Machine Learning Project: Credit Risk

FANG HSUAN (ADAM) TSENG

Agenda

1. Introduction
2. Data Source and Review
3. Explanatory Analysis
4. Model Result
5. Conclusion

Introduction

The focus of this project is to try find different machine learnings models – other than logistic regression model - that can make good predictions with binary outcome.

The motivation is based on that realizing the wide application of logistic regression in industry and the trend moving towards machine learning, I want to research on different models that can make binary binary predictions and compare them to see which one should be applied under different circumstances.

Data Source and Review

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Data Source and Review

- Data Source: Lending Club Official Website
- Dates of Data: 2007 – 2018Q2
- Total number of observations: 843,934
- Independent Variables: 151
- Default Percentage: 0.2024116

Explanatory Analysis

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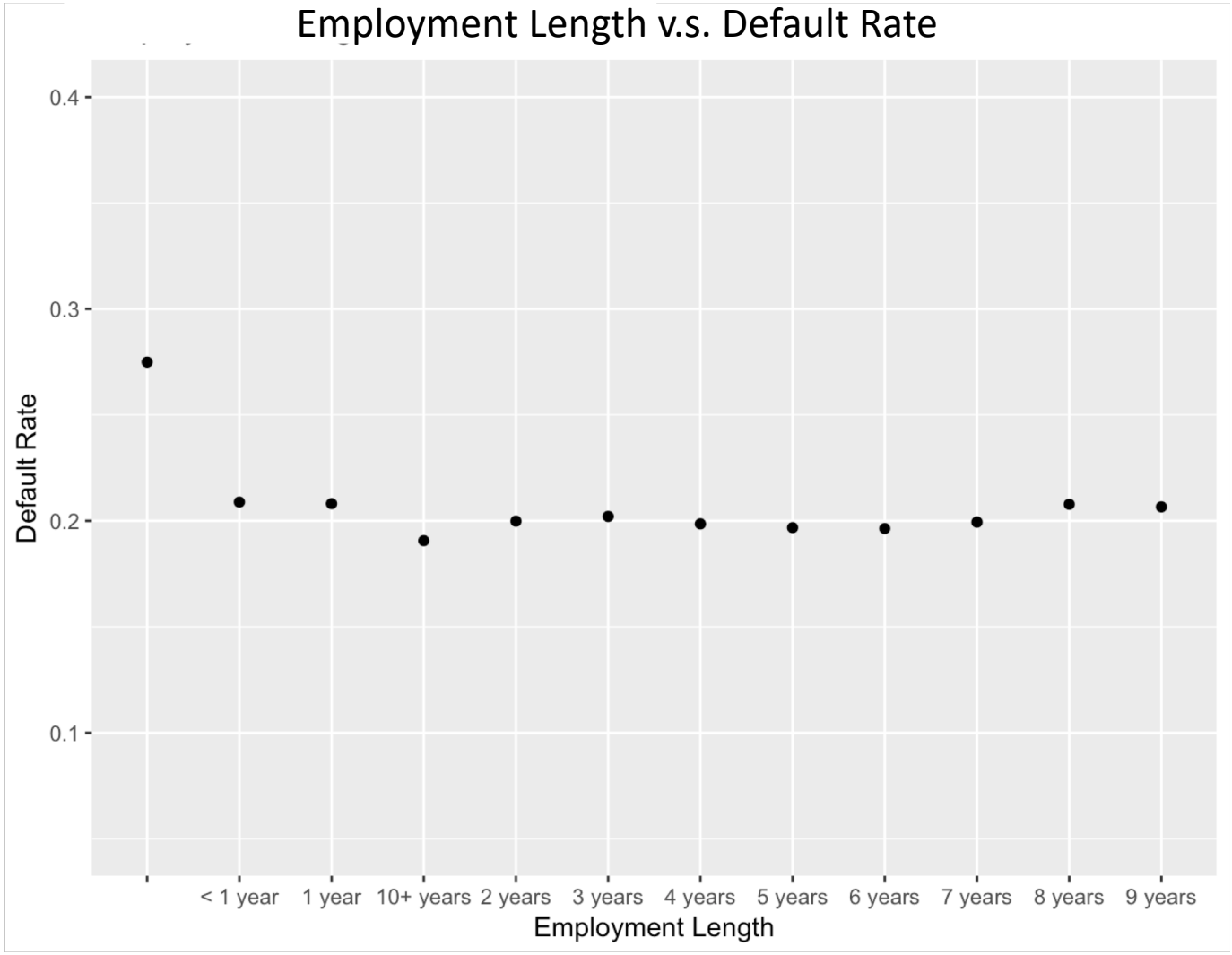
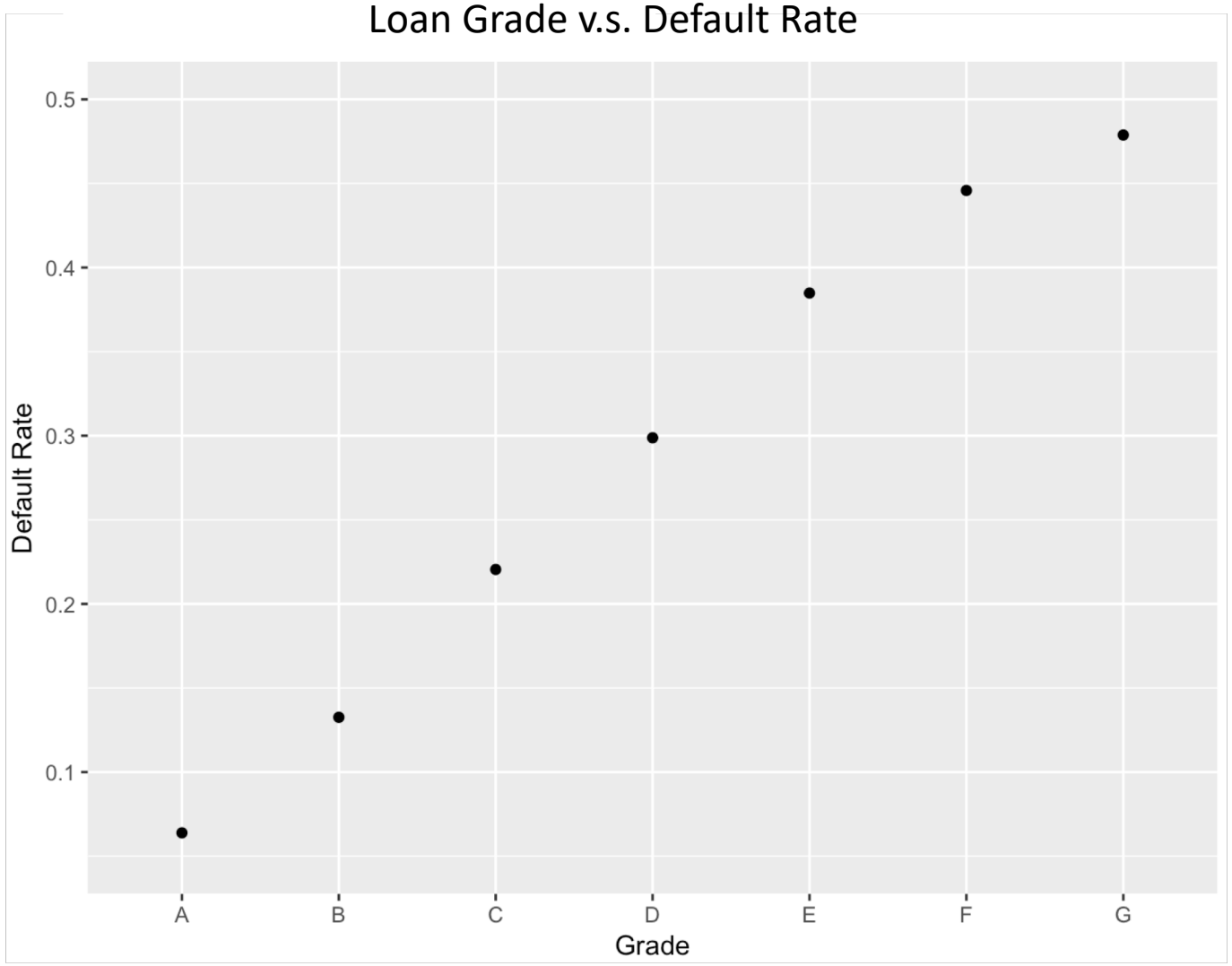
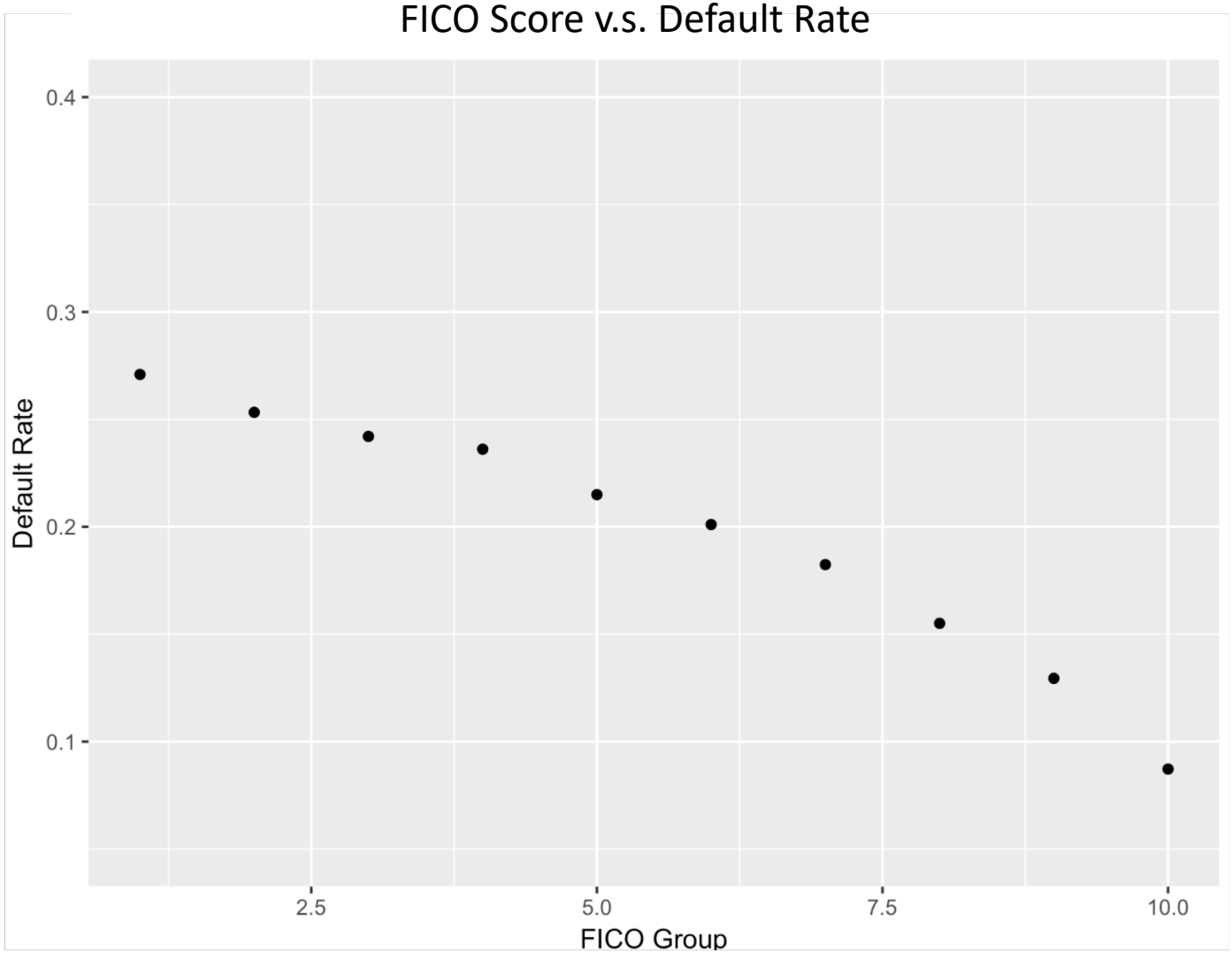

