Extending a lending hand

Analyzing consumer credit data to provide financial help to consumers in need

Sam Reiff

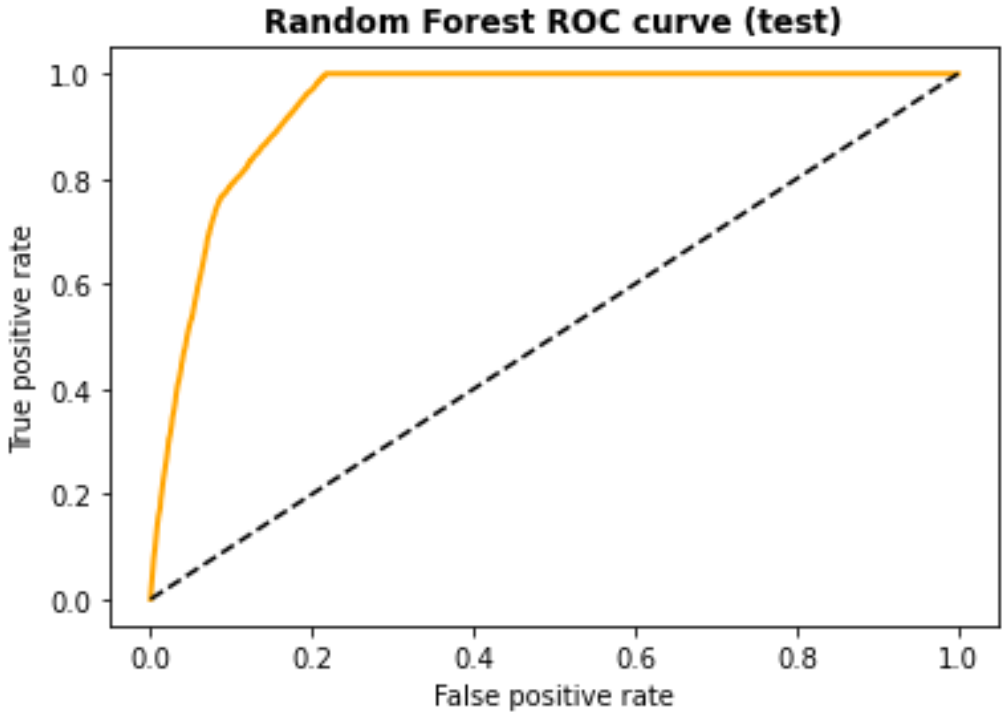
Sept 2021

Executive summary

- **Motivation:** Identify default-prone consumers for debt relief outreach

- **Objective:** Establish an effective classification algorithm with acceptable recall/F-beta

- **Conclusion:** Random Forest produces results superior to LR, in-line with KNN with better scalability
  - **Target: default / no-default**
  - Recall on test: 76%
  - F-beta on test: 71%
  - ROC on test: 94%



Random Forest has reasonable performance metrics and can scale with the business need

Methodology

Project workflow

Data acquisition

kaggle

Cleaning

pandas

NumPy

Analysis

scikit learn

Visualization

matplotlib

seaborn

- **252k observations**
  - — Target class: loan default
  - — Target distr.: ~10% default rate on sample
- **11 features**
  - — Target: default/no default
  - — Numerical: income, age, work experience, employment, time at residence
  - — Categorical: marriage status, house ownership, car ownership, profession

