

Contents

1	The Scorecard Development Process	1
1.1	The Standard Scorecard	1
1.1.1	Types and Objectives of Scorecards	1
1.1.2	The Good, the Bad, and the Undefined	2
1.1.3	The Standard Scorecard Format	4
1.2	The Scorecard Development Process	6
1.3	Problem Setup	7
1.4	Data Acquisition and Integration	8
1.5	EDA and Data Profiling	8
1.6	Data Preparation	9
1.7	Variable Selection	10
1.8	Model Development	11
1.9	Model Evaluation	11
1.10	Scorecard Creation and Scaling	12
1.11	Scorecard Deployment	12
1.12	Reject Inference	13
1.13	Monitoring and Reporting	13
1.14	Notes on the SAS Code	14
2	Data Acquisition and Integration	19
2.1	Introduction	19
2.2	Variable Types	20
2.3	The Modeling (Mining) View	21
2.4	Sources of Data	23

2.5	Modeling and Deployment Windows	24
2.6	Data Alignment	25
2.7	Data Roll-up	28
2.7.1	Continuous Variables	29
2.7.2	Nominal and Ordinal Variables	31
2.8	Data Integration	33
2.8.1	Merging	33
2.8.2	Concatenation	35
2.8.3	Data Step or PROC SQL?	36
2.9	Integrity Checks	36
3	EDA and Data Profiling	41
3.1	Introduction	41
3.2	Univariate Statistics	42
3.3	Variable Distribution	46
3.4	Characteristics Analysis	47
3.5	Cross-tabulation	51
3.6	Detection of Outliers	55
3.6.1	Identification of Outliers Using Ranges . . .	58
3.6.2	Identification of Outliers Using Clustering . .	59
3.6.3	Multistage Identification of Outliers	62
3.6.4	Treatment of Outliers	63
4	Measures of Predictive Power	65
4.1	Introduction	65
4.2	Notation	68
4.2.1	Two Continuous Variables	68
4.2.2	Two Nominal Variables	68
4.2.3	Nominal x and Continuous y	70
4.3	Pearson Correlation Coefficient	72
4.4	Spearman Correlation Coefficient	76
4.5	The Pearson Chi-square Statistic	79
4.6	The Likelihood Ratio Test Statistic	82
4.7	Odds Ratio	85
4.8	The F-Test	92

4.9	The Gini Variance	93
4.10	The Entropy Variance	99
4.11	The Information Value	101
4.12	Automation of Variable Selection	105
5	Data Preparation	113
5.1	Introduction	113
5.2	Reduction of Cardinality	115
5.3	Binning of Continuous Variables	120
5.4	Sampling and Calculation of Weights	124
5.4.1	Sampling Methods	124
5.4.2	Sample Size	125
5.4.3	Random Sampling	126
5.4.4	Balanced Sampling and Weights	128
5.4.5	Calculation of Sample Weights	130
6	The Credit Card Sample Dataset	135
6.1	Introduction	135
6.2	The Data Dictionary	135
7	Logistic Regression	139
7.1	Introduction	139
7.2	Basic Formulations	140
7.3	The Likelihood Equations	144
7.4	Information Matrix	148
7.5	Parameter Estimation	150
7.6	Model Fit Statistics	154
7.7	The Hosmer-Lemeshow Test	158
7.8	Testing the Global Null Hypothesis	161
7.9	The Score Statistic	163
7.10	Interpretation of Model Parameters	164
7.11	Confidence Intervals for Odds Ratios	166
7.12	Prior Probabilities and Weights	167

8 Coarse Classing and WOE	169
8.1 Introduction	169
8.2 Definition of WOE	170
8.3 The Meaning of WOE	171
8.4 WOE and the Standard Scorecard	174
8.5 SAS Implementation	177
8.6 WOE for Continuous Variables	178
9 Methods of Variable Selection	185
9.1 Introduction	185
9.2 Overview of Selection Methods	186
9.3 Stepwise Variables Selection	191
9.4 Forcing Variables into the Model	197
9.5 Controlling Selection Sequence	199
9.6 Logistic Regression Output	200
10 Model Evaluation	205
10.1 Introduction	205
10.2 Validation and Confusion Matrix	206
10.3 The Lift and Lorenz Curve	213
10.4 The Gini Coefficient	219
10.5 The K-S Curve and Statistic	221
10.6 The ROC Curve and the c-Statistic	224
10.7 Overall Model Evaluation	229
11 Scorecard Scaling and Deployment	231
11.1 The Standard Format	231
11.2 Scaling the Scorecard	233
11.3 Assigning the Score Points	235
11.4 SAS Implementation	238
11.5 Setting the Cut-off Levels	249
12 Monitoring and Reporting	253
12.1 Objectives of Reporting	253
12.2 Stability Report	254

12.3 Scorecard Characteristics Analysis	259
13 Reject Inference	261
13.1 Definition and Justification	261
13.2 Methods of Reject Inference	262
13.3 Simple Assignment Methods	263
13.3.1 Ignore Rejects	263
13.3.2 Assign All Rejects a Bad Status	263
13.3.3 Proportional Assignment	263
13.4 Augmentation Methods	266
13.4.1 Simple Augmentation	266
13.4.2 Fuzzy Augmentation	268
13.4.3 Parceling	270
13.5 Using Inferred Rejects	274
A Obtaining the Source Code	277
B SAS Macros	279
C Listing of SAS Macros	283
C.1 Copyright and Software License	283
C.2 %ApplyMap1	284
C.3 %ApplyMap2	285
C.4 %AVRollup	286
C.5 %B2Partitions	288
C.6 %BinContVar	291
C.7 %BinVar	306
C.8 %BSWeight	306
C.9 %CalcGrF	307
C.10 %CalcWOE	309
C.11 %ChcAnalysis	311
C.12 %ChiLike	314
C.13 %ClustOL	315
C.14 %ConfMat	316
C.15 %DummyGrpn	317

C.16 %DummyGrps	319
C.17 %ENomNom	320
C.18 %EqWBinn	323
C.19 %ExtractCorr	324
C.20 %ExtrctTop	326
C.21 %Extremes	327
C.22 %ExtUnique	328
C.23 %FAugment	330
C.24 %GenSCDS	332
C.25 %GiniStat	338
C.26 %GNomNom	340
C.27 %GrFBinDV	343
C.28 %InfValue	345
C.29 %KSStat	347
C.30 %LiftChart	349
C.31 %OddsRatio	351
C.32 %Parceling	352
C.33 %PlotKS	357
C.34 %PlotLift	358
C.35 %PlotLorenz	358
C.36 %PlotROC	359
C.37 %PowerChIL	359
C.38 %PowerFG	361
C.39 %PowerGini	362
C.40 %PowerIV	363
C.41 %PowerOdds	364
C.42 %PropAssign	366
C.43 %R2Partitions	369
C.44 %RandomSample	371
C.45 %ReduceCats	371
C.46 %ROC	385
C.47 %SAugment	388
C.48 %SCCCode	390
C.49 %SCCSV	393

CONTENTS***CONTENTS***

C.50 %SCSQLCode	395
C.51 %SCSSasCode	399
C.52 %TRollup	403
C.53 %VarMode	404

About the Author	407
-------------------------	------------

Bibliography	409
---------------------	------------

Index	411
--------------	------------