SCORECARD

Contents

PEAKS2TAILS

Default Definition and Data Preparation

Following Basel II principles

"A default is considered to have occurred when:
the banking institution considers that an obligor is unlikely to repay in full its credit obligations to the banking group,
without recourse by the banking institution to actions such as realising security;
or the obligor has breached its contractual repayment schedule and is past due for more than 90 days on any material credit obligation to the banking group"

From an IFRS 9 perspective, Section B5.5.37 of IASB (2014) does not directly define default, but requires entities to align with internal credit risk management

From a FASB (2016) standpoint,

"Estimating expected credit losses is highly judgmental and generally will require an entity to make specific judgments.
Those judgments may include any of the following: a. The definition of default for default-based statistics ..."

As standard practice, one may consider the following definition:

Quantitative indicators.

90 days past due (DPD) or 3 months in arrears (MIA) are common default triggers. A counter is put in place to account for delays or arrears balance

Qualitative indicators.

Bankruptcy
Balance due after maturity/expiry
Others (Forbearance)

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PEAKS2TAILS

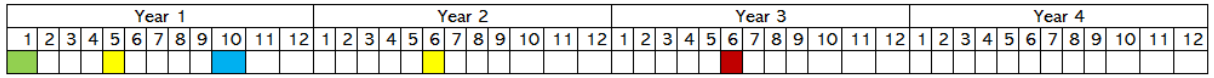
Formula Bar

Data Preparation

To build a PD base, we need an account to be non-defaulted /up-to-date/ Current status in the beginning of the year and default at least once within the year.

Let's consider the following account. The time points correspond to month beginnings.

up-to-date Default Cure Write-off



Under Instant Cure method

✓ for Y1 : Account is up-to-date in the beginning and has defaulted in the year.
So, it will enter in PD base for year 1.

✓ for Y2 : Since, account cures instantly, it will be in up-to-date status in the beginning of year 2.
The Account does default in year 2 as well.
So, it will enter in PD base for year 2.

✗ for Y3 : Since the account does not cure in year 2, the status of the account in the beginning of year 3 will be Defaulted.
So, it will not enter in the PD base for year 3.

✗ for Y4 : Since, the account is already written off in year 3, it won't enter in PD base for year 4.

Under Probationary period method

✓ for Y1 : Account is up-to-date in the beginning and has defaulted in the year.
So, it will enter in PD base for year 1.

✗ for Y2 : Since, account cures on month 10, it will be under probation till month 3 of Year2 and will be in Defaulted status in this pe
Therefore, the Account Status in the beginning of year 2 will be Defaulted.
So, it will not enter in PD base for year 2.

✗ for Y3 : Since the account does not cure in year 2, the status of the account in the beginning of year 3 will be Defaulted.
So, it will not enter in the PD base for year 3.

✗ for Y4 : Since, the account is already written off in year 3, it won't enter in PD base for year 4.

PEAKS2TAILS

Default Definition (Bad flag creation) and Data Preparation

Bad Flag creation

Default Event will be set to 1 if one or more of the following three conditions is TRUE.
Account is at least in 3m arrears (arrears_event = 1)
Account is declared bankrupt (bankruptcy_event =1)
Account has residual outstanding balance after maturity (term_expiry_event = 1)

Train , Test split

The observations are randomly split based on a desired ratio (Training Set & Testing Set)
We will use rand() function to categorize observations into training and testing (it will be an approximate split)
It is important to ensure default rates are comparable between Training and Testing sets.

Sl	id	vintage_ye	monthly_installmer	loan_balan	bureau_sco	num_bankrupt_i	time_since_bankru	num_c	time_since_c	ccj_amou	num_bankru	num_i	min_months_since_bankru	pl_fl	regi	ltv	arrears_montl	origination_da	ma
1	6670001	2005	746.7	131304.44	541	0	0	0	0	0	0	0	0	1	r_a	0.7586	0	14-09-2005	3
2	9131199	2006	887.4	115486.51	441	0	0	0	0	0	0	0	0	1	r_b	0.6973	0	20-01-2006	3
3	4963167	2004	1008.5	128381.73	282	0	0	1	36	459	0	0	0	0	r_c	0.6959	2.188230045	21-12-2004	3
4	3918582	2005	458.23	35482.96	461	0	0	0	0	0	0	0	0	0	r_d	0.1099	0	21-06-2005	3
5	5949777	2006	431.2	77086.31	466	0	0	0	0	0	0	0	0	1	r_e	0.3776	0	19-07-2006	3
6	1868971	2005	228.86	40380.63	470	0	0	0	0	0	0	0	0	0	r_c	0.2192	0	13-09-2005	3
7	8656464	2004	370.21	44978.8	515	0	0	0	0	0	0	0	0	1	r_c	0.4727	0	29-07-2004	3
8	2347301	2005	1665.05	440127.97	487	0	0	0	0	0	0	0	0	0	r_f	0.5215	0	27-09-2005	3
9	7372573	2007	397.1	100918.22	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	r_g	0.9995	1.775698816	31-01-2007	3
10	7843579	2004	615.51	77337.43	307	0	0	0	0	0	0	0	0	0	r_h	0.4302	0	16-12-2004	3
11	4066165	2005	471.44	125415.07	367	0	0	0	0	0	0	0	0	0	r_c	0.8256	0.607924656	06-10-2005	3
12	3188782	2007	334.7	83965.1	328	0	0	0	0	0	0	0	0	1	r_a	1.078	0	23-04-2007	3
13	3581494	2006	771.3	194978.99	518	0	0	0	0	0	0	0	0	1	r_h	0.862	0	22-06-2006	3
14	8028525	2005	363	56273.26	428	0	0	0	0	0	0	0	0	1	r_a	0.6885	0	14-12-2005	3
15	5253590	2003	321.16	80971.8	472	0	0	0	0	0	0	0	0	1	r_d	0.7259	0	29-10-2003	3
16	3510252	2007	437.9	59906.35	427	0	0	0	0	0	0	0	0	1	r_i	0.709	0	06-03-2007	3
17	7042373	2006	189.7	191292.23	430	0	0	0	0	0	0	0	0	0	r_d	0.8023	0	16-01-2006	3
18	6838892	2006	372.32	98419.41	426	0	0	0	0	0	0	0	0	0	r_e	0.2471	0	24-04-2006	3
19	3691330	2007	976.02	257951.62	458	0	0	0	0	0	0	0	0	0	r_a	0.8819	0	07-03-2007	3
20	1108986	2003	370	13120.04	537	0	0	0	0	0	0	0	0	0	r_g	0.1028	0	14-11-2003	3
21	1567700	2006	1002.99	113546.28	180	0	0	0	0	0	0	0	0	1	r_e	0.3749	0	24-04-2006	3
22	8007790	2005	777.2	119226.81	494	0	0	0	0	0	0	0	0	1	r_g	0.7808	0	16-05-2005	3
23	4149143	2005	527.46	139325.95	365	1	56	1	56	0	0	1	0	0	r_d	0.6523	0	25-04-2005	3
24	1848036	2006	505.7	127972.39	502	0	0	0	0	0	0	0	0	1	r_d	0.6869	0	25-05-2006	3
25	3966099	2006	1286.8	340015.6	378	0	0	0	0	0	0	0	0	0	r_l	0.7559	0	20-12-2006	3
26	8534650	2007	574.11	94911.49	444	0	0	0	0	0	0	0	0	0	r_d	0.2331	0	24-05-2007	3
27	8452715	2006	762.84	104257.5	417	0	0	0	0	0	0	0	0	0	r_d	0.512	0	09-11-2006	3
28	4093539	2007	388.9	85946.99	213	0	0	0	0	0	0	0	0	1	r_h	0.8805	0	22-03-2007	3
29	3337583	2006	591.27	164732.04	494	0	0	0	0	0	0	0	0	0	r_b	0.5028	0	21-11-2006	3
30	8033354	2006	565.4	139603.15	160	0	0	0	0	0	0	0	0	1	r_d	0.7772	0	08-05-2006	3
31	1832358	2006	761.06	188346.73	278	0	0	0	0	0	0	0	0	0	r_e	0.2454	0	02-11-2006	3
32	1909666	2004	402.66	57664.72	363	0	0	0	0	0	0	0	0	1	r_c	0.6812	0	05-04-2004	3
33	8438164	2005	152.21	16658.53	539	0	0	0	0	0	0	0	0	0	r_i	0.1736	0	31-08-2005	3
34	9023854	2007	410.6	88083.64	227	0	0	0	0	0	0	0	0	0	r_d	0.2409	0	04-04-2007	3
35	5252710	2006	218.2	125401.41	406	0	0	0	0	0	0	0	0	0	r_h	0.9391	0	23-02-2006	2
36	2425429	2005	226	29211.8	469	0	0	0	0	0	0	0	0	0	r_g	0.4817	0	27-10-2005	3
37	7134595	2007	721.74	99138.37	119	0	0	0	0	0	0	0	0	1	r_e	0.1854	0	22-05-2007	3
38	6063761	2005	641.37	81090.98	518	0	0	0	0	0	0	0	0	0	r_g	0.6634	0	30-03-2005	3
39	5705263	2005	551.16	95579.7	561	0	0	0	0	0	0	0	0	0	r_e	0.276	0	20-06-2005	3
40	5130189	2002	179.2	13311.42	361	0	0	0	0	0	0	0	0	0	r_m	0.1167	0	19-12-2002	3
41	7172370	2005	771.56	172139.71	514	0	0	0	0	0	0	0	0	0	r_b	0.8239	0	10-08-2005	3
42	2451709	2006	445.4	79204.01	473	0	0	0	0	0	0	0	0	1	r_c	0.8025	0	18-07-2006	3

