


Paycheck Protection Program


Recommendations for Loan Recovery

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Paycheck Protection Program (PPP)

The 2020 CARES Act established \$953-billion in loans guaranteed by the US federal government



Scope of the program



Low-interest private loans

In partnership with originating and servicing lenders



Coverage for Operational Costs

Payroll, rent, interest, utilities, healthcare



Loan Forgiveness

Guaranteed by the Small Business Administration (SBA)



Efficacy

2 to 3 million job-years of employment may have been preserved



Auditing the efficacy of PPP



A 2022 study found that less than 34 percent of PPP dollars went directly to workers.²

The majority share of funds were accrued by business owners, shareholders, and lending institutions.

Alternatives to support the pandemic economy

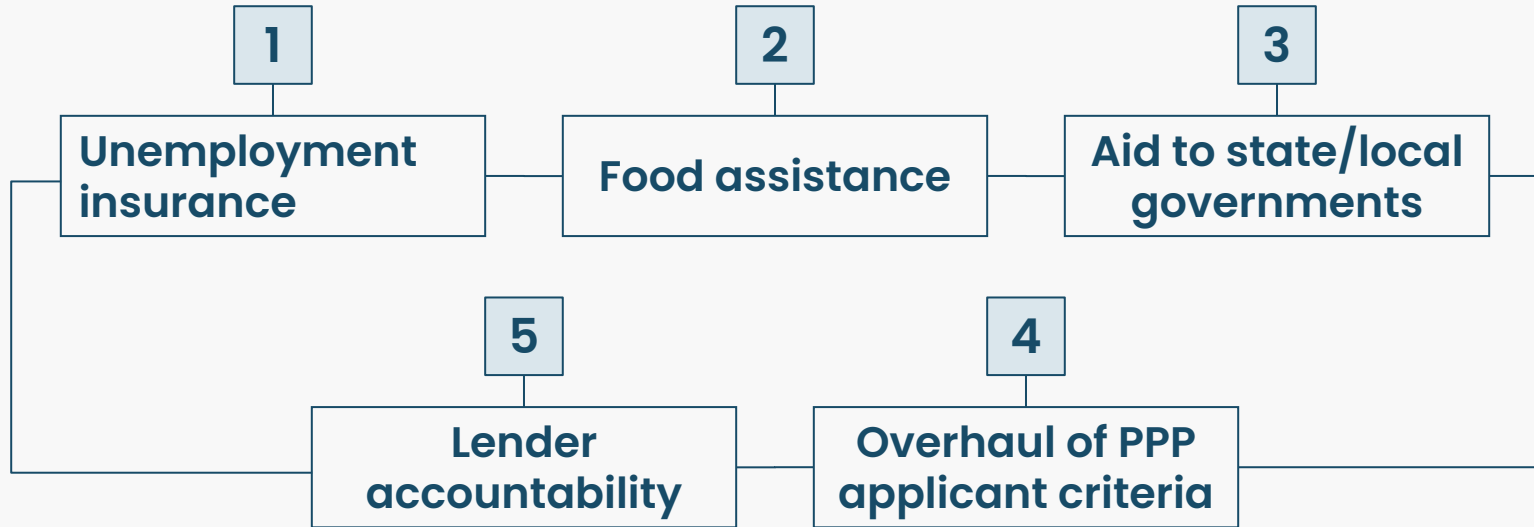


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01

Mission Objective

A robust classification model to predict if a small business will repay a PPP loan.



