UW x PCTY Capstone Project

Final Presentation

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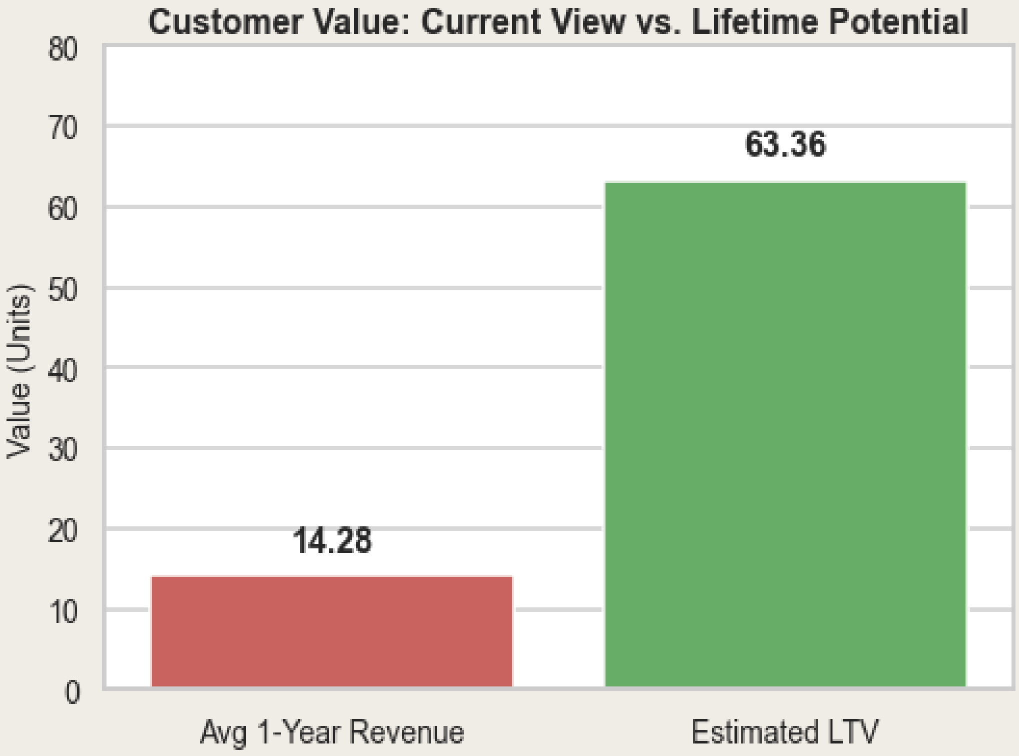
WHAT’S THE PROBLEM

The Blind Spot in SaaS Practices

Paylocity's current view of customer value is backward-looking.



- SaaS companies often know **how much they made**, not **how much value clients still hold**
- Even when using LTV, most rely on **averages** — ARPU × retention
- Paylocity makes most decisions based on average **1-year revenue**
- That **downplays retention, growth, and time value of money**

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Misallocation Without Forward Value

Same revenue, different lifetime value.

- There's no way to **tell who's high-value vs short-term**
- Resource allocation becomes **guesswork**
- Retention, upsell, and acquisition aren't targeted
- The current model **misses growth signals and customer heterogeneity**

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Data Sources Behind the Model

What powers our analysis: 5 years of billing, behavior, and customer profile data

- 📊 **1. Billing Data (NetSuite)**
  - 5 fiscal years of client-level billing
  - Reflects **cash flow**, not booked revenue
  - *Note: Excludes child-parent mapping (reseller/partner level)*
- 👥 **2. Client Profiles (Salesforce)**
  - Segment, Employee Count, Industry, Region
  - Used for segmentation and CAC estimation
- 🚥 **3. Account Health (Salesforce)**
  - 5 years of status data (Green / Yellow / Red / Grey / Black)
  - Used to infer retention risk and model churn patterns
- 📁 **4. CAC Estimates (Provided)**
  - Segment-level CAC based on **lead → close rates**
  - *Benchmark only — not actual spend*

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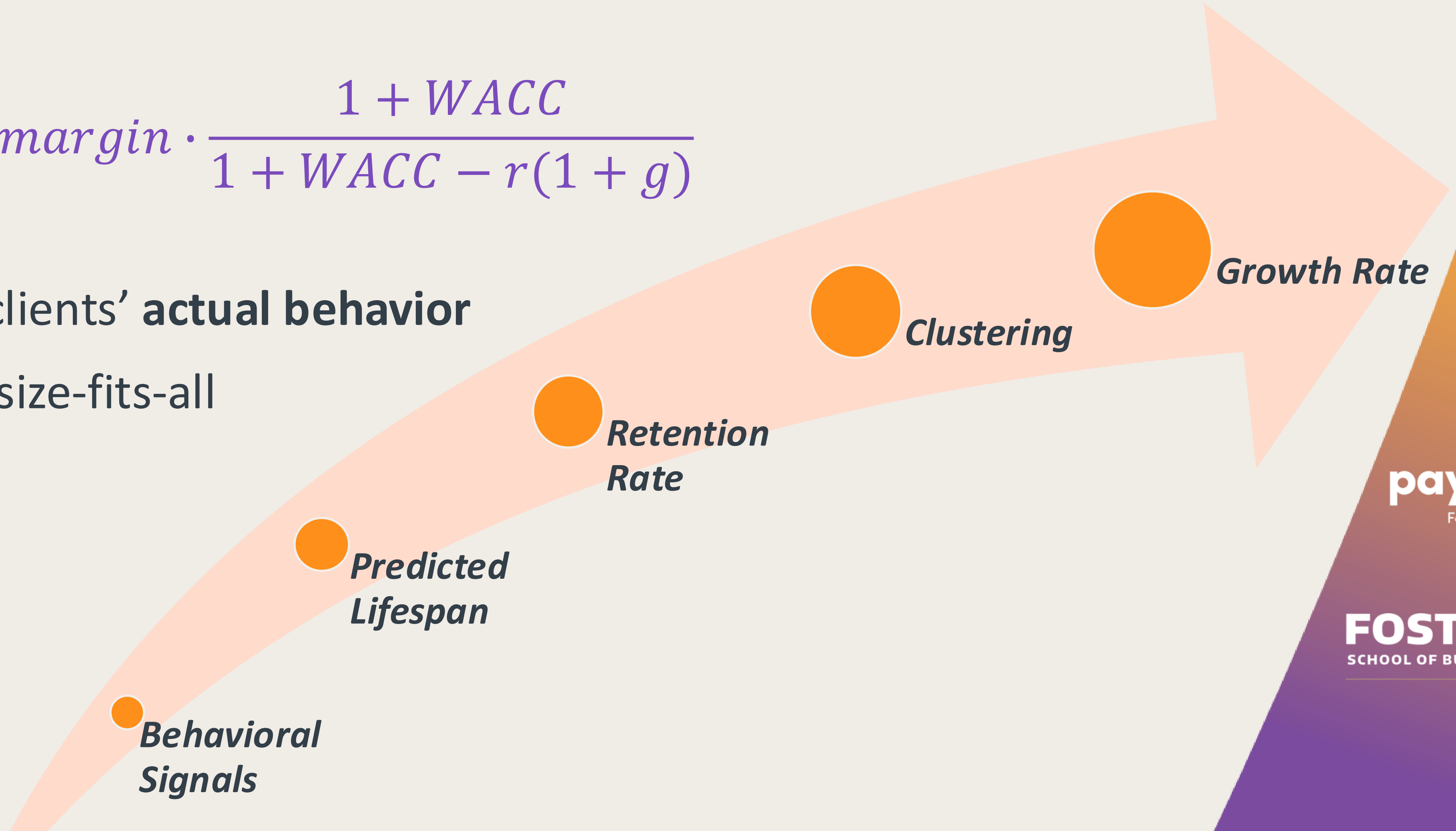
HOW WE APPROACHED IT

A Behavior-Driven Pipeline

From revenue tracking → to value forecasting

$$LTV = annual\ margin \cdot \frac{1 + WACC}{1 + WACC - r(1+g)}$$

- We modeled clients' **actual behavior**
- No more one-size-fits-all



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Modeling Retention — Predicting How Long Clients Stay

Retention is derived, not assumed

⚠ *The Problem We Faced*

- Multi Collinearity
- Limited features
- Low predictive value
- No access to behavioral logs
- Missing transactional signals
- Lacked engagement metrics

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Modeling Retention — Our Feature Engineering Solution

If we can't measure behavior directly, let's infer it from what we do have

Engineered Feature	Meaning	Main Source Field
➕ `cross_sell_count`	*Times the client adopted **new product lines***	`product_group`
➕ `cross_sell_yr_count`	***Yearly frequency** of cross-sell behavior*	`product_group`
📈 `upsell_count`	*Times the client upgraded **within a product***	`product_group`
📈 `upsell_avg_growth`	***Average upsell growth** over 5 years*	`product_group`
🔁 `recurring_ratio`	*% of billing that's **subscription-based***	`line_type`
⚠️ `risk_score`	*Weighted **churn risk** from health trajectory*	`health_status`