Employment Length v.s. Default Rate
0.4
0.3
0.2
0.1
Default Rate
< 1 year
1 year
10+ years
2 years
3 years
4 years
5 years
6 years
7 years
8 years
9 years
Employment Length

Loan Grade v.s. Default Rate



FICO Score v.s. Default Rate



Model Result

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Logistic Regression – Simple Model

Logistic Regression Full Model

Logit Regression Results

Dep. Variable:	loan_status	No. Observations:	590753
Model:	Logit	Df Residuals:	590693
Method:	MLE	Df Model:	59
Date:	Tue, 13 Nov 2018	Pseudo R-squ.:	0.9841
Time:	23:48:18	Log-Likelihood:	-4739.0
converged:	True	LL-Null:	-2.9737e+05
		LLR p-value:	0.000

	coef	std err	z	P>|z|	[0.025	0.975]
loan_amnt	0.0032	4.53e-05	70.050	0.000	0.003	0.003
int_rate	-0.0632	0.010	-6.020	0.000	-0.084	-0.043
annual_inc	-2.187e-06	4.21e-07	-5.197	0.000	-3.01e-06	-1.36e-06
dti	0.0127	0.001	9.364	0.000	0.010	0.015
delinq_2yrs	0.1573	0.049	3.240	0.001	0.062	0.252
inq_last_6mths	0.0475	0.038	1.267	0.205	-0.026	0.121
open_acc	-0.6462	0.057	-11.372	0.000	-0.758	-0.535
pub_rec	0.0551	0.139	0.396	0.692	-0.218	0.328
revol_bal	-2.494e-05	4.22e-06	-5.905	0.000	-3.32e-05	-1.67e-05
revol_util	-0.0071	0.002	-3.251	0.001	-0.011	-0.003
total_acc	-0.3563	0.022	-16.355	0.000	-0.399	-0.314
total_pymnt	-0.0035	4.75e-05	-73.504	0.000	-0.004	-0.003
total_rec_int	0.0039	7.33e-05	52.836	0.000	0.004	0.004
total_rec_late_fee	0.0389	0.002	16.527	0.000	0.034	0.044
recoveries	120.3509	5.377	22.384	0.000	109.813	130.889
collection_recovery_fee	1.9541	10.707	0.183	0.855	-19.031	22.939
last_pymnt_amnt	-0.0007	2.7e-05	-26.027	0.000	-0.001	-0.001
last_fico_range_high	-0.0142	0.001	-27.813	0.000	-0.015	-0.013

Logistic Regression Full Model

last_fico_range_low	-0.0012	0.000	-4.396	0.000	-0.002	-0.001
collections_12_mths_ex_med	0.1187	0.123	0.963	0.335	-0.123	0.360
acc_now_delinq	-0.5231	1.102	-0.475	0.635	-2.682	1.636
tot_coll_amt	-1.647e-05	2.47e-05	-0.667	0.505	-6.49e-05	3.19e-05
tot_cur_bal	-3.562e-06	7.09e-07	-5.025	0.000	-4.95e-06	-2.17e-06
total_rev_hi_lim	2.349e-06	9.49e-07	2.477	0.013	4.9e-07	4.21e-06
acc_open_past_24mths	0.0239	0.017	1.437	0.151	-0.009	0.057
avg_cur_bal	1.92e-05	4.37e-06	4.391	0.000	1.06e-05	2.78e-05
bc_open_to_buy	-2.902e-06	6.77e-06	-0.429	0.668	-1.62e-05	1.04e-05
bc_util	0.0122	0.002	5.165	0.000	0.008	0.017
chargeoff_within_12_mths	0.1567	0.264	0.593	0.553	-0.361	0.675
delinq_amnt	7.706e-06	4.81e-05	0.160	0.873	-8.66e-05	0.000
mo_sin_old_il_acct	0.0010	0.001	1.580	0.114	-0.000	0.002
mo_sin_old_rev_tl_op	0.0020	0.000	5.277	0.000	0.001	0.003
mo_sin_rcnt_rev_tl_op	-7.358e-05	0.003	-0.024	0.981	-0.006	0.006
mo_sin_rcnt_tl	0.0004	0.005	0.076	0.940	-0.010	0.010
mort_acc	0.3947	0.031	12.818	0.000	0.334	0.455
mths_since_recent_bc	0.0026	0.001	2.113	0.035	0.000	0.005
mths_since_recent_inq	0.0159	0.006	2.591	0.010	0.004	0.028
num_accts_ever_120_pd	0.1775	0.027	6.597	0.000	0.125	0.230
num_actv_bc_tl	-0.0934	0.038	-2.433	0.015	-0.169	-0.018
num_actv_rev_tl	0.0266	0.024	1.119	0.263	-0.020	0.073
num_bc_sats	0.1252	0.027	4.580	0.000	0.072	0.179
num_bc_tl	-0.0407	0.018	-2.244	0.025	-0.076	-0.005
num_il_tl	0.3399	0.023	15.050	0.000	0.296	0.384
num_op_rev_tl	-0.0772	0.024	-3.205	0.001	-0.124	-0.030

