END-TO-END ML PIPELINE · BEHAVIORAL INSIGHTS · ROI SIMULATION

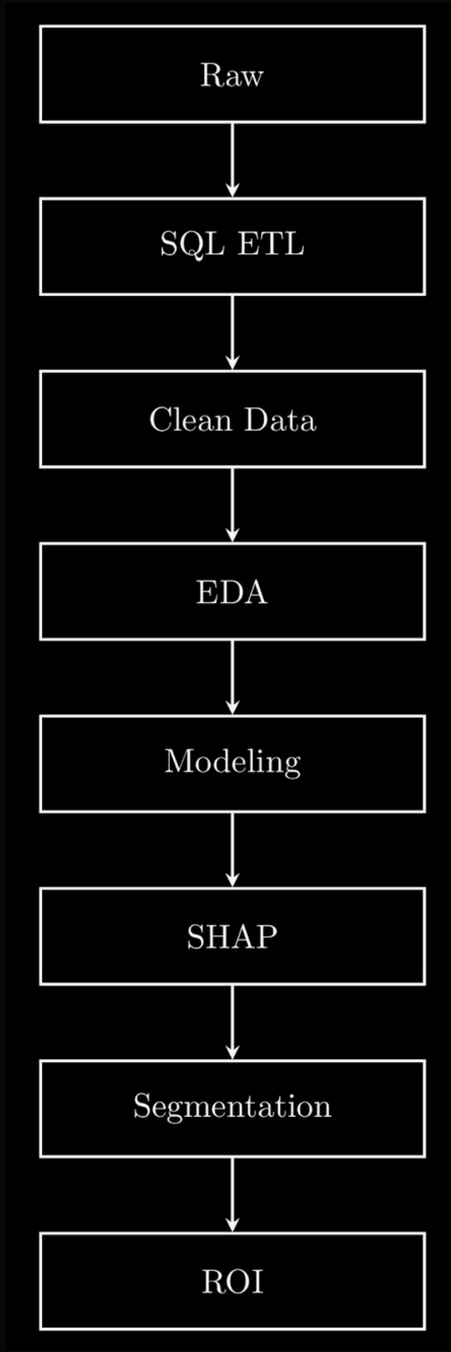
BANK CHURN PREDICTION & CUSTOMER SEGMENTATION

CAROLINE KUO, KLINA LI · AAE 722

2025 FALL

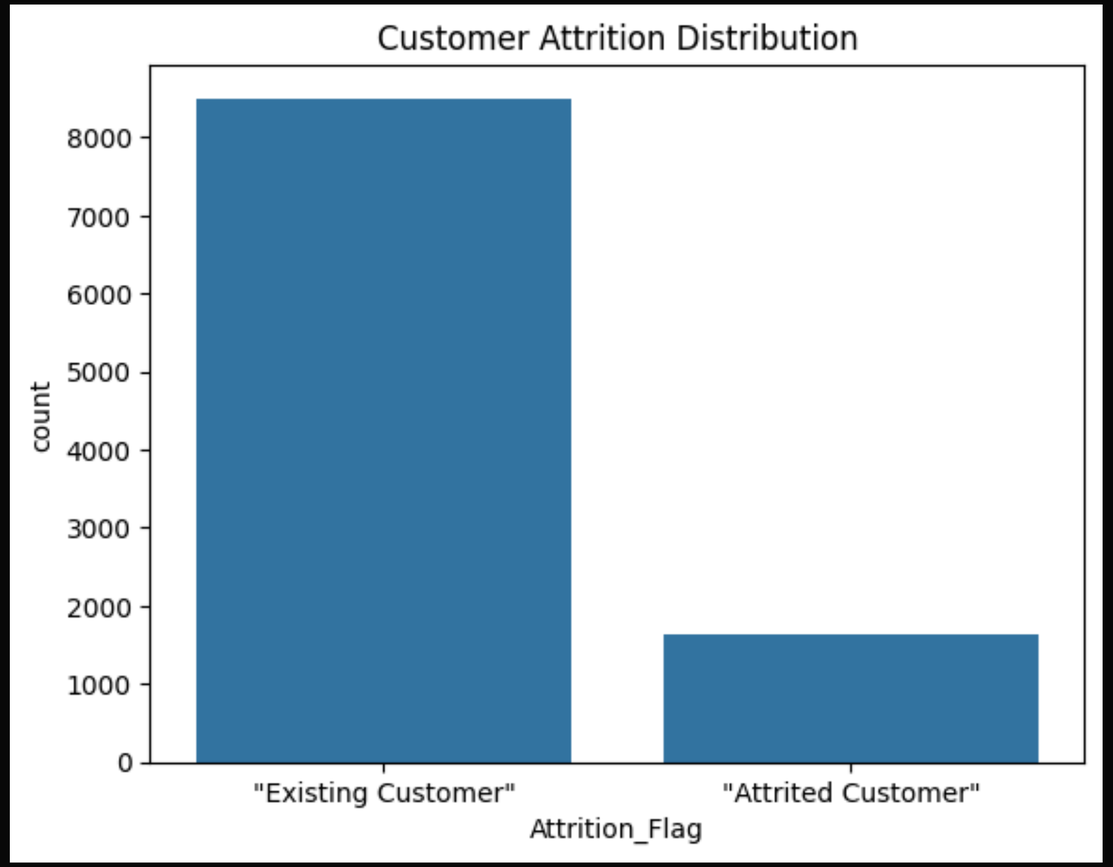
PROJECT PIPELINE OVERVIEW

- SQL SERVER ETL: STAGING → ODS (TYPED, CLEANED)
- PYTHON EDA + FEATURE ENGINEERING
- MODELING: LOGISTIC → RF → XGBOOST
- SHAP EXPLAINABILITY
- K-MEANS SEGMENTATION
- ROI DASHBOARD (STREAMLIT)



CHURN OVERVIEW: DEMOGRAPHICS ARE ALMOST FLAT

- 10,127 CUSTOMERS; ~16% CHURN → MODERATELY IMBALANCED.
- DEMOGRAPHICS SHOW LITTLE DIFFERENCE ACROSS CHURN GROUPS.
- CHURN IS NOT DRIVEN BY PROFILE → MUST FOCUS ON BEHAVIORAL DRIVERS.



