Churn Modelling Report

BCG X Hackathon

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Churn Down For What

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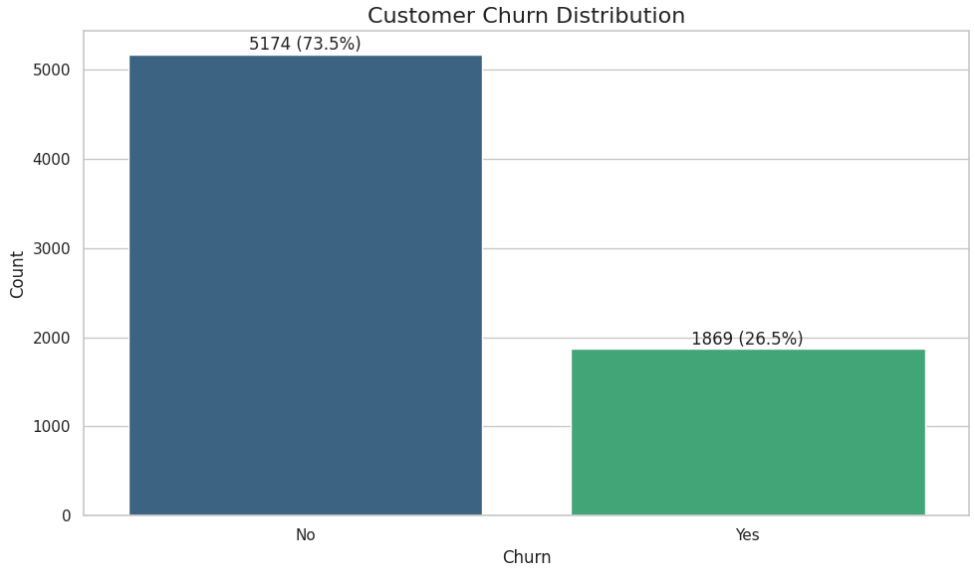
1. Introduction

In today's highly competitive telecommunications landscape, customer retention is more important than ever. ABC TelCo, a fictional telecommunications provider, is struggling with a significant challenge: customer churn.

ABC TelCo is experiencing a ***26.5 %* annual customer-churn rate**, equivalent to losing one in every four broadband subscribers each year. Quantifying this figure in terms of revenue, so far ABCTelco has already **given up about €1.7 million in future revenue** from customers who have churned, and the **gap grows by roughly €139.000 every month** unless new customers replace the lost income. Because replacing a lost customer costs 5-7×[1] more than retaining one, churn has become a board-level KPI.



Customer churn is more than an inconvenience, it is a direct profit drain. European telecom operators **lose 20–31 %[2] of their customer base every year.** Replacing each lost subscriber is expensive: acquisition subsidies and marketing average about four months of Average Revenue Per User (ARPU), so a **€60-ARPU customer costs roughly €240 to win back[3].** Oliver Wyman calculates that even a two-point rise in churn can **decrease 3–5 percentage points off EBITDA margin**[4], underlining why retention now outranks net-adds as a CFO metric.

Leveraging both structured and unstructured data, our analysis delves into customer behaviors and service usage trends, identifying critical factors that predispose certain segments of the customer base to churn. Our goal is to develop a predictive model that accurately forecasts churn events and to extract actionable insights that enable ABCTelCo to implement targeted retention strategies.

[1] HBR – Keeping the Right Customers
[2] Customer Gauge – Average Churn Rate by Industry
[3] STL Partners – Reduction Strategies
[4] Oliver Wyman – 2019 Insights Report

2. Diagnostic Analysis

We conduct a comprehensive diagnostic analysis on the **dataset containing structured information** on customer demographics, service usage, billing preferences, tenure, and payment behaviors. Moreover, we process the **unstructured textual complaints** and extract information like most common adjectives and sentiment to gain a wider understanding of the issues at play causing churn.