Logistic Regression Full Model

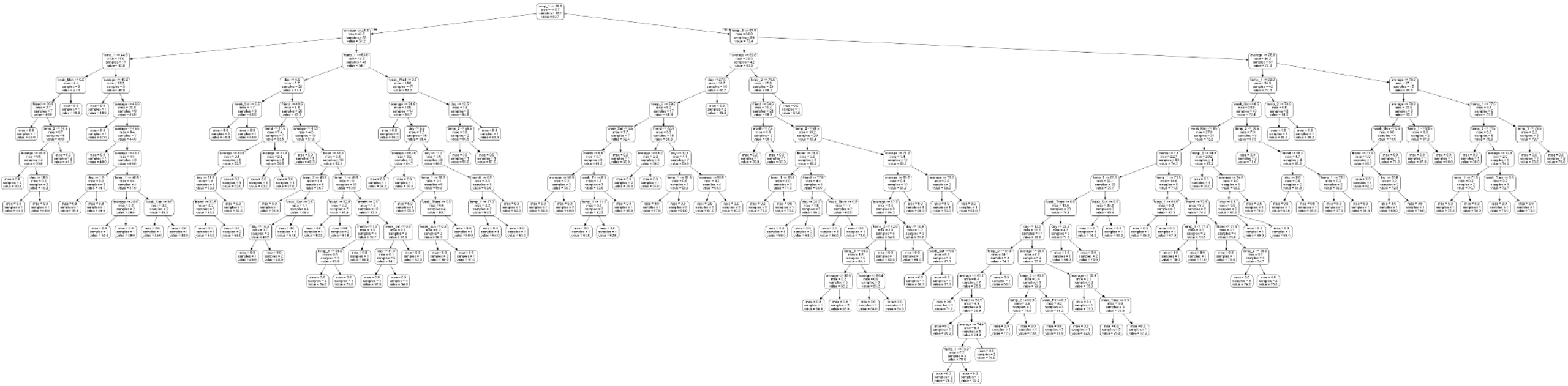
num_rev_accts	0.3870	0.025	15.680	0.000	0.339	0.435
num_sats	0.6898	0.057	12.104	0.000	0.578	0.802
num_tl_120dpd_2m	1.2717	1.280	0.994	0.320	-1.236	3.780
num_tl_30dpd	1.0913	1.183	0.922	0.356	-1.228	3.411
num_tl_90g_dpd_24m	-0.1670	0.078	-2.142	0.032	-0.320	-0.014
num_tl_op_past_12m	0.0126	0.027	0.463	0.643	-0.041	0.066
pct_tl_nvr_dlq	0.0542	0.004	13.340	0.000	0.046	0.062
percent_bc_gt_75	-0.0049	0.002	-3.135	0.002	-0.008	-0.002
pub_rec_bankruptcies	0.0005	0.157	0.003	0.997	-0.308	0.309
tax_liens	-0.0087	0.150	-0.058	0.953	-0.302	0.284
tot_hi_cred_lim	9.915e-07	2.64e-07	3.760	0.000	4.75e-07	1.51e-06
total_bal_ex_mort	1.852e-05	3.17e-06	5.845	0.000	1.23e-05	2.47e-05
total_bc_limit	1.253e-05	4.82e-06	2.601	0.009	3.09e-06	2.2e-05
total_il_high_credit_limit	-1.682e-05	3.33e-06	-5.044	0.000	-2.34e-05	-1.03e-05
fico_average	0.0014	0.001	1.866	0.062	-7.21e-05	0.003
fico_group	-0.0873	0.016	-5.376	0.000	-0.119	-0.055

Logistic Regression – Complex Model

Logistic Regression – Complex Model Confusion Matrix

prediction	0	1
y_test		
0	201846	268
1	1265	49802

Random Forest Model– Decision Process



Random Forest Model– Confusion Matrix

prediction	0	1
y_test		
0	202058	7
1	241	50875

Conclusion

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Conclusion

1. We see huge improving in using random forest model.
2. We can continue to work on different machine learning models on different data set and different scenarios that need to predict binary outcomes.