LOGISTIC MODEL: Backwards Elimination

The LOGISTIC Procedure

Model Information	
Data Set	WORK.ATTRITION
Response Variable	Attrition
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	1470
Number of Observations Used	1470

Response Profile		
Ordered Value	Attrition	Total Frequency
1	No	1233
2	Yes	237

Probability modeled is Attrition='Yes'.

Backward Elimination Procedure

Class Level Information										
Class	Value	Design Variables								
BusinessTravel	Non-Travel	0	0							
	Travel_Frequently	1	0							
	Travel_Rarely	0	1							
Department	Human Resources	0	0							
	Research & Development	1	0							
	Sales	0	1							
Education	1	0	0	0	0					
	2	1	0	0	0					
	3	0	1	0	0					
	4	0	0	1	0					
	5	0	0	0	1					
EducationField	Human Resourc	0	0	0	0	0				
	Life Sciences	1	0	0	0	0				
	Marketing	0	1	0	0	0				
	Medical	0	0	1	0	0				
	Other	0	0	0	1	0				
	Technical Deg	0	0	0	0	1				
EmployeeCount	1									
EnvironmentSatisfaction	1	0	0	0						
	2	1	0	0						
	3	0	1	0						
	4	0	0	1						
Gender	Female	0								
	Male	1								
JobInvolvement	1	0	0	0						
	2	1	0	0						
	3	0	1	0						
	4	0	0	1						
JobLevel	1	0	0	0	0					
	2	1	0	0	0					
	3	0	1	0	0					
	4	0	0	1	0					
	5	0	0	0	1					
JobRole	Healthcare Representative	0	0	0	0	0	0	0	0	
	Human Resources	1	0	0	0	0	0	0	0	
	Laboratory Technician	0	1	0	0	0	0	0	0	
	Manager	0	0	1	0	0	0	0	0	
	Manufacturing Director	0	0	0	1	0	0	0	0	
	Research Director	0	0	0	0	1	0	0	0	
	Research Scientist	0	0	0	0	0	1	0	0	
	Sales Executive	0	0	0	0	0	0	1	0	
	Sales Representative	0	0	0	0	0	0	0	1	
JobSatisfaction	1	0	0	0						
	2	1	0	0						
	3	0	1	0						
	4	0	0	1						
MaritalStatus	Divorced	0	0							
	Married	1	0							
	Single	0	1							
OverTime	No	0								
	Yes	1								
PerformanceRating	3	0								
	4	1								
RelationshipSatisfaction	1	0	0	0						
	2	1	0	0						
	3	0	1	0						
	4	0	0	1						
StandardHours	80									

Class Level Information										
Class	Value	Design Variables								
StockOptionLevel	0	0	0	0						
	1	1	0	0						
	2	0	1	0						
	3	0	0	1						
WorkLifeBalance	1	0	0	0						
	2	1	0	0						
	3	0	1	0						
	4	0	0	1						

Step 0. 33 effects were entered.

Model Convergence Status
Quasi-complete separation of data points detected.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	901.298
SC	1305.876	1234.758
-2 Log L	1298.583	775.298

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	523.2846	62	<.0001
Score	440.5465	62	<.0001
Wald	242.3277	62	<.0001

Note: EmployeeCount was removed because of its redundancy.

Note: StandardHours was removed because of its redundancy.

Step 1. Effect Education is removed:

Model Convergence Status
Quasi-complete separation of data points detected.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	894.101
SC	1305.876	1206.389
-2 Log L	1298.583	776.101

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	522.4813	58	<.0001
Score	439.0308	58	<.0001
Wald	241.7439	58	<.0001

Residual Chi-Square Test		
Chi-Square	DF	Pr > ChiSq
0.7892	4	0.9399

Step 2. Effect PerformanceRating is removed:

Model Convergence Status
Quasi-complete separation of data points detected.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	892.179
SC	1305.876	1199.174
-2 Log L	1298.583	776.179

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	522.4034	57	<.0001
Score	438.9670	57	<.0001
Wald	241.8870	57	<.0001

Residual Chi-Square Test		
Chi-Square	DF	Pr > ChiSq
0.8672	5	0.9726

Step 3. Effect Department is removed:

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	890.420

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
SC	1305.876	1186.829
-2 Log L	1298.583	778.420