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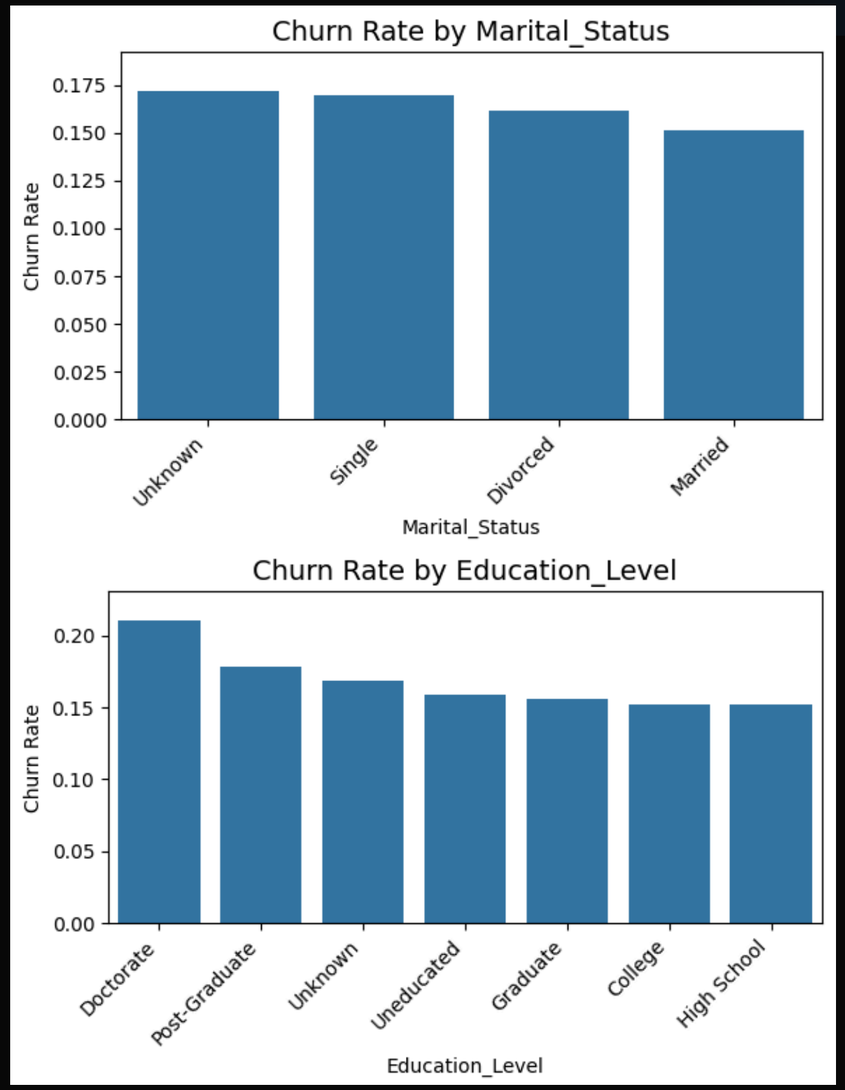
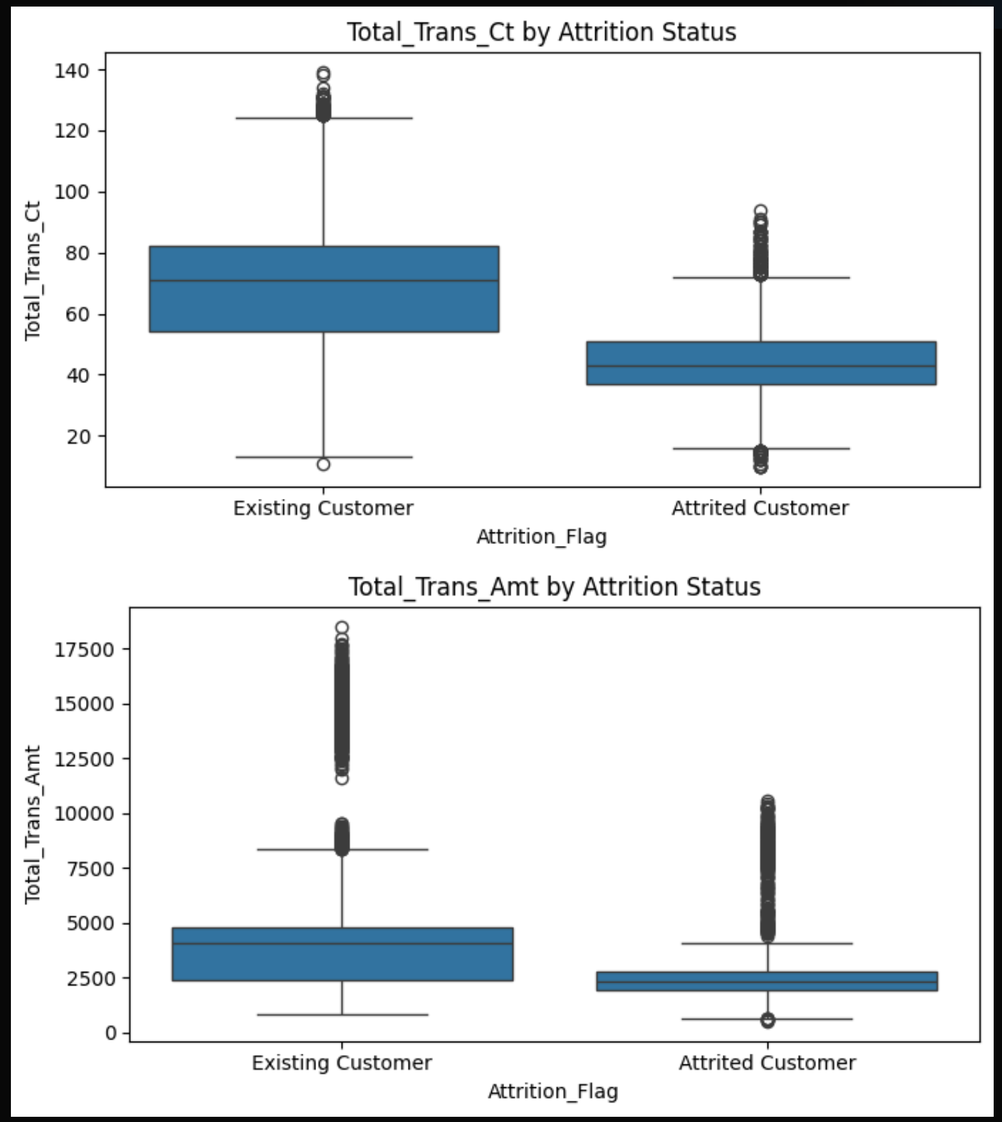


