

Determinants to IMF Loan Completion

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INNOVATION

What is an IMF Loan?

- When countries are in economic distress, the IMF acts as a lender of last resort.
- The IMF will only give the money to a country *if* the government / central bank sets macroeconomic targets and promises to uphold them.
- Example: In order to borrow \$12M from the IMF, country X promises to: (1) improve tax efficiency; (2) privatize national assets; (3) reduce inflation to 5% in the short-term.



Expectation



vs. Reality



Research Question:

What determines loan completion to the IMF?

Arrangement Code	Arr. No.	Review number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
AFGHANISTAN,ISLAMIC REPUBLIC OF ECF ..	675	Green	Red	Red	Red	Red	Red							
AFGHANISTAN,ISLAMIC REPUBLIC OF ECF ..	745	Green	Green	Grey										
AFGHANISTAN,ISLAMIC REPUBLIC OF PRG..	570	Green	Green	Green	Green	Yellow	Green	Red						
ALBANIA EFF 2014	709	Green	Yellow	Green	Green	Red	Green	Green	Green	Yellow	Green			
ALBANIA PRGF 2002	507	Green	Green	Green	Green	Green	Red							
ALBANIA PRGF-EFF 2006	565	Green	Green	Green	Green	Green	Green							
ANGOLA SBA 2009	623	Green	Green	Green	Green	Yellow	Green							
ANTIGUA AND BARBUDA SBA 2010	644	Green	Yellow	Green	Red	Green	Green	Yellow	Yellow	Green	Green	Red	Red	Red
ARGENTINA SBA 2003	508	Green	Green	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
	510	Green	Green	Green										
ARMENIA ECF-EFF 2010	649	Green	Green	Green	Green	Green	Green							
ARMENIA EFF 2014	710	Green	Yellow	Green	Green	Green	Red							
ARMENIA PRGF 2005	657	Green	Green	Green	Green	Green	Green							

Loan categorization:

- On-track, completed in full
- On-track, largely completed
- Off-track, delinquent
- Off-track, quickly

Data Science Process

Data Prep and Cleaning

Visualization
Feature engineering
Standardization

Define Analytical Model and Parameter Tuning

$y = B_0 + B_i X_i + e$
Randomized Search
Cross Validation Score

Model selection

KNN
Random Forest Classifier

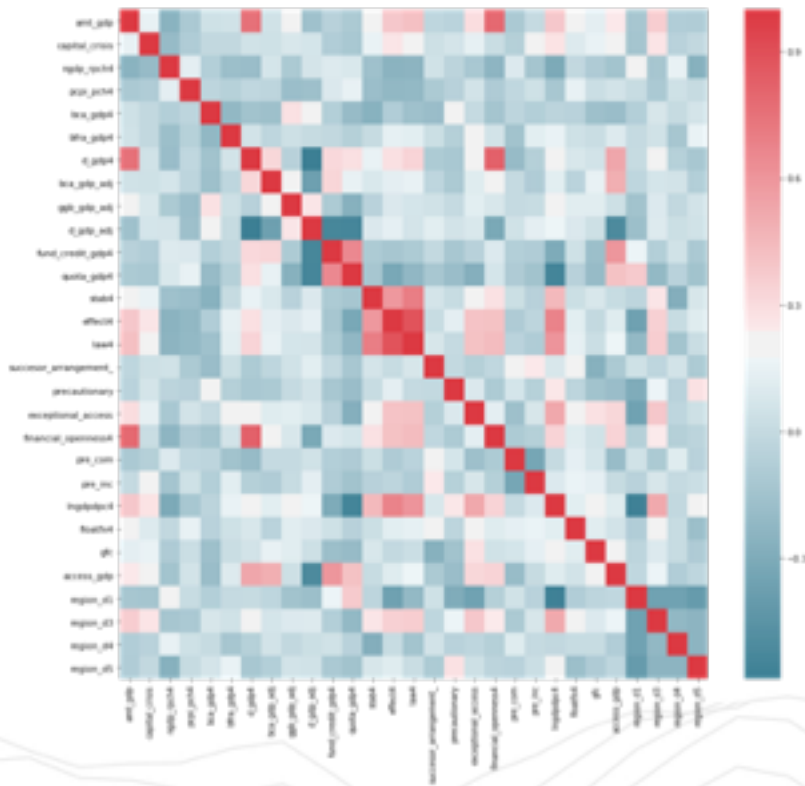
Robustness Check using a Binary model

KNN
Random Forest
Logistic Regression

Analysis of Results / Conclusion

Step 1. Data Prep and Cleaning

```
df.shape  
(79573, 490)
```



- **Collapse** data by program and year
- **Merge** y = completion score
- **Drop** null values
- **Normalize**: Standard Scaler
- **Feature engineering** (and normalize)
 - % of GDP – debt, fiscal balance, FDI
 - % change – growth rate, inflation
 - Natural log – GDP, GDP per capita

