
# Customer Churn Modeling

## Connex Communications

Connex is a communications company that provides phone, internet, and streaming services. In addition, they offer supportive services like online security, device protection, etc.

Connex would like to utilize machine learning methodologies to create a model that gives them the ability to get ahead of customer churn.

# Key Questions

## What model can best predict churn?

Test and optimize a variety of machine learning algorithms

Use product subscription status, account, and demographic information as inputs into the modeling process

## Which features (inputs) are more likely to predict churn?

Utilize logistic regression feature coefficients and the feature_importances_ tool in sklearn’s random forest


# Getting to Answers

# The Data

Kaggle Telco Dataset

7,032 observations

30 Features

## Products

- Phone
- Multiple Lines
- Internet
- Online Security
- Online Backup
- Device Protection
- Tech Support
- Streaming TV
- Streaming Movie

## Account Info

- Time as Customer
- Contract Type
- Payment Method
- Paperless Billing
- Monthly Charges
- Total Charges

## Demographics

- Senior
- Dependents
- Gender
- Partner

## Churn

Last month

- Yes
- No

# Approach


- Logistic Regression
- Evaluate key metrics
- Address class imbalance

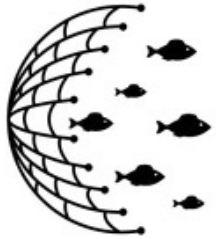

- Decision Trees, Random Forest, XGBoost
- Tune hyperparameters


- Best performing model
- Most important features


- Identify further tuning opportunities
- Explore other ideas

Tools: Pandas – Sklearn – Imblearn - Numpy

# Which metric should we use to optimize the model?



## Recall

It’s better for the business to cast the net wider and capture more potential churn customers than to use precision metric and miss potential churn customers.

Recall

VS.

Precision

- Answers what proportion of actual positives was identified correctly.
- Selects best model when there’s a high cost associated with false negative (person that’s predicted not to churn when they did churn)

- Answers what proportion of positive identifications was actually correct.
- Selects best model when there’s a high cost associated with false positive (person that’s predicted to churn when in fact they’re not churning.)

