Project Home-a-loan

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July 19, 2017

The Challenge

Part 1: Lead Conversion

Part 2: Loan Processing

Lead → Lock → Fund

Mission:

- Predict whether a lead will convert to “lock”
- Supervised learning (Classification)

Business Values:

- Know the potential of each customer - know the ones to focus on
- Best Customers profiling - targeted marketing for new customer acquisition

Mission:

- Predict “locked-to-funded” time (efficiency)
- Supervised learning (Regression)

Business Values:

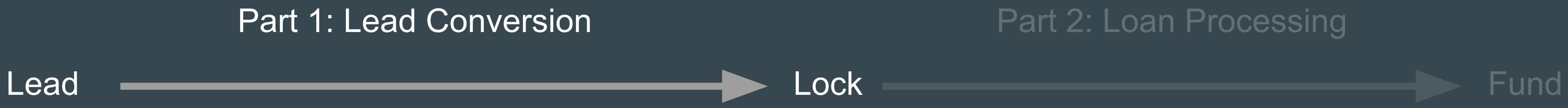
- Improve customer experience by providing an expected waiting time
- Know areas of improvement for efficiency

The data

- 9752 cases
- 417 features
- Cleaning / pre-processing:

Data Type	Examples	Processing
Numerical	Borrower income, loan amount	None
Categorical	Type of home, Education level, City of property, Gender	Dumification
Text	Goal of refinancing, Unqualified reason note	Tfidf Vectorization (limiting stop words)
Datetime	Created time, Last modified	Categorize (year, quarter, month, dow), Calculate Period (difference of dates/times), Calculate Cohort (quarter/month since initiation)

Part 1 - Leads Conversion



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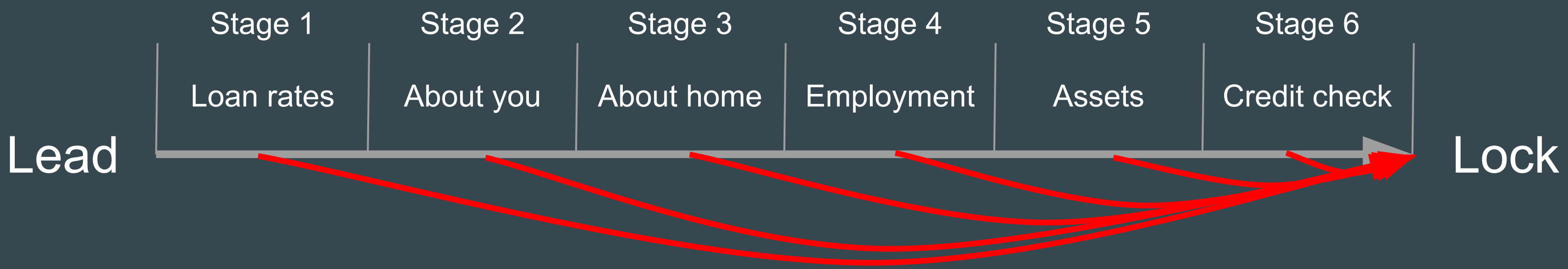


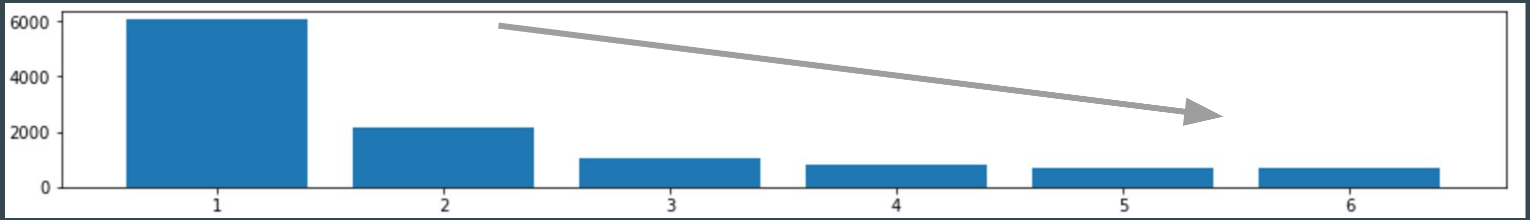
Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Loan rates	About you	About home	Employment	Assets	Credit check