Methodology

Project workflow

Analysis

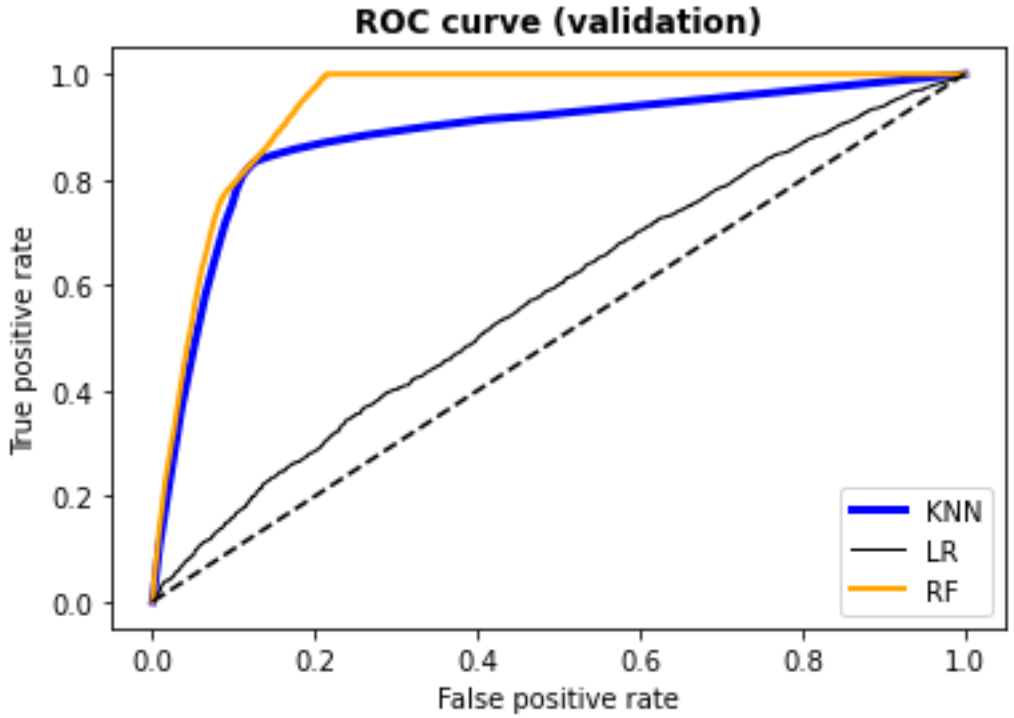
Partitioning	Training	Diagnostics	Model selection	Testing
— 60 / 20 / 20	— Regularization — Resampling	— Recall — Fβ — ROC-AUC	— Best Fβ — Interpretability — Computational cost	

Results

Validation

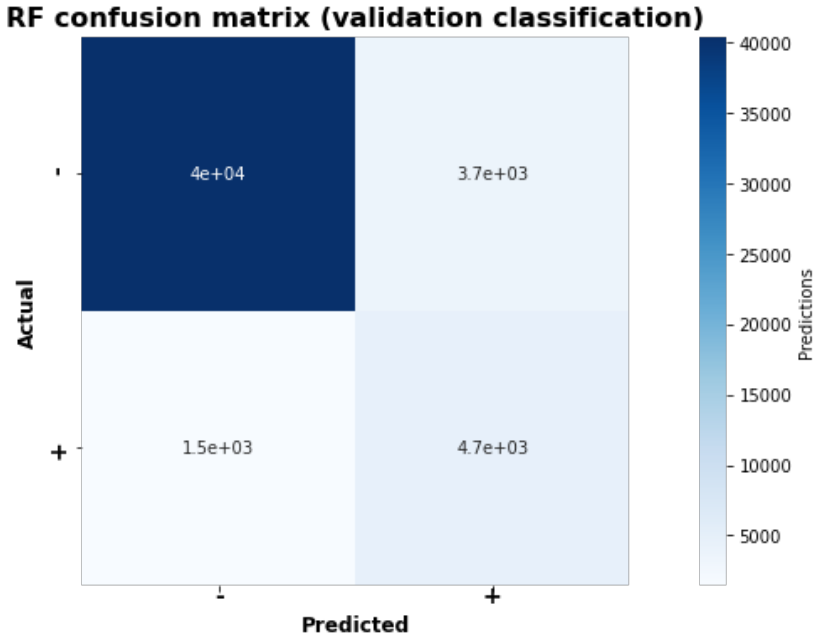
- **KNN:**
  - Recall: 0.81
  - Fβ: 0.72
  - ROC: 0.88
- **Logistic Regression:**
  - Recall: 0.03
  - Fβ: 0.04
  - ROC: 0.58
- **Random Forest:**
  - Recall: 0.76
  - **Fβ: 0.71**
  - **ROC: 0.94**