Results

# Model Performance

Model Settings:
- Default hyperparameters
- Oversampling

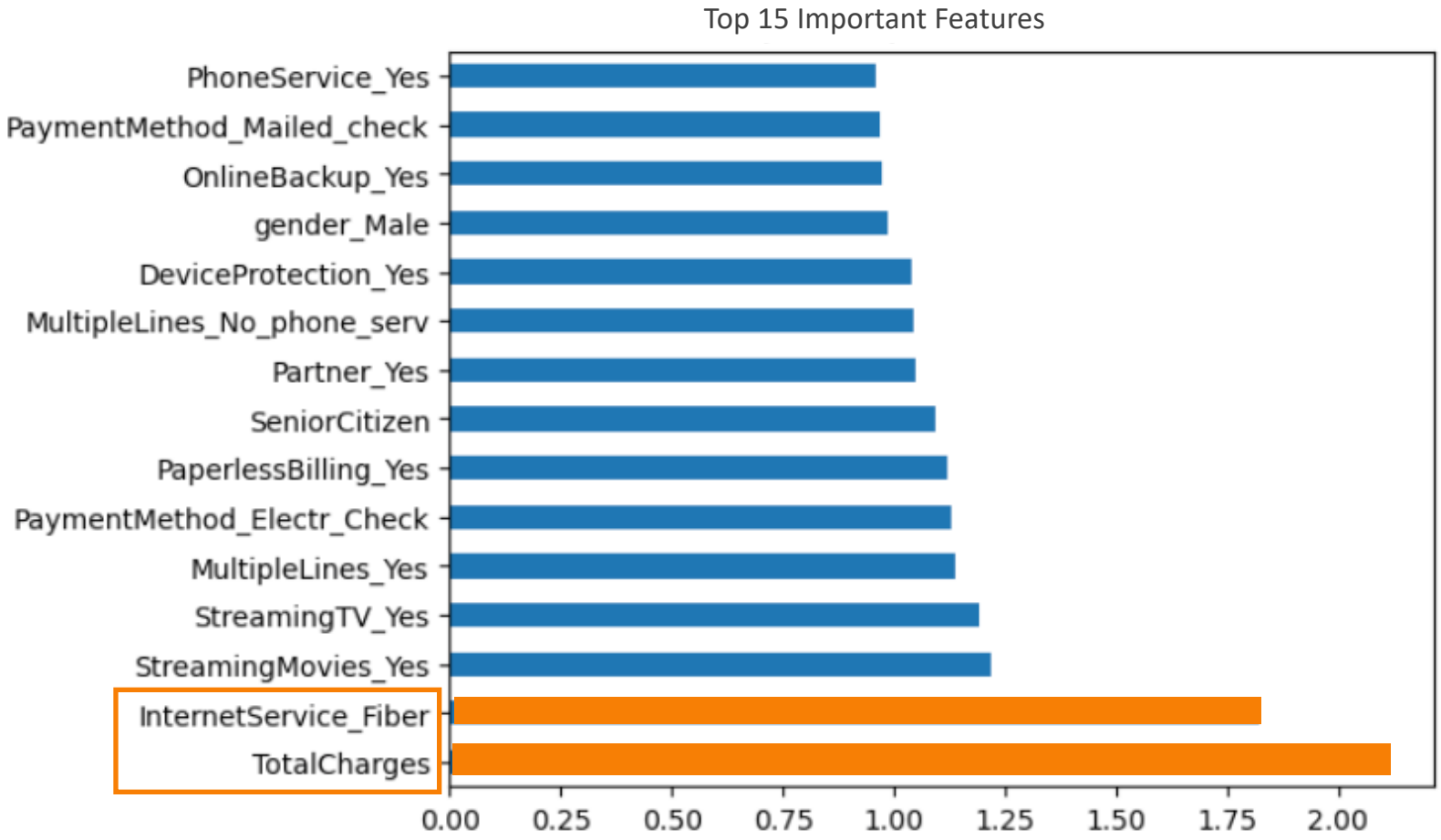
# Benchmark

Started with Logistic Regression

| Model | Recall | Precision | F1 |
|---|---|---|---|
| Logistic Regression | 80% | 48% | 60% |

# Feature Probability

**Coefficient Odds Review: F**eature Probability of Churn (Logistic Regression)




**Highest Probability of Indicating Churn**

- TotalCharges
- Fiber Internet Service

**Lowest  Probability of Indicating Churn**

- Tenure
- Two Year Contract

Model Settings:
- Default hyperparameters
- Oversampling

# Test More Models

Additional algorithms

| Model | Recall | Precision | F1 |
|---|---|---|---|
| Logistic Regression | 80% | 48% | 60% |
| XGBoost | 74% | 50% | 60% |
| Random Forest | 60% | 57% | 58% |
| Decision Tree | 48% | 47% | 48% |

# Tune Hyperparameters

Random Forest + Decision Tree

- Default hyperparameters
- Oversampling

- Tuned hyperparameters
- Oversampling

| Model | Recall | Precision | F1 |
|---|---|---|---|
| Logistic Regression | 80% | 48% | 60% |
| Random Forest<br>Hyperparameters Tuned | 76% | | |
| XGBoost | 74% | 50% | 60% |
| Random Forest | 60% | 57% | 58% |
| Decision Tree | 48% | 47% | 48% |
| Decision Tree<br>Hyperparameters Tuned | 48% | | |

Random Forest Gridsearch Best Parameters: max_features: 23, n_estimators: 119

Decision Tree Gridsearch Best Parameters: max_depth: 1, min_samples_leaf: 1

# Winners

(thus far in the process)

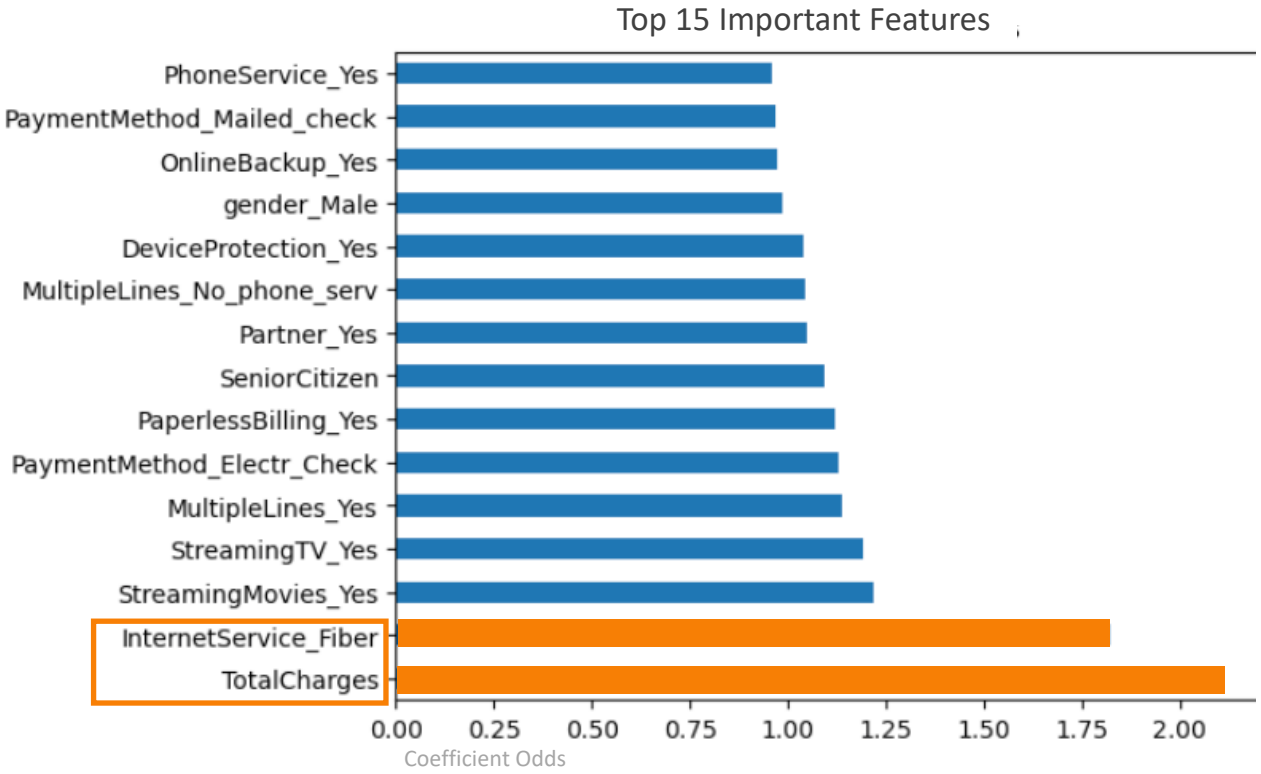
| Model | Recall |
| --- | --- |
| Logistic Regression | 80% |
| Random Forest<br>Hyperparameters Tuned | 76% |