💡 ***The Result***

Transformed weak profile signals into strong predictive features

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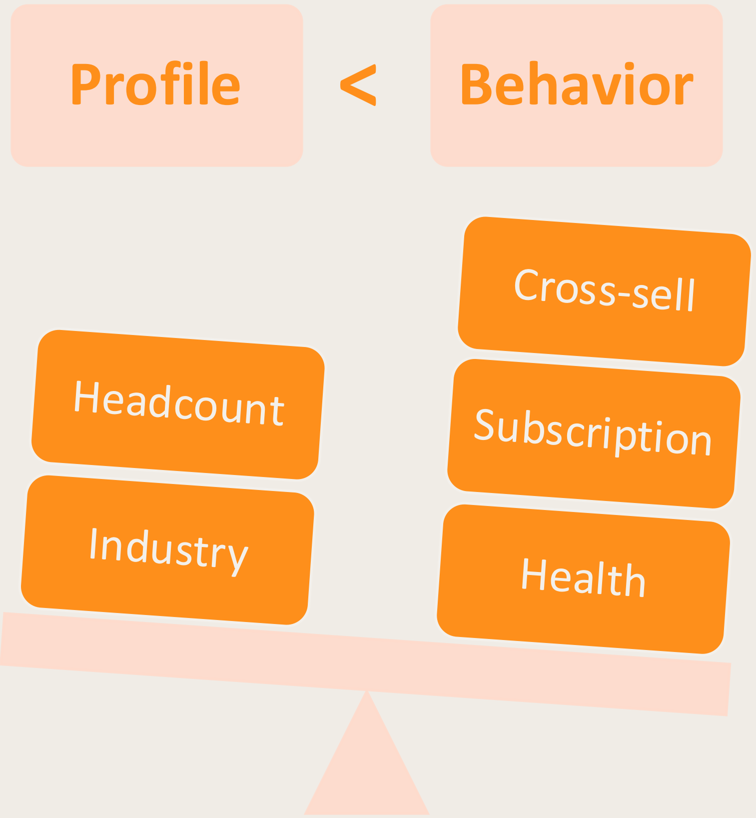
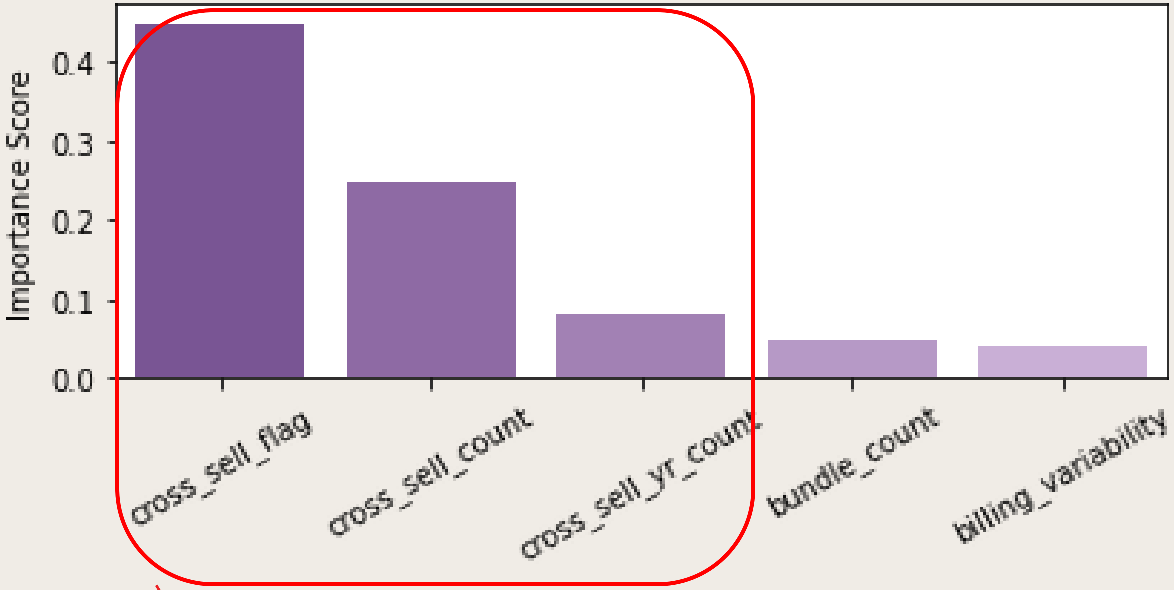
Modeling Retention — Feature Importance (XGBoost) Top 5

What features impacting the model performance?

Predicting Power:





💡 *Cross-selling features altogether explain over 75% variance*

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Modeling Retention — Results & Performance

How Did Feature Engineering Boost Performance?

Feature Engineering

Model	R^2 Before FE	R^2 After FE	Impact of FE
OLS	-	0.471	Strong
Ridge	0.0618	0.4711	8x Better
XGBoost	0.2344	0.6812	3x Better

✅ ***Key success:***

Feature engineering increased model performance 8x for Ridge and 3x for XGBoost, proving that creative data engineering can overcome behavioral data limitations and deliver actionable business intelligence.

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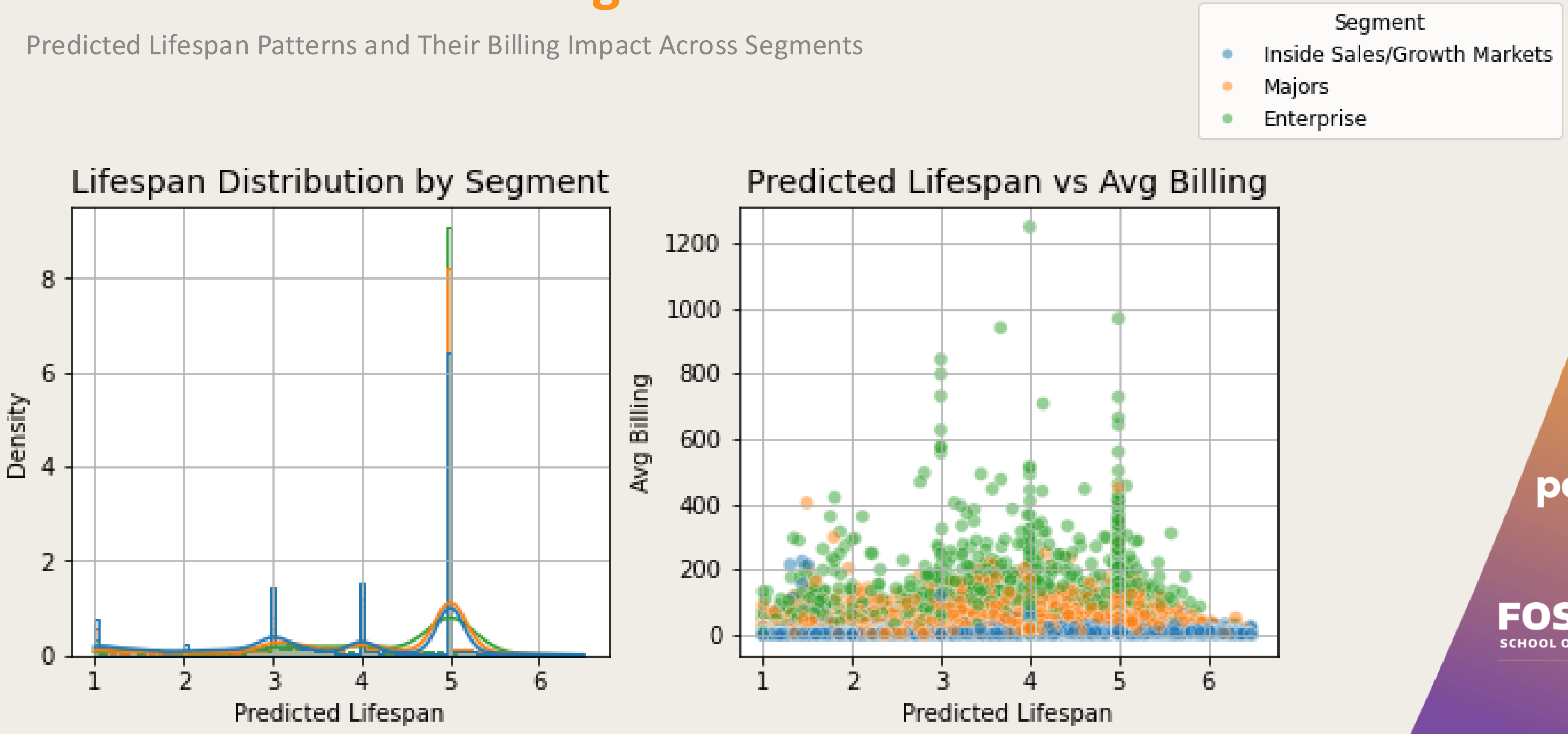
Retention as a Value Signal

Predicted Lifespan Patterns and Their Billing Impact Across Segments



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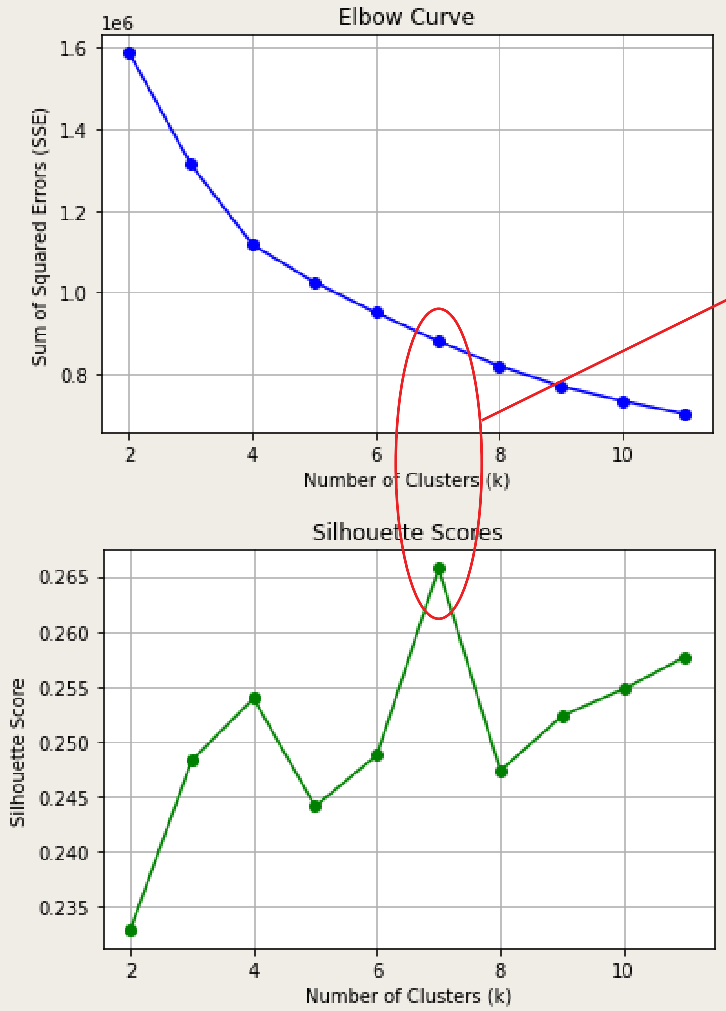
What's the Problem → **How We Approached It** → What We Discovered → How It Drives Strategy