Lead

Lock

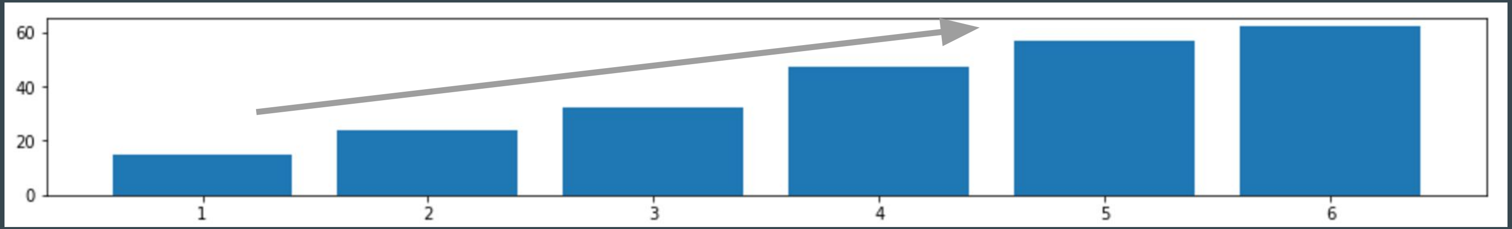
Sample Sizes

(Rows)



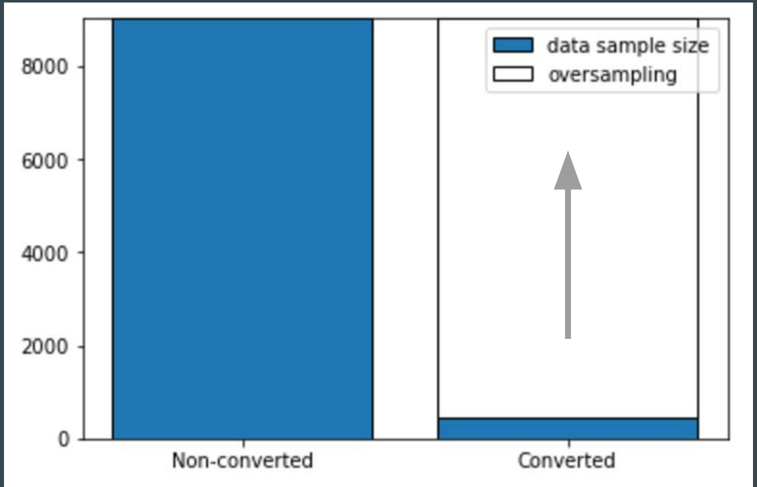
#Features

(Columns)