Training Set

Gross Default rate 5.16%

SL	Defa	id	vintage_ye	monthly_installme	loan_balan	bureau_sco	num_bankrupt_i	time_since_bankru	num_	time_since_	ccj_amou	num_bankru	num_i	min_months_since_bankru	pl_fl	regi
4	0	3918582	2005	458.23	35482.96	461	0	0	0	0	0	0	0	0	0	r_d
6	1	1868971	2005	228.86	40380.63	470	0	0	0	0	0	0	0	0	0	r_c
7	0	8656464	2004	370.21	44978.8	515	0	0	0	0	0	0	0	0	1	r_c
8	0	2347301	2005	1665.05	440127.97	487	0	0	0	0	0	0	0	0	0	r_f
9	1	7372573	2007	397.1	100918.22	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	r_g
10	0	7843579	2004	615.51	77337.43	307	0	0	0	0	0	0	0	0	0	r_h
12	0	3188782	2007	334.7	83965.1	328	0	0	0	0	0	0	0	0	1	r_a
13	0	3581494	2006	771.3	194978.99	518	0	0	0	0	0	0	0	0	1	r_h
14	0	8028525	2005	363	56273.26	428	0	0	0	0	0	0	0	0	1	r_a
15	0	5253590	2003	321.16	80971.8	472	0	0	0	0	0	0	0	0	1	r_d
16	0	3510252	2007	437.9	59906.35	427	0	0	0	0	0	0	0	0	1	r_i
17	0	7042373	2006	189.7	191292.23	430	0	0	0	0	0	0	0	0	0	r_d
18	0	6838892	2006	372.32	98419.41	426	0	0	0	0	0	0	0	0	0	r_e
20	0	1108986	2003	370	13120.04	537	0	0	0	0	0	0	0	0	0	r_g
21	0	1567700	2006	1002.99	113546.28	180	0	0	0	0	0	0	0	0	1	r_e
22	0	8007790	2005	777.2	119226.81	494	0	0	0	0	0	0	0	0	1	r_g
25	0	3966099	2006	1286.8	340015.6	378	0	0	0	0	0	0	0	0	0	r_l
26	0	8534650	2007	574.11	94911.49	444	0	0	0	0	0	0	0	0	0	r_d
28	0	4093539	2007	388.9	85946.99	213	0	0	0	0	0	0	0	0	1	r_h
29	0	3337583	2006	591.27	164732.04	494	0	0	0	0	0	0	0	0	0	r_b
31	0	1832358	2006	761.06	188346.73	278	0	0	0	0	0	0	0	0	0	r_e
32	0	1909666	2004	402.66	57664.72	363	0	0	0	0	0	0	0	0	1	r_c
33	0	8438164	2005	152.21	16658.53	539	0	0	0	0	0	0	0	0	0	r_i
35	1	5252710	2006	218.2	125401.41	406	0	0	0	0	0	0	0	0	0	r_h
37	0	7134595	2007	721.74	99138.37	119	0	0	0	0	0	0	0	0	1	r_e
38	0	6063761	2005	641.37	81090.98	518	0	0	0	0	0	0	0	0	0	r_g
40	0	5130189	2002	179.2	13311.42	361	0	0	0	0	0	0	0	0	0	r_m
41	0	7172370	2005	771.56	172139.71	514	0	0	0	0	0	0	0	0	0	r_b
42	0	2451709	2006	445.4	79204.01	473	0	0	0	0	0	0	0	0	1	r_c
43	0	4564543	2006	1056.22	154142.51	356	1	65	0	0	0	1	0	65	0	r_c
44	0	7501286	2003	651.7	71529.58	334	1	51	1	51	0	0	1	0	0	r_c
45	0	7809718	2005	146.13	36685.73	343	0	0	0	0	0	0	0	0	1	r_g
46	0	3741667	2005	931.26	147849.22	380	0	0	0	0	0	0	0	0	1	r_d
47	0	4535656	2003	387.3	102889.71	318	0	0	1	65	16380	0	0	0	0	r_e
49	0	8382476	2006	532.4	94252.51	375	0	0	0	0	0	0	0	0	1	r_c
50	0	5028198	2005	1332.69	154456.8	446	0	0	0	0	0	0	0	0	1	r_f
51	0	5941201	2007	715.9	95496.38	141	0	0	2	3	9530	0	0	0	1	r_g
52	0	3823552	2005	811.7	197744.22	297	1	35	1	35	0	0	1	0	0	r_a
54	0	1848311	2005	461.82	116138.43	307	0	0	0	0	0	0	0	0	1	r_d
55	0	4940776	2003	673.6	52071.48	229	0	0	1	16	653	0	0	0	0	r_d
57	0	1316778	2005	407.9	108203.09	470	0	0	0	0	0	0	0	0	0	r_f
58	0	5952964	2007	536	74087.57	323	0	0	0	0	0	0	0	0	1	r_i
59	0	4699197	2006	267.9	47902.56	471	0	0	0	0	0	0	0	0	1	r_g