02

Exploratory Data Analysis

Trends and characteristics of in loan features



Target variable: Loan Status

LoanStatus	
Paid in full	0.908
Charged Off	0.062
Exemption 4	0.030



Baseline model is the majority Class	
LoanStatus	
1	0.908
0	0.092

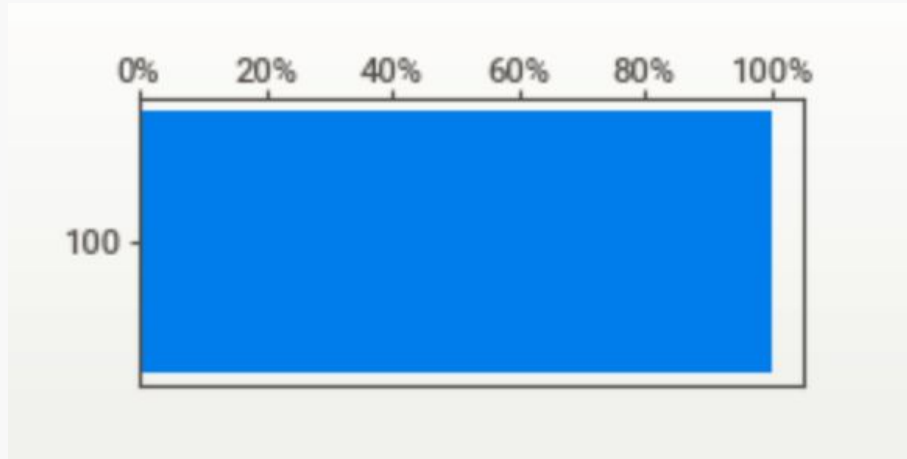


How PPP loans were spent

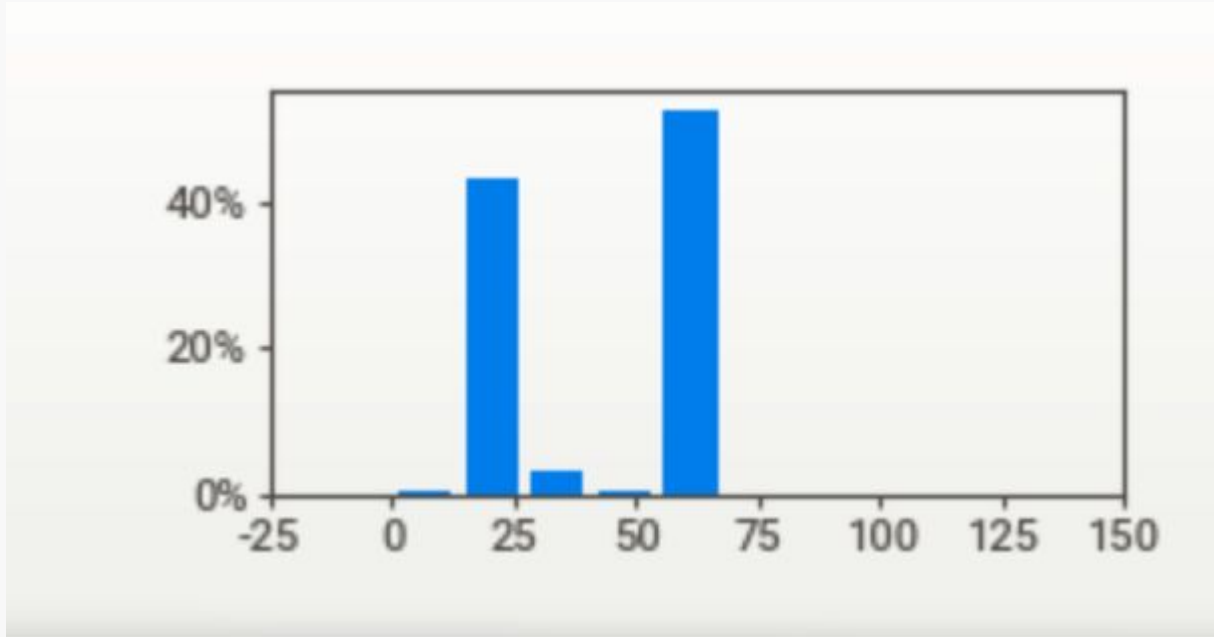
Repaid		Defaulted	
UTILITIES_PROCEED	0.006	UTILITIES_PROCEED	~1.0
PAYROLL_PROCEED	0.983	PAYROLL_PROCEED	~1.0
MORTGAGE_INTEREST_PROCEED	0.002031	MORTGAGE_INTEREST_PROCEED	0.000442
RENT_PROCEED	0.006086	RENT_PROCEED	0.002417
REFINANCE_EIDL_PROCEED	0.000457	REFINANCE_EIDL_PROCEED	0.000448
HEALTH_CARE_PROCEED	0.000713	HEALTH_CARE_PROCEED	0.000119
DEBT_INTEREST_PROCEED	0.000307	DEBT_INTEREST_PROCEED	0.000148