2.1 Feature Engineering

To deepen our insights, we engineer additional variables. First, we compute indicators for whether a customer has **changed, upgraded, or downgraded** their **plan** over time by comparing Total Charges against Tenure x Monthly Charges.

Second, we engineer **Internet Services Density** – the percentage of internet services a customer has purchased out of all services available – based on the intuition that more involved customers are more loyal.

Finally, we create a binary flag for the customers who have left a **textual complaint**, and control for emotional involvement by estimating a "anger score" using **Generative Artificial Intelligence**. We generate the anger score by prompting an open-source **Large Language Model** by Meta ('TinyLlama/TinyLlama-1.1B-Chat-v1.0') to rate the level of anger of each complaint on a scale from 0 to 10, where 5.0 is a neutral tone. As expected, the share of churned customers increases as the anger score grows (Appendix). This enriched dataset serves as a vital foundation for **identifying churn drivers** and crafting **targeted retention strategies**.

2.2 Customer base exploration

Our exploratory analysis uncovers key behavioral and demographic patterns associated with **churn**. Among the most striking findings:

- Contract Type: Customers on **month-to-month contracts** churn at rates **3.8× higher** than those locked into 1- or 2-year agreements.
- Tenure: churn is **46% within the first year** but drops to **17% after five years**, highlighting the importance of early-stage retention.
- Internet Technology: **Fiber-optic** users churn at **42.1%**, compared to just **19.6%** for **DSL** users.
- Price Sensitivity: Customers paying **under €40 per month** churn at **11.6%**, while those paying **over €90** churn at **32.8%**—a nearly 3× increase.
- Age Demographics: **Senior** citizens churn at **41.7%**, substantially more than the **23.6%** churn rate for **younger** customers.

Furthermore, churn is disproportionately higher among customers who:

- Use fiber optic internet services
- Do not subscribe to value-added services like online security, backup, device protection, or tech support
- Lack a partner or dependents
- Are on month-to-month contracts
- Opt for paperless billing
- Pay via electronic check

Quantitatively, the churn rate for these groups of customers is considerably higher than the average churn rate. There are two possible explanations: either the presence of the feature causes the increase in churn rate, or customers who present the feature have latent behaviours that make them churn at a higher rate.

Feature	**Above average churn rate**
Pays via electronic check	+ 18.7%
Subscribed to a month-to-month contract	+ 16.2%
Has fiber optic service	+ 15.4%
No online security service	+ 15.2%
No technical support	+ 15.1%
No online backup service	+ 13.4%
No online device protection	+ 12.6%
Has paperless billing	+ 7.0%
No partner	+ 6.4%
No dependents	+ 4.7%

These patterns strongly suggest that customers with fewer service bundles, weaker personal or contractual ties, and more impersonal payment methods are more likely to leave. Moreover, the steep rise in churn among higher-spending users indicates a perceived disconnect between cost and value, and many customers likely feel they're not getting their money's worth.

2.3 Business Diagnostic: Sources of Revenue

From a **financial perspective**, ABC TelCo's revenue is primarily anchored in its internet services, especially its premium **fiber-optic plans**, which are **priced between €95 and €105 per month**. These plans not only command the **highest ARPU** but also represent the largest segment of the customer base.

Behind fiber, the **DSL offering**, priced at **roughly €55 to €65/month**, remains a steady contributor, supported by a loyal base of users. Value-added services such as **streaming TV, cloud backup, and device protection** further enhance revenue, with 45–60% of broadband subscribers opting for at least one add-on, each **boosting ARPU by €8 to €15**. It is evident that bundle-ups significantly increase ARPU.

Mobile services and multi-line phone bundles add further income, but typically only yield strong margins when sold in conjunction **with broadband**. **Stand-alone voice services**, particularly single-line plans, contribute the least, with **sub-€25 ARPU** and declining usage. While one could argue that mobile services are more scalable and may eventually become more profitable[5]. Internet services act as a strategic anchor when it comes to revenue.