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	520.1630	55	<.0001
Score	438.2370	55	<.0001
Wald	243.1979	55	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
2.5305	7	0.9248

Step 4. Effect PercentSalaryHike is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	888.659
SC	1305.876	1179.775
-2 Log L	1298.583	778.659

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	519.9235	54	<.0001
Score	438.2366	54	<.0001
Wald	243.3290	54	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
2.7754	8	0.9477

Step 5. Effect MonthlyRate is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	887.194
SC	1305.876	1173.017
-2 Log L	1298.583	779.194

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	519.3887	53	<.0001
Score	437.8780	53	<.0001
Wald	242.9627	53	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
3.3077	9	0.9508

Step 6. Effect HourlyRate is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	885.839
SC	1305.876	1166.369
-2 Log L	1298.583	779.839

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	518.7440	52	<.0001
Score	437.8449	52	<.0001
Wald	243.8965	52	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
3.9482	10	0.9497

Step 7. Effect MaritalStatus is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	884.128
SC	1305.876	1154.072
-2 Log L	1298.583	782.128

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	516.4550	50	<.0001
Score	437.0188	50	<.0001
Wald	244.7618	50	<.0001

Residual Chi-Square Test		
Chi-Square	DF	Pr > ChiSq
6.2426	12	0.9034

Step 8. Effect MonthlyIncome is removed:

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	884.024
SC	1305.876	1148.675
-2 Log L	1298.583	784.024

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	514.5586	49	<.0001
Score	435.7761	49	<.0001
Wald	244.7931	49	<.0001

Residual Chi-Square Test		
Chi-Square	DF	Pr > ChiSq
8.0817	13	0.8382

Step 9. Effect DailyRate is removed:

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1300.583	885.845
SC	1305.876	1145.202
-2 Log L	1298.583	787.845

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	510.7382	48	<.0001
Score	433.3897	48	<.0001
Wald	244.7123	48	<.0001

Residual Chi-Square Test		
Chi-Square	DF	Pr > ChiSq
11.8412	14	0.6191

Note: No (additional) effects met the 0.05 significance level for removal from the model.

Summary of Backward Elimination					
Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq
1	Education	4	29	0.7877	0.9401
2	PerformanceRating	1	28	0.0779	0.7801
3	Department	2	27	0.5313	0.7667
4	PercentSalaryHike	1	26	0.2384	0.6253
5	MonthlyRate	1	25	0.5345	0.4647
6	HourlyRate	1	24	0.6436	0.4224
7	MaritalStatus	2	23	2.2497	0.3247
8	MonthlyIncome	1	22	1.8706	0.1714
9	DailyRate	1	21	3.7932	0.0515

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
BusinessTravel	2	32.1696	<.0001
EducationField	5	14.8820	0.0109
EnvironmentSatisfact	3	29.4341	<.0001
Gender	1	4.2726	0.0387
JobInvolvement	3	25.4382	<.0001
JobLevel	4	29.8923	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
JobRole	8	36.9388	<.0001
JobSatisfaction	3	23.6257	<.0001
OverTime	1	106.3616	<.0001
RelationshipSatisfac	3	18.8508	0.0003
StockOptionLevel	3	53.1621	<.0001
WorkLifeBalance	3	18.4565	0.0004
Age	1	4.3427	0.0372
DistanceFromHome	1	22.9217	<.0001
NumCompaniesWorked	1	25.6404	<.0001
TotalWorkingYears	1	5.0732	0.0243
TrainingTimesLastYea	1	6.2017	0.0128
YearsAtCompany	1	5.2077	0.0225
YearsInCurrentRole	1	9.1680	0.0025
YearsSinceLastPromot	1	14.9216	0.0001
YearsWithCurrManager	1	7.5278	0.0061