Loan Forgiveness Guarantee

**% Forgiveness
(Guaranteed
by SBA)**



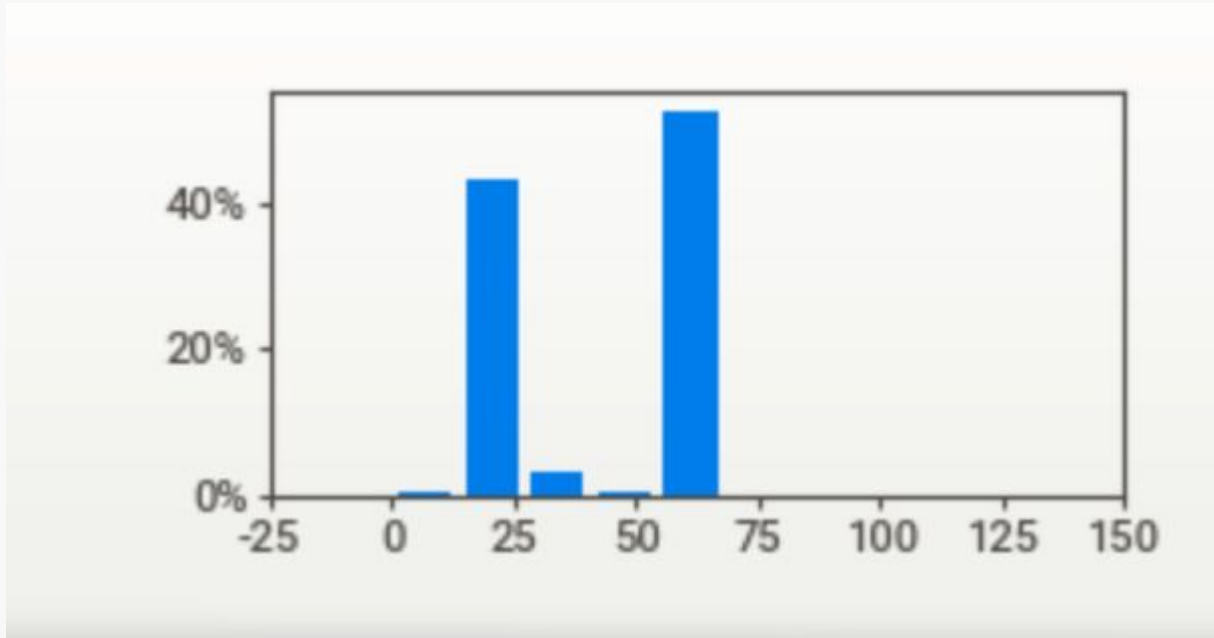
Average Loan Term



Loan Term (months)



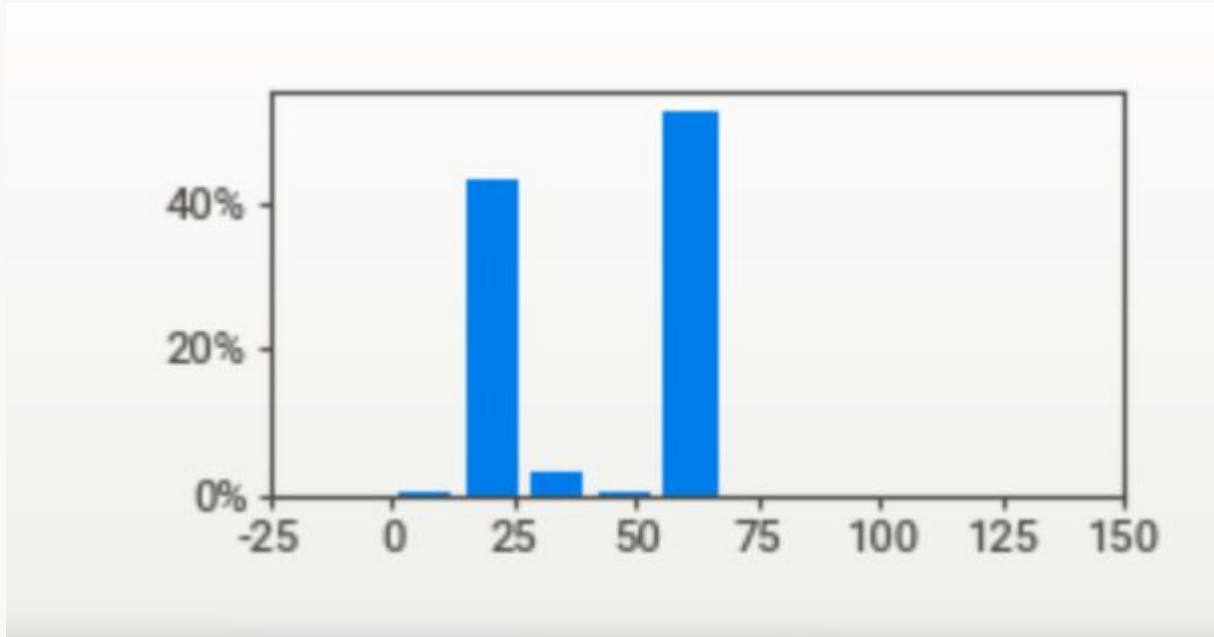
Loan Approval Size



Total Loan Amount Approved (\$k)



