paying only the minimum due.	Encourage higher payments without aggressive collections.
GREEN	**Upsell:** Offer product upgrades or limit increases.	Increase "Share of Wallet."

6. Conclusion

The Early Risk Signal System meets the challenge of being "lightweight" and "integratable." By automating the detection of pre-delinquency behaviors, the bank can move from a reactive posture to a proactive partnership with its customers, ultimately reducing NII losses and improving portfolio health.