BEHAVIORAL PATTERNS: CHURN IS ENGAGEMENT-DRIVEN

- ATTRITED CUSTOMERS TRANSACT FAR LESS IN BOTH COUNT AND AMOUNT.
- THEY SHOW MORE INACTIVITY AND MORE SERVICE CONTACTS.
- SCATTER PLOTS PLACE CHURNERS IN LOW-ACTIVITY, LOW-SPEND CLUSTERS.
- CHURN IS FUNDAMENTALLY AN ENGAGEMENT DECLINE, NOT DEMOGRAPHICS.



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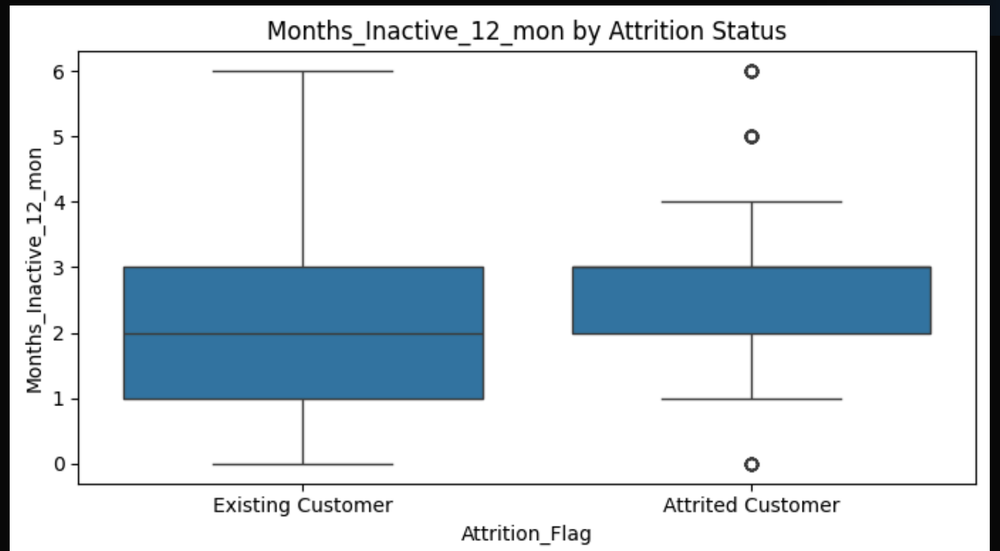