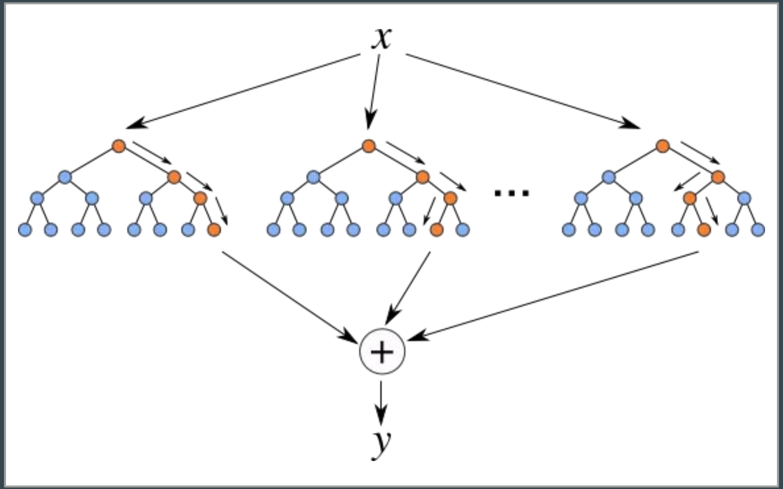


Part 1 - Leads Conversion - Methodology

Random Oversampling for Imbalance Classes

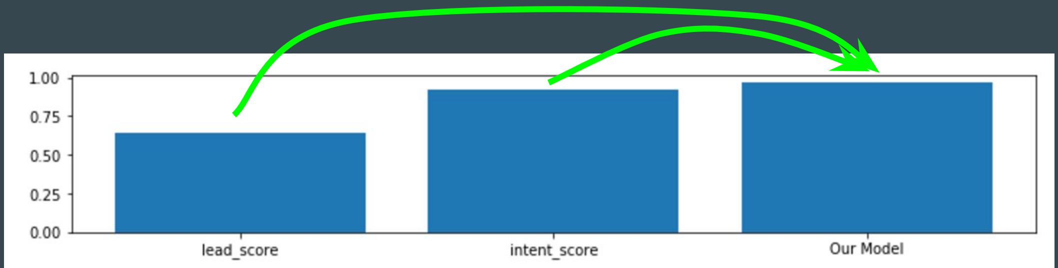


Random Forest Classifier

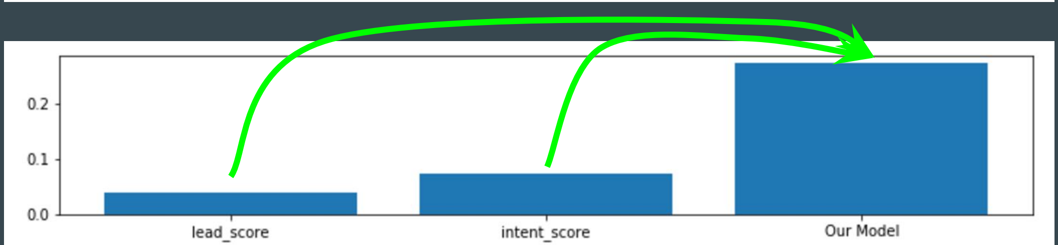


Part 1 - Leads Conversion - Results

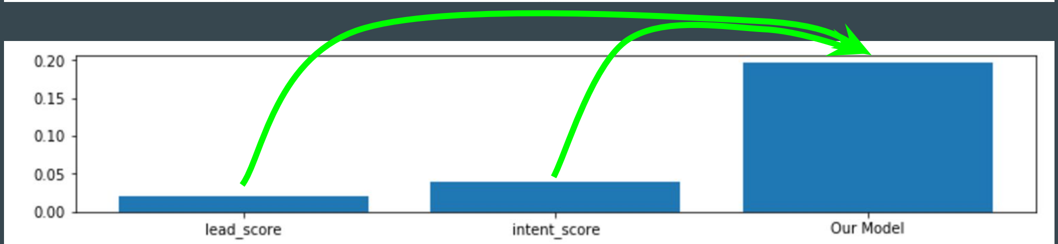
Accuracy



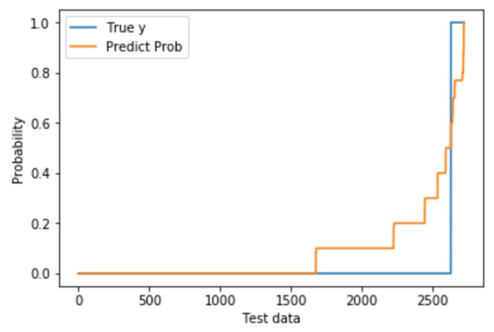
F1-score

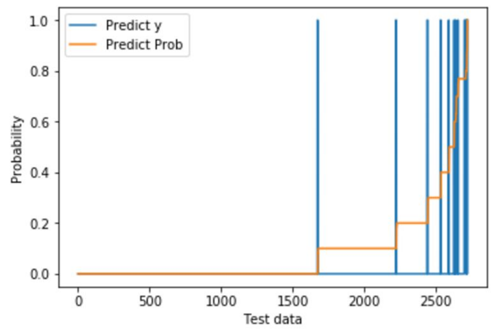


Precision

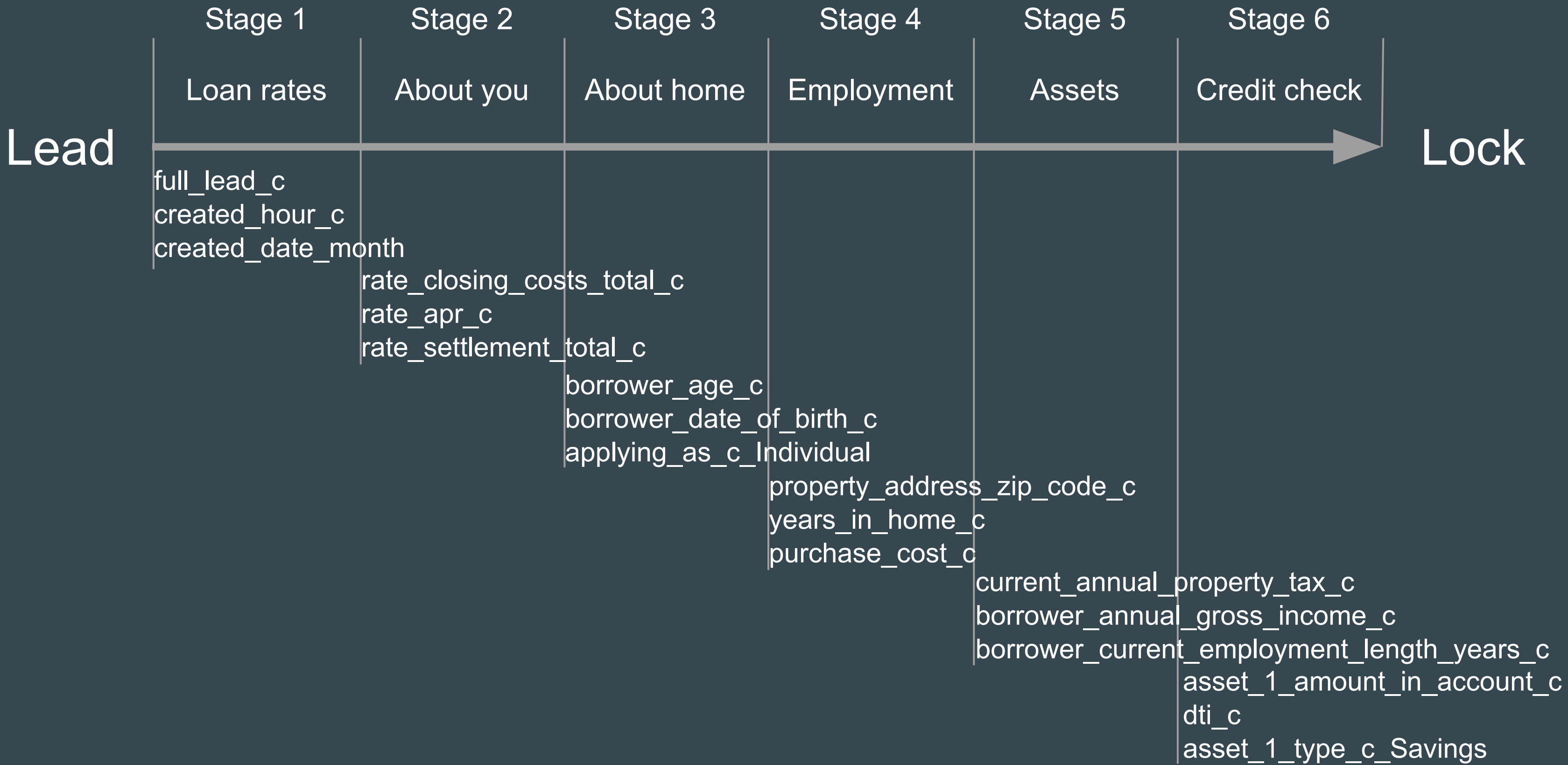


Predicted Probability v.s. True Value





Part 1 - Leads Conversion - Interpretation



Lead

Stage 1

Loan rates

full_lead_c
created_hour_c
created_date_month

Stage 2

About you

rate_closing_costs_total_c
rate_apr_c
rate_settlement_total_c