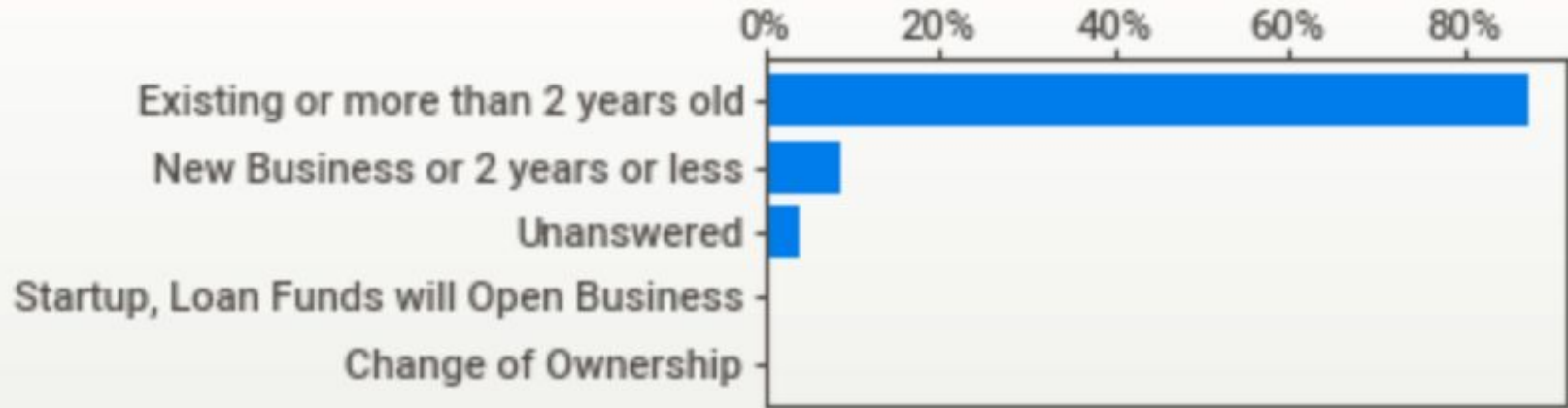
Business Type



Total Loan Amount Approved (\$k)



Age of Business






03

Classification model

A robust classification model to predict if a small business will repay a PPP loan



Random Forest Classifier

- High Accuracy
 -
 - Reduces overfitting
 -
 - Handles Large Datasets***
 - Wide dataset after One Hot Encoding
 - Implicit Feature Selection
 - Feature Importances permit reduction of dimensionality
- 