Growth Assignment – Based on Cluster Behavior, Not Heuristic

Growth isn't adjusted based on heuristic rules — it adapts to cluster performance

- All clients start with baseline growth rate 4.4% (inflation)
- We used **KMeans++ to cluster clients (k = 7)** based on behavioral and billing features
    - Clustering quality was validated using **Elbow** and **Silhouette** methods



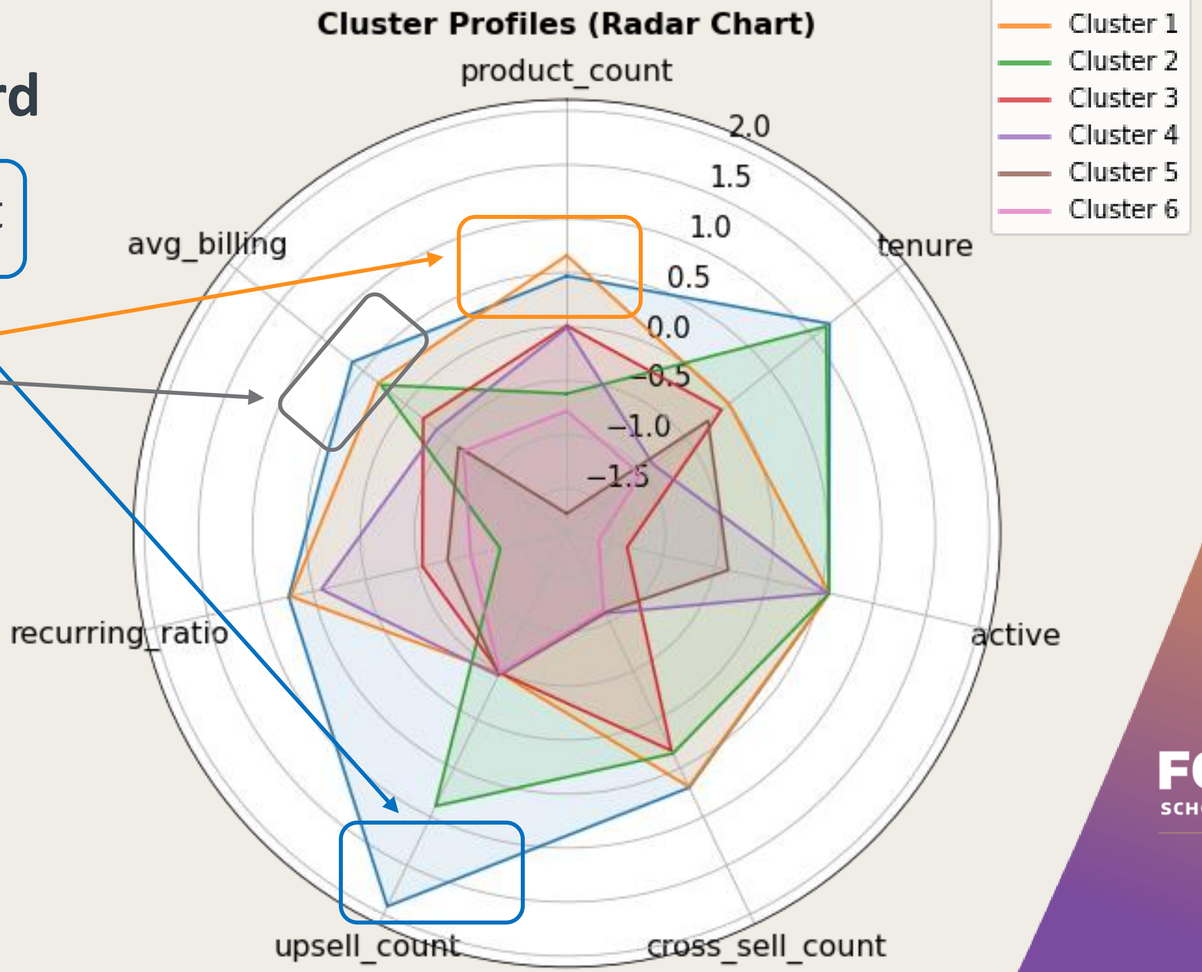
7 clusters offered the best balance of compactness and separation.

Growth Assignment – Based on Cluster Behavior, Not Heuristic

Growth isn't adjusted based on heuristic rules — it adapts to cluster performance

For select clusters, we **adjust upward**

- **Cluster 0**: High Billing + High Engagement
- **Cluster 1**: High Billing + Broad Usage
- **Cluster 4**: New & Active



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Growth Assignment – Based on Cluster Behavior, Not Heuristic

Growth isn't adjusted based on heuristic rules — it adapts to cluster performance

For select clusters, we **adjust upward**

- **Cluster 0**: High Billing + High Engagement
- **Cluster 1**: High Billing + Broad Usage
- **Cluster 4**: New & Active

cluster	0	1	4	2	3	5	6
market_size_mil	1.98	3.18	1.56	1.25	1.38	0.33	1.10
avg_billing	23.31	15.92	6.45	13.98	7.67	6.18	3.88
tenure	5.00	3.18	1.79	4.93	3.03	2.80	1.57
active	1.00	1.00	0.99	1.00	0.16	0.58	0.04
growth	0.20	-0.01	-0.00	0.08	-0.03	-0.00	-0.00
recurring_ratio	0.79	0.78	0.67	0.00	0.29	0.20	0.11
cross_sell_count	3.55	3.47	0.03	2.42	2.10	0.02	0.00
risk_avg	0.84	0.71	0.51	0.69	2.77	0.96	2.68

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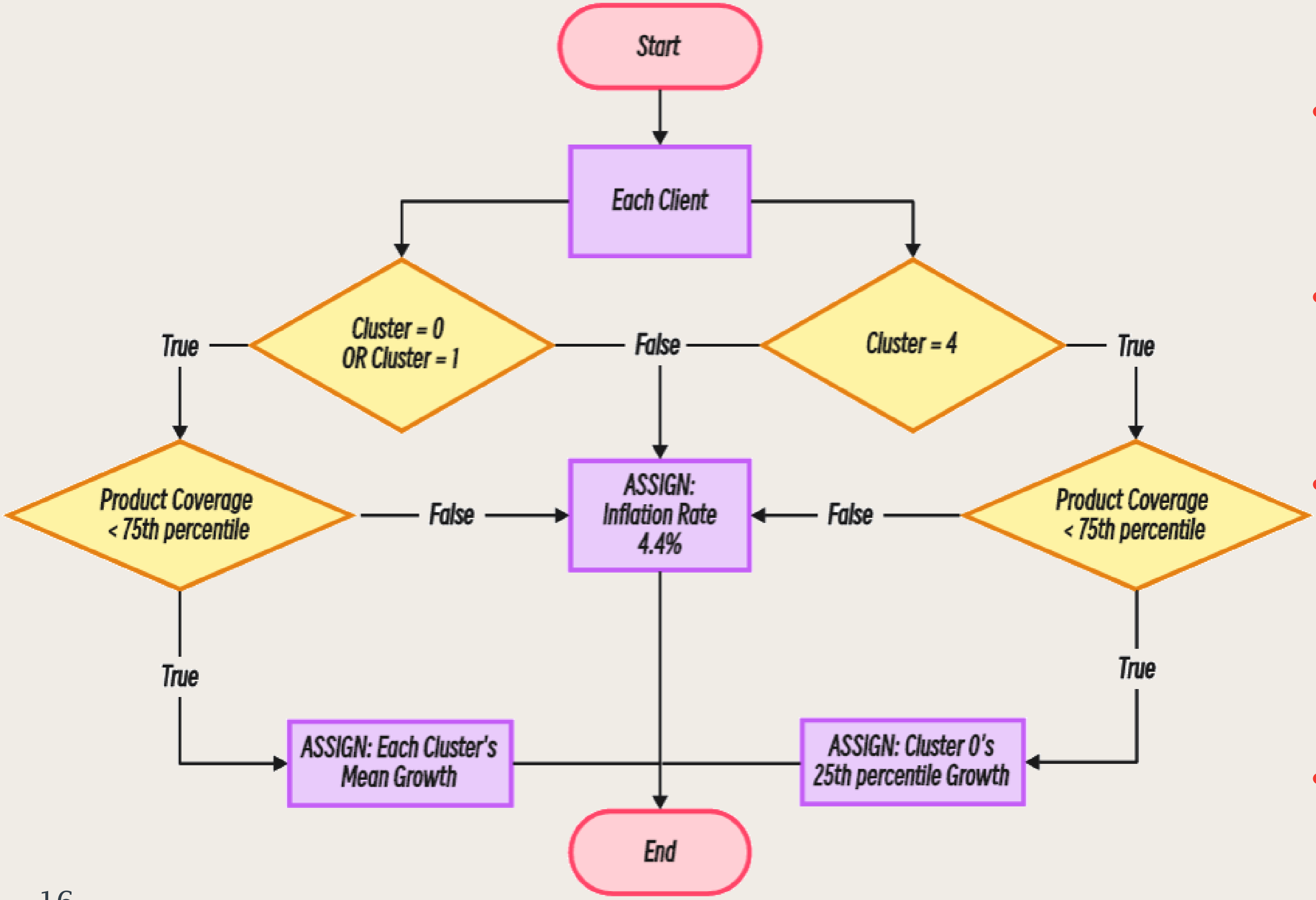
Growth Assignment – Based on Cluster Behavior, Not Heuristic