Testing Set

Gross Default rate 5.49%

SL	Default	id	vintage_year	monthly_installment	loan_balance	bureau_score	num_bankrupt_iva	time_since_bankrupt	num_ccj	time_since_ccj	ccj_amount	num_bankrupt	num_iva	min_months_since_bankrupt	pl_flag	region	ltv	arrea
1	0	6670001	2005	746.7	131304.44	541	0	0	0	0	0	0	0	0	1	r_a	0.7586	
2	0	9131199	2006	887.4	115486.51	441	0	0	0	0	0	0	0	0	1	r_b	0.6973	
3	1	4963167	2004	1008.5	128381.73	282	0	0	1	36	459	0	0	0	0	r_c	0.6959	2.18
5	0	5949777	2006	431.2	77086.31	466	0	0	0	0	0	0	0	0	1	r_e	0.3776	
11	0	4066165	2005	471.44	125415.07	367	0	0	0	0	0	0	0	0	0	r_c	0.8256	0.60
19	0	3691330	2007	976.02	257951.62	458	0	0	0	0	0	0	0	0	0	r_a	0.8819	
23	0	4149143	2005	527.46	139325.95	365	1	56	1	56	0	0	1	0	0	r_d	0.6523	
24	0	1848036	2006	505.7	127972.39	502	0	0	0	0	0	0	0	0	1	r_d	0.6869	
27	0	8452715	2006	762.84	104257.5	417	0	0	0	0	0	0	0	0	0	r_d	0.512	
30	0	8033354	2006	565.4	139603.15	160	0	0	0	0	0	0	0	0	1	r_d	0.7772	
34	0	9023854	2007	410.6	88083.64	227	0	0	0	0	0	0	0	0	0	r_d	0.2409	
36	0	2425429	2005	226	29211.8	469	0	0	0	0	0	0	0	0	0	r_g	0.4817	
39	0	5705263	2005	551.16	95579.7	561	0	0	0	0	0	0	0	0	0	r_e	0.276	
48	0	6317615	2007	448.49	81019.68	195	0	0	0	0	0	0	0	0	1	r_c	0.8336	
53	0	3682722	2004	703.4	185883.99	505	0	0	0	0	0	0	0	0	0	r_f	0.5197	
56	0	2429741	2006	661.81	67241.82	499	0	0	0	0	0	0	0	0	0	r_e	0.2828	
60	0	7555242	2005	790.86	101770.69	268	0	0	0	0	0	0	0	0	1	r_l	0.6281	
61	0	8431952	2005	325.9	37927.29	350	0	0	0	0	0	0	0	0	1	r_c	0.4715	
62	0	4221098	2006	1537.11	209038.72	208	0	0	1	16	8822	0	0	0	0	r_i	0.4537	1.7
63	0	5099527	2006	262.15	35837.51	520	0	0	0	0	0	0	0	0	0	r_c	0.2252	
66	0	9601371	2005	569.87	143047.4	411	1	42	1	42	0	0	1	0	0	r_e	0.4379	
68	0	7171719	2004	703.8	53883.7	540	0	0	0	0	0	0	0	0	1	r_l	0.3695	
72	0	6444874	2007	234.4	58669.11	454	0	0	0	0	0	0	0	0	1	r_i	0.9577	
74	0	3126447	2006	750.56	122569.63	352	0	0	0	0	0	0	0	0	0	r_c	0.7675	
77	0	5512049	2005	300.78	53486.58	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	r_g	0.8612	
86	0	3743439	2007	881.43	161787.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	r_h	0.6758	
91	0	7889331	2006	678.3	171327.29	348	0	0	1	69	9550	0	0	0	0	r_f	0.6167	
94	0	7666011	2006	987.36	161265.41	563	0	0	0	0	0	0	0	0	0	r_d	0.6905	
96	0	4193714	2003	907.54	87202.81	318	0	0	0	0	0	0	0	0	0	r_h	0.7002	
103	0	1873590	2006	359.99	95121.12	306	0	0	0	0	0	0	0	0	0	r_e	0.3945	
105	0	4049563	2004	79.77	21084.66	542	0	0	0	0	0	0	0	0	0	r_i	0.1392	
108	0	2957269	2006	859.94	114286.13	343	1	63	0	0	0	1	0	63	0	r_c	0.7679	
109	0	3096903	2005	459.5	115783.16	343	0	0	0	0	0	0	0	0	1	r_a	0.8563	
112	0	9579301	2006	387.7	98962.7	205	0	0	0	0	0	0	0	0	1	r_l	0.898	
113	0	7089380	2005	479.65	61028.24	539	0	0	0	0	0	0	0	0	1	r_e	0.3369	
118	0	4561644	2005	609.57	77198.25	448	0	0	0	0	0	0	0	0	0	r_g	0.7519	
130	0	8796368	2004	934.1	200980.8	247	0	0	1	38	3666	0	0	0	0	r_g	1.0034	1.46
137	0	4913838	2006	871.04	113306.69	392	0	0	0	0	0	0	0	0	1	r_g	0.7759	
141	0	7858458	2006	466	73609.61	517	0	0	0	0	0	0	0	0	1	r_e	0.2444	
145	0	5737866	2006	522.6	88533.76	229	0	0	0	0	0	0	0	0	1	r_c	0.768	0.78
152	0	3903550	2007	436.33	60920.46	453	0	0	0	0	0	0	0	0	0	r_i	0.7665	
153	0	5818601	2006	824.2	131124.79	391	0	0	0	0	0	0	0	0	1	r_d	0.6516	

Univariate Analysis

vintage_year	Bad	Good
2001	0	2
2002	36	635
2003	57	1061
2004	77	1623
2005	226	3847
2006	385	6929
2007	155	3121
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	2	20
2013	0	14
2014	1	11
2015	0	3
Total	939	17266

vintage_year	Bad	Good	%Bad	%Good	WOE	IV
2001-02	36	637	0.03834	0.03689	-0.0384	5.55421E-05
2003	57	1061	0.0607	0.06145	0.01224	9.14548E-06
2004	77	1623	0.082	0.094	0.13655	0.001638243
2005	226	3847	0.24068	0.22281	-0.0772	0.00137923
2006	385	6929	0.41001	0.40131	-0.0215	0.000186666
2007	155	3121	0.16507	0.18076	0.0908	0.001424783
2008 and above	3	48	0.00319	0.00278	-0.1391	5.77027E-05
Total	939	17266			Total	0.004751312

monthly_installment	Bad	Good
500	444	8503
1000	405	7422
1500	70	1083
2000	17	201
2500	1	35
3000	2	11
3500	0	5
4000	0	4
4500	0	0
5000	0	1

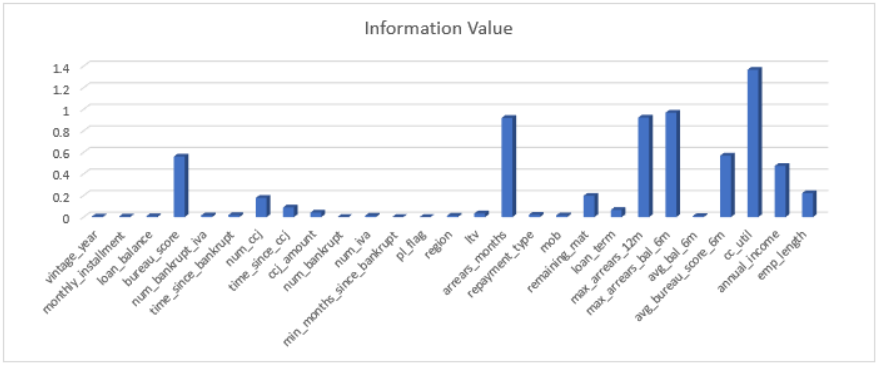
monthly_installment	Bad	Good	%Bad	%Good	WOE	IV
Less then 500	444	8503	0.47284	0.4925	0.04073	0.000800555
500 - 1000	405	7422	0.43131	0.42989	-0.0033	4.7016E-06
1000-1500	70	1083	0.07455	0.06273	-0.1726	0.002040325
1500 and Above	20	257	0.0213	0.01489	-0.3583	0.002297865
Total	939	17265			Total	0.005143446

loan_balance	Bad	Good
100000	548	10605
200000	314	5510
300000	51	867
400000	15	182
500000	9	70
600000	1	22
700000	0	3
800000	1	3
900000	0	3
1000000	0	1

loan_balance	Bad	Good	%Bad	%Good	WOE	IV
Less than 100000	548	10605	0.5836	0.61421	0.05113	0.001565153
100000-200000	314	5510	0.3344	0.31912	-0.0468	0.000714092
200000-300000	51	867	0.05431	0.05021	-0.0785	0.000321616
300000 and Above	26	284	0.02769	0.01645	-0.5208	0.005854078
Total	939	17266			Total	0.008454939

bureau_score	Bad	Good
100	21	51
200	124	702
300	323	2994
400	260	4324
500	131	5630
600	59	3179

bureau_score	Bad	Good	%Bad	%Good	WOE	IV
Less than 100	21	51	0.02236	0.00295	-2.0244	0.039294016
100 - 200	124	702	0.13206	0.04066	-1.178	0.107668669
200 - 300	323	2994	0.34398	0.1734	-0.685	0.116840496
300 - 400	260	4324	0.27689	0.25043	-0.1004	0.002656824
400 - 500	131	5630	0.13951	0.32607	0.84899	0.158390873
500 - 600	59	3179	0.06283	0.18412	1.07511	0.13039554