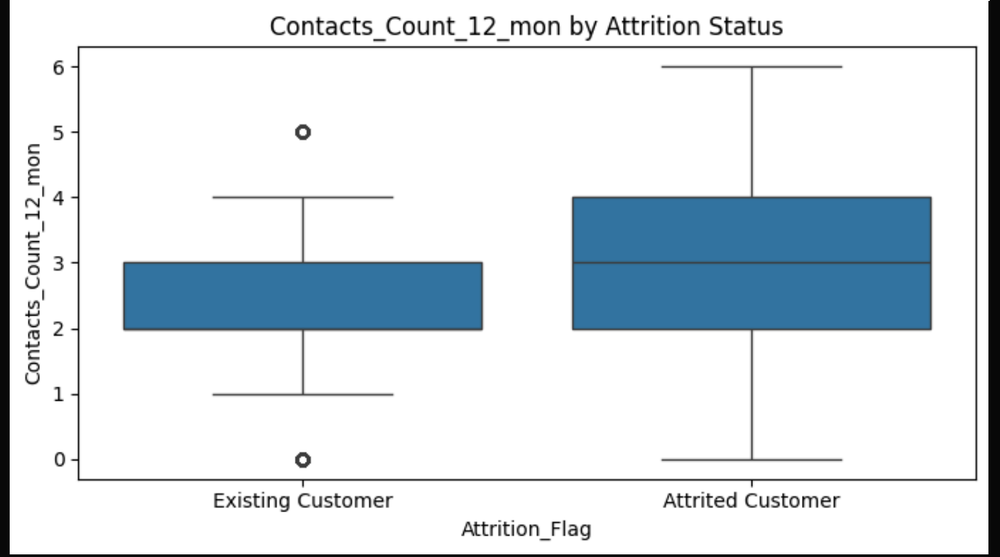

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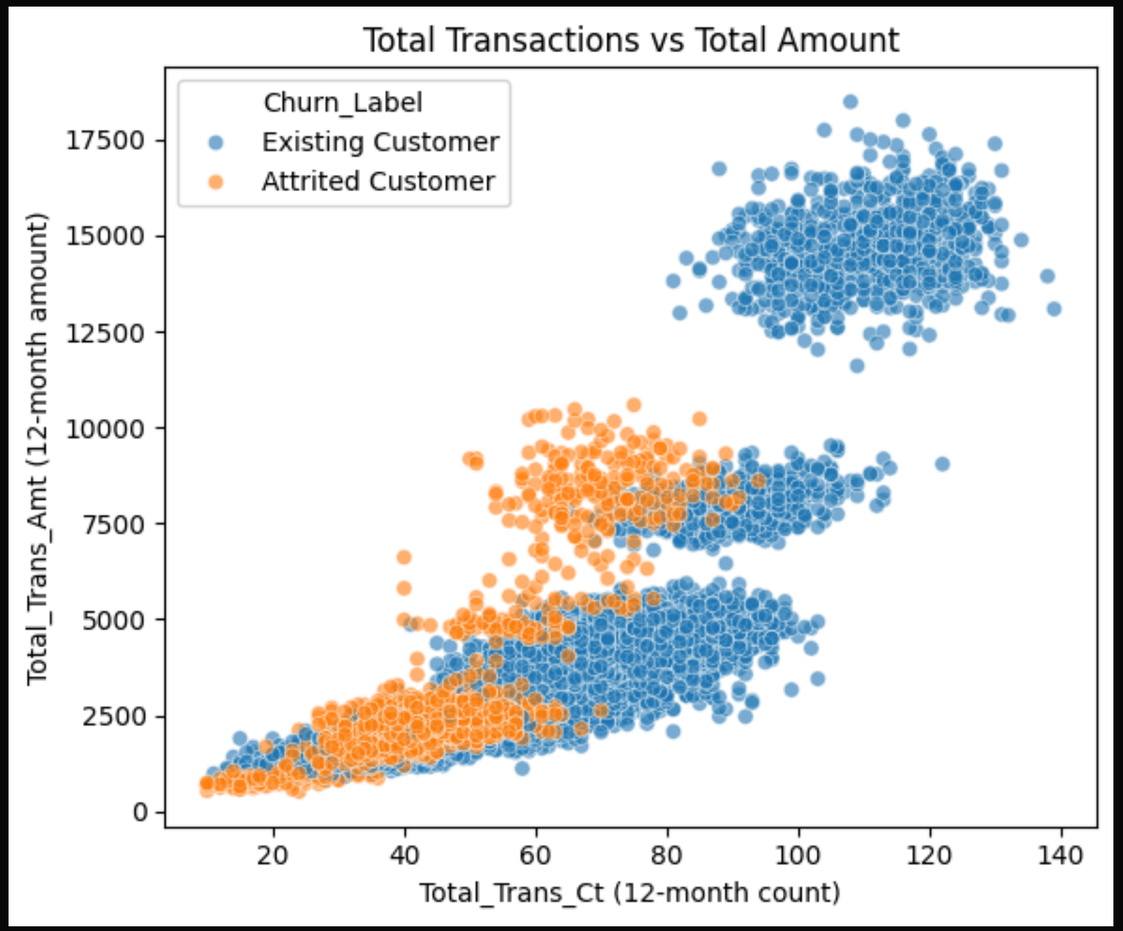
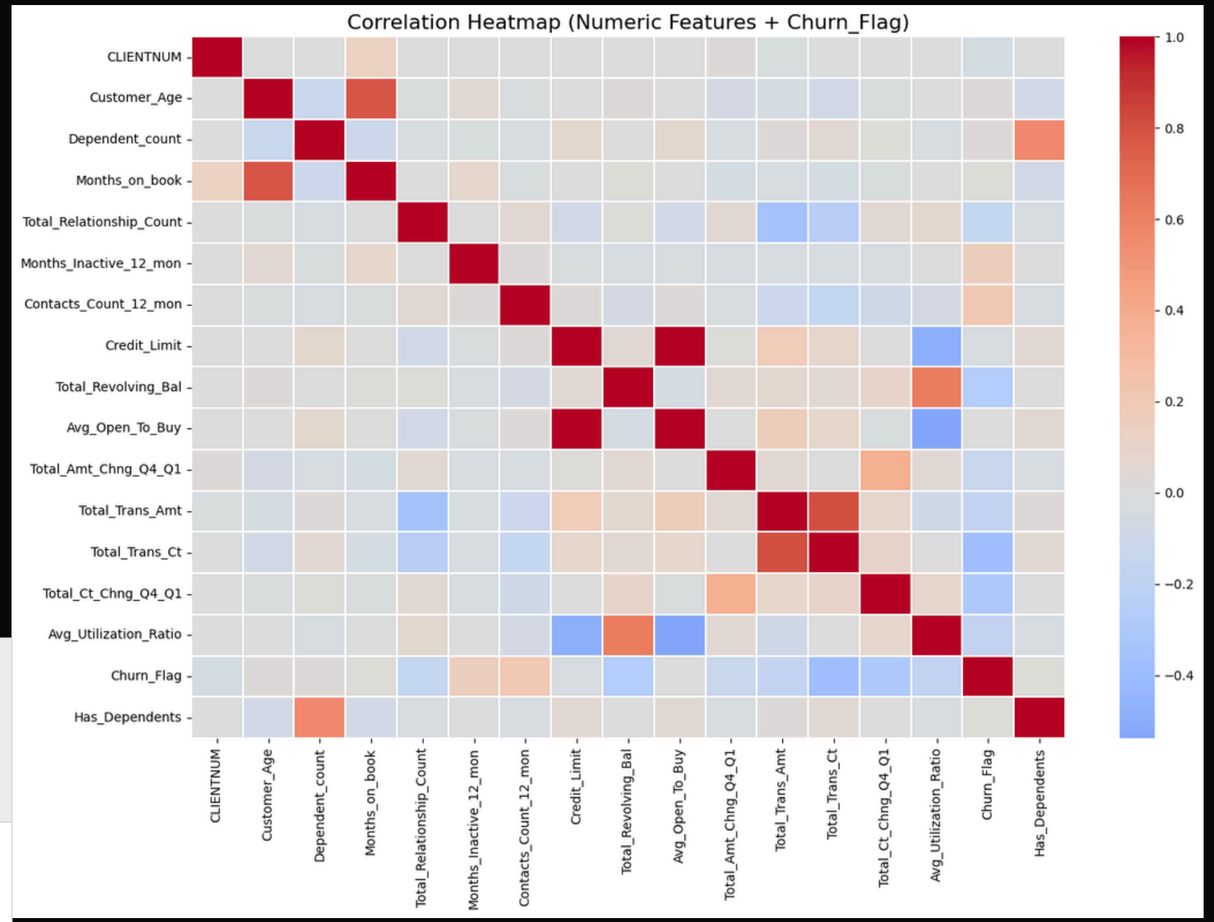