**Let’s compare how the features performed for each model**

# Feature Comparison by Model

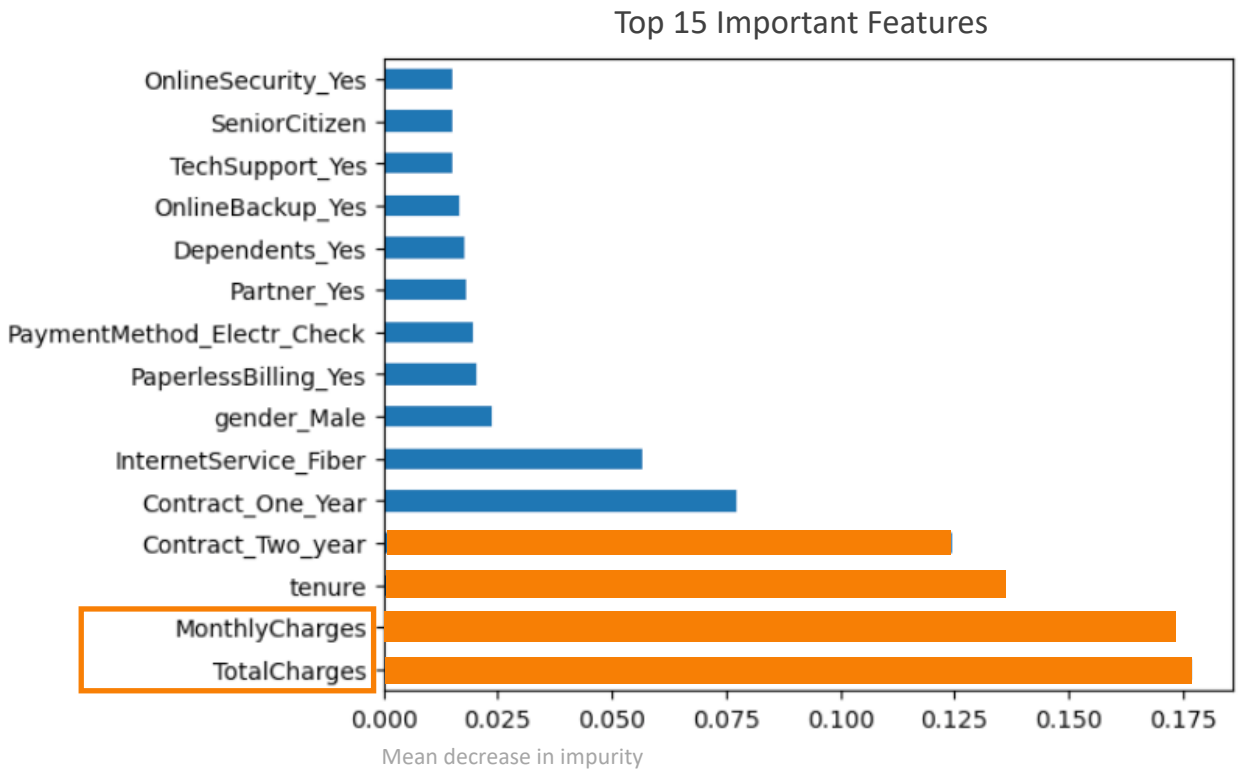
Both models agree that Total Charges is the most important, differ on others

**Logistic Regression, Defaults**




Recall: 80%

**Random Forest, Tuned Hyperparameters**




Recall: 76%

# Future Work

## Modeling

### Further Hyperparameter Tuning

- XGBoost is likely to be the best performing algorithm with hyperparameter tuning
- Logistic Regression:
    - Grid search with lasso regression to reduce feature space and determine impact on model score
    - Experiment with probability threshold

### Create Additional Features

- Review churn research that other departments have implemented to get ideas for new features to enhance model performance

### Try Voting + Stacking Ensemble Techniques

- To learn the different aspects of the data with each model

## Business Strategy

### Identify customers with highest churn probability

- Create communication strategies toward this audience considering both strongest features that indicate churn and strongest features that don't indicate churn. Features that strongly indicate not churning can also potentially inform retention strategy

## Coding

### Update pipeline to work with Gridsearch

- Utilize workflows discovered while doing this project

# Discussion