Stage 3

About home

borrower_age_c
borrower_date_of_birth_c
applying_as_c_Individual

Stage 4

Employment

property_address_zip_code_c
years_in_home_c
purchase_cost_c

Stage 5

Assets

current_annual_property_tax_c
borrower_annual_gross_income_c
borrower_current_employment_length_years_c

Stage 6

Credit check

asset_1_amount_in_account_c
dti_c
asset_1_type_c_Savings

Lock

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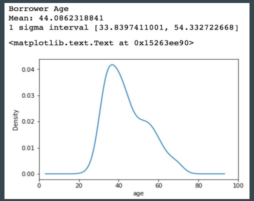
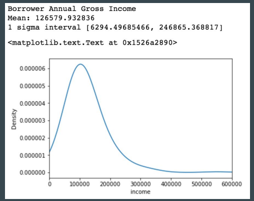
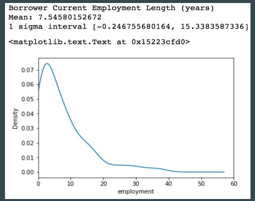


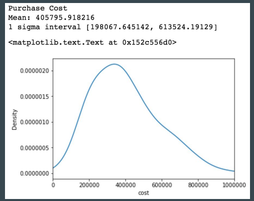
```
Borrower Age
Mean: 44.0862318841
1 sigma interval [33.8397411001, 54.332722668]

<matplotlib.text.Text at 0x15263ee90>