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	3.5771	1.2561	8.1094	0.0044
BusinessTravel	Travel_Frequently	1	2.1263	0.4305	24.3891	<.0001
BusinessTravel	Travel_Rarely	1	1.0958	0.3944	7.7172	0.0055
EducationField	Life Sciences	1	-0.8136	0.8034	1.0255	0.3112
EducationField	Marketing	1	-0.2696	0.8518	0.1002	0.7516
EducationField	Medical	1	-0.8606	0.8050	1.1430	0.2850
EducationField	Other	1	-0.7799	0.8795	0.7862	0.3752
EducationField	Technical Deg	1	0.2532	0.8257	0.0941	0.7591
EnvironmentSatisfact	2	1	-1.0485	0.2888	13.1815	0.0003
EnvironmentSatisfact	3	1	-1.1421	0.2649	18.5899	<.0001
EnvironmentSatisfact	4	1	-1.3594	0.2679	25.7543	<.0001
Gender	Male	1	0.4009	0.1940	4.2726	0.0387
JobInvolvement	2	1	-1.2367	0.3689	11.2378	0.0008
JobInvolvement	3	1	-1.5476	0.3473	19.8609	<.0001
JobInvolvement	4	1	-2.1576	0.4797	20.2268	<.0001
JobLevel	2	1	-1.6579	0.4480	13.6949	0.0002
JobLevel	3	1	-0.4040	0.5650	0.5112	0.4746
JobLevel	4	1	-1.5487	0.9813	2.4908	0.1145
JobLevel	5	1	0.8086	1.2805	0.3988	0.5277
JobRole	Human Resources	1	0.5277	0.7529	0.4913	0.4833
JobRole	Laboratory Technician	1	0.7952	0.5925	1.8011	0.1796
JobRole	Manager	1	-0.9643	1.0189	0.8958	0.3439
JobRole	Manufacturing Director	1	0.5075	0.5578	0.8278	0.3629
JobRole	Research Director	1	-2.1442	1.0836	3.9154	0.0478
JobRole	Research Scientist	1	-0.3035	0.6121	0.2458	0.6201
JobRole	Sales Executive	1	1.3011	0.4739	7.5367	0.0060
JobRole	Sales Representative	1	1.2613	0.6604	3.6479	0.0561
JobSatisfaction	2	1	-0.6812	0.2852	5.7053	0.0169
JobSatisfaction	3	1	-0.6597	0.2512	6.8983	0.0086
JobSatisfaction	4	1	-1.3070	0.2691	23.5972	<.0001
OverTime	Yes	1	2.1251	0.2061	106.3616	<.0001
RelationshipSatisfac	2	1	-0.9642	0.2958	10.6213	0.0011
RelationshipSatisfac	3	1	-0.9773	0.2653	13.5702	0.0002
RelationshipSatisfac	4	1	-1.0049	0.2660	14.2776	0.0002
StockOptionLevel	1	1	-1.4760	0.2169	46.3093	<.0001
StockOptionLevel	2	1	-1.4472	0.3743	14.9514	0.0001
StockOptionLevel	3	1	-0.8235	0.4038	4.1601	0.0414
WorkLifeBalance	2	1	-0.9971	0.3833	6.7685	0.0093
WorkLifeBalance	3	1	-1.4728	0.3609	16.6534	<.0001
WorkLifeBalance	4	1	-1.0736	0.4369	6.0385	0.0140
Age		1	-0.0292	0.0140	4.3427	0.0372
DistanceFromHome		1	0.0547	0.0114	22.9217	<.0001
NumCompaniesWorked		1	0.2060	0.0407	25.6404	<.0001
TotalWorkingYears		1	-0.0693	0.0308	5.0732	0.0243
TrainingTimesLastYea		1	-0.1891	0.0759	6.2017	0.0128
YearsAtCompany		1	0.0973	0.0426	5.2077	0.0225
YearsInCurrentRole		1	-0.1534	0.0507	9.1680	0.0025
YearsSinceLastPromot		DF	0.1744	0.0451	14.9216	0.0001
YearsWithCurrManager		1	-0.1383	0.0504	7.5278	0.0061

Association of Predicted Probabilities and Observed Responses

Percent Concordant	89.2	Somers' D	0.784
Percent Discordant	10.8	Gamma	0.784
Percent Tied	0.0	Tau-a	0.212
Pairs	292221	c	0.892

Odds Ratio Estimates and Profile-Likelihood Confidence Intervals

Effect	Unit	Estimate	95% Confidence Limits	
BusinessTravel Travel_Frequently vs Non-Travel	1.0000	8.383	3.724	20.266
BusinessTravel Travel_Rarely vs Non-Travel	1.0000	2.991	1.430	6.758