Variables	IV
vintage_year	0.00475
monthly_installment	0.00514
loan_balance	0.00845
bureau_score	0.56076
num_bankrupt_iva	0.01517
time_since_bankrupt	0.0182
num_ccj	0.17735
time_since_ccj	0.08907
ccj_amount	0.04142
num_bankrupt	0.001
num_iva	0.01172
min_months_since_bankrupt	0.00083
pl_flag	0.00025
region	0.01221
ltv	0.03341
arrears_months	0.9191
repayment_type	0.02158
mob	0.01549
remaining_mat	0.19698
loan_term	0.0665
max_arrears_12m	0.92283
max_arrears_bal_6m	0.96793
avg_bal_6m	0.0091
avg_bureau_score_6m	0.56911
cc_util	1.36593
annual_income	0.47443
emp_length	0.22107
months_since_recent_cc_delinq	0.37367

Most Prominent variables (IV > 0.4)

bureau_score

arrears_months (dropped since it is repeat

max_arrears_12m

max_arrears_bal_6m

avg_bureau_score_6m (dropped since it is repeat

cc_util

annual_income

Medium Important (included as part of expert judgement)

num_ccj

emp_length

months_since_recent_cc_delinq

PEAKS2TAILS

WOE Transformed (Training Set)

Default	bureau_score	max_arrears_12m	max_arrears_bal_6m	cc_util	annual_income	num_ccj	emp_length	months_since_recent_cc_delinq
0	0.848988348	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.519371295	-0.379586857
1	0.848988348	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	-0.382216378	-0.359844634
0	1.075105467	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.88879147	1.036190088
0	0.848988348	0.446897907	0.605966823	1.14072133	0.056834275	0.182549	-0.180192003	-0.359844634
1	-0.232100523	-1.708298136	-1.371963137	-1.9129446	-0.641267459	-0.2321	-0.306787205	-0.359844634
0	-0.100424502	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	-0.860408385	1.036190088
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.627726273	1.036190088
0	1.075105467	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	-0.180192003	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.520370796	-0.379586857
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.519371295	-0.379586857
0	0.848988348	0.446897907	0.605966823	-0.7399926	-0.641267459	0.182549	-0.306787205	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.211585475	-0.359844634
0	1.075105467	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	0.211585475	-0.359844634
0	-1.178027211	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.627726273	-0.379586857
0	0.848988348	0.446897907	0.605966823	-1.9129446	0.056834275	0.182549	0.519371295	1.036190088
0	-0.100424502	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	-0.306787205	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.379586857
0	-0.684965808	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.519371295	1.036190088
0	0.848988348	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.211585475	-0.359844634
0	-0.684965808	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.211585475	1.036190088
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.520370796	-0.359844634
0	1.075105467	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.211585475	-0.379586857
1	0.848988348	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	-0.382216378	1.036190088
0	-1.178027211	0.446897907	0.605966823	-1.9129446	0.659648047	0.182549	0.520370796	-0.379586857
0	1.075105467	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	0.211585475	-0.379586857
0	-0.100424502	0.446897907	0.605966823	-0.7399926	0.056834275	0.182549	0.211585475	-0.379586857
0	1.075105467	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	-0.306787205	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.359844634
0	-0.100424502	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	0.211585475	-0.379586857
0	-0.100424502	0.446897907	0.605966823	-1.9129446	-0.641267459	-0.84072	-0.382216378	-0.359844634
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	-0.180192003	1.036190088
0	-0.100424502	0.446897907	0.605966823	-0.7399926	0.659648047	0.182549	0.520370796	-0.379586857
0	-0.100424502	0.446897907	-1.371963137	1.14072133	0.324421315	-0.84072	0.520370796	-0.379586857
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.056834275	0.182549	0.627726273	1.036190088
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.359844634
0	-1.178027211	-1.708298136	-1.371963137	-1.9129446	0.324421315	-0.9376	-0.306787205	-0.379586857
0	-0.684965808	0.446897907	0.605966823	1.14072133	-0.641267459	-0.84072	-0.860408385	1.036190088
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.88879147	1.036190088
0	-0.684965808	-2.643118019	0.605966823	1.14072133	0.324421315	-0.84072	0.519371295	-0.379586857
0	0.848988348	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	-0.382216378	-0.379586857
0	-0.100424502	0.446897907	0.605966823	-1.9129446	-0.641267459	0.182549	-0.382216378	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.519371295	1.036190088

PEAKS2TAILS

WOE Transformed (Training Set)

Default	bureau_score	max_arrears_12m	max_arrears_bal_6m	cc_util	annual_income	num_ccj	emp_length	months_since_recent_cc_delinq
0	0.848988348	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.519371295	-0.379586857
1	0.848988348	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	-0.382216378	-0.359844634
0	1.075105467	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.88879147	1.036190088
0	0.848988348	0.446897907	0.605966823	1.14072133	0.056834275	0.182549	-0.180192003	-0.359844634
1	-0.232100523	-1.708298136	-1.371963137	-1.9129446	-0.641267459	-0.2321	-0.306787205	-0.359844634
0	-0.100424502	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	-0.860408385	1.036190088
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.627726273	1.036190088
0	1.075105467	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	-0.180192003	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.520370796	-0.379586857
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.519371295	-0.379586857
0	0.848988348	0.446897907	0.605966823	-0.7399926	-0.641267459	0.182549	-0.306787205	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.211585475	-0.359844634
0	1.075105467	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	0.211585475	-0.359844634
0	-1.178027211	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.627726273	-0.379586857
0	0.848988348	0.446897907	0.605966823	-1.9129446	0.056834275	0.182549	0.519371295	1.036190088
0	-0.100424502	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	-0.306787205	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.379586857
0	-0.684965808	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.519371295	1.036190088
0	0.848988348	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.211585475	-0.359844634
0	-0.684965808	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.211585475	1.036190088
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.520370796	-0.359844634
0	1.075105467	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	0.211585475	-0.379586857
1	0.848988348	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	-0.382216378	1.036190088
0	-1.178027211	0.446897907	0.605966823	-1.9129446	0.659648047	0.182549	0.520370796	-0.379586857
0	1.075105467	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	0.211585475	-0.379586857
0	-0.100424502	0.446897907	0.605966823	-0.7399926	0.056834275	0.182549	0.211585475	-0.379586857
0	1.075105467	0.446897907	0.605966823	1.14072133	0.324421315	0.182549	-0.306787205	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.359844634
0	-0.100424502	0.446897907	0.605966823	1.14072133	-0.641267459	0.182549	0.211585475	-0.379586857
0	-0.100424502	0.446897907	0.605966823	-1.9129446	-0.641267459	-0.84072	-0.382216378	-0.359844634
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	-0.180192003	1.036190088
0	-0.100424502	0.446897907	0.605966823	-0.7399926	0.659648047	0.182549	0.520370796	-0.379586857
0	-0.100424502	0.446897907	-1.371963137	1.14072133	0.324421315	-0.84072	0.520370796	-0.379586857
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.056834275	0.182549	0.627726273	1.036190088
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.439573656	-0.359844634
0	-1.178027211	-1.708298136	-1.371963137	-1.9129446	0.324421315	-0.9376	-0.306787205	-0.379586857
0	-0.684965808	0.446897907	0.605966823	1.14072133	-0.641267459	-0.84072	-0.860408385	1.036190088
0	-0.100424502	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.88879147	1.036190088
0	-0.684965808	-2.643118019	0.605966823	1.14072133	0.324421315	-0.84072	0.519371295	-0.379586857
0	0.848988348	0.446897907	0.605966823	-0.7399926	0.324421315	0.182549	-0.382216378	-0.379586857
0	-0.100424502	0.446897907	0.605966823	-1.9129446	-0.641267459	0.182549	-0.382216378	-0.359844634
0	0.848988348	0.446897907	0.605966823	1.14072133	0.659648047	0.182549	0.519371295	1.036190088