```



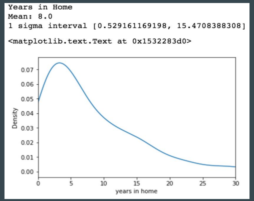
```
Borrower Annual Gross Income
Mean: 126579.932836
1 sigma interval [6294.49685466, 246865.368817]

<matplotlib.text.Text at 0x1526a2890>
```



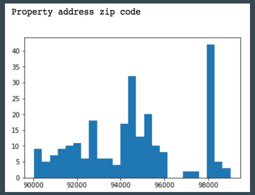
```
Borrower Current Employment Length (years)
Mean: 7.54580152672
1 sigma interval [-0.246755680164, 15.3383587336]

<matplotlib.text.Text at 0x15223cfd0>
```



```
Purchase Cost
Mean: 405795.918216
1 sigma interval [198067.645142, 613524.19129]

<matplotlib.text.Text at 0x152c556d0>
```



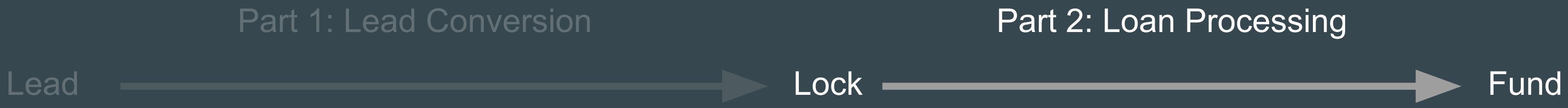
```
Years in Home
Mean: 8.0
1 sigma interval [0.529161169198, 15.4708388308]

<matplotlib.text.Text at 0x1532283d0>
```



