

## Business problem

The primary objective of this project is to optimize the ATM network's efficiency and enhance customer experience by predicting cash withdrawal patterns at specific locations. By leveraging historical transaction data and geospatial analysis, the financial institution aims to improve cash replenishment strategies, reduce operational costs, and enhance marketing effectiveness.

Related business questions include:

- How does transaction volume vary by time and location, and how can this data be used to optimize cash replenishment schedules?
- Does improving ATM availability and reducing downtime lead to higher customer satisfaction and retention?
- Will targeted marketing efforts based on ATM usage behavior increase the adoption of other financial products?
- Can predictive analytics reduce emergency maintenance and cash shortages, leading to cost savings?

Key Insights		Strategic Objectives	
Aspect	Analysis	Objective	Expected Impact
Spatial Demand	Higher cash dependency near markets, schools, and elderly neighborhoods.	Predict client-ATM withdrawal probabilities	Dynamic cash allocation per location
H3Index	Level 9 ( $1 \text{ km}^2$ ) balances privacy and spatial precision for logistics planning.	Reduce cash logistics costs	Target 15-20% operational savings
Granularity	Level 9 ( $1 \text{ km}^2$ ) balances privacy and spatial precision for logistics planning.	Improve customer satisfaction (NPS)	Achieve +10 points via reliability
Temporal Trends	Peak withdrawals: Weekday mornings (8-10 AM) and weekends. Seasonal spikes before holidays.	Leverage H3Index geospatial data	Identify high-demand zones ( $1 \text{ km}^2$ )

## Solution Overview

Stage	Components	Metric	Description
Data Ingestion	- Transaction aggregates (count, sum, std) - ATM locations (H3Index) - OpenStreetMap POI integration	High-Demand Zones	Identified via H3Index heatmaps (prioritize red zones for frequent replenishment).
Model Development	- Features: Historical patterns, geospatial proximity - Output: Probability scores per (client, ATM) pair	Low-Demand Zones	Optimize cash reserves to reduce idle capital (blue zones).
Operational Integration	- Automated low-cash alerts - Dashboard-driven replenishment schedules	Data Enrichment	OpenStreetMap API integration for POI correlation (markets, schools).

## Next Steps

Action Item	Details
Dashboard Exploration	Filter by time (hour/day/week) and compare predicted vs. actual withdrawals.
Hexagon Analysis	Drill into H3Index zones to analyze demographics and cross-sell opportunities.
Threshold Adjustment	Customize cash replenishment alerts based on probability thresholds.