Customers are far more likely to choose their ISP provider for mobile service if service is perceived as high quality. In that sense, Internet service can be conceived as the entrance to a more profitable mobile service market where customers place higher value and fidelity[6][7].

In the early years of operation, when capital expenditures are high, revenue stability is essential. Losing high-value fiber customers undermines this foundation. Thus, churn is a significant threat that could erode recurring revenue streams and place ABC TelCo in a precarious financial position.

3. Modelling

Our modeling strategy is designed with two clear business goals. First, understand the specific factors driving the customer's decision to leave; second, identify the customers at risk by estimating the probability of churn. This dual focus enables ABC TelCo to not only predict which customers might leave but also develop targeted interventions to retain them.

Given that the **cost of acquiring new customers is 5-7× higher than retention**, our modeling prioritizes minimizing missed churn cases (false negatives) over incorrectly flagging loyal customers (false positives). This business-driven decision leads us to optimize for the **F2 score**, which weighs recall (**catching churners**) more heavily than precision

3.1 Model Development and Selection

We test several models with increasing complexity, evaluating each based on its predictive performance and business interpretability.

[5] NetSec Cloud – ISP vs Mobile Data
[6] Fierce Network – Consumers Report
[7] Quad Rang – Business vs Residential

Model	*Accuracy*	*Precision*	*Recall*	*F1 score*	***F2 score***	*Business Losses (€)*
Business Rules	0.704	0.461	0.687	0.552	0.626	57277
Logistic Regression (L1)	**0.816**	**0.703**	0.532	0.606	0.559	62106
Random Forest	0.802	0.678	0.484	0.565	0.513	68065
XGBoost	0.710	0.475	**0.896**	**0.621**	**0.761**	**36591**

The XGBoost model delivers the strongest overall performance, with particular strength in recall, our priority metric. This means that **out of all customers who actually churned, our model successfully identified 90% of them**, giving the company tangible opportunities for intervention.

From a business losses perspective, our optimized XGBoost model represents reducing the business losses by approximately **€20686 in monthly charges** (Appendix), compared to simple business rules by reducing missed churn cases, which are evaluated 5 times more costly than a false positive.

3.2 Key Churn Drivers: What Matters Really?

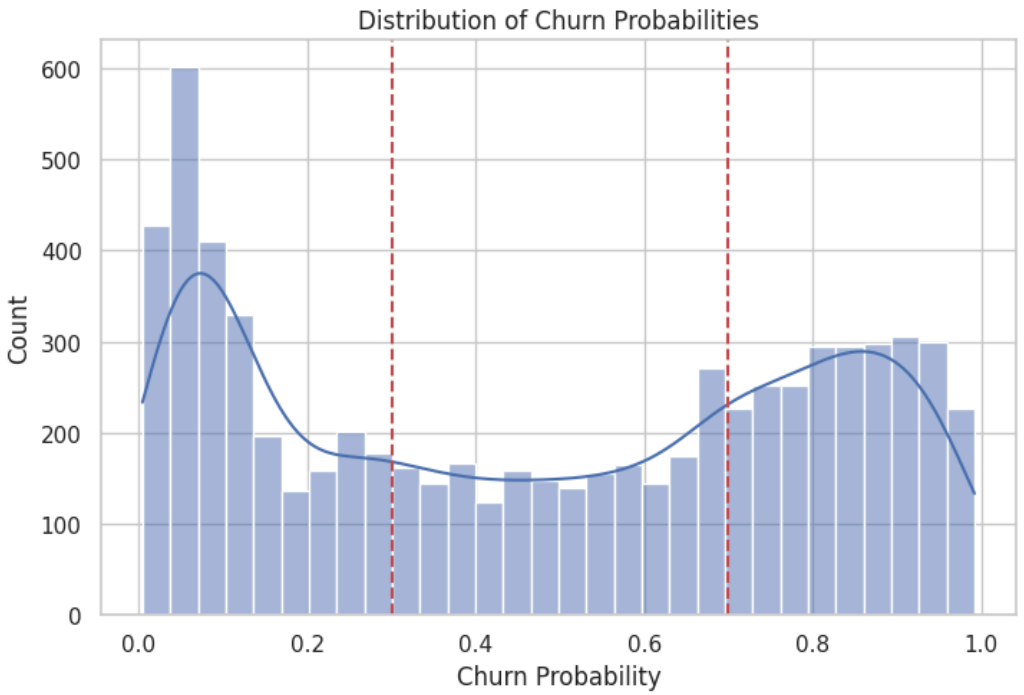
Our XGBoost model, which achieved the highest F2 score and lowest business cost, identified these factors as the strongest predictors of churn (in order of importance):