PEAKS2TAILS

Multivariate Analysis

	bureau_score	max_arrears_12m	max_arrears_bal_6m	cc_util	annual_income	num_ccj	emp_length	months_since_recent_cc_delinq
bureau_score	1	0.266246184	0.321168348	0.054	0.022599645	0.35108	0.005446495	0.024246518
max_arrears_12m	0.266246184	1	0.701763068	0.1096	0.065276107	0.19883	0.032128934	0.042527845
max_arrears_bal_6m	0.321168348	0.701763068	1	0.0988	0.059666063	0.213646	0.0299829	0.032641582
cc_util	0.054001383	0.109595561	0.098803204	1	0.061351839	0.040001	0.03022804	0.302193037
annual_income	0.022599645	0.065276107	0.059666063	0.06135	1	0.02938	0.512690878	0.036437727
num_ccj	0.351080139	0.198830077	0.213646372	0.04	0.029380478	1	0.017346211	0.01929747
emp_length	0.005446495	0.032128934	0.0299829	0.03023	0.512690878	0.017346	1	0.008514278
months_since_recent_cc_delinq	0.024246518	0.042527845	0.032641582	0.30219	0.036437727	0.019297	0.008514278	1

max_arrears_bal_6m will be dropped as it is highly correlated with max_arrears_12m

The Final Selection of variables

bureau_score
max_arrears_12m
cc_util
annual_income
num_ccj
emp_length
months_since_recent_cc_delinq

Stepwise Regression (NULL Model)

min AIC

7396.298783

-2.911679291

Default	Intercept	P(1)	ylnP(1) + (1-y)ln(1-P(1))
0	-2.911679291	0.051579	-0.052957019
1	-2.911679291	0.051579	-2.964636311
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
1	-2.911679291	0.051579	-2.964636311
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
1	-2.911679291	0.051579	-2.964636311
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019
0	-2.911679291	0.051579	-0.052957019

Stepwise Regression (1 variable)

Min AIC is achieved with **'cc_util'**

(Not suprising as cc_util had highest IV)

min AIC

6903.857161

	-2.911680374	-0.999998675		
Default	Intercept	bureau_score	P(1)	ylnP(1) + (1-y)ln(1-P(1))
0	-2.911680374	0.848988348	0.022739	-0.023001624
1	-2.911680374	0.848988348	0.022739	-3.783669222
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	0.848988348	0.022739	-0.023001624
1	-2.911680374	-0.232100523	0.064189	-2.745922002
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	-1.178027211	0.150121	-0.162660936
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.684965808	0.097377	-0.102450257
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.684965808	0.097377	-0.102450257
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	1.075105467	0.018221	-0.018389175
1	-2.911680374	0.848988348	0.022739	-3.783669222
0	-2.911680374	-1.178027211	0.150121	-0.162660936
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-1.178027211	0.150121	-0.162660936
0	-2.911680374	-0.684965808	0.097377	-0.102450257
0	-2.911680374	-0.100424502	0.056719	-0.058390997

min AIC

6424.296113

	-2.91168	-1.000001147		
Default	Intercept	max_arrears_12m	P(1)	ylnP(1) + (1-y)ln(1-P(1))
0	-2.91168	0.446897907	0.033615	-0.034193395
1	-2.91168	0.446897907	0.033615	-3.392770773
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
1	-2.91168	-1.708298136	0.230875	-1.465880223
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
1	-2.91168	0.446897907	0.033615	-3.392770773
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	-1.708298136	0.230875	-0.262501359
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395

min AIC

6131.777902

	-2.91168	-1.000001073		
Default	Intercept	cc_util	P(1)	ylnP(1) + (1-y)ln(1-P(1))
0	-2.91168	1.14072133	0.017084	-0.017231208
1	-2.91168	-0.739992552	0.102322	-2.279632819
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
1	-2.91168	-1.912944649	0.26919	-1.312337691
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
1	-2.91168	1.14072133	0.017084	-4.069636334
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208

PEAKS2TAILS

[Stepwise Regression (1 variable)]

Min AIC is achieved with **'cc_util'**

(Not suprising as cc_util had highest IV)

min AIC

6903.857161

Default	Intercept	bureau_score	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.911680374	-0.999998675		
0	-2.911680374	0.848988348	0.022739	-0.023001624
1	-2.911680374	0.848988348	0.022739	-3.783669222
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	0.848988348	0.022739	-0.023001624
1	-2.911680374	-0.232100523	0.064189	-2.745922002
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	-1.178027211	0.150121	-0.162660936
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.684965808	0.097377	-0.102450257
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.684965808	0.097377	-0.102450257
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	1.075105467	0.018221	-0.018389175
1	-2.911680374	0.848988348	0.022739	-3.783669222
0	-2.911680374	-1.178027211	0.150121	-0.162660936
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	1.075105467	0.018221	-0.018389175
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	-0.100424502	0.056719	-0.058390997
0	-2.911680374	0.848988348	0.022739	-0.023001624
0	-2.911680374	-1.178027211	0.150121	-0.162660936
0	-2.911680374	-0.684965808	0.097377	-0.102450257
0	-2.911680374	-0.100424502	0.056719	-0.058390997

min AIC

6424.296113

Default	Intercept	max_arrears_12m	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.91168	-1.000001147		
0	-2.91168	0.446897907	0.033615	-0.034193395
1	-2.91168	0.446897907	0.033615	-3.392770773
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
1	-2.91168	-1.708298136	0.230875	-1.465880223
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
1	-2.91168	0.446897907	0.033615	-3.392770773
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	-1.708298136	0.230875	-0.262501359
0	-2.91168	0.446897907	0.033615	-0.034193395
0	-2.91168	0.446897907	0.033615	-0.034193395

min AIC

6131.777902

Default	Intercept	cc_util	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.91168	-1.000001073		
0	-2.91168	1.14072133	0.017084	-0.017231208
1	-2.91168	-0.739992552	0.102322	-2.279632819
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
1	-2.91168	-1.912944649	0.26919	-1.312337691
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
1	-2.91168	1.14072133	0.017084	-4.069636334
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-0.739992552	0.102322	-0.107943594
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	-1.912944649	0.26919	-0.313601822
0	-2.91168	1.14072133	0.017084	-0.017231208
0	-2.91168	1.14072133	0.017084	-0.017231208

PEAKS2TAILS

Stepwise Regression (3 variables)

3 variables selected so far are :

cc_util, max_arrears_12m, annual_income

min AIC

5019.264266

Default	Intercept	cc_util	max_arrears_12m	annual_income	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.91237698	-0.981180025	-0.958784912	-0.985164084		
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
1	-2.91237698	-0.739992552	0.446897907	0.324421315	0.050479	-2.986195999
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.056834275	0.010813	-0.010872256
1	-2.91237698	-1.912944649	-1.708298136	-0.641267459	0.774555	-0.255467104
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-0.739992552	0.446897907	-0.641267459	0.120996	-0.128965297
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-0.739992552	0.446897907	0.324421315	0.050479	-0.051797732
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	-1.912944649	0.446897907	0.056834275	0.179476	-0.197811707
0	-2.91237698	-0.739992552	0.446897907	0.324421315	0.050479	-0.051797732
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
1	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-3.849867559
0	-2.91237698	-1.912944649	0.446897907	0.659648047	0.107765	-0.114025964
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	-0.739992552	0.446897907	0.056834275	0.06472	-0.066908977
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	-1.912944649	0.446897907	-0.641267459	0.303189	-0.361240653
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-0.739992552	0.446897907	0.659648047	0.036804	-0.037498312
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.056834275	0.010813	-0.010872256
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-1.912944649	-1.708298136	0.324421315	0.570244	-0.844538594
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116

min AIC

5324.541447

Default	Intercept	cc_util	max_arrears_12m	num_ccj	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.9067	-0.981943205	-0.917025532	-0.482702242		
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
1	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-2.744443629
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
1	-2.9067	-1.912944649	-1.708298136	-0.232100523	0.657077	-0.419954432
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-1.912944649	0.446897907	0.182549259	0.178546	-0.196679643
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
1	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-4.53553359
0	-2.9067	-1.912944649	0.446897907	0.182549259	0.178546	-0.196679643
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-1.912944649	0.446897907	-0.840719323	0.26264	-0.304678526
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	-0.840719323	0.01745	-0.017603891
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-1.912944649	-1.708298136	-0.937598024	0.729254	-1.306573045
0	-2.9067	1.14072133	0.446897907	-0.840719323	0.01745	-0.017603891
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071