CORRELATION SUMMARY: BEHAVIORAL FEATURES DOMINATE

- BEHAVIORAL FEATURES CORRELATE MOST WITH CHURN (TRANSACTIONS, SPENDING, INACTIVITY).
- DEMOGRAPHICS ARE NEAR ZERO.
- CHURN IS BEHAVIOR-DRIVEN, NOT PROFILE-DRIVEN.

Highest + corr:	Contacts_Count_12_mon
Highest – corr:	Total_Trans_Ct



FEATURE ENGINEERING: PREPARING 46 MODEL-READY FEATURES

CATEGORICAL FEATURES	ONE-HOT ENCODED
SKEWED MONETARY FEATURES	LOG-TRANSFORMED VERSIONS
TENURE & AGE	TENURE BINS & AGE GROUPS
DEPENDENTS	HAS_DEPENDENTS INDICATOR
IDS & LABELS	REMOVED FROM MODELING

MODELING OVERVIEW & MODEL COMPARISON

- BASELINE: LOGISTIC REGRESSION

→ SIMPLE, INTERPRETABLE, WEAKER PERFORMANCE

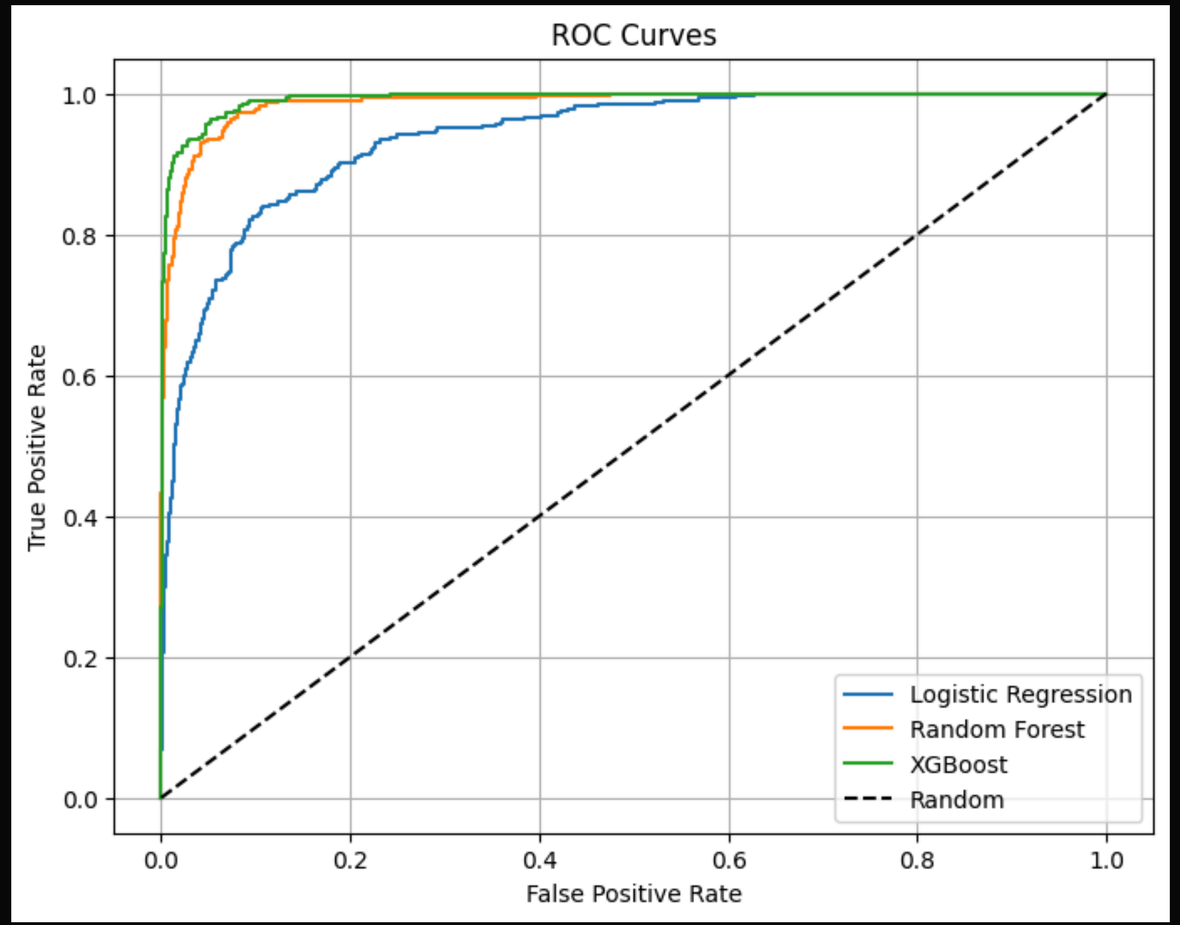
- RANDOM FOREST

→ BETTER HANDLING OF NONLINEAR PATTERNS

- XGBOOST (BEST MODEL)

→ STRONGEST PERFORMANCE ON CHURN PREDICTION

- EVALUATED USING ACCURACY, RECALL FOR CHURN, AND F1-SCORE



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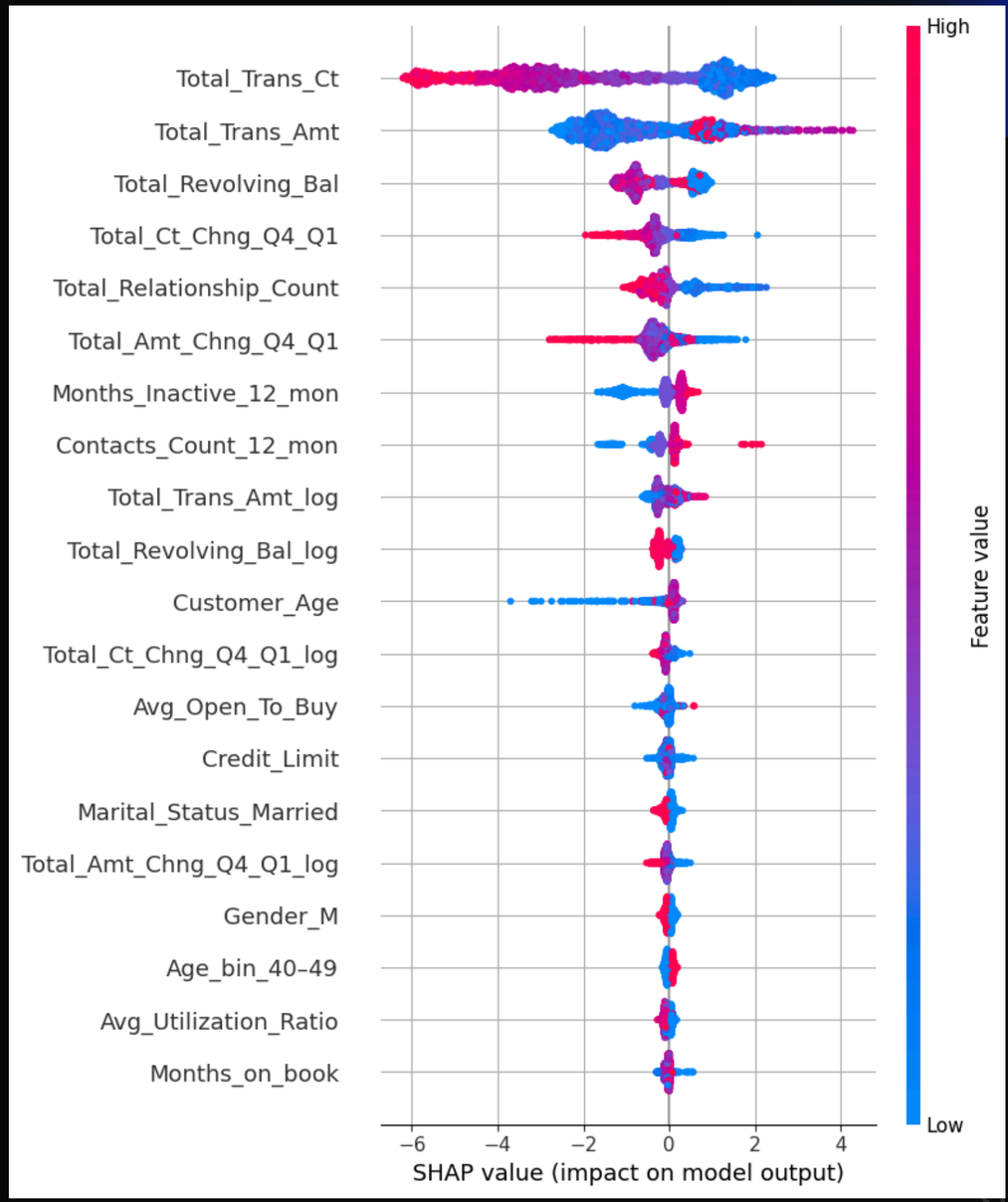
Model	Accuracy	Recall	F1	ROC-AUC
Logistic Regression	0.869	0.846	0.674	0.938
Random Forest	0.956	0.825	0.858	0.987
XGBoost	**0.968**	**0.926**	**0.903**	**0.993**

