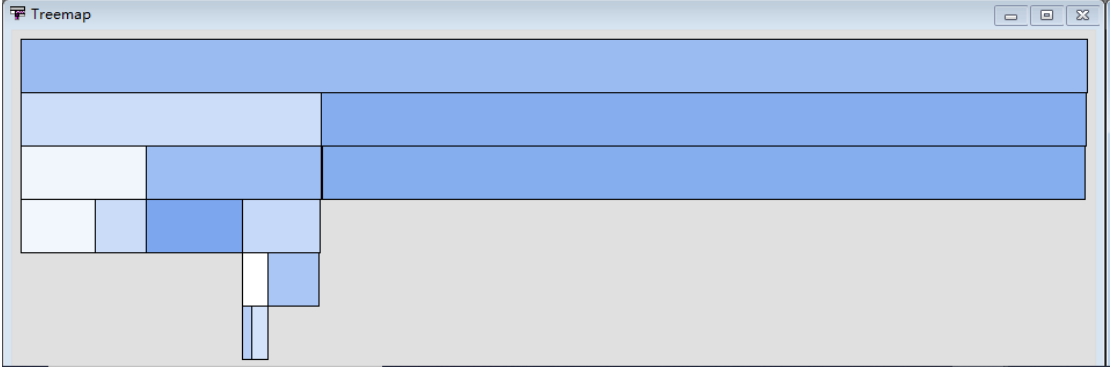
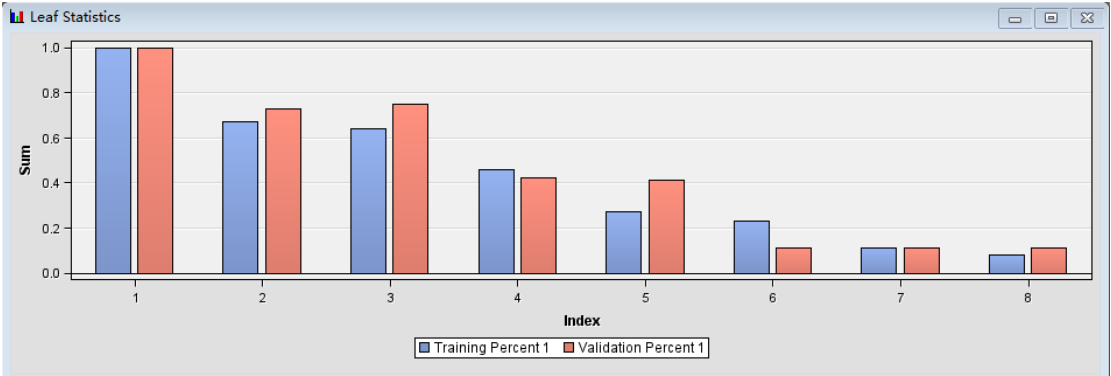
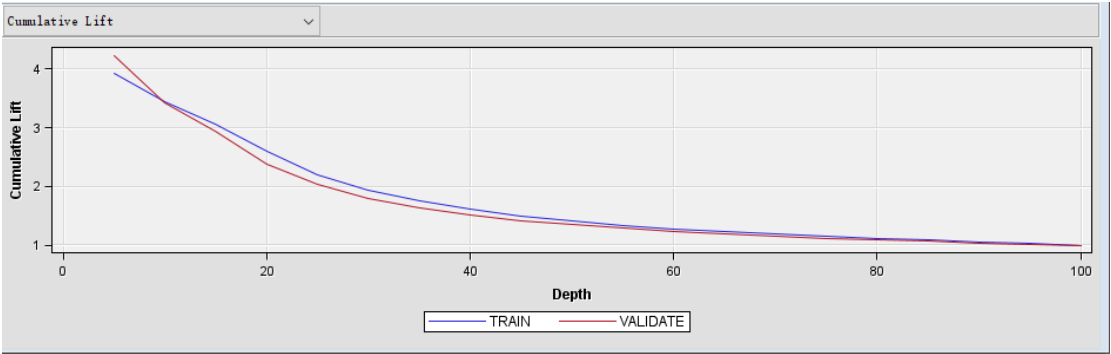