Odds Ratio Estimates and Profile-Likelihood Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
EducationField Life Sciences vs Human Resourc	1.0000	0.443	0.093	2.245
EducationField Marketing vs Human Resourc	1.0000	0.764	0.147	4.240
EducationField Medical vs Human Resourc	1.0000	0.423	0.089	2.145
EducationField Other vs Human Resourc	1.0000	0.458	0.082	2.648
EducationField Technical Deg vs Human Resourc	1.0000	1.288	0.261	6.836
EnvironmentSatisfact 2 vs 1	1.0000	0.350	0.197	0.614
EnvironmentSatisfact 3 vs 1	1.0000	0.319	0.189	0.535
EnvironmentSatisfact 4 vs 1	1.0000	0.257	0.151	0.432
Gender Male vs Female	1.0000	1.493	1.024	2.193
JobInvolvement 2 vs 1	1.0000	0.290	0.140	0.599
JobInvolvement 3 vs 1	1.0000	0.213	0.107	0.421
JobInvolvement 4 vs 1	1.0000	0.116	0.044	0.290
JobLevel 2 vs 1	1.0000	0.191	0.075	0.440
JobLevel 3 vs 1	1.0000	0.668	0.215	1.981
JobLevel 4 vs 1	1.0000	0.213	0.029	1.377
JobLevel 5 vs 1	1.0000	2.245	0.187	31.005
JobRole Human Resources vs Healthcare Representative	1.0000	1.695	0.372	7.279
JobRole Laboratory Technician vs Healthcare Representative	1.0000	2.215	0.694	7.202
JobRole Manager vs Healthcare Representative	1.0000	0.381	0.039	2.411
JobRole Manufacturing Director vs Healthcare Representative	1.0000	1.661	0.556	5.053
JobRole Research Director vs Healthcare Representative	1.0000	0.117	0.010	0.811
JobRole Research Scientist vs Healthcare Representative	1.0000	0.738	0.221	2.476
JobRole Sales Executive vs Healthcare Representative	1.0000	3.673	1.506	9.775
JobRole Sales Representative vs Healthcare Representative	1.0000	3.530	0.967	13.051
JobSatisfaction 2 vs 1	1.0000	0.506	0.288	0.881
JobSatisfaction 3 vs 1	1.0000	0.517	0.315	0.845
JobSatisfaction 4 vs 1	1.0000	0.271	0.159	0.456
OverTime Yes vs No	1.0000	8.374	5.632	12.647
RelationshipSatisfac 2 vs 1	1.0000	0.381	0.212	0.677
RelationshipSatisfac 3 vs 1	1.0000	0.376	0.223	0.631
RelationshipSatisfac 4 vs 1	1.0000	0.366	0.216	0.615
StockOptionLevel 1 vs 0	1.0000	0.229	0.148	0.347
StockOptionLevel 2 vs 0	1.0000	0.235	0.108	0.473
StockOptionLevel 3 vs 0	1.0000	0.439	0.193	0.945
WorkLifeBalance 2 vs 1	1.0000	0.369	0.175	0.789
WorkLifeBalance 3 vs 1	1.0000	0.229	0.114	0.470
WorkLifeBalance 4 vs 1	1.0000	0.342	0.145	0.805
Age	1.0000	0.971	0.944	0.998
DistanceFromHome	1.0000	1.056	1.033	1.080
NumCompaniesWorked	1.0000	1.229	1.135	1.331
TotalWorkingYears	1.0000	0.933	0.877	0.990
TrainingTimesLastYea	1.0000	0.828	0.712	0.959
YearsAtCompany	1.0000	1.102	1.014	1.199
YearsInCurrentRole	1.0000	0.858	0.776	0.947
YearsSinceLastPromot	1.0000	1.191	1.090	1.302
YearsWithCurrManager	1.0000	0.871	0.789	0.961

Odds Ratios with 95% Profile-Likelihood Confidence Limits

Predicted Probabilities for Attrition=Yes
At EducationField=Human Resourc EnvironmentSatisfaction=1 Gender=Female JobInvolvement=1
JobLevel=1 JobRole=Healthcare Representative JobSatisfaction=1 OverTime=No
RelationshipSatisfaction=1 StockOptionLevel=0 WorkLifeBalance=1 DistanceFromHome=9.193...