

“What Do They Do Next?”

Recommendations with Action Classification

Macy's Advisor: Rohan Talati, Donghao Pei
Faculty Advisor: James (Jim) Butler



Haibu Shi



Leo He

About Macy's Inc

- USA's most iconic department store
- Founded in 1858, 166 years history
- 519 stores in USA & online ecommerce
- Offers fashion, beauty, home essentials
- Annual revenue of \$23B in 2024

Problem Statement

Macy's Next Best Action initiative aims to recommend highly-engaged customer actions—such as credit signup, loyalty upgrade, or channel opt-in—based on each user's behavioral signals. Predicting what customers will do next enables smarter engagement and personalized growth.



Predict Probabilities of taking highly-engaged actions

Combine with estimated causal CLV uplift of each action



Align targeting with actual journeys



Enable Data-Driven Personalization



Drive higher-value engagement

Data

Bounty Actions
email_optin, sms_optin, loyalty_signup, app_download, creditcard_signup, tier_upgrade

Purchase Actions
First_purchase, second_purchase, first_reward, first_coupon, cross_shopping

Online Activities
Browse_page, Add_to_bag

Campaign Data

5-Year

Time Stamp

Top 10-15 common journeys

19M Customer Journeys

Top 10-15 common journey types

11 Types

Customer Journey Construction

Growth
Engaged but never purchased

Conversion
Completed 1st purchase, but no repeat purchase / credit card

Repeat Purchase
Made 2+ purchases

Dormant Card Holders
Credit card holders who never upgraded or became inactive

Credit-Driven Tier Advancement
Credit card users who upgraded to higher loyalty tiers

Drop-off
Showed intent but never purchased

Deal Seeker
Used coupons on >80% purchase

Category Expander
Completed ≥ 2 cross-category purchases

Campaign Driven
Triggered purchases by campaign

Omnichannel
Interacted via multiple channels

High-value
Performed multiple high-value actions

Analysis

6 Highly-Engaged Action

- Email Opt-in
- SMS Opt-in
- App Download
- Propcard Signup
- Cobrand Signup
- Tier Upgrade

Methodology



Data Loading

Features

- Purchase Related**
Recency, frequency, monetary, discount usage
- Online Activities**
Search, browse, view, clicks, omnichannel flags, cart
- Segmentations**
Channel, loyalty tier, journey types, days_since...

124 Features



Preprocessing

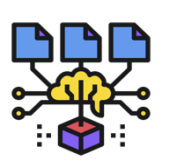
Handle Missing Value
Fill in NA value with 0;
Remove rows ~0.2%

Prevent Data Leakage
Create dictionary to mask out invalid labels per row per column

Correct Data Type

One-hot Encode

93% Skewness reduced



Forecast Modeling

Baseline (Random Guess)

ML Modeling Approach
Binary: 6 XGBoost models
Multi-label: XGBoost (Baseline, tune parameter, classifier chain, focal loss), Neural Network