Stepwise Regression (3 variables)

3 variables selected so far are :

cc_util, max_arrears_12m, annual_income

min AIC

5019.264266

Default	Intercept	cc_util	max_arrears_12m	annual_income	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.91237698	-0.981180025	-0.958784912	-0.985164084		
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
1	-2.91237698	-0.739992552	0.446897907	0.324421315	0.050479	-2.986195999
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.056834275	0.010813	-0.010872256
1	-2.91237698	-1.912944649	-1.708298136	-0.641267459	0.774555	-0.255467104
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-0.739992552	0.446897907	-0.641267459	0.120996	-0.128965297
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-0.739992552	0.446897907	0.324421315	0.050479	-0.051797732
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	-1.912944649	0.446897907	0.056834275	0.179476	-0.197811707
0	-2.91237698	-0.739992552	0.446897907	0.324421315	0.050479	-0.051797732
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
1	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-3.849867559
0	-2.91237698	-1.912944649	0.446897907	0.659648047	0.107765	-0.114025964
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	-0.739992552	0.446897907	0.056834275	0.06472	-0.066908977
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	-1.912944649	0.446897907	-0.641267459	0.303189	-0.361240653
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-0.739992552	0.446897907	0.659648047	0.036804	-0.037498312
0	-2.91237698	1.14072133	0.446897907	0.324421315	0.008328	-0.008363304
0	-2.91237698	1.14072133	0.446897907	0.056834275	0.010813	-0.010872256
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116
0	-2.91237698	-1.912944649	-1.708298136	0.324421315	0.570244	-0.844538594
0	-2.91237698	1.14072133	0.446897907	-0.641267459	0.021283	-0.021512294
0	-2.91237698	1.14072133	0.446897907	0.659648047	0.006	-0.006018116

min AIC

5324.541447

Default	Intercept	cc_util	max_arrears_12m	num_ccj	P(1)	ylnP(1) + (1-y)ln(1-P(1))
	-2.9067	-0.981943205	-0.917025532	-0.482702242		
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
1	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-2.744443629
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
1	-2.9067	-1.912944649	-1.708298136	-0.232100523	0.657077	-0.419954432
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-1.912944649	0.446897907	0.182549259	0.178546	-0.196679643
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
1	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-4.53553359
0	-2.9067	-1.912944649	0.446897907	0.182549259	0.178546	-0.196679643
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-1.912944649	0.446897907	-0.840719323	0.26264	-0.304678526
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-0.739992552	0.446897907	0.182549259	0.064284	-0.066443328
0	-2.9067	1.14072133	0.446897907	-0.840719323	0.01745	-0.017603891
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071
0	-2.9067	-1.912944649	-1.708298136	-0.937598024	0.729254	-1.306573045
0	-2.9067	1.14072133	0.446897907	-0.840719323	0.01745	-0.017603891
0	-2.9067	1.14072133	0.446897907	0.182549259	0.010721	-0.010779071

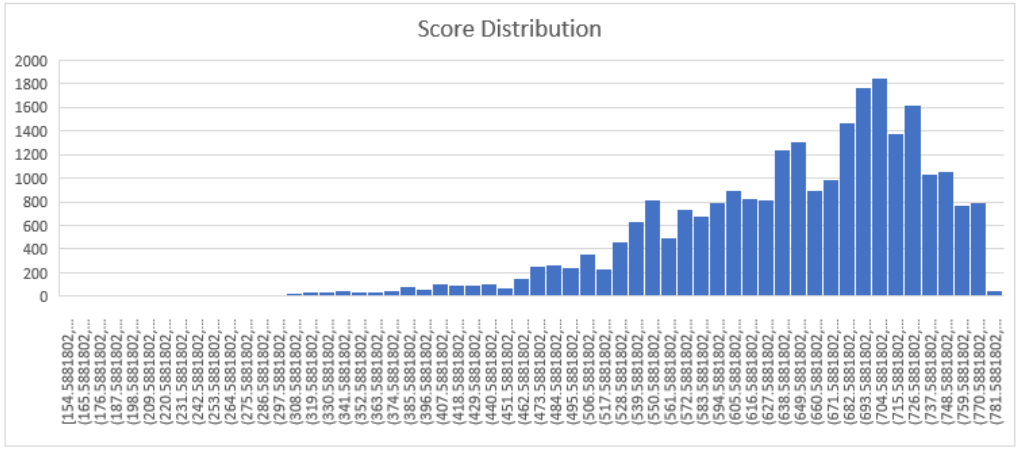
PEAKS2TAILS

Score Normalization

Goal is to score the entire data set
Odds 72 : 1 is anchored at score 660 as per standard
An increment of score 40 doubles the odds of not defaulting

So we have
ln (odds) = a + b * Score
ln(72) = a + 660b
ln(36) = a + 620b

Solving
b = 0.01732868
a = -7.16026236



As expected, the score is concentrated at high scores indicati

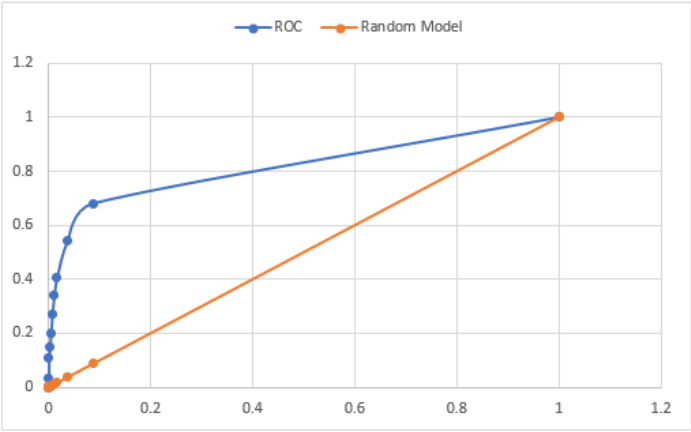
Note that , we are able to derive scores from PD estimates
If softwares produce score as direct output, it's easy to backtra

IRB in BASEL requires accounts to be mapped to a rating.
IFRS/CECL does not require mapping to a rating