- EVALUATED USING ACCURACY, RECALL FOR CHURN, AND F1-SCORE

SHAP EXPLAINABILITY

- LOW TRANSACTIONS & LOW SPENDING ↑ CHURN
- DECLINING ACTIVITY TREND ↑ CHURN
- MORE INACTIVE MONTHS ↑ CHURN
- MORE SERVICE CONTACTS ↑ CHURN
- FEWER PRODUCT RELATIONSHIPS ↑ CHURN



CUSTOMER SEGMENTATION (K-MEANS): FOUR DISTINCT BEHAVIORAL SEGMENTS

Cluster 1 – Active Stable Users
- High usage & consistent activity
- Low inactivity
- Churn: 4%

→ Stable, low-risk users

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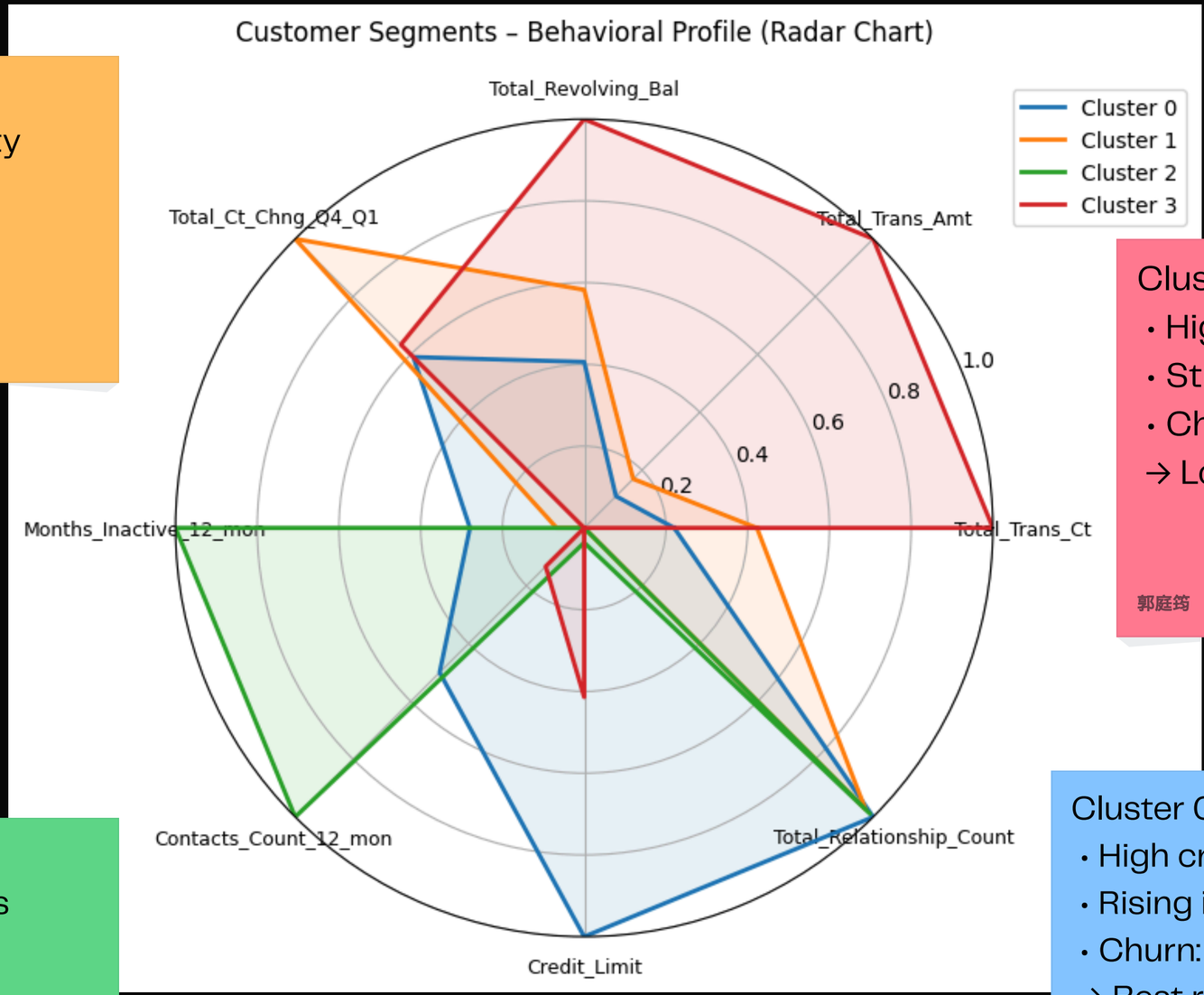

Cluster 3 – High-Value Loyal Users
- Highest transactions & spending
- Strong engagement
- Churn: 4%