Growth isn't adjusted based on heuristic rules — it adapts to cluster performance



- **Adjust ↑ for clients with room to expand**
  - *Defined as below the 75th percentile in product coverage*
- **If in Cluster 0 or 1**
  - *Assigned the cluster's historical **mean** growth*
- **If in Cluster 4 (new, active)**
  - *Mapped to the **25th percentile** growth of Cluster 0*
  - *Why? We treat them as early-stage versions of Cluster 0 — with caution*
- **All others default to 4.4% baseline (inflation rate)**

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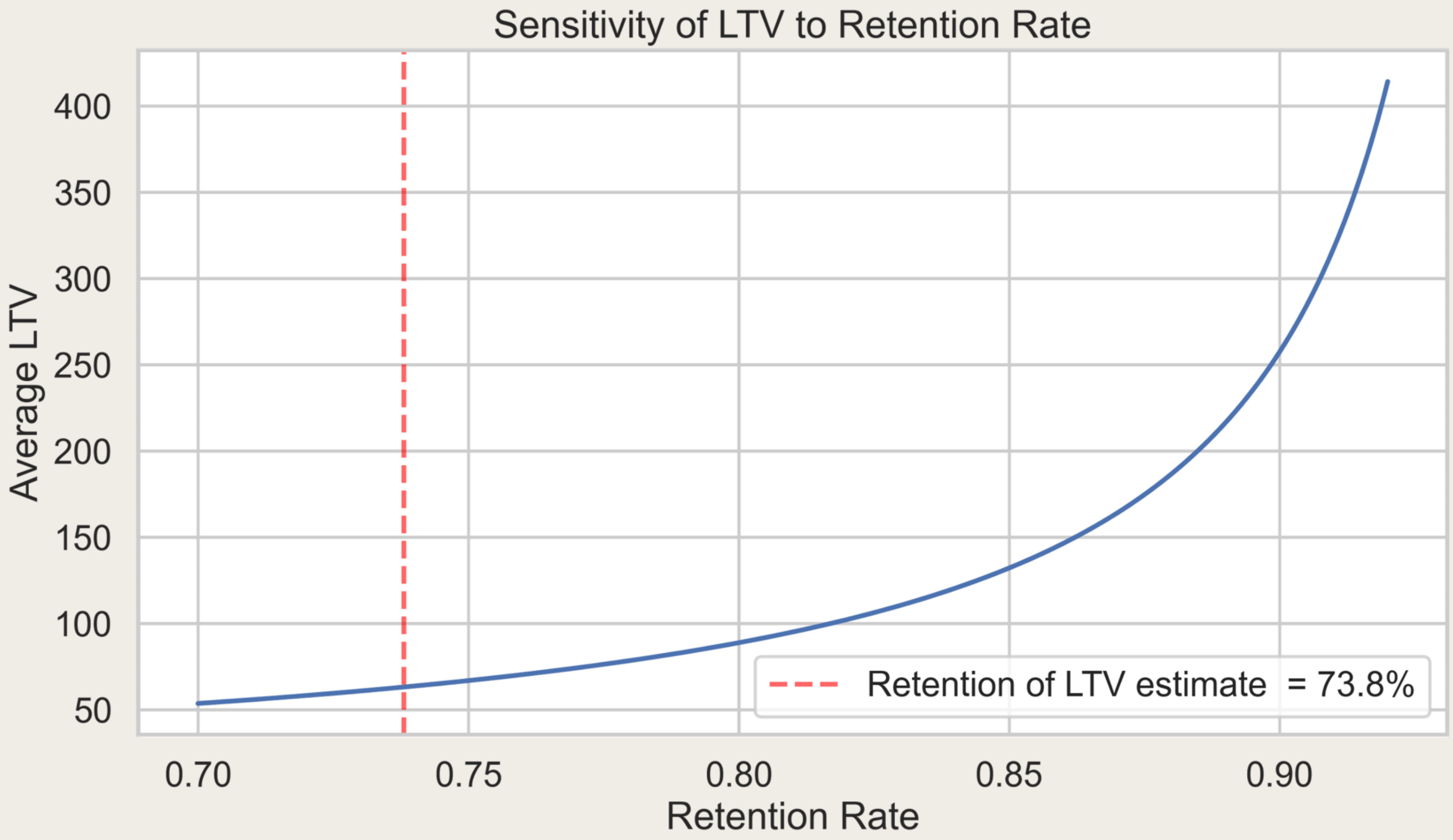
WHAT WE DISCOVERED

Retention Is the Exponential Lever

Small improvements lead to exponential value gain



What's the Problem → How We Approached It → **What We Discovered** → How It Drives Strategy

Retention Is the Exponential Lever

Small improvements lead to exponential value gain

💡 ***Sensitivity Coefficient*** *tells us how much LTV changes for a 1% change in the parameter*

Why 73.8% retention appears 👉 lower than you might expect?

Retention (%)	Average_LTV	Sensitivity	Note
73.8%	63.35	3.43	*LTV estimate*
85.0%	132.33	8.25	
88.0%	186.81	12.06	
89.0%	216.53	14.14	
92.0%	414.20	27.97	

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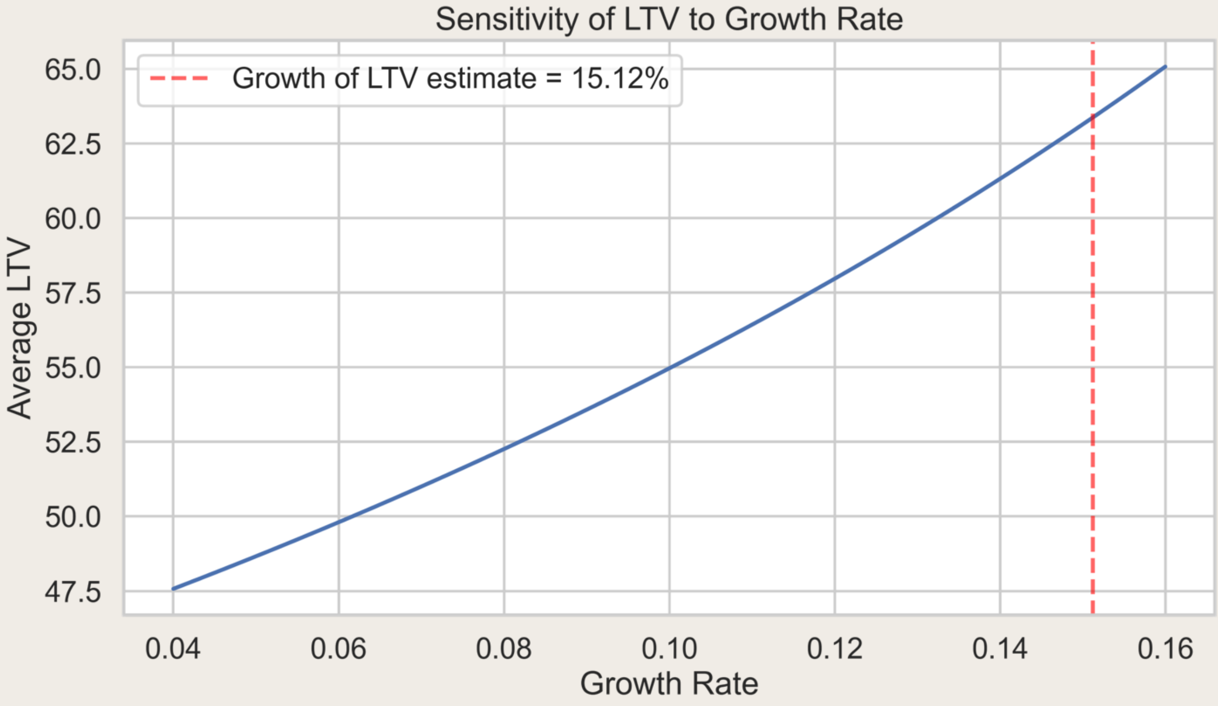
How Growth Rate *(g)* Affects LTV