Model Selection
Multi-Label Classifier Chain

Multi-Label Classifier Chain Best Model



Enhancement

Rank Probability under each customer

Predict Multiple Possible Actions Per Customer

Dependent Target Actions

Data-Driven Model

53% Performance Improved



Recommendation

CLV Uplift Per Action
 $MAX(P(action_i) \times \Delta CLV)$

Preferred Next Action Prediction

Customer History **Propensity Model**

Recommendation

Interpretation

Next Best Action Recommended to Each Customer

Modeling Results

Best Model

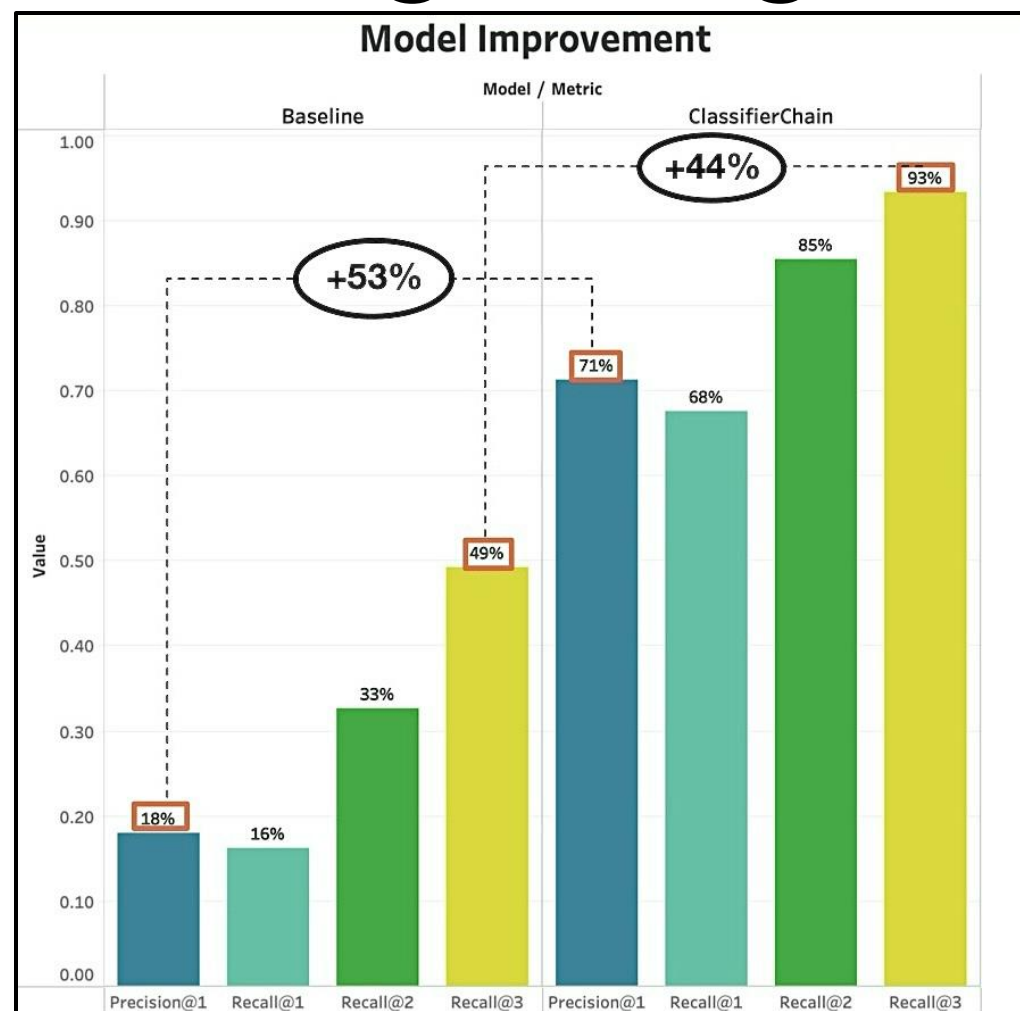
71% **Precision@1** **+53%** Over Baseline

93% **Recall@3** **+44%** Over Baseline

\$30 **CLV Uplift** **+296%** Over Baseline

Our Best Model: XGBoost Classifier Chain
Baseline: Random Guess
Target: 6 highly-engaged actions
Customer Level: All customers ~ 50m
Quarter: 2025.05 (30d) & 2025.0506 (60d)