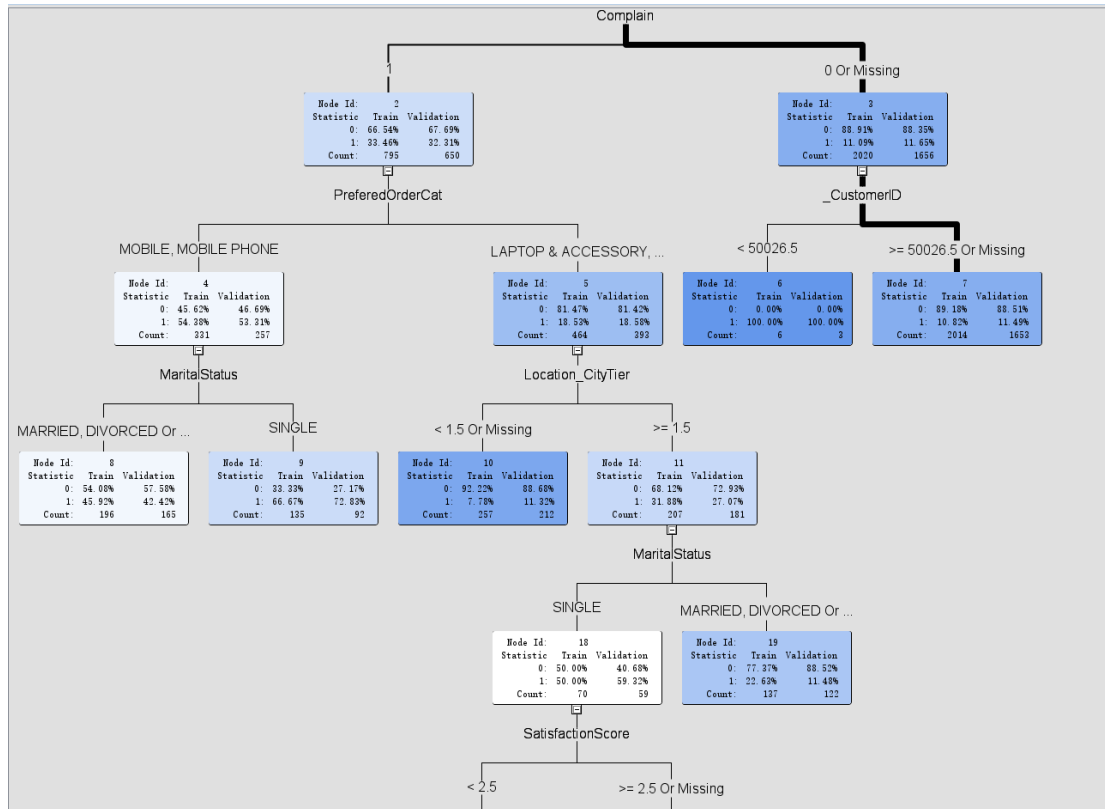
# Results

## Model: Decision Tree



Fit Statistics

Target	Target Label	Fit Statistics	Statistics Label	Train	Validation	Test
Churn	Churn	_NOBS_	Sum of Frequencies	2815		2306
Churn	Churn	_MISC_	Misclassification Rate	0.151687	0.148309	.
Churn	Churn	_MAX_	Maximum Absolute Err...	0.922179	0.922179	.
Churn	Churn	_SSE_	Sum of Squared Errors	661.6057	552.4034	.
Churn	Churn	_ASE_	Average Squared Error	0.117514	0.119775	.
Churn	Churn	_RASE_	Root Average Squared...	0.342804	0.346086	.
Churn	Churn	_DIV_	Divisor for ASE	5630		4612
Churn	Churn	_DFT_	Total Degrees of Free...	2815		.