Small acceleration, moderate impact — and it only works if clients stay



Growth (%)	Average_LTV	Sensitivity	Note
4.4%	48.00	0.10	*inflation*
13.2%	59.93	0.37	*industry average*
15.1%	63.36	0.45	*LTV estimate*
16.0%	65.07	0.49	

$$LTV = m \cdot \frac{1+i}{1+i-r(1+g)}$$

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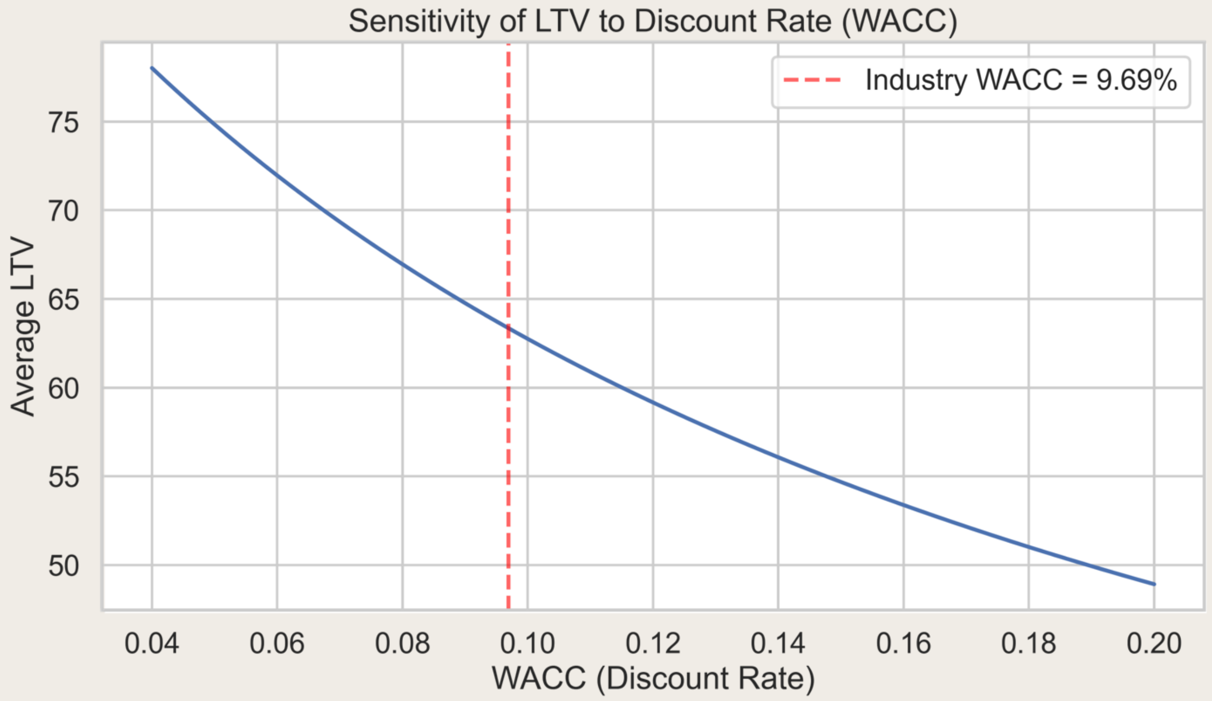
How Financing Cost *(Interest Rate, i)* Affects LTV

An uncontrollable drag — but one we need to plan around



📖 ***Industry Avg WACC***:
from [NYU Stern / Damodaran]

WACC (%)	Average_LTV	Sensitivity	Note
5.00%	74.84	-0.20	
9.69%	63.36	-0.3	*industry average*
12.00%	59.16	-0.33	
20.00%	48.92	-0.40	

$$LTV = m \cdot \frac{1+i}{1+i-r(1+g)}$$

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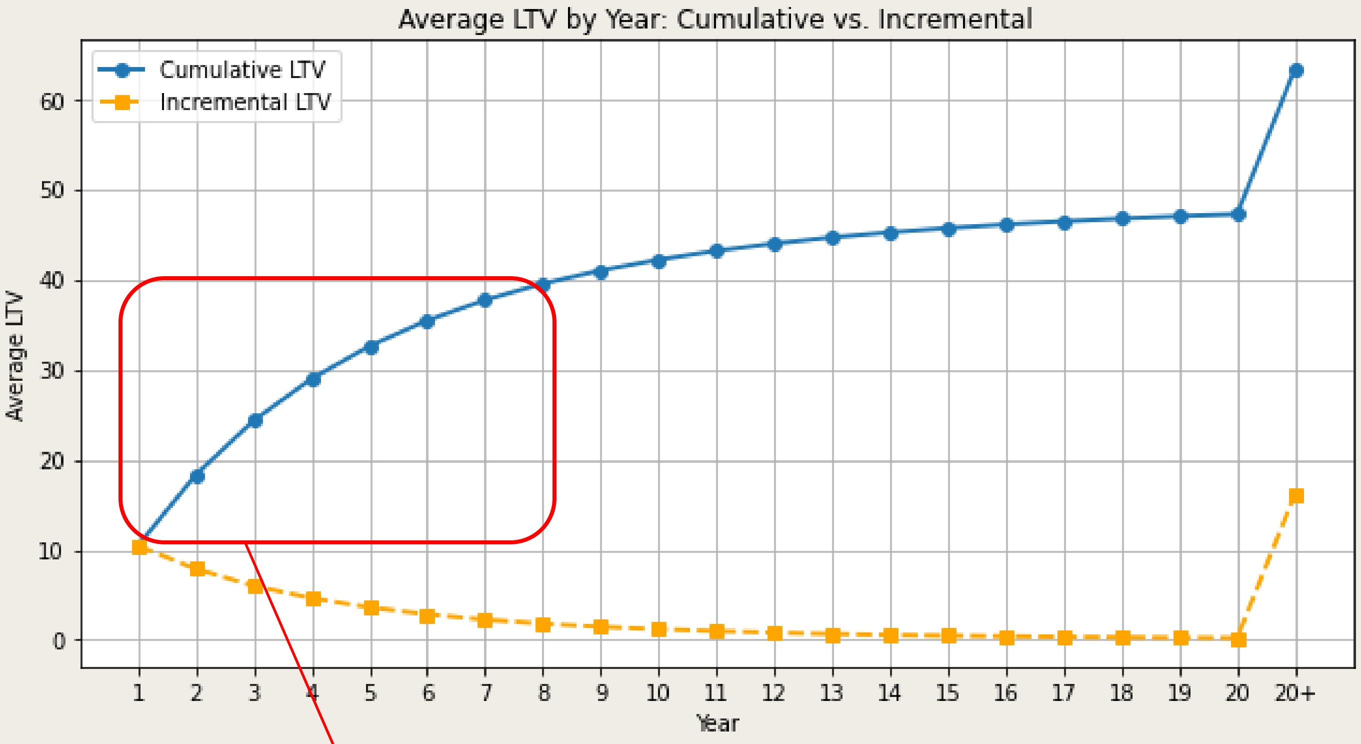
Retention Builds the Base, Acquisition Extends the Frontier

Retention creates exponential value — but can't fuel growth forever



💡 ***More than 60%*** *of LTV realized within the first 8 years*

- Retention delivers steep value gain in early years
- By year 4, half of LTV has already materialized
- After year 8, marginal value flattens
- New clients are needed to maintain revenue momentum

Retention creates value.
Acquisition sustains momentum.
You need both!

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What's the Problem → How We Approached It → **What We Discovered** → How It Drives Strategy

Strategic Segments: A Portfolio View of Customer Value

Grouped for clarity — derived from 7 clusters, driven by behavior

strat_seg	1-Prime	2-Loyal	3-Climbers	4-Churning
market_size_mil	2.58	0.79	1.47	1.10
avg_billing	19.62	10.08	7.06	3.88
tenure	4.09	3.86	2.41	1.57
active	1.00	0.79	0.58	0.04
growth	0.10	0.04	-0.02	-0.00
recurring_ratio	0.78	0.10	0.48	0.11
cross_sell_count	3.51	1.22	1.07	0.00
risk_avg	0.78	0.82	1.64	2.68

- We grouped clients into **four strategic segments** to simplify communication and enable business action.
- These segments reflect differences in billing, engagement, risk, and growth potential.
- This heatmap summarizes their key signals — you'll see clear contrasts in billing, tenure, and risk.

⚠️ *Note*: This merge favors clarity. **For actual execution, we recommend operating at the 7-cluster level** to retain granularity.

The "Climbers" segment, for example, combines both high-growth and lower-engagement clusters — hence the dip in active rate

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Prime & Loyal: High Value, Low Risk — But Different Plays

Two retaining segments, two very different strategies

- 🔷 Prime *(C0 + C1)*
  - High billing, wide product usage, active & loyal
  - Top-tier LTV & engagement — ideal for flagship marketing
  - Strategic moves:
    - Deepen with cross-sell & success teams
    - Feature in **referral & showcase programs**

strat_seg	1-Prime	0	1	
market_size_mil	5.17	1.98	3.18	*million ppl (staff)*
avg_billing	39.23	23.31	15.92	*units*
tenure	4.09	5.00	3.18	*years*
active	1.00	1.00	1.00	*%*
growth	0.10	0.20	-0.01	*%*
recurring_ratio	0.78	0.79	0.78	*%*
cross_sell_count	3.51	3.55	3.47	*#*
risk_avg	0.78	0.84	0.71	*x/4 score*

⚠ *Note*: This merge favors clarity. **For actual execution, we recommend operating at the 7-cluster level** to retain granularity.

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Prime & Loyal: High Value, Low Risk — But Different Plays

Two retaining segments, two very different strategies

- 🔷 Loyal *(C2 + C5)*
  - Passive users, but low churn & stable tenure
  - Low-touch needed — but don't neglect renewals
  - Strategic moves:
    - Low-cost email/drip campaigns
    - Consider **auto-renew or passive engagement programs**

strat_seg	2-Loyal
market_size_mil	1.59
avg_billing	20.16
tenure	3.86
active	0.79
growth	0.04
recurring_ratio	0.10
cross_sell_count	1.22
risk_avg	0.82

2	5	
1.25	0.33	*million ppl (staff)*
13.98	6.18	*units*
4.93	2.80	*years*
1.00	0.58	*%*
0.08	-0.00	*%*
0.00	0.20	*%*
2.42	0.02	*#*
0.69	0.96	*x/4 score*

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⚠ *Note*: This merge favors clarity. **For actual execution, we recommend operating at the 7-cluster level** to retain granularity.

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What's the Problem → How We Approached It → **What We Discovered** → How It Drives Strategy

Climbers & Churning: Nurture or Exit

Emerging upside — and the warning signs

- 🔷 Climbers *(C3 + C4)*
  - High growth signals — especially in C4
  - But engagement is mixed due to C3's shallow usage
  - Strategic moves:
    - **Onboarding optimization**, education nudges
    - Set **risk watchlists**, define **reactivation triggers**
    - Experiment with test campaigns or limited offers

strat_seg	3-Climbers	3	4	
market_size_mil	2.94	1.38	1.56	*million ppl (staff)*
avg_billing	14.12	7.67	6.45	*units*
tenure	2.41	3.03	1.79	*years*
active	0.58	0.16	0.99	*%*
growth	-0.02	-0.03	-0.00	*%*
recurring_ratio	0.48	0.29	0.67	*%*
cross_sell_count	1.07	2.10	0.03	*#*
risk_avg	1.64	2.77	0.51	*x/4 score*

⚠️ *Note*: This merge favors clarity. **For actual execution, we recommend operating at the 7-cluster level** to retain granularity.