Training + Testing Data Set

	-2.91589321	-0.652455435	-0.785562379	-0.924812	-0.865525003	-0.14029063	-0.337886572	-0.528973758			
Default	Intercept	bureau_score	max_arrears_12m	cc_util	annual_income	num_ccj	emp_length	months_since_recent_cc_delinq	P(1)	ln(odds)	Score
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.324421315	0.182549259	0.519371295	-0.379586857	0.005726	5.156941	710.7988
1	-2.91589321	0.848988348	0.446897907	-0.739993	0.324421315	0.182549259	-0.382216378	-0.359844634	0.042151	3.123443	593.45
0	-2.91589321	1.075105467	0.446897907	1.1407213	0.659648047	0.182549259	0.88879147	1.036190088	0.001549	6.468351	786.4773
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.056834275	0.182549259	-0.180192003	-0.359844634	0.009019	4.699408	684.3955
1	-2.91589321	-0.232100523	-1.708298136	-1.912945	-0.641267459	-0.23210052	-0.306787205	-0.359844634	0.773509	-1.22823	342.3243
0	-2.91589321	-0.100424502	0.446897907	1.1407213	-0.641267459	0.182549259	-0.860408385	1.036190088	0.018264	3.984364	643.1319
0	-2.91589321	-0.100424502	0.446897907	1.1407213	0.659648047	0.182549259	0.627726273	1.036190088	0.003636	5.61316	737.1261
0	-2.91589321	1.075105467	0.446897907	1.1407213	0.659648047	0.182549259	-0.180192003	-0.359844634	0.004639	5.36869	723.0183
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.659648047	0.182549259	0.439573656	-0.359844634	0.004361	5.430569	726.5892
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.324421315	0.182549259	0.520370796	-0.379586857	0.005724	5.157279	710.8182
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.659648047	0.182549259	0.519371295	-0.379586857	0.00429	5.447089	727.5425
0	-2.91589321	0.848988348	0.446897907	-0.739993	-0.641267459	0.182549259	-0.306787205	-0.359844634	0.090044	2.313101	546.687
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.659648047	0.182549259	0.211585475	-0.359844634	0.004709	5.353535	722.1437
0	-2.91589321	1.075105467	0.446897907	-0.739993	0.324421315	0.182549259	0.211585475	-0.359844634	0.030131	3.471612	613.5421
0	-2.91589321	-1.178027211	0.446897907	1.1407213	0.324421315	0.182549259	0.627726273	-0.379586857	0.020412	3.871016	636.5908
0	-2.91589321	0.848988348	0.446897907	-1.912945	0.056834275	0.182549259	0.519371295	1.036190088	0.054672	2.850179	577.6806
0	-2.91589321	-0.100424502	0.446897907	-0.739993	0.324421315	0.182549259	-0.306787205	-0.359844634	0.073817	2.52948	559.1737
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.659648047	0.182549259	0.439573656	-0.379586857	0.004407	5.420126	725.9866
0	-2.91589321	-0.684965808	0.446897907	1.1407213	0.324421315	0.182549259	0.519371295	1.036190088	0.007355	4.905014	696.2606
0	-2.91589321	0.848988348	0.446897907	1.1407213	0.324421315	0.182549259	0.211585475	-0.359844634	0.006284	5.063388	705.4
0	-2.91589321	-0.684965808	0.446897907	1.1407213	0.324421315	0.182549259	0.211585475	1.036190088	0.008154	4.801017	690.2591
0	-2.91589321	-0.100424502	0.446897907	1.1407213	0.659648047	0.182549259	0.520370796	-0.359844634	0.007857	4.83842	692.4176
0	-2.91589321	1.075105467	0.446897907	1.1407213	0.324421315	0.182549259	0.211585475	-0.379586857	0.005484	5.200476	713.311
1	-2.91589321	0.848988348	0.446897907	1.1407213	-0.641267459	0.182549259	-0.382216378	1.036190088	0.008448	4.765388	688.2031
0	-2.91589321	-1.178027211	0.446897907	-1.912945	0.659648047	0.182549259	0.520370796	-0.379586857	0.214027	1.300821	488.2705

Default	bureau_score	max_arrears_12m	cc_util	annual_income	num_ccj	emp_length	months_since_recent_cc_delinq	P(1)	Default (Pred)
0	1.075105467	0.446897907	1.14072133	0.659648047	0.182549259	-0.382216378	1.036190088	0.002379	0
0	0.848988348	0.446897907	-0.739992552	0.659648047	0.182549259	0.439573656	-0.379586857	0.024583	0
1	-0.684965808	-2.643118019	-0.739992552	-0.641267459	-0.840719323	-0.382216378	-0.379586857	0.784928	0
0	0.848988348	0.446897907	-1.912944649	0.659648047	0.182549259	0.439573656	-0.359844634	0.068721	0
0	-0.100424502	-1.708298136	1.14072133	0.324421315	0.182549259	0.519371295	-0.379586857	0.054969	0
0	0.848988348	0.446897907	1.14072133	-0.641267459	0.182549259	-0.860408385	1.036190088	0.009914	0
0	-0.100424502	0.446897907	1.14072133	0.659648047	-0.840719323	0.627726273	-0.359844634	0.008739	0
0	1.075105467	0.446897907	1.14072133	0.324421315	0.182549259	0.519371295	1.036190088	0.002344	0
0	0.848988348	0.446897907	-3.025007735	0.659648047	0.182549259	0.211585475	-0.379586857	0.183836	0
0	-1.178027211	0.446897907	-3.025007735	0.659648047	0.182549259	0.520370796	-0.379586857	0.432325	0
0	-0.684965808	0.446897907	1.14072133	-0.641267459	0.182549259	-0.655185064	-0.379586857	0.051008	0
0	0.848988348	0.446897907	1.14072133	0.659648047	0.182549259	0.520370796	-0.359844634	0.004245	0
0	1.075105467	0.446897907	1.14072133	0.659648047	0.182549259	0.211585475	1.036190088	0.001947	0
0	-1.178027211	0.446897907	1.14072133	0.324421315	0.182549259	-0.860408385	1.036190088	0.01603	0
0	1.075105467	0.446897907	1.14072133	0.659648047	0.182549259	-0.306787205	-0.359844634	0.00484	0
0	0.848988348	0.446897907	-1.912944649	0.324421315	0.182549259	0.519371295	-0.359844634	0.087598	0
0	-0.684965808	0.446897907	1.14072133	0.324421315	0.182549259	-0.180192003	1.036190088	0.009298	0
0	-0.100424502	0.446897907	1.14072133	-0.641267459	0.182549259	-0.306787205	1.036190088	0.015196	0
0	-0.684965808	-2.643118019	1.14072133	0.324421315	-0.840719323	-0.306787205	1.036190088	0.113557	0
0	1.075105467	0.446897907	-0.739992552	0.324421315	0.182549259	0.519371295	-0.379586857	0.027514	0
0	0.848988348	0.446897907	1.14072133	-0.641267459	-0.840719323	-0.382216378	1.036190088	0.009739	0
0	1.075105467	0.446897907	1.14072133	0.324421315	0.182549259	0.519371295	-0.379586857	0.004945	0
0	0.848988348	0.446897907	1.14072133	0.659648047	0.182549259	0.88879147	1.036190088	0.001795	0
0	-0.100424502	0.446897907	1.14072133	0.659648047	0.182549259	0.519371295	-0.359844634	0.00786	0
0	-0.232100523	0.446897907	1.14072133	0.324421315	-0.232100523	-0.655185064	-0.359844634	0.017863	0
0	-0.232100523	0.446897907	1.14072133	-0.641267459	-0.232100523	-0.180192003	1.036190088	0.016789	0
0	-0.100424502	0.446897907	-0.739992552	0.324421315	-0.840719323	-0.860408385	-0.379586857	0.100795	0
0	1.075105467	0.446897907	-0.739992552	0.324421315	0.182549259	-0.306787205	-0.359844634	0.035693	0
0	-0.100424502	0.446897907	1.14072133	0.324421315	0.182549259	-0.180192003	-0.359844634	0.013235	0
0	-0.100424502	0.446897907	1.14072133	-0.641267459	0.182549259	-0.306787205	1.036190088	0.015196	0
0	1.075105467	0.446897907	-1.912944649	-0.641267459	0.182549259	-0.306787205	-0.379586857	0.203359	0
0	-0.100424502	0.446897907	1.14072133	0.324421315	0.182549259	0.520370796	-0.359844634	0.010475	0
0	-0.100424502	0.446897907	1.14072133	0.324421315	0.182549259	-0.306787205	1.036190088	0.006645	0
0	-0.684965808	0.446897907	-1.912944649	0.324421315	0.182549259	0.627726273	-0.379586857	0.202838	0
0	1.075105467	0.446897907	1.14072133	0.324421315	0.182549259	-0.655185064	1.036190088	0.003483	0
0	0.848988348	0.446897907	-0.739992552	0.324421315	0.182549259	0.627726273	-0.379586857	0.030642	0
0	-0.684965808	-2.643118019	1.14072133	-0.641267459	-0.840719323	-0.655185064	1.036190088	0.249484	0
0	-0.100424502	0.446897907	1.14072133	0.324421315	0.182549259	0.439573656	1.036190088	0.005171	0
0	1.075105467	0.446897907	-1.912944649	0.324421315	0.182549259	0.519371295	-0.359844634	0.076502	0
0	-0.684965808	0.446897907	1.14072133	0.324421315	0.182549259	-0.382216378	-0.359844634	0.020595	0
0	0.848988348	0.446897907	1.14072133	0.324421315	0.182549259	0.439573656	1.036190088	0.00279	0
0	-0.684965808	0.446897907	1.14072133	-0.641267459	0.182549259	-0.180192003	1.036190088	0.02119	0
0	1.075105467	0.446897907	-0.739992552	0.659648047	0.182549259	-0.180192003	-0.359844634	0.025847	0
0	0.848988348	0.446897907	1.14072133	0.659648047	0.182549259	0.439573656	-0.359844634	0.004361	0