Preprocessing

One Hot Encoding

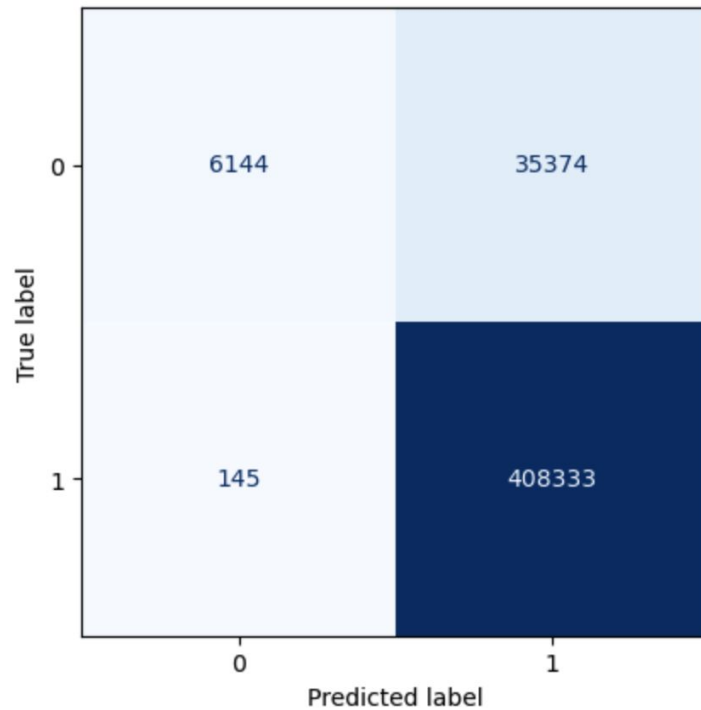
Standard Scaling

Prepares categorical
values for splitting

Improves
interpretability of
feature importances

Simple Model Fit Results

Metrics	
Overall Accuracy:	0.9211
Baseline Accuracy:	0.9080
Precision:	0.9203



Simple Model Fit Results

Metrics	
Overall Accuracy:	0.9211
Baseline Accuracy:	0.9080
Precision:	0.9203

**Modest increase of defaulted
loan detection still represents
billions in savings**



Feature Importances

Feature	Importance
Loan Term	0.794465
BusinessType_Limited Liability Company(LLC)	0.062520
BusinessType_Self-Employed Individuals	0.053172
BusinessType_Corporation	0.039418
BusinessType_Subchapter S Corporation	0.021683
BusinessType_Sole Proprietorship	0.016327



Model expanded to consider all numeric features

'Term'
'SBAGuarantyPercentage',
'CurrentApprovalAmount',
'JobsReported',
'NAICSCode'

'UTILITIES_PROCEED',
'PAYROLL_PROCEED',
'MORTGAGE_INTEREST_PROCEED',
'RENT_PROCEED',
'REFINANCE_EIDL_PROCEED',
'HEALTH_CARE_PROCEED',
'DEBT_INTEREST_PROCEED',

Metrics	
Overall Accuracy:	0.9077
Baseline Accuracy:	0.9080
Precision:	0.9077



Feature Importances

Feature	Importance
Term	3.994239e-01
OriginatingLenderLocationID	1.761027e-01
InitialApprovalAmount	1.483764e-01
PAYROLL_PROCEED	1.205263e-01
CurrentApprovalAmount	6.175452e-02
BusinessType_Limited Liability Company(LLC)	3.079272e-02
BusinessType_Corporation	3.079252e-02



Model expanded to consider all categorical features

'ProcessingMethod',
'BorrowerZip',
'ServicingLenderLocationID',
'CD',
'NAICSCode',
'OriginatingLenderLocationID'

**Dataset widened to 663453
features**

Metrics	
Overall Accuracy:	0.9087
Baseline Accuracy:	0.9080
Precision:	0.9087

Feature Importances

Feature	Importance
OriginatingLenderLocationID_69819	0.162327
NAICSCode_999990	0.149183
ServicingLenderLocationID_71727	0.129181
ServicingLenderLocationID_368915	0.116784
CD_VA-11	0.081150
BorrowerZip_32807-3752	0.071136
BorrowerZip_33054-2126	0.047417






04

Recommendations

Proposed improvements to loan application
evaluation metrics



Recommendations

Loan Term

**>40 month terms are
more likely to be paid
back**

Business Type

**Limited Liability Company
Self-Employed Individuals
Corporation
Subchapter S Corporation
Sole Proprietorship**



Recommendations

Lender identity	
Harvest Small Business Finance, LLC	14373
Loan Source Incorporated	11353
U.S. Bank, National Association	11026
Customers Bank	10416
PNC Bank, National Association	6572





Recommendations

Borrower Zip Code

BorrowerZip	Location	Median income
32807-3752	Orange County, Florida	\$68,465
33054-2126	Miami-Dade County, Florida	36,383



Final remarks

Our study provides recommendations for loan repayment recovery

Classifier tool to identify the characteristics of loans most likely to be repaid

Caveat - the ultimate mission of PPP is to save jobs and stimulate the economy

Small businesses that **do not evaluate to good candidates** for PPP form a useful dataset for identifying **alternative relief strategies**

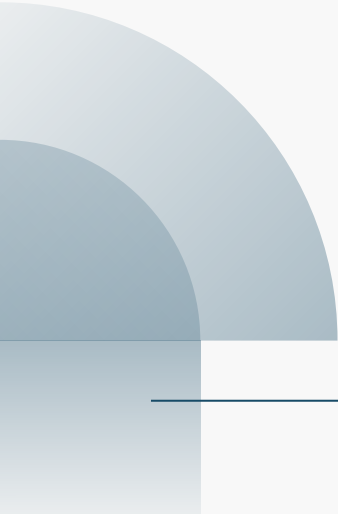


Thanks!

Any questions?

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References

- (1) <https://data.sba.gov/dataset/ppp-foia>
- (2) <https://www.stlouisfed.org/publications/regional-economist/2022/jul/was-paycheck-protection-program-effective>