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What's the Problem → How We Approached It → **What We Discovered** → How It Drives Strategy

Climbers & Churning: Nurture or Exit

Emerging upside — and the warning signs

- ◆ Churning *(C6)*
  - Extremely low activity and poor retention
  - High churn scores, often post-onboarding drop-offs
  - Strategic moves:
    - Exit flow design — offboarding, feedback capture
    - Or experiment with last-touch recovery campaigns
    - Consider reducing CS effort / automating deactivation

strat_seg	4-Churning	6	
market_size_mil	1.10	1.10	*million ppl (staff)*
avg_billing	3.88	3.88	*units*
tenure	1.57	1.57	*years*
active	0.04	0.04	*%*
growth	-0.00	-0.00	*%*
recurring_ratio	0.11	0.11	*%*
cross_sell_count	0.00	0.00	*#*
risk_avg	2.68	2.68	*x/4 score*

⚠ *Note*: This merge favors clarity. **For actual execution, we recommend operating at the 7-cluster level** to retain granularity.

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Validation with Decision Tree

💡 ***Churning*** *clients often have short tenure and low recurring usage.*

🌱 ***Climbers*** *show up as new clients who are highly active, but still some churn risk.*

strat_seg
- 1-Prime
- 2-Loyal
- 3-Climbers
- 4-Churning

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ROI Snapshot: Where Do We Win?

LTV-to-CAC ratios tell us which segments drive profitable growth.
(Based on Paylocity's internal segmentation and CAC assumptions.)

PCTY Segment	Avg LTV	CAC	LTV/CAC
1-Growth	30.48	6.00	5.08
2-Major	167.63	5.01	33.46
3-Enterprise	572.82	14.28	40.11
Total	**63.36**	**6.04**	**10.49**

- **CAC**: Estimated, not modeled — provided by client as rough benchmarks
- Enterprise ROI is exceptional (40x), but accounts for only **16% of billing**
- Growth segment has decent return (5x) — but potential may be capped
- **Takeaway**: Helps **prioritize investment** across segments based on potential payoff

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HOW IT DRIVES STRATEGY

Turning Segment Insights into Strategy

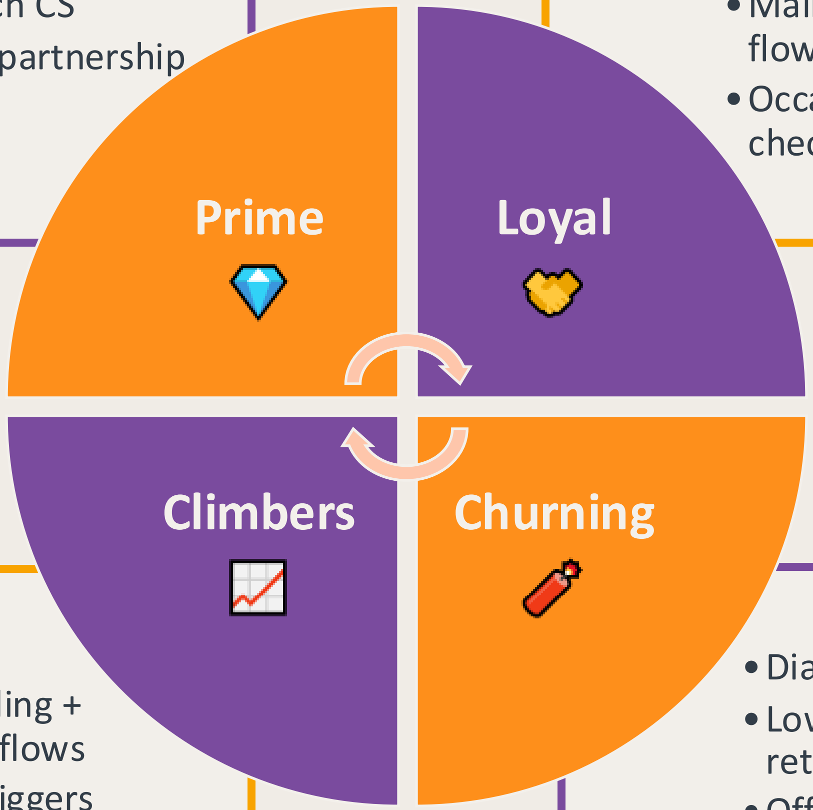
Tailored actions by customer segment to maximize value

- High-touch CS
- Strategic partnership
- Referrals

LTV = 88.41

- Maintenance flows
- Occasional check-ins

LTV = 53.61



LTV = 17.65

- Onboarding + Nurture flows
- Upsell triggers

LTV = 11.07

- Diagnostic flags
- Low-cost retention
- Offboarding flow

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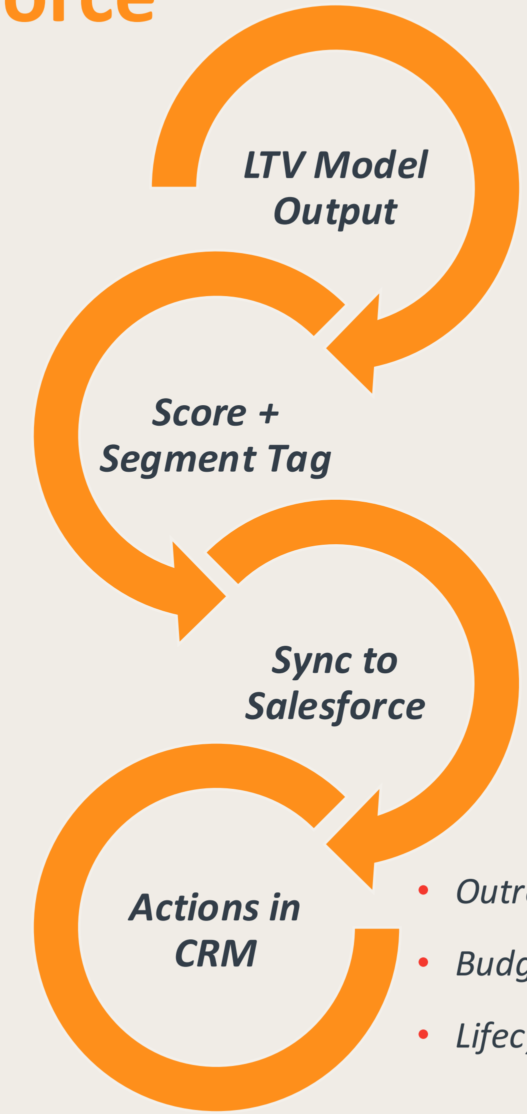
Scoring and Prioritization in Salesforce

Using LTV + Retention to guide budget and outreach in real-time

- **Why this matters**
  - Your CRM (e.g., Salesforce) is where reps make day-to-day decisions
  - Embedding LTV + Segment scores = smarter resource allocation
  - Let sales/CS see: *who to focus on, who's at risk, who to grow*
- **What we recommend**
  - Integrate LTV scores and segment labels into Salesforce client records
  - Create workflows that:
    - Flag high-potential climbers for onboarding push
    - Set CS priorities by segment (e.g., Prime = high touch)
    - Trigger retention playbooks for Churning clients



- *Outreach prompts*
- *Budget decisions*
- *Lifecycle playbooks*

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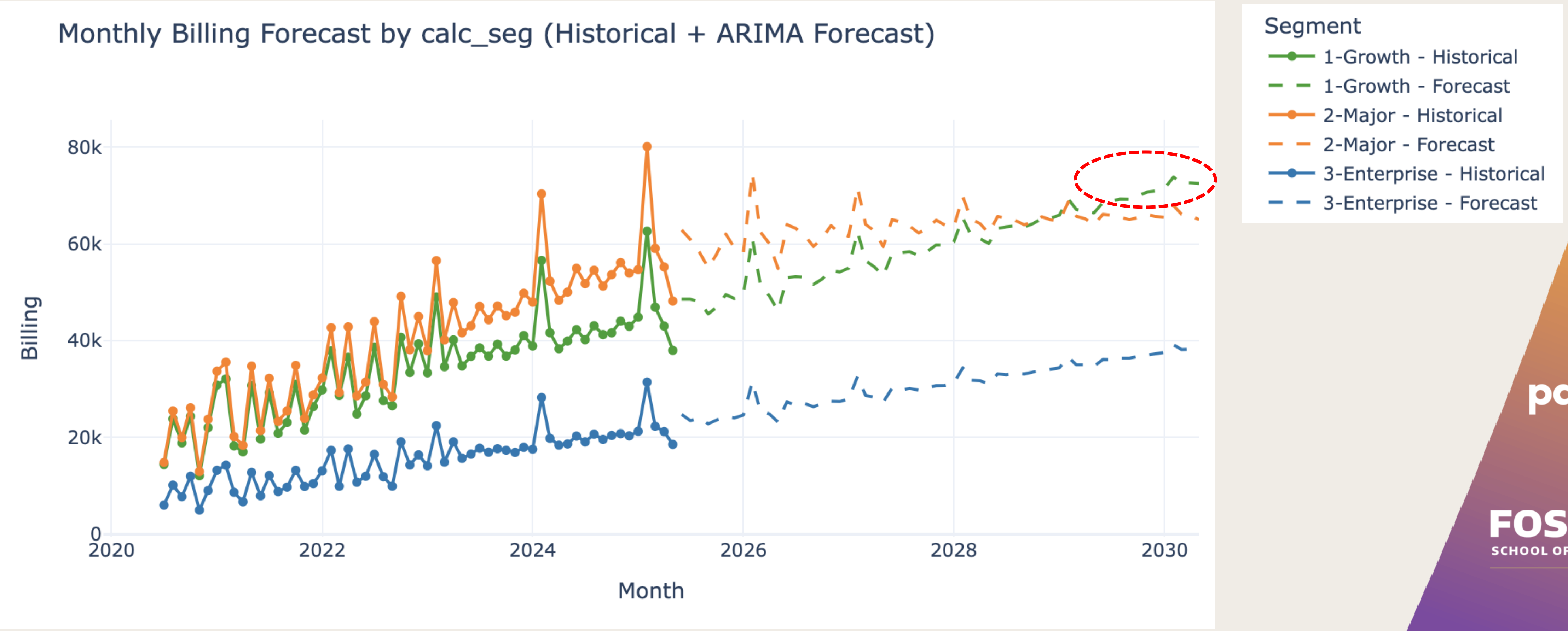
Bridging Potential and Reality