Property address zip code

Feature	Borrower Age	Borrower's Annual Income	Borrower current employment	Home purchase cost	Years in home	Property zip code
Mean	44	127,000	7.5	406,000	8	98103
Common range	33 - 54	6,300 - 247,000	0 - 15	190,000 - 614,000	0.5 - 15	98103, 92691, 98125, 93003

Part 2 - Loan Processing



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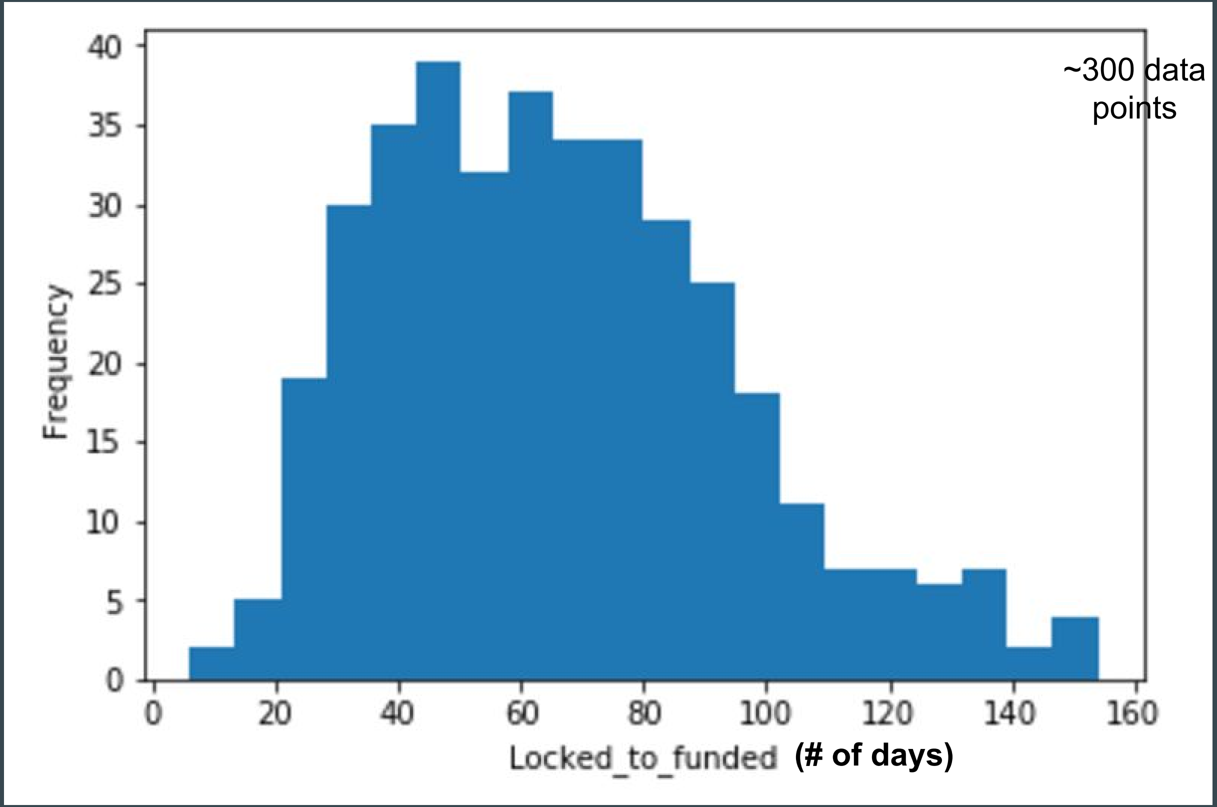


Outcome:

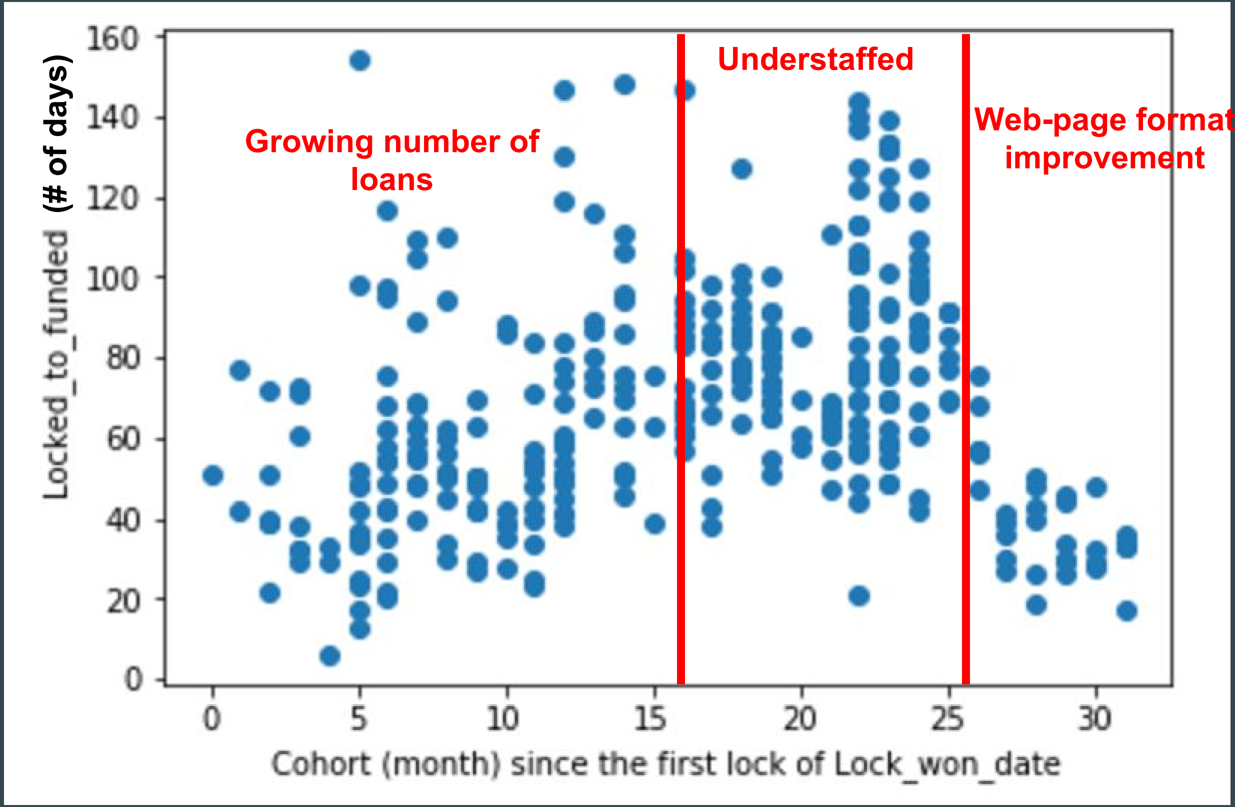
- **Experimented with different features, different algorithms (Linear, L1/L2, KNN, Decision tree, Bagging, RF, Grad/AdaBoosting)**
- **No strong signal (near zero R2)**

Potential reason:

- **Data set too small**
- **Signals lie in external factors**

Part 2 - Loan Processing

(the higher, the worse)



(or, months since the company launched)

Conclusions

Part 1

- Multistage model construction, Oversampling, Random Forest Classification
- Outperform existing models in Accuracy, F1-score, Precision
- Import feature extracted, Best Customer Profiling

Part 2

- Too few data points (~300) to detect signal for prediction
- Time cohort analysis indicated trends in outcome

Future work

- Implement prediction pipeline into existing workflow
- Include new features (from internal and external sources) into prediction models
- Try different models (neural network) that can take care of wide data sets

Thank you

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