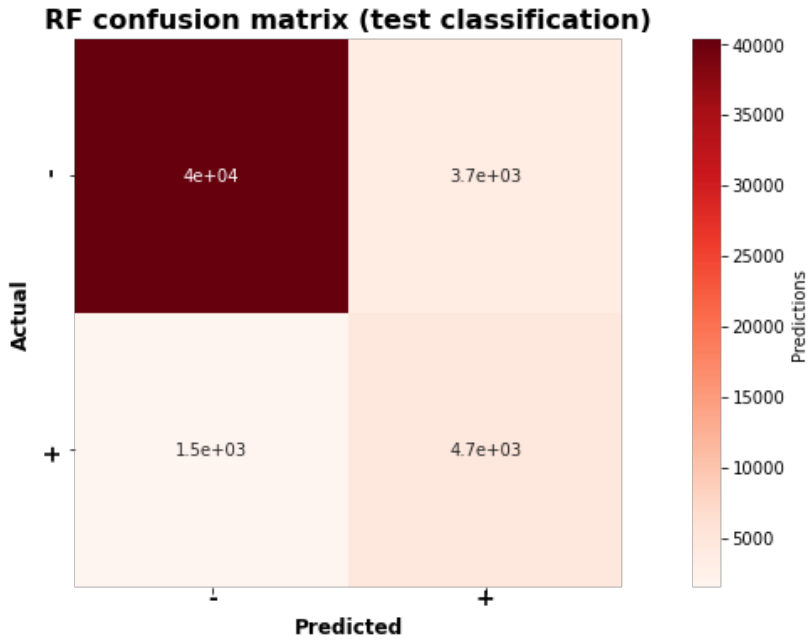
Marginally worse recall/f-beta than KNN but acceptable, and will scale better with Ks/Ms more observations



	model	recall	precision	f1	f-beta	roc
0	KNN	0.812893	0.501441	0.620266	0.723071	0.880015
1	Logistic Regression	0.032393	0.276860	0.058000	0.039341	0.577027
2	Random Forest	0.760516	0.557867	0.643617	0.709006	0.938439

Conclusions





RF results on test

```
Accuracy:  0.8956150793650793
Recall:  0.7580361426515273
Precision:  0.558435438265787
F1:  0.6431042670103793
F-beta:  0.7074626865671643
ROC:  0.9378033040255929
```

The model holds reasonably stable on test, and could be a viable tool for credit relief outreach

Further due diligence/future work

- **Parameter tuning**
  - — Decision thresholds
  - — KNN: neighbors, distance metric
  - — RF: depth, more estimators