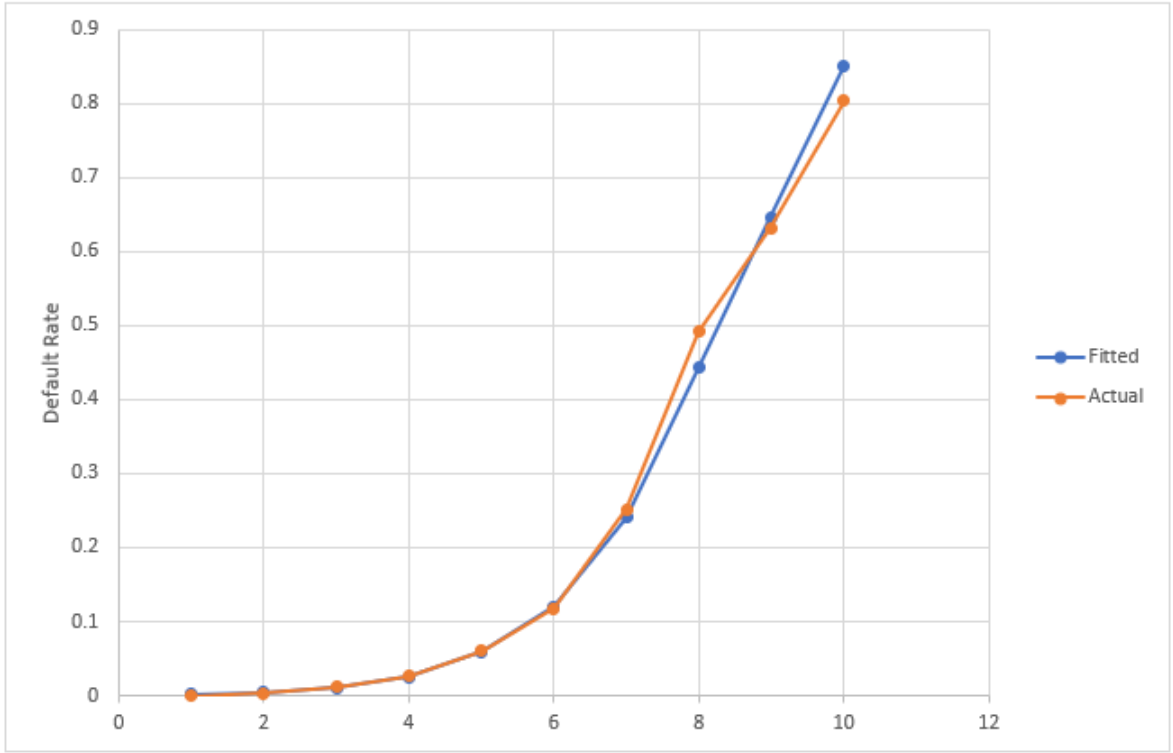
Cutoff	TPR	FPR	Random		area
0	1	1	1		0.76716276
0.1	0.6809	0.0872	0.0872		0.0305575
0.2	0.5414	0.0372	0.0372		0.0098118
0.3	0.4066	0.0165	0.0165		0.00205315
0.4	0.34	0.011	0.011		0.001219
0.5	0.2695	0.007	0.007		0.000538315
0.6	0.1986	0.0047	0.0047		0.000364875
0.7	0.1489	0.0026	0.0026		0.000242535
0.8	0.1064	0.0007	0.0007		0.000020565
0.9	0.0307	0.0004	0.0004		0.00000614
1	0	0	0	Total	0.81197664

PEAKS2TAILS

Calibration

In calibration, we test if the fitted PDs align with the Actual PDs.
We will consider score bands and calculate average fitted PD and actual default rate.

Score Bands	fitted PD	Actual PD
750+	0.00228556	0
700-750	0.004769593	0.003525985
650-700	0.010531161	0.011509817
600-650	0.02488564	0.026638378
550-600	0.058764453	0.060295061
500-550	0.119951039	0.117940199
450-500	0.240974951	0.251732102
400-450	0.443401856	0.49187935
350-400	0.646351889	0.631799163
350-	0.851015006	0.803652968



PEAKS2TAILS

Low Default Portfolio

When portfolios have very low default occurrences (banks , sovereigns etc.), one needs special techniques to estimate PDs since history does not have enough data points.

Pluto and Tasche Method

If the average PD of a portfolio is p, the Probability that number of defaults observed in a portfolio of n accounts will be less than k is
γ = BINOM.DIST(k,n,p,CUMULATIVE)

Cum Binomial is related to Cum Beta distribution
p = BETA.INV(1-γ, k+1, n-k)

γ is the Confidence used to estimate p

Van Der Burgt Method

$$y(z) = \frac{1 - e^{-\theta \cdot z}}{1 - e^{-\theta}},$$

y is the cum % of defaults as a function of the cumulative % of debtors (z) in a rating class
θ is the Concavity parameter of CAP profile

First , one has to minimize the RMS (which is the Root Mean Square error between Default function and Actual Defaults)

$$RMS_{CAP} = \sqrt{\frac{1}{n_{class}} \sum_{j=1}^{n_{class}} \left(y_j - \frac{1 - e^{-\theta \cdot z_j}}{1 - e^{-\theta}} \right)^2},$$

n_{class} is the number of rating classes

After , θ is estimated , PD for each class can be found out from the following expression

$$PD_j = \frac{\theta \cdot \bar{DR}}{1 - e^{-\theta}} e^{-\theta z_j}$$

where, DR is the average default rate of the Portfolio

PEAKS2TAILS

Pluto and Tasche Method

Assume our portfolio contains the following observations

Ratings	A	B	C	D	E	Total	C.I. (γ)	0.9
#Accounts	10	40	25	15	10	100		
#Defaults	2	1	0	0	0	3		
PD	0.1158	0.0134	0.0042	0.007	0.0105			

PEAKS2TAILS

Van Der Burgt Method

Assume our portfolio contains the following observations

Ratings	A	B	C	D	E	Total
#Accounts	10	40	25	15	10	100
#Defaults	2	1	0	0	0	3
Cum Defaults	2	3	3	3	3	
Cum % y	0.6667	1	1	1	1	
Cum Accounts	10	50	75	90	100	
Cum % (z)	0.1	0.5	0.75	0.9	1	
yj - y(z)	-0.0003	0.0041	0.000245763	3.36644E-05	0	
Min : RMS	0.0018					
PD	0.1099	0.0014	8.65977E-05	1.66478E-05	5.54527E-06	

n_{class}	5
θ	10.99331
DR	0.03