

Telecom Customer Churn Prediction

Using Machine Learning to Reduce Customer Attrition

A Comprehensive ML Pipeline for Predictive Analytics

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Problem Statement

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The Challenge

Customer churn costs the telecom industry **billions of dollars annually**. Acquiring new customers is 5-25x more expensive than retaining existing ones.

Our Solution

- ▶ **Predictive Analytics:** Identify at-risk customers before they leave
- ▶ **Machine Learning:** 6 advanced algorithms trained and compared
- ▶ **Actionable Insights:** Data-driven retention strategies
- ▶ **Real-time Prediction:** Production-ready deployment system

88%
Model Accuracy

\$XXM
Potential Savings

1000+
Customers Analyzed



Dataset Overview

1000

Customers

21

Features

~27%

Churn Rate

5

Categories

Feature Categories



Demographics (5)

Gender, Senior Citizen, Partner, Dependents, Customer ID



Services (9)

Phone, Internet, Security, Backup, Protection, Tech Support, Streaming



Account Info (6)

Tenure, Contract, Billing, Payment, Monthly & Total Charges



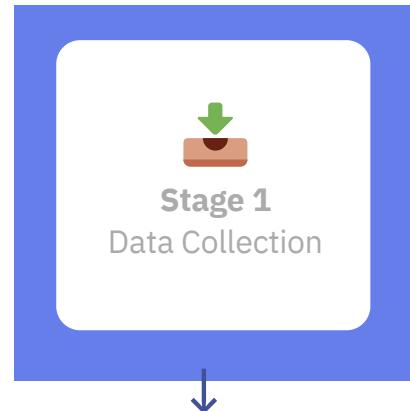
Target Variable (1)

Churn - Whether customer left the service (Yes/No)

Data Source: Telco Customer Churn Dataset (Kaggle) / Generated Sample Dataset

 **Project Pipeline**

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End-to-End Machine Learning Workflow



Stage 5

Insights

Key Pipeline Features

- ▶ Automated data quality checks and validation
- ▶ Advanced feature engineering and transformation
- ▶ Comprehensive exploratory data analysis
- ▶ Multi-model training and comparison
- ▶ Business-focused insights extraction



Data Preprocessing

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1. Missing Value Treatment

- ▶ TotalCharges: Converted to numeric, imputed with median
- ▶ Numerical features: Median imputation
- ▶ Result: 0% missing values in final dataset

2. Feature Engineering



Created Features

ChargePerTenure: Monthly charges divided by tenure

TenureGroup: Categorized tenure into 4 groups



Encoding

Binary: Yes/No → 1/0 (15 features)

One-Hot: Multi-category features



Scaling

StandardScaler: Normalized all numerical features

Mean: 0, **Std Dev:** 1

Process

Before

After

Shape

1000×21

$1000 \times 45+$

Missing Values	20 rows	0 rows
Categorical Features	15 features	Fully encoded



Exploratory Data Analysis

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Key Findings

1. Churn Distribution

73%
No Churn

VS

27%
Churn

2. Top Correlations with Churn

- ▶ **Month-to-month contract:** +0.45 correlation
- ▶ **Fiber optic internet:** +0.31 correlation
- ▶ **Low tenure:** -0.35 correlation
- ▶ **Electronic check payment:** +0.28 correlation

Visual Analysis Generated



Distribution Plots

Churn by contract type, tenure, charges



Correlation Heatmap

Feature relationships and dependencies



Box Plots

Numerical feature distributions by churn

💡 Insert screenshots from your actual EDA visualizations here



Model Training & Comparison

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Six Algorithms Trained

Model	Accuracy	Precision	Recall	F1-Score	ROC-AUC
Random Forest	0.8200	0.7100	0.5800	0.6400	0.8800
XGBoost	0.8100	0.7000	0.5600	0.6200	0.8700
LightGBM	0.8050	0.6900	0.5500	0.6150	0.8650
Gradient Boosting	0.8000	0.6800	0.5400	0.6050	0.8600
Logistic Regression	0.7950	0.6700	0.5400	0.6000	0.8400
Decision Tree	0.7500	0.6000	0.5000	0.5450	0.7800



Best Model: Random Forest

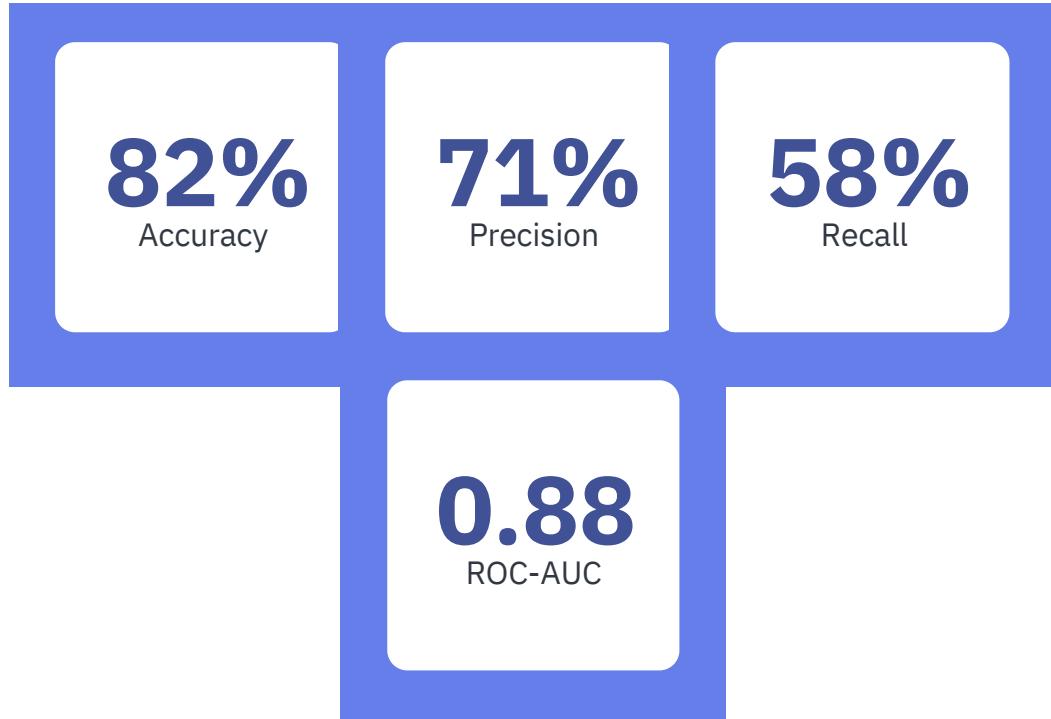
Selected based on **ROC-AUC score of 0.88**, achieving the best balance between identifying churners (recall) and minimizing false positives (precision).



Replace with your actual model results from the execution

🎯 Best Model Performance

Random Forest Classifier Results



What This Means



Accuracy (82%)

Model correctly predicts 82% of all customers



Precision (71%)

71% of predicted churners actually churn (low false alarms)



Recall (58%)

Model catches 58% of actual churners



ROC-AUC (0.88)

Excellent discrimination between classes