1. **Contract Length** (0.265): By far the most influential factor, accounting for over 26% of the model's predictive power. Month-to-month contracts significantly increase churn risk compared to longer-term commitments.
2. **Internet Service Type** (0.205 combined): Fiber optic service (0.120) and having no internet service (0.085) both strongly predict churn behavior, though in different directions. Despite being a premium offering, fiber customers show substantially higher churn rates than DSL users.
3. **Payment Method** (0.073): Electronic check payment emerges as a significant churn indicator. This aligns with the notion that less automated payment methods correlate with weaker customer commitment.
4. **Customer Complaints** (0.054): The presence of a complaint (HasComplaint) is the fifth most important predictor, highlighting the importance of service satisfaction.

3.3 Probability of Churning: Who is at Risk?

Using our model, we also predict the probability of churn for each customer. Focusing on the customers who have not churned yet, we inspect the distribution of probabilities of churning, visualized below, and find that there are **three distinct groups**:

1. **Low Risk**: probability of churning is **below 30%**.
2. **Medium Risk**: probability of churning is **between 30% and 70%**.
3. **High Risk**: probability of churning is **above 70%**.



Out of the **5174 customers who haven't churned**:

- 50% (2579) valued at **€135,750.45** in monthly charges are at a **low risk** of leaving,
- 31% (1627) valued at **€108,316.60** in monthly charges are **medium risk**,
- 19% (968) valued at **€72,918.70** in monthly charges are **high risk**.

With this information, we compute the revenue at risk or expected loss – the product between churn probability and monthly charges per customer, and then the sum across all customers. We find that ABC TelCo's **revenue** is expected to **decrease** by **€131,563.88** purely due to churn in the coming months. This result underlines the urgent need to intervene with preventive measures that curb churn probabilities and enhance retention.