dmlc XGBoost + scikit learn

- **More models to employ**
  - — Boosted trees
  - — Naïve Bayes

- **Incorporate more data**
  - — Monthly payment data
  - — More demographics

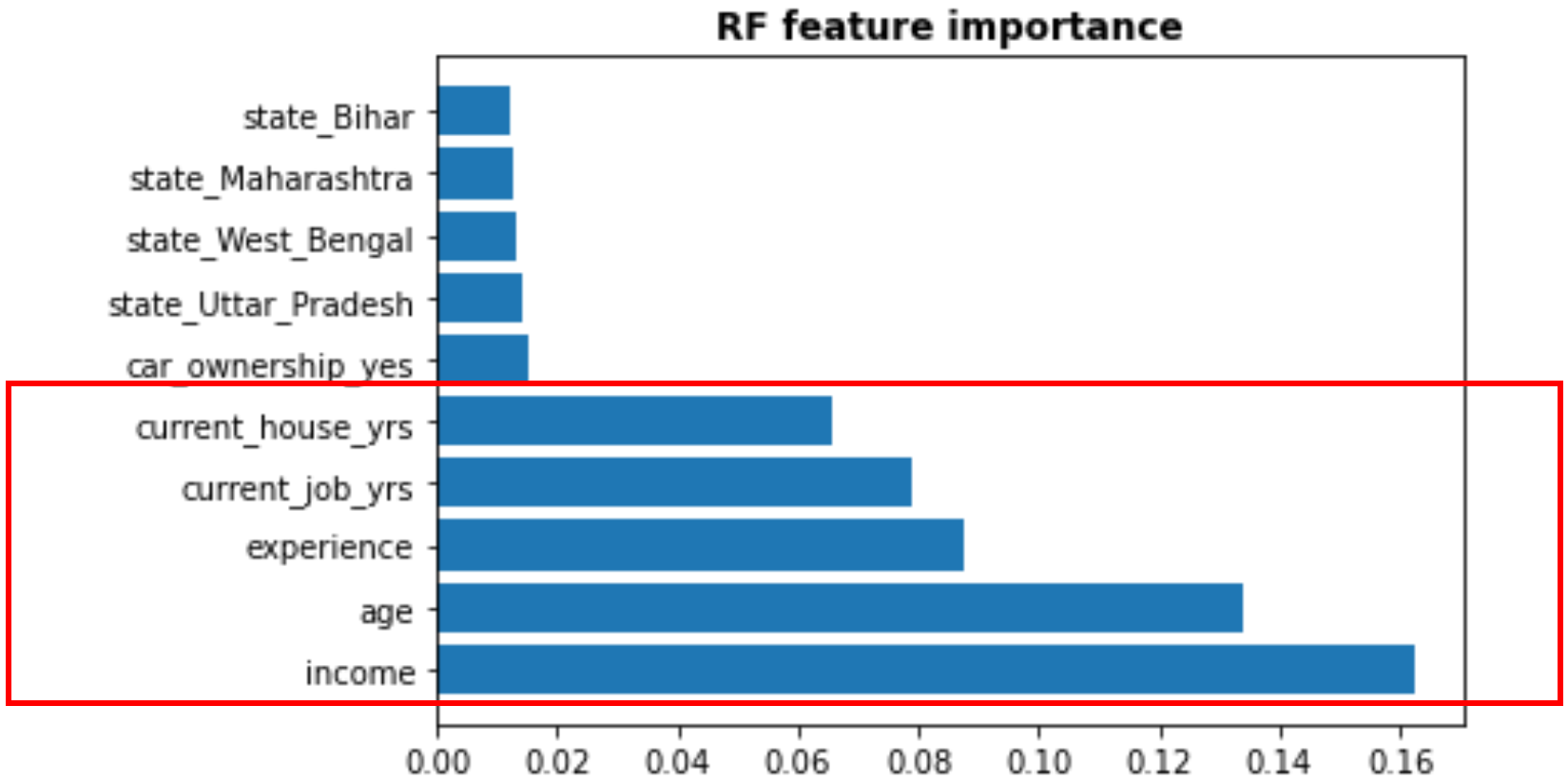
Sam Reiff

reiff.sam@gmail.com

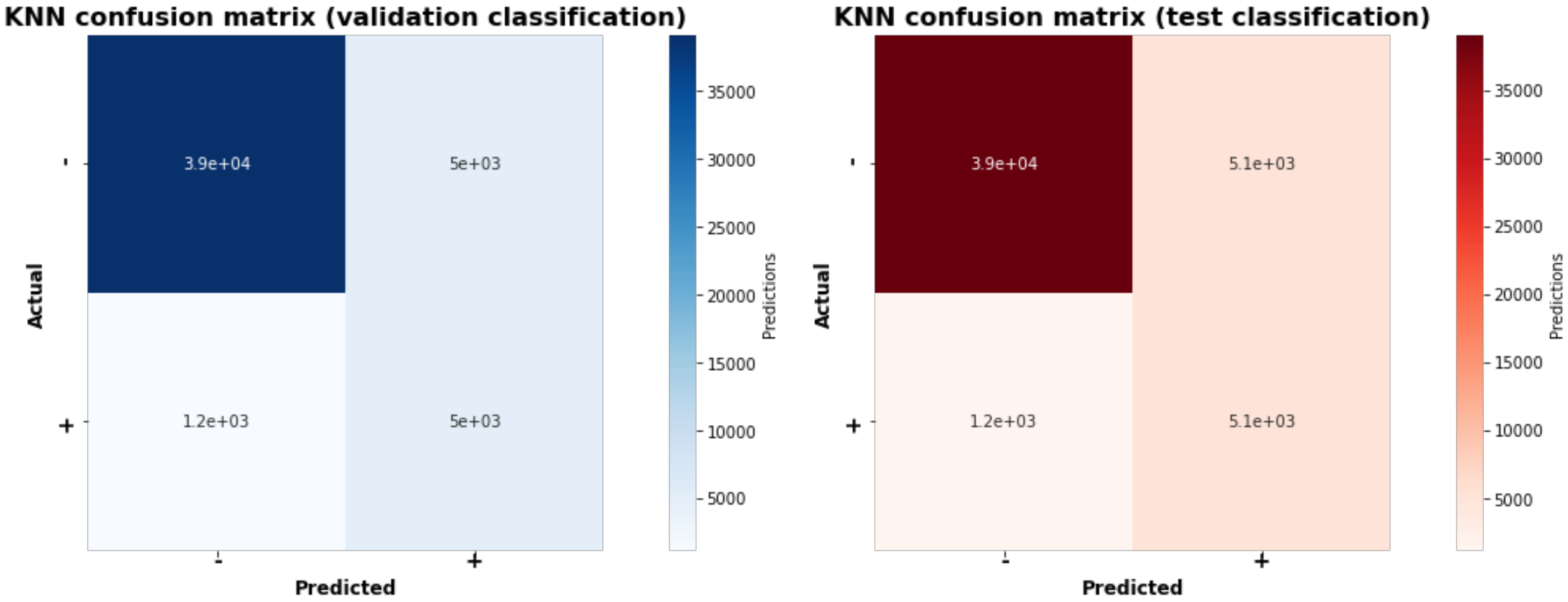
