Report_synergyminds_retailbanking_challenge2

Team: synergy-minds | Participant: Feifei Li (solo) | Final Metric: MacroF1 = 0.9553

1. **Objective & Problem Framing**

Predict `DefaultLabel` for each customerweek combination in a dynamic panel dataset. The challenge required building a robust model that captures credit utilization trends, payment behavior, and inquiry history to forecast default risk over time.

2**. Final Data & Feature Engineering Strategy**

- **Core Data:** Integrated `customer_panel_`, `customers_all`, and `accounts_all` using `CustomerID` and `Week`.
- **Temporal Features:** Generated 1, 2, and 4week lagged values and rolling statistics (mean, std, trend) for `Utilisation` and `PaymentRatio`.
- **Advanced Behavioral Features**:
- **Action Sequence Complexity:** Quantified behavioral complexity from session patterns (Top feature: 15.8% importance).
- **SessionCredit Interactions:** Combined realtime behavior with credit profile data.
- **Risk Flags:** Utilization spikes (> p90), payment shortfalls (< 0.2), cumulative hard inquiries.
- **Stability Measures:** Implemented robust feature selection (60 most predictive features) with reproducible preprocessing.

3**. Final Modeling & Validation Approach**

- **Model:** Stable Ensemble (Treebased) with fixed weights and comprehensive random seed control.
- **Validation:** Temporal crossvalidation grouped by `CustomerID` to prevent data leakage.
- **Threshold Optimization:** Used bootstrapped optimization, finalizing at 0.500 for maximum stability and performance.

Stability Check: Achieved consistent results across runs (Score range: 0.9908 0.9915).

4. Final Results & Performance

Best MacroF1 Score: 0.9553

- **Key Drivers:** Action sequence complexity, sessioncredit interactions, credit health index, and utilization volatility.
- **Improvement:** +0.0047 over previous best **(0.9506**), demonstrating the value of stabilityfocused enhancements.

5. HumanAI Collaboration

AI Contribution: Generated initial code for lag/rolling features, suggested stability techniques, and provided SHAP analysis snippets. Assisted with rapid prototyping and debugging of the feature engineering pipeline.

Human Oversight: Directed the overall strategy, performed final feature validation, enforced reproducibility, and curated the minimal feature set for generalization. All analytical decisions, model interpretation, and threshold calibrations were made manually.

6. Reproducibility & Artifacts

Notebook: `synergyminds_retailbanking_challenge2.ipynb` (executable file).

Environment: Python 3.11, with pinned versions: `pandas==2.2.0`, `scikitlearn==1.4.2`, `lightgbm==4.1.0`.

Determinism: Fixed random seeds, saved feature lists, and logged optimal thresholds to ensure full reproducibility.