Step 2. Analytical Model and Parameter Tuning

$$\text{Status} = B_0 + B_i \text{BOPneed}_i + B_i \text{prog_strength}_i + B_i \text{capacity_repay}_i + B_i \text{prog_type}_i + B_i \text{systemic}_i + B_i \text{track_record}_i + B_i \text{other_factors}_i + B_i \text{region_dummy}_i + e$$

```
bop_need = ['amt_gdp', 'capital_crisis', 'ngdp_rpch4', 'pcpi_pch4', 'bca_gdp4', 'bfra_gdp4', 'd_gdp4']  
strength_prg = ['bca_gdp_adj', 'ggb_gdp_adj', 'd_gdp_adj']  
capacity_repay = ['fund_credit_gdp4', 'quota_gdp4', 'stab4', 'effect4', 'law4'] #eliminate acct and qual  
program_type = ['succesor_arrangement_', 'precautionary']  
systemic = ['exceptional_access', 'financial_openness4']  
track_record = ['pre_com', 'pre_inc']  
other_factors = ['lngdpdpc4', 'floatfx4', 'gfc', 'access_gdp']  
region = ['region_d1', 'region_d3', 'region_d4', 'region_d5']  
y = ['Status']
```

Step 2. Analytical Model and Parameter Tuning

KNN

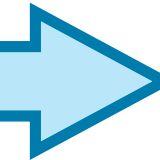
Method	Best score	Best parameter
Randomized Search	0.5833	{'weights': 'uniform', 'n_neighbors': 22, metric = 'manhattan'}
Cross Val score	0.5837	{'weights': 'distance', 'n_neighbors': 22, metric = 'manhattan'}

Random Forest Classifier

Method	Best score	Best parameter
Randomized Search	0.5555	{'n_estimators': 19, 'min_samples_leaf': 3, 'max_features': 10}

Step 3. Model Selection

Model	Accuracy Score
KNN	0.666
Random Forest	0.822 (training), 0.666 (testing)



	importance
fund_credit_gdp4	0.112202
bfra_gdp4	0.065629
ngdp_rpch4	0.065268
access_gdp	0.063356
d_gdp4	0.062603
amt_gdp	0.062393
bca_gdp_adj	0.062034
stab4	0.059985
quota_gdp4	0.053011
d_gdp_adj	0.049008
lngdpdpc4	0.048586



Step 4. Robustness using a Binary Model

Loan categorization: On-track or Off-track

KNN

Best parameters using CV:

```
k=19, weight = uniform,  
metric = manhattan
```

Accuracy score on model
(\hat{y} minus y):

```
0.6666666666666666
```

Random Forest

Best parameters using RS:

```
{'n_estimators': 13,  
'min_samples_leaf': 4,  
'max_features': 28}
```

Accuracy score:

```
0.925 (training)
```

```
0.6 (testing)
```

Logistic Regression

RMSE:

```
0.7453559924999299
```

Accuracy score:

```
0.4444444444444444
```

Step 4. Robustness using a Binary Model

	importance
stab4	0.145962
bfra_gdp4	0.106970
effect4	0.096848
pcpi_pch4	0.081845
d_gdp4	0.071730
amt_gdp	0.068462
fund_credit_gdp4	0.055074
ngdp_rpch4	0.054544
d_gdp_adj	0.046760
bca_gdp4	0.042094
financial_openness4	0.039603
quota_gdp4	0.039582