479.426.3700

Appendix

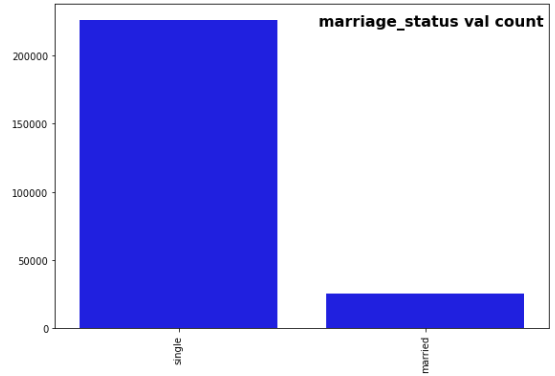
Random Forest feature importance, top ten influential feats

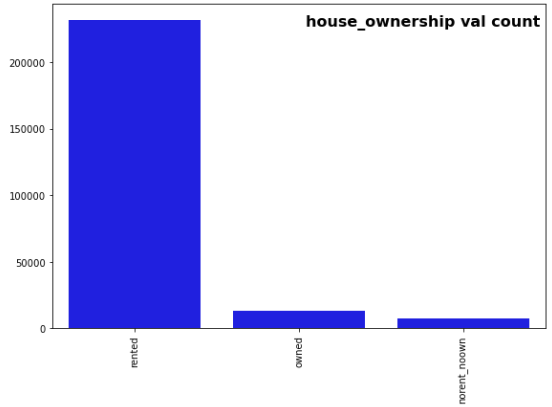


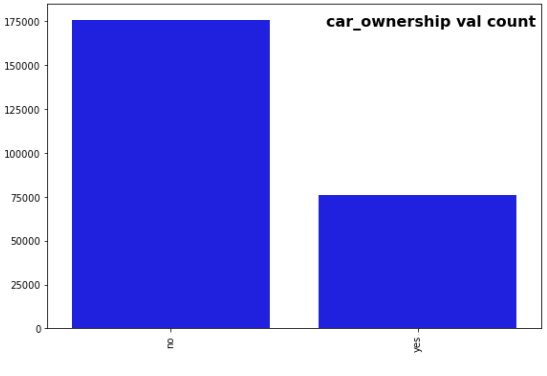
KNN confusion matrix on validation and test