→ Loyal high-value base

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Cluster 2 – Severely Disengaged
- Lowest transactions & balances
- Very high inactivity
- Churn: 38%

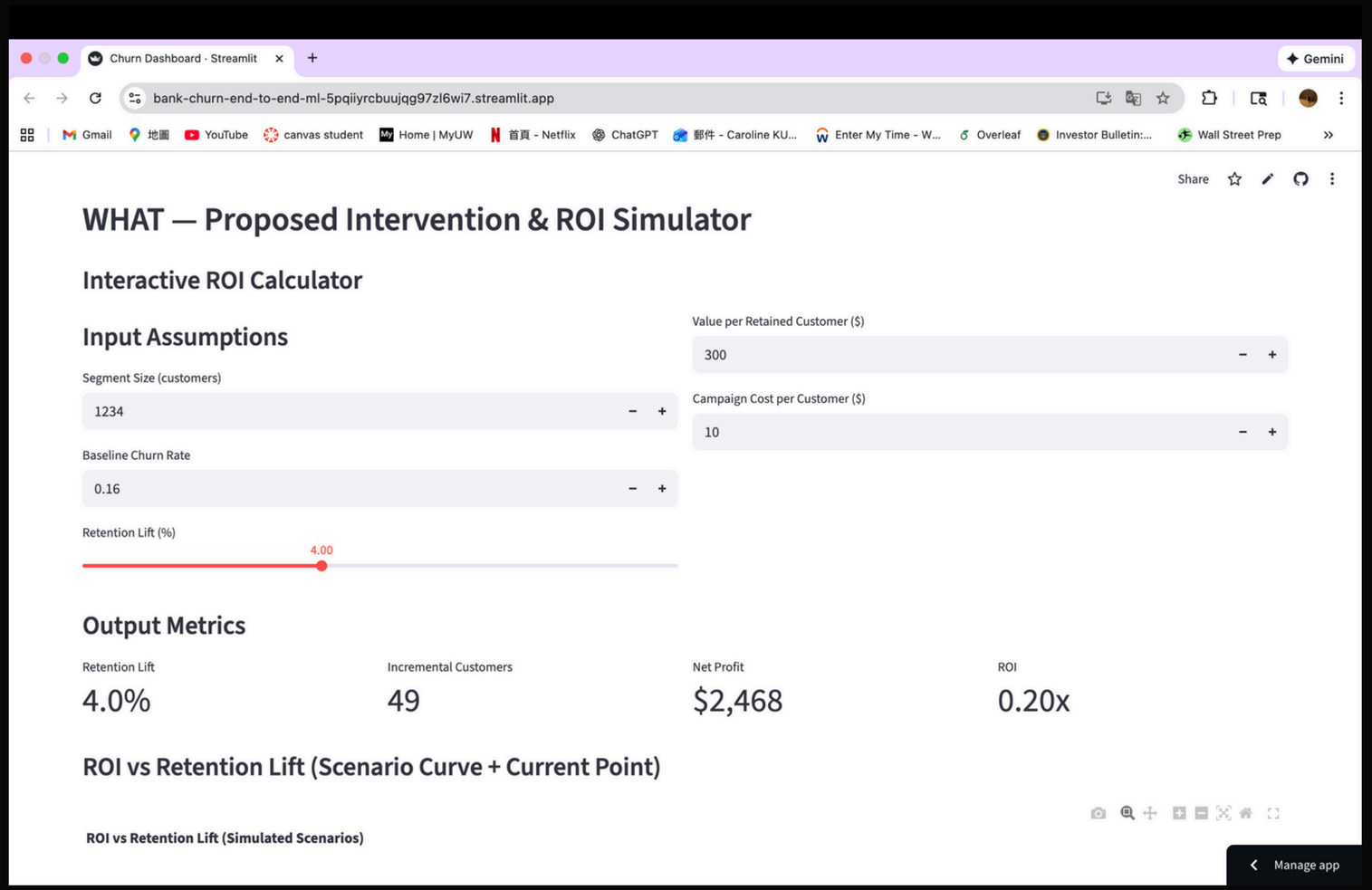
→ Low-ROI retention group

Cluster 0 – Mid-Value Early Disengagement
- High credit limit but declining activity
- Rising inactivity & service contacts
- Churn: 16%

→ Best reactivation target

TARGET SEGMENT & STRATEGY RECOMMENDATION

- WHY FOCUS ON CLUSTER 0?
- WHAT ACTION TO TAKE?
- HOW TO INTERVENE?
- STREAMLIT
- EXPECTED IMPACT



FINAL RECOMMENDATIONS

- Target Cluster 0 for reactivation
- Do NOT heavily invest in Cluster 2
- Maintain loyalty for Clusters 1 & 3

- Use ROI-guided incentives, not blanket offers
- Monitor early disengagement signals

THIS PROJECT DEMONSTRATES AN END-TO-END CHURN PREDICTION PIPELINE:

SQL → EDA → Feature Engineering → Modeling → SHAP → Segmentation → ROI simulation

XGBoost achieved strong recall (92%) and AUC (0.993)

CONCLUSION

Key takeaway:
→ Churn is behavior-driven, predictable, and actionable.

Segmentation revealed a clear high-ROI target group (Cluster 0)

A Streamlit tool was built to support data-driven retention decisions

FUTURE WORK

Run a real A/B test on Cluster 0

Measure true causal impact on churn, activity, and revenue

Optimize offer size and eligibility rules based on test results

Feed experimental results back into the model and ROI tool

THANKS!
Q&A