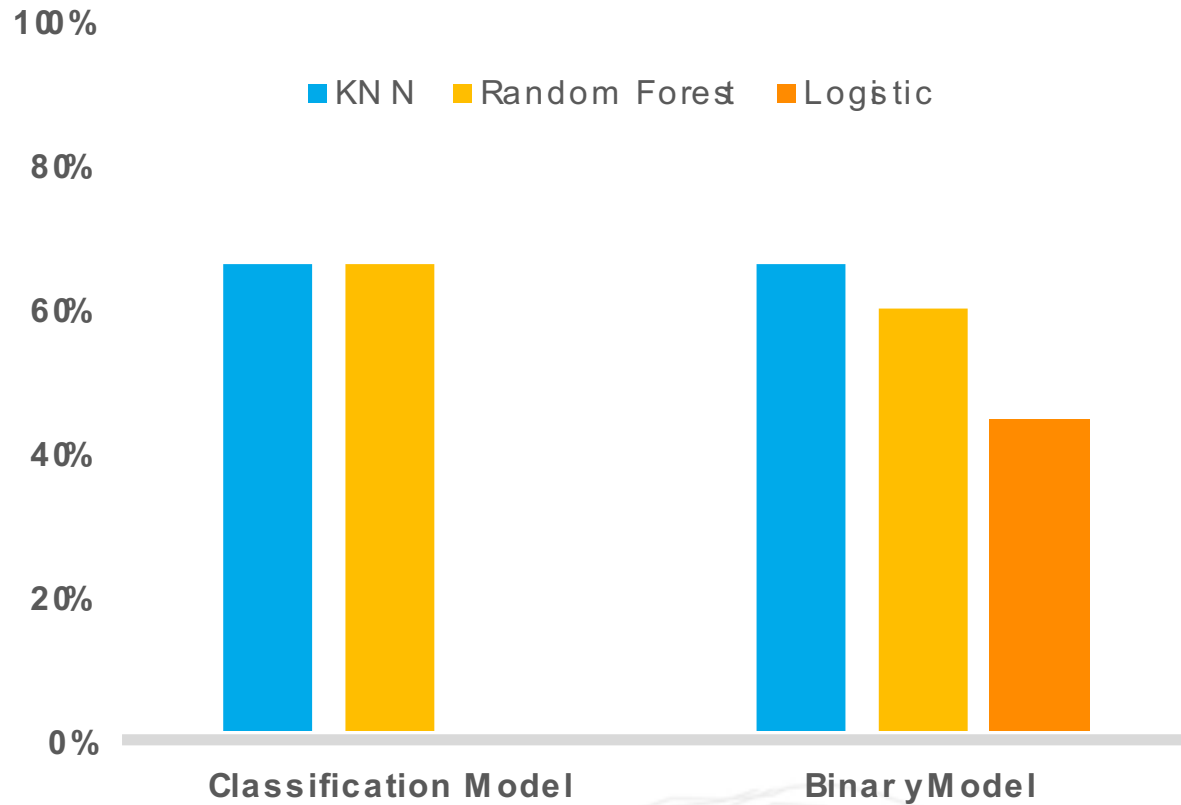
Political

Political

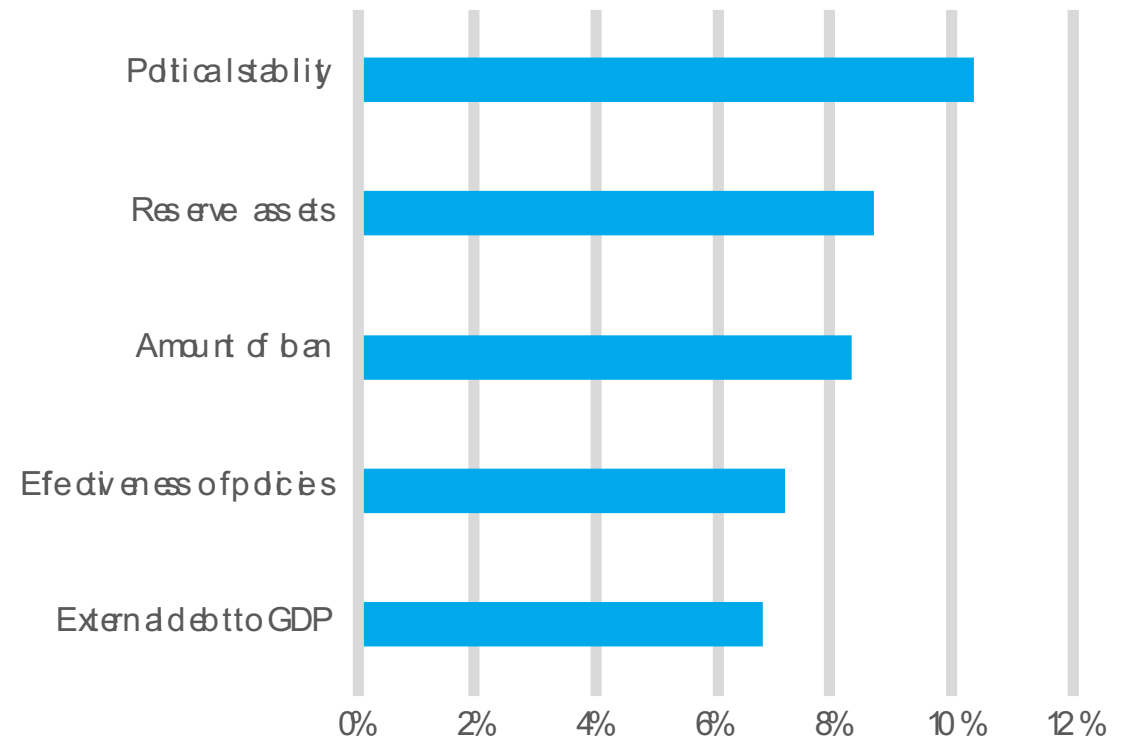


Step 5. Analysis and Conclusion

Model Performance Comparison



Top 5 determinants of loan completion



Thank you

Code: github.com/carlaint



INNOVATION