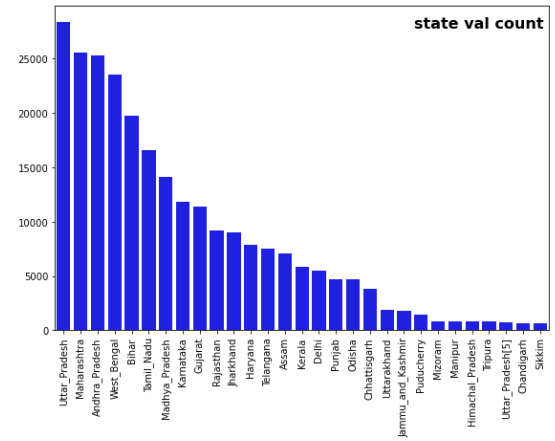


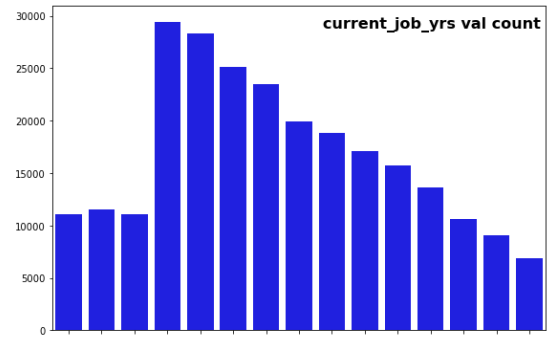
Feature value counts

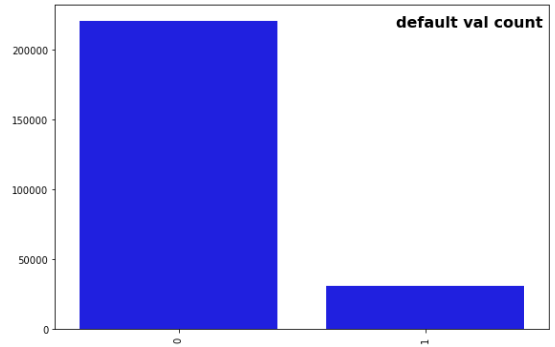




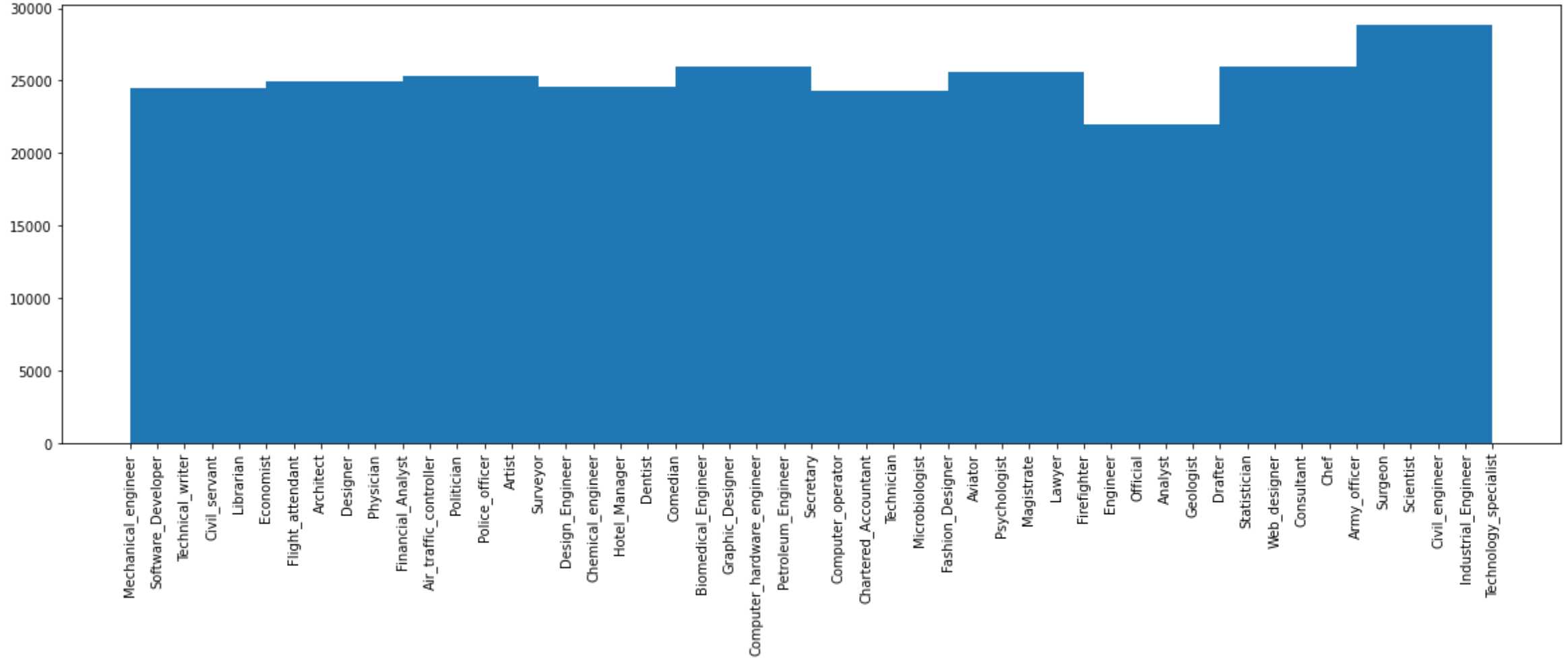








Profession feature distribution

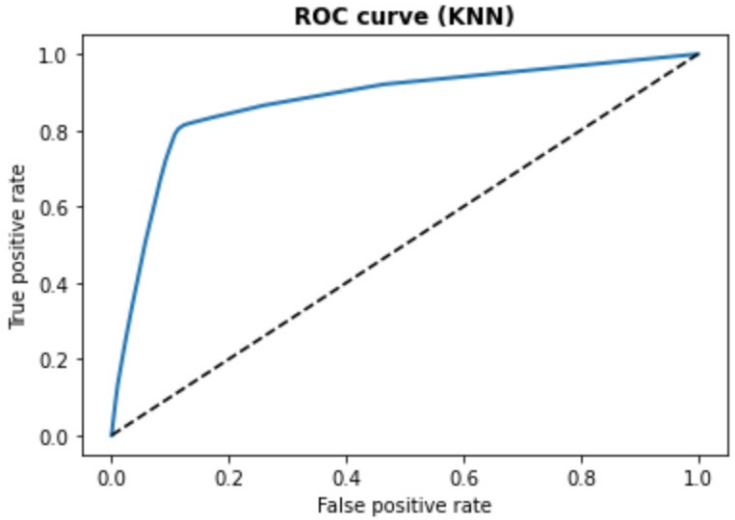


KNN validation results

KNN classification metrics with no resampling

```
KNN classification accuracy of:  0.8882539682539683
KNN classification recall of:  0.41418211120064463
KNN classification precision of:  0.5627326472520254
KNN classification F1 of:  0.47716301522465654
KNN classification F-beta (2) of:  0.4372681798073978
```