Comparing long-term LTV potential with SARIMA revenue forecasts



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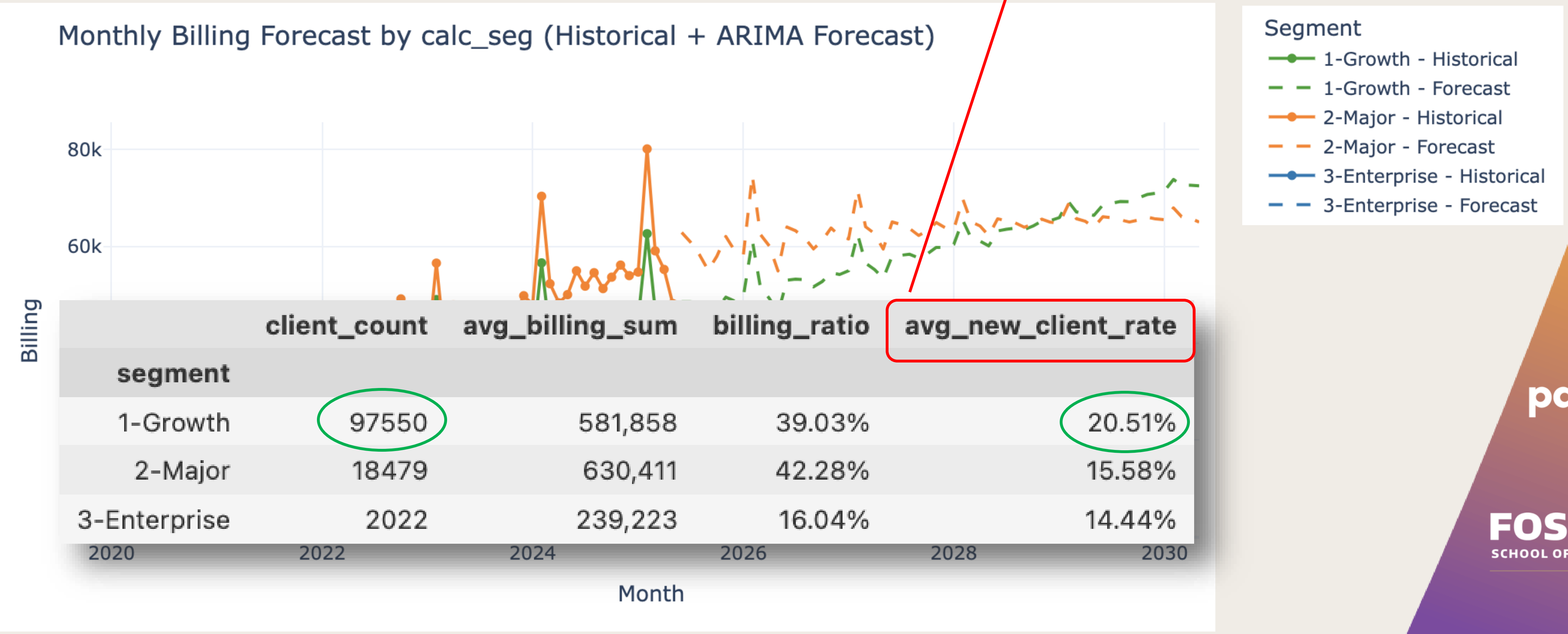
Bridging Potential and Reality

Comparing long-term LTV potential with SARIMA revenue forecasts

*New client acquisition — **naturally beyond** LTV's scope*



segment	client_count	avg_billing_sum	billing_ratio	avg_new_client_rate
1-Growth	97550	581,858	39.03%	20.51%
2-Major	18479	630,411	42.28%	15.58%
3-Enterprise	2022	239,223	16.04%	14.44%

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QUICK WRAP-UP

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Quick Wrap-Up

Final Takeaways — Turning Insights into Action

Retention protects. Growth extends. Acquisition expands.

$$LTV = annual\ margin \cdot \frac{1 + \mathrm{i}}{1 + i - r \cdot (1 + g)}$$

- 💎 **Retention protects the core** — most value is realized early
  - Strengthen loyalty *(Prime & Loyal)* and reduce churn through segment-based playbooks
- 📈 **Growth matters — once retention is strong**
  - Expand future stars *(Climbers)* with upsell nudges and onboarding reinforcement
- 🌍 **Acquisition expands the frontier** — it's how scale happens
  - Target strategically with *real-time clustering*, not just demographic profiles

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Thank You!

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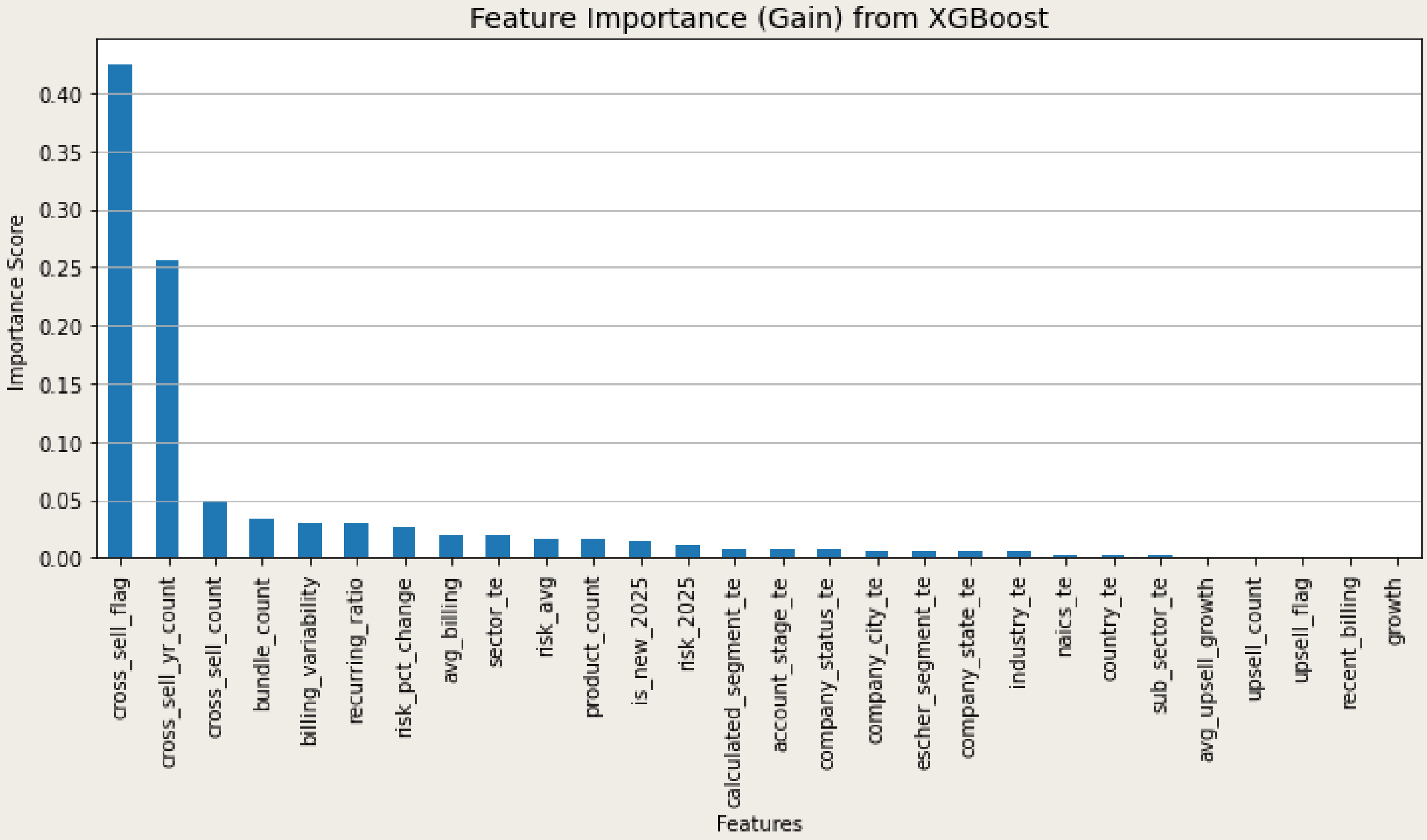
Modeling Retention – Feature Importance (XGBoost)