Data Role=TRAIN Target Variable=Churn Target Label=Churn

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	86.0837	97.3763	2264	80.4263
1	0	13.9163	74.6939	366	13.0018
0	1	32.9730	2.6237	61	2.1670
1	1	67.0270	25.3061	124	4.4050

Data Role=VALIDATE Target Variable=Churn Target Label=Churn

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	85.8192	98.2659	1870	81.0928
1	0	14.1808	76.6749	309	13.3998
0	1	25.9843	1.7341	33	1.4310
1	1	74.0157	23.3251	94	4.0763

Event Classification Table

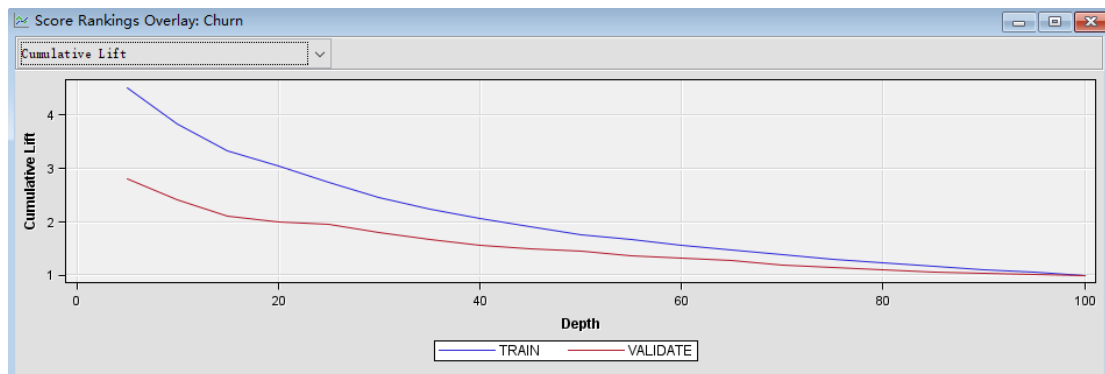
Data Role=TRAIN Target=Churn Target Label=Churn

False Negative	True Negative	False Positive	True Positive
366	2264	61	124

Data Role=VALIDATE Target=Churn Target Label=Churn

False Negative	True Negative	False Positive	True Positive
309	1870	33	94

## Model: Gradient Boosting

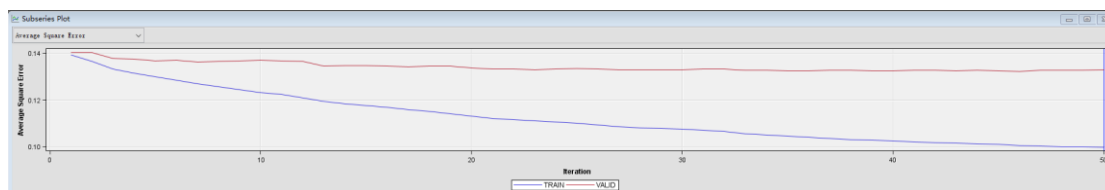


Variable Importance

Variable Name	Label	Number of Splitting Rules	Importance	Validation Importance	Ratio of Validation to Training Importance
LastPurchaseDate	LastPurchaseDate	36	1	0.084162	0.084162
Complain	Complain	12	0.645018	1	1.550345
PreferredOrderCat	PreferredOrderCat	10	0.540483	0.875498	1.619843
_CustomerID	_CustomerID	5	0.250463	0.432843	1.728171
MaritalStatus	MaritalStatus	2	0.243373	0.550831	2.263322
Location_CityTier	Location_CityTier	2	0.200092	0.064856	0.324128
IMP_DaySinceLastOrder	Imputed: DaySinceLastOr...	1	0.13228	0	0
SatisfactionScore	SatisfactionScore	1	0.124985	0.150481	1.203989
IMP_OrderCount	Imputed: OrderCount	0	0	0	-
Gender	Gender	0	0	0	-
Aging	Aging	0	0	0	-
REP_Gender	Replacement: Gender	0	0	0	-
MembershipLevel	MembershipLevel	0	0	0	-
Sales	Sales	0	0	0	-

Fit Statistics

Target	Target Label	Fit Statistics	Statistics Label	Train	Validation	Test
Churn	Churn	_NOBS_	Sum of Frequencies	2815	2306	-
Churn	Churn	_SUMW_	Sum of Case Weights ...	5630	4612	-
Churn	Churn	_MISC_	Misclassification Rate	0.154885	0.167823	-
Churn	Churn	_MAX_	Maximum Absolute Err...	0.932871	0.962566	-
Churn	Churn	_SSE_	Sum of Squared Errors	626.056	614.0287	-
Churn	Churn	_ASE_	Average Squared Error	0.1112	0.133137	-
Churn	Churn	_RASE_	Root Average Squared...	0.333467	0.36488	-
Churn	Churn	_DIV_	Divisor for ASE	5630	4612	-
Churn	Churn	_DFT_	Total Degrees of Free...	2815	-	-