ROC AUC score = 0.8735908556312999

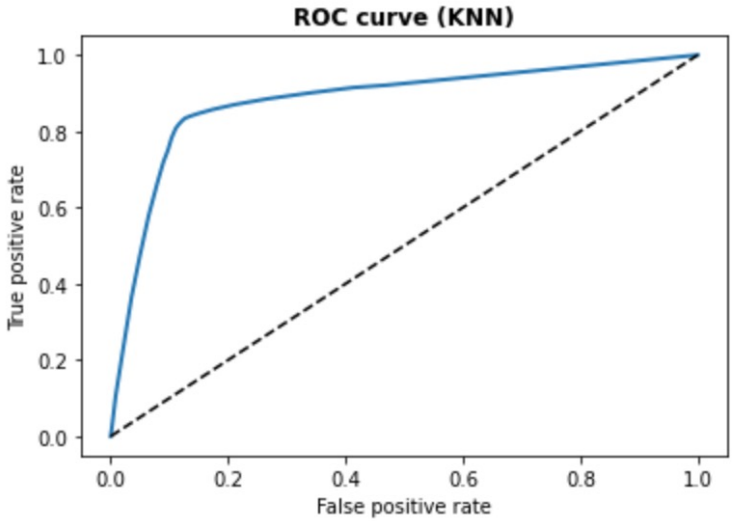


KNN validation results

KNN classification metrics with resampling

```
KNN classification accuracy of:  0.8774603174603175
KNN classification recall of:  0.8128928283642224
KNN classification precision of:  0.5014414951784472
KNN classification F1 of:  0.6202656173143137
KNN classification F-beta (2) of:  0.7230711889675736
```

```
ROC AUC score =  0.8800150931713429
```



Logistic regression validation results

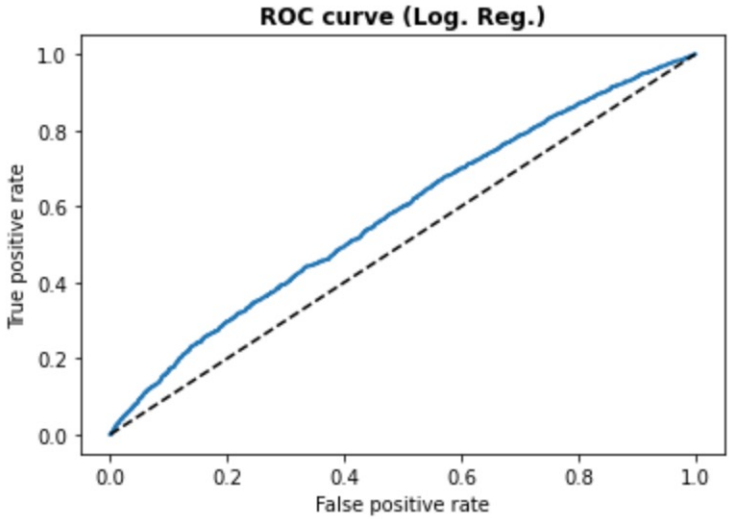
Logistic Regression classification metrics with no resampling

---

```
Logistic regression (hard preds) accuracy of:  0.8768849206349206
Logistic regression (hard preds) recall of:  0.0
Logistic regression (hard preds) precision of:  0.0
Logistic regression (hard preds) F1 of:  0.0
Logistic regression (hard preds) F-beta (2) of:  0.0
------------------------------------------------------------

Logistic regression (soft preds with 0.17 decision threshold) accuracy of:  0.8340674603174603
Logistic regression (soft preds with 0.17 decision threshold) recall of:  0.11845286059629331
Logistic regression (soft preds with 0.17 decision threshold) precision of:  0.2025909592061742
Logistic regression (soft preds with 0.17 decision threshold) F1 of:  0.149496593104851
Logistic regression (soft preds with 0.17 decision threshold) F-beta (2) of:  0.12918307086614175
Logistic regression (soft preds with 0.17 decision threshold) log loss of:  0.3689427109489983
------------------------------------------------------------

ROC AUC score =  0.5768461945124708
```