Top drivers of customer lifespan prediction, ranked by model contribution



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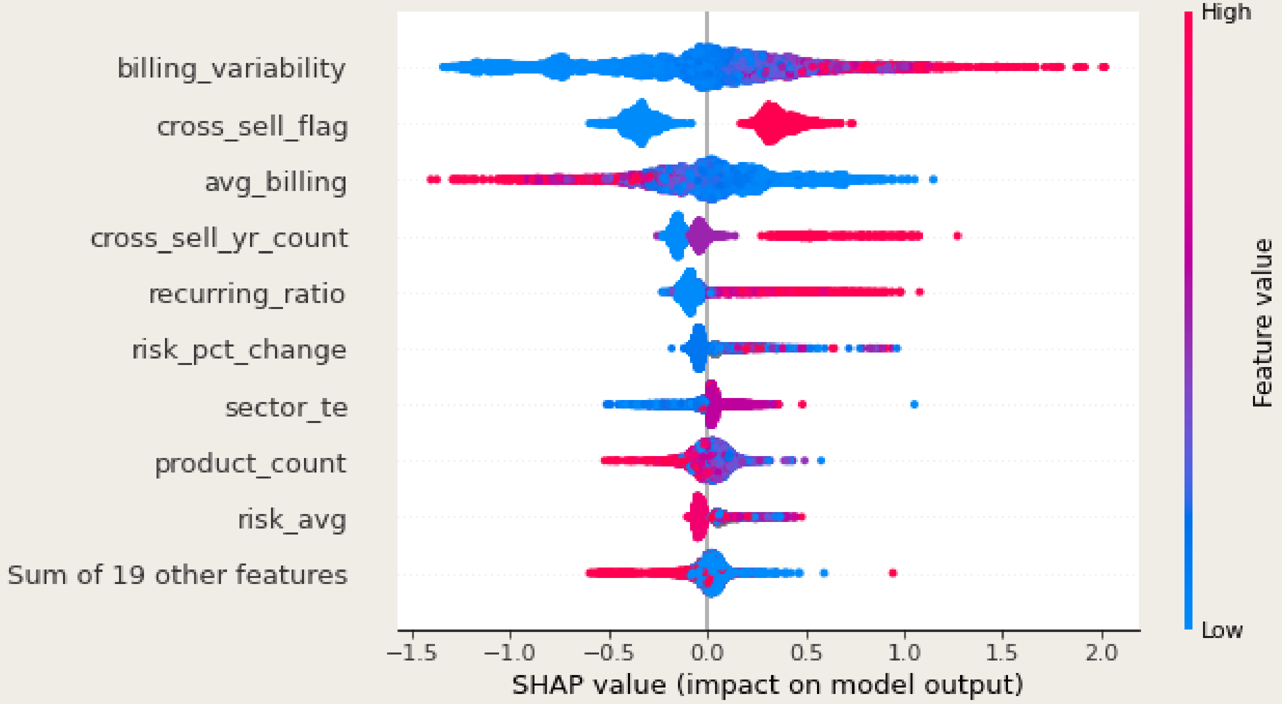
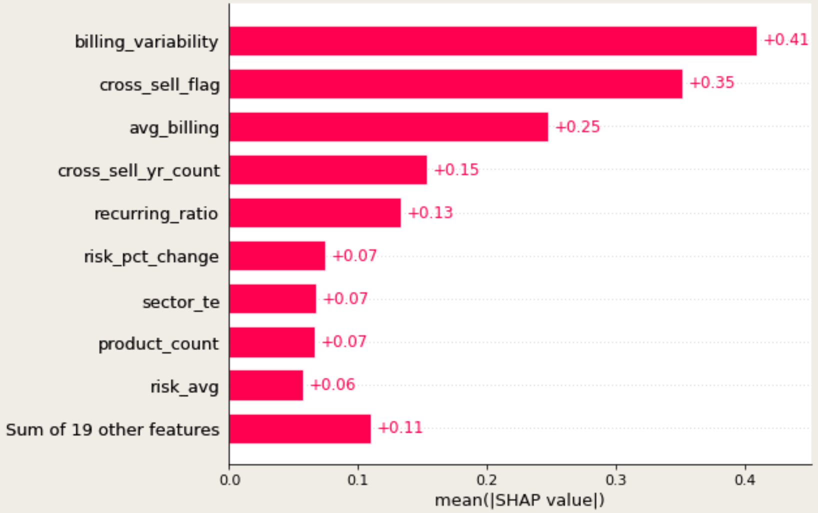
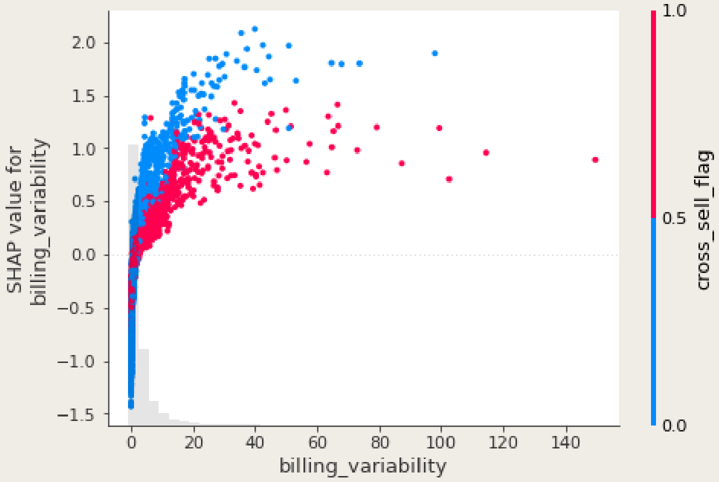
Modeling Retention – SHAP Analysis

Explaining the model: how each feature pushes retention predictions up or down







SARIMA Model Selection Summary by Segment

Auto-selected via AIC optimization using 60 months of segment-level billing data

Segment	ARIMA Order	Seasonal Order	AIC	Notes
1-Growth	(3,1,1)	(1,0,0)[12]	1167.56	Acceptable, modest variance
2-Major	(4,1,0)	(1,0,0)[12]	1199.23	Slightly higher, still stable
3-Enterprise	(4,1,1)	(1,0,0)[12]	1082.56	Lowest AIC, most stable model

- We selected the SARIMA configuration for each segment based on the lowest AIC value found via ***auto_arima***.
- All models have moderate complexity and include yearly seasonality.
- AIC values range from 1082 to 1199, indicating reasonable fit given the data scale (~60 monthly observations).

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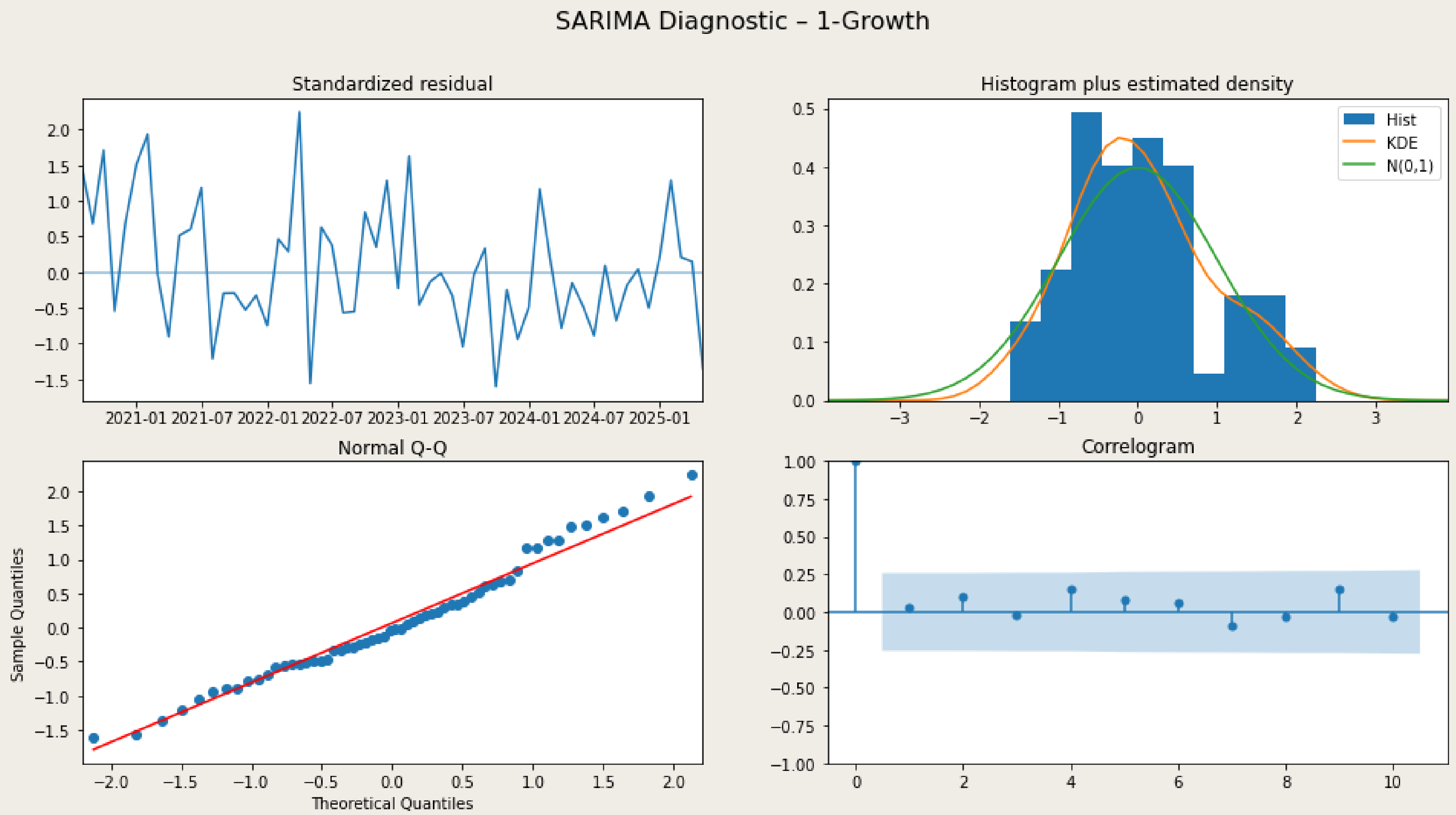
SARIMA Residual Diagnostics

Residuals across all segments behave as white noise — no signal left unexplained.



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