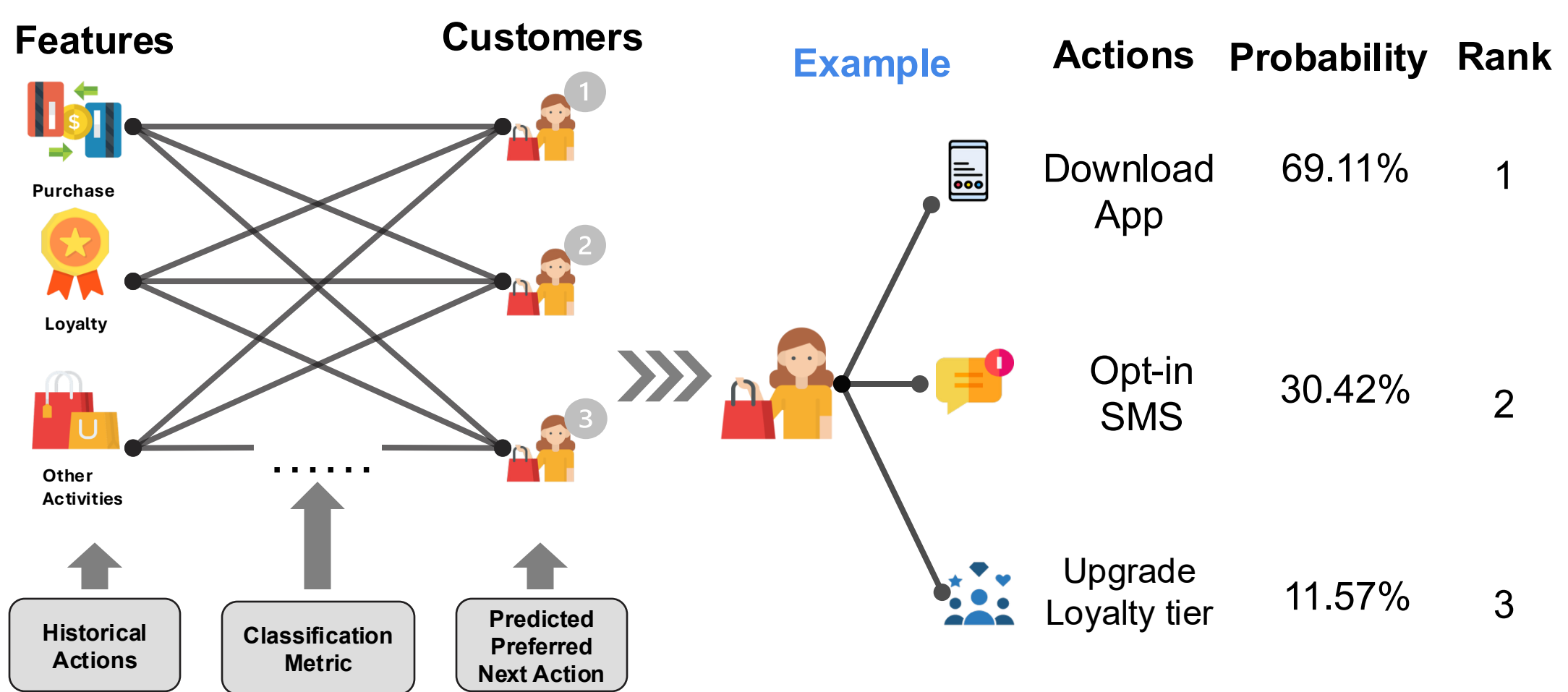
Precision@k & Recall@k



Top Features

- Days_since_loyalty_signup
- Recency
- Days_since_app_download
- Is_dormant_card_holder
- Days_since_email_optin

Action Recommendations



CLV Uplift for Action_i = ΔCLV_i

Probability of Taking Action_i = $P(Action_i)$

Expected Value of Action_i = $P(Action_i) \times \Delta CLV_i$

Recommended Action: $MAX(P(Action_i) \times \Delta CLV_i)$

Business Use Case

Initiate Data-Driven Personalized Marketing Strategy



Power personalized journeys by surfacing the most relevant next action for each customer



Use model predictions to filter customers eligible for credit card offers before running acquisition campaigns

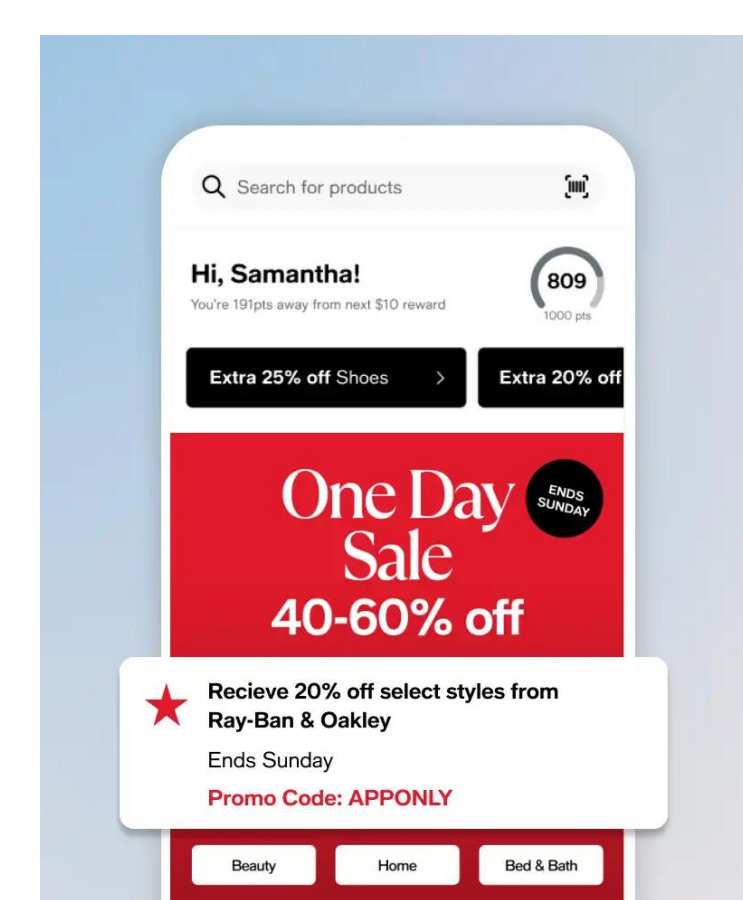


Trigger timely omnichannel nudges (e.g., app download prompts) for users close to full-channel activation



Tailor message framing based on the predicted action (e.g., promote cross-category variety vs. loyalty benefits)

Business Impact



Personalized Customer Engagement: Recommend the most relevant marketing action (e.g., app download, loyalty upgrade, or credit card signup) for each customer based on their journey and behavior.

Marketing Campaign Optimization: Predict which customers are most likely to respond to each type of campaign (email, SMS, app push) and allocate resources accordingly.

Customer Loyalty Tier Advancement: Identify which customers are likely to advance to higher loyalty tiers (Gold, Platinum) and what actions influence that upgrade.

Acknowledgements: We would like to thank the Macy's Inc. EDA team (especially Donghao Pei and Rohan Talati) for their time and support, and our faculty advisor James (Jim) Butler for his insights and guidance. Together they have helped us develop the work presented in this poster.