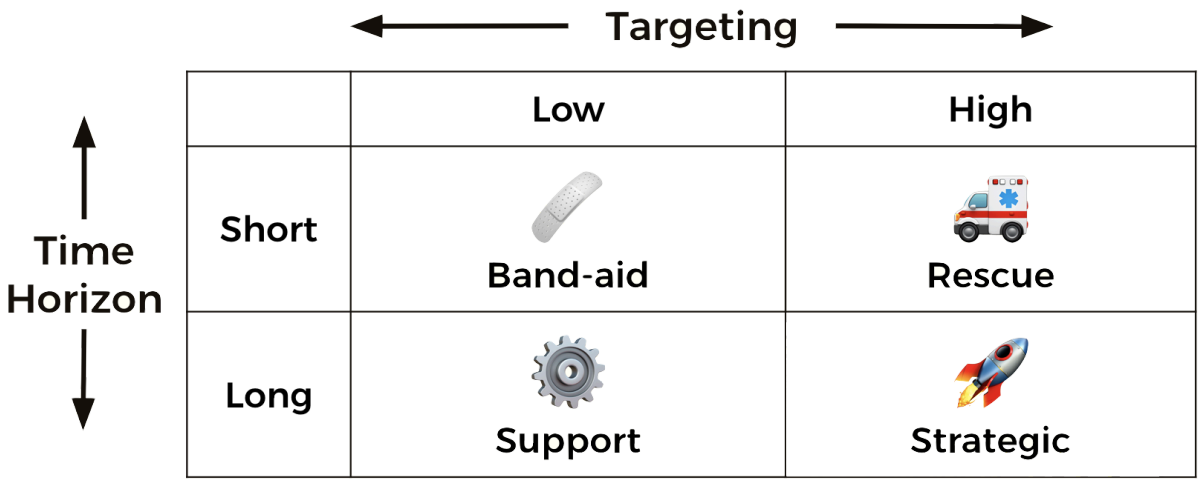
4. Intervention Strategy

We propose an intervention strategy aimed at maximising revenue through user retention. Our recommendations are built on two axes: targeting and time horizon.

Targeting defines the personalisation of the intervention. Churn is a causal phenomenon peculiar to each customer. Hence, effective interventions target the root causes. While targeting is **expensive**, it is capable of **saving customers** from churning. **Non-targeted** interventions are **cheaper**, but are **band-aid-like** as they don't solve a problem at its core.

Time horizon defines the timing of the intervention. **Short term** strategies are **pragmatic** and data driven, can be implemented in a week, and will yield **results** in the **next months**. **Long term** strategies are **strategic**, should be implemented gradually over the **next 5 years**, but will yield **revolutionary results**.

Below we present the "**Churn Down For What matrix**", which schematically presents the 4 intervention types of our strategy.



4.1 The Root Causes

Throughout our analysis, we found tenure to be highly correlated with low churn probability. However, tenure is the result of customer satisfaction. Hence, we use it as a key performance indicator and focus on other **root cause variables: Senior Citizen, Fiber Optic Internet Service, Has Complaint, Non-Automatic Payment Methods, and Short Contract Length.** The proportion of customers with these characteristics grows as we move from the Low to the High risk category, which further supports our conclusions.

4.2 Short Term

In the short run, ABC TelCo should aim at maximising profit by **minimising the number of users churning**, particularly those in the Medium and High risk categories. The two groups have similar characteristics, but High Risk customers paying on average €8.75 more per month for 14 months of less tenure. Thus, effective **Band-aid interventions** will be:

- Make new customers commit with **lower monthly charges** for **contracts** having **longer durations**. While average monthly revenue is similar across all contract lengths, the total revenue generated by two-year contracts exceeds that of one-month contracts by **more than €2000 on average**.

- Improve loyalty by **upselling services**, using **incentives** such as free trials or money-back guarantees to **ease adoption**. Currently, 1744 customers have no additional internet services. This means that there is about **€123,920 of untapped revenue**, found by comparing the average monthly charge for customers with all internet services against the average of those who have none.

- Facilitate payments by offering to **change payment methods** to a "stress-free" automatic option. Full conversion would **de-risk €166,938.80** of monthly revenue.

- **Support elderly** customers, who account for **€52,735.25 in monthly revenue**, with frequent, informative, and helpful communication.

Moreover, we propose the following Saver interventions to address the root cause of problems:

- Manage frustration with **ad-hoc, end-to-end care** for **complaining customers**. Currently, complaining customers are **worth €17,784.05 of monthly charges**. However, their average churn probability is 55%, which translates to an expected decrease in revenue by €9,781.23 if no preventive action is taken.

- **Resolve product issues** by employing technical staff and applying fixes where indicated by customers. For instance, ensure that **Fiber Optic** works perfectly, potentially **de-risking €168,984.35** of monthly revenue.

The above interventions will act upon the immediate causes of churn and thus yield return in the coming months. Below, we suggest intervention that will have a lasting effect on ABC TelCo's business.