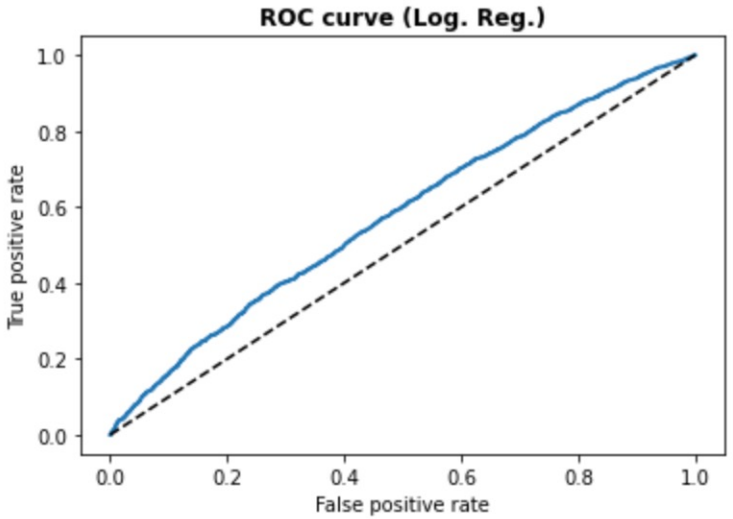
Logistic regression validation results

```
Logistic Regression classification metrics with resampling
_____________________________________________________________________________

Logistic regression (hard preds) accuracy of:  0.8704563492063492
Logistic regression (hard preds) recall of:  0.032393231265108784
Logistic regression (hard preds) precision of:  0.2768595041322314
Logistic regression (hard preds) F1 of:  0.05800028855864955
Logistic regression (hard preds) F-beta (2) of:  0.0393407969936585
------------------------------------------------------------

Logistic regression (soft preds with 0.17 decision threshold) accuracy of:  0.1252579365079365
Logistic regression (soft preds with 0.17 decision threshold) recall of:  0.9988718775181306
Logistic regression (soft preds with 0.17 decision threshold) precision of:  0.12327459326146625
Logistic regression (soft preds with 0.17 decision threshold) F1 of:  0.21946426358373317
Logistic regression (soft preds with 0.17 decision threshold) F-beta (2) of:  0.4126607899011958
Logistic regression (soft preds with 0.17 decision threshold) log loss of:  0.5096175315499527
------------------------------------------------------------

ROC AUC score =  0.5770271739987578
```

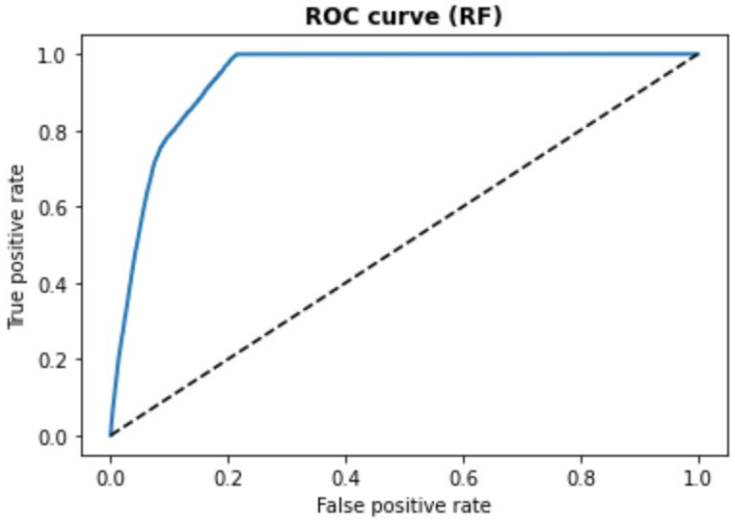


Random forest validation results

Random Forest classification metrics with no resampling

```
Random forest classification accuracy of:  0.8998015873015873
Random forest classification recall of:  0.5381144238517325
Random forest classification precision of:  0.6045627376425855
Random forest classification F1 of:  0.569406548431105
Random forest classification (hard preds) F-beta (2) of:  0.5502092739676366
```

ROC AUC score = 0.9380972685425798



Random forest validation results

Random Forest classification metrics with resampling

```
Random forest classification accuracy of:  0.8963095238095238
Random forest classification recall of:  0.7605157131345689
Random forest classification precision of:  0.5578673602080624
Random forest classification F1 of:  0.6436170212765957
Random forest classification F-beta (2) of:  0.7090056792571892
```

ROC AUC score = 0.9384385951973339