4.3 Long Term

In the long run, ABC TelCo should aim at **improving its product**, benefiting customers at all risk levels, and **expanding its customer base** to grow its monthly contract revenue and sustain investments.

The first long term intervention we suggest is augmenting the **breadth and depth of data collection**, a **support strategy**. This will enable a more granular understanding of customer behaviors and pain points, facilitating targeted interventions and predictive churn modeling. For instance, collect temporal data to map user satisfaction over time and run A/B tests to gauge the effectiveness of interventions. Moreover, better data will assist marketing efforts in ensuring that new customer acquisition outpaces churn, thus establishing long-term growth.

Secondly, on a more transformative level, we suggest focusing on strategic investments in **technology and product innovation**. This **strategic intervention** will be critical to elevating the customer experience and differentiating the offering.

Introducing new products and features, like a VPN service, will drive higher engagement and stickiness, as demonstrated by the positive impact of increased internet service density. Additionally, scaling the workforce to strengthen customer care capabilities will foster deeper relationships and trust, reducing churn by proactively addressing root cause issues and enhancing overall satisfaction.

4.4 Implementation Considerations

The proposed interventions vary in scalability across our matrix. Band-aid interventions like contract restructuring and payment method changes can be implemented through automated systems with minimal marginal cost. Support strategies such as enhanced data collection can be developed once and scaled efficiently. Saver interventions present scalability challenges, requiring dedicated resources per customer interaction. Finally, strategic quadrant interventions need significant initial investment but can be designed with scalability as a core principle, benefiting both new and tenured customers post launch.

Financial implications can also be studied by quadrant. Suppose ABC TelCo operates in the Italian market. Band-aid interventions have the lowest cost, approximately one-time fees of €40,000-60,000.[8] Saver interventions demand more substantial investment, particularly in technical staff, projected at €180,000-230,000 annually.[9] Support strategies require approximately €270,000-320,000 annually[10]. Strategic interventions represent the highest cost at €500,000+ over three years.[11]
Note that the intervention categories are not mutually exclusive, and that the benefits of investing in one intervention will spillover notable to other categories. Moreover, once the €166,938.80 monthly revenue at risk is secured, these figures would be paid back relatively quickly.

Our intervention strategy transforms ABC TelCo's customer relationships and market position. Despite the financial commitments required, these investments are foundational building blocks for sustainable growth. Short-term interventions will stabilise revenue by addressing immediate churn risks, while long-term strategies build lasting capabilities. By addressing both symptoms and root causes of dissatisfaction, ABC TelCo will not only retain customers but develop competitive advantage through superior customer experience and product offerings.

[8] Digital Strategy – Digital Connectivity in Italy
[9] Statista – Personnel Costs in Italy
[10] Doxee – Paradoxes telecommunications industry in Italy
[11] Gruppo Tim – Corporate Report 2017

Appendix

1. Calculation – lost future revenue

Average monthly revenue per churned customer: €74.44 per month.
Number of churned customers: 1866
€74.44 × 1866 ≈ €139.000 / month
€139.000 × 12 ≈ €1.67 million / year

2. Business Rules Model Implementation

The Business Rule method applies four business rules to identify customers at risk of churning:

1. Low tenure customers: Customers who have been with the company for a short period (tenure below -0.5 standard deviations from the mean)
2. Month-to-month contract: Customers with the shortest contract length (indicated by a standardized value of -0.8)
3. Customers with complaints: Any customer who has filed a complaint
4. High charges without security: Customers paying above-average monthly charges (>0.5 std) who don't have online security

The model then:

- Creates an array of zeros (default: not churning)
- Sets the prediction to 1 (will churn) for any customer who meets ANY of the four rules
- Returns these binary predictions

3. Calculation of ARPU (Average revenue per user)

The ARPU was computed as the average on the MonthlyCharges variable across all the customers, which resulted in it being equal to 64.742€.

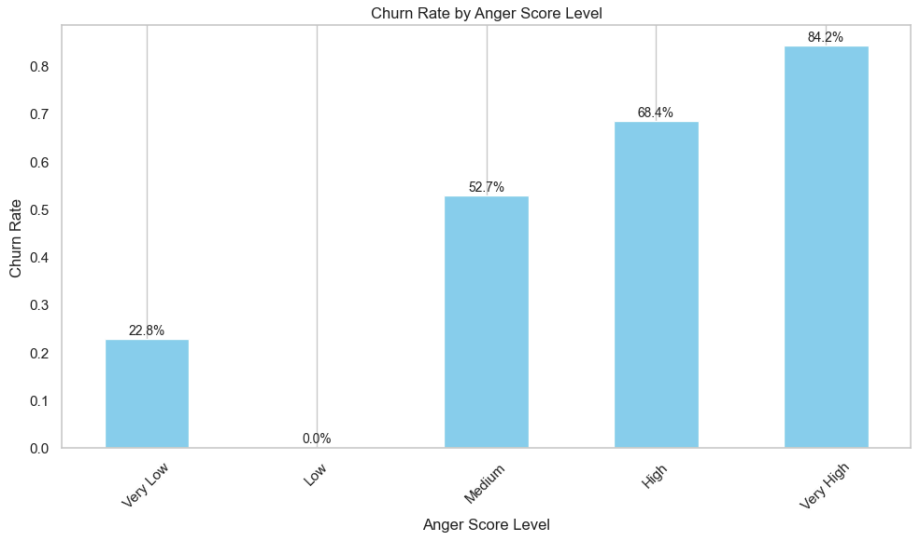
4. Calculation of Business Losses Metric

It is a weighted average. Business losses (€) = 1 * Number of False Positives * ARPU + 5 * Number of False Negatives * ARPU.

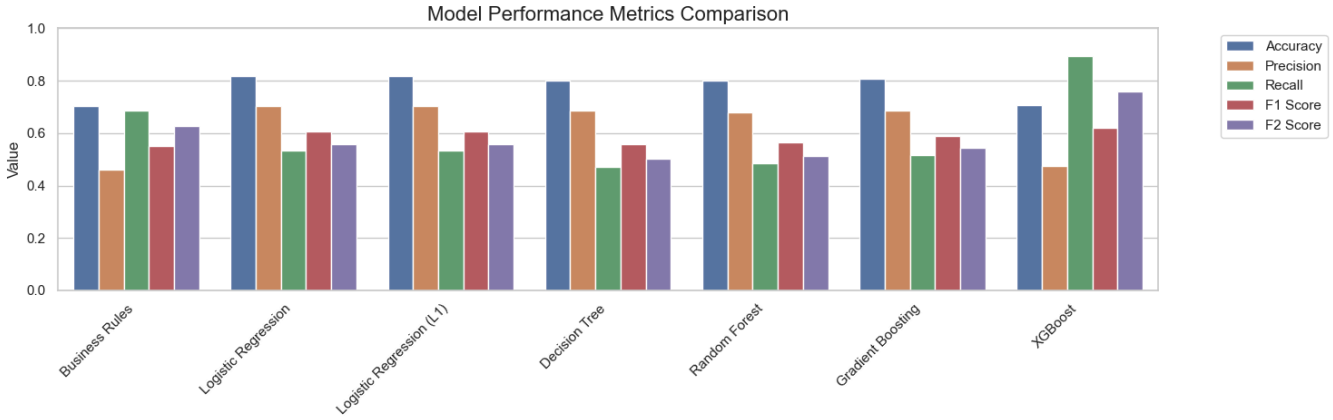
5. Calculation – XGBoost saving losses

It is the difference in the Business losses Metric between the Business Rules Model and the XGBoost Model: **57277 - 36591 = 20686**

6. Churn Rate by Anger Score Level



7. Model Performance Comparison



8. Feature Importance (SHAP Values)