### Classification Table

Data Role=TRAIN Target Variable=Churn Target Label=Churn

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	84.4080	99.6559	2317	82.3091
1	0	15.5920	87.3469	428	15.2043
0	1	11.4286	0.3441	8	0.2842
1	1	88.5714	12.6531	62	2.2025

Data Role=VALIDATE Target Variable=Churn Target Label=Churn

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	83.4215	99.4220	1892	82.0468
1	0	16.5785	93.3002	376	16.3053
0	1	28.9474	0.5780	11	0.4770
1	1	71.0526	6.6998	27	1.1709

### Event Classification Table

Data Role=TRAIN Target=Churn Target Label=Churn

False Negative	True Negative	False Positive	True Positive
428	2317	8	62

Data Role=VALIDATE Target=Churn Target Label=Churn

False Negative	True Negative	False Positive	True Positive
376	1892	11	27

## Model: HP Forest



Number of Trees	Number of Leaves	Average Square Error (Train)	Average Square Error (Out of Bag)	Average Square Error (Validate)	Misclassification Rate (Train)	Misclassification Rate (Out of Bag)	Misclassification Rate (Validate)	Log Loss (Train)	Log Loss (Out of Bag)	Log Loss (Validate)
1	13	0.120	0.132	0.125	0.159	0.160	0.167	0.432	0.528	0.472
2	25	0.117	0.130	0.123	0.164	0.173	0.174	0.382	0.479	0.399
3	34	0.117	0.129	0.121	0.167	0.172	0.170	0.380	0.454	0.393
4	44	0.116	0.125	0.120	0.167	0.165	0.170	0.376	0.431	0.389
5	53	0.116	0.124	0.120	0.162	0.164	0.164	0.376	0.418	0.387
6	62	0.116	0.125	0.119	0.162	0.166	0.164	0.376	0.418	0.387
7	74	0.116	0.124	0.119	0.162	0.165	0.164	0.377	0.415	0.386
8	82	0.115	0.122	0.118	0.161	0.163	0.163	0.374	0.403	0.383
9	101	0.115	0.122	0.118	0.161	0.165	0.164	0.376	0.395	0.383
10	108	0.115	0.121	0.118	0.162	0.164	0.164	0.377	0.394	0.384
11	117	0.115	0.121	0.118	0.162	0.165	0.164	0.377	0.394	0.384
12	130	0.116	0.121	0.118	0.160	0.167	0.168	0.377	0.383	0.384
13	132	0.115	0.121	0.119	0.166	0.167	0.169	0.378	0.384	0.385
14	144	0.115	0.121	0.118	0.166	0.168	0.170	0.378	0.384	0.385
15	163	0.115	0.121	0.118	0.161	0.164	0.167	0.377	0.382	0.384
16	168	0.115	0.121	0.118	0.167	0.165	0.171	0.378	0.392	0.385
17	179	0.115	0.120	0.118	0.162	0.163	0.166	0.377	0.391	0.384
18	188	0.115	0.120	0.118	0.167	0.169	0.171	0.379	0.390	0.384
19	195	0.115	0.120	0.118	0.161	0.163	0.163	0.377	0.390	0.383
20	212	0.115	0.120	0.118	0.161	0.163	0.163	0.377	0.391	0.384
21	220	0.116	0.120	0.118	0.161	0.163	0.165	0.378	0.391	0.384
22	227	0.115	0.121	0.118	0.161	0.162	0.164	0.377	0.392	0.384
23	233	0.116	0.121	0.118	0.161	0.163	0.163	0.379	0.392	0.384
24	249	0.116	0.120	0.118	0.161	0.161	0.165	0.378	0.391	0.384
25	267	0.115	0.120	0.118	0.160	0.162	0.165	0.377	0.390	0.384
26	275	0.115	0.120	0.119	0.158	0.162	0.163	0.376	0.390	0.383
27	299	0.115	0.120	0.117	0.156	0.161	0.163	0.376	0.389	0.383
28	300	0.115	0.120	0.118	0.160	0.161	0.163	0.376	0.389	0.383
29	311	0.115	0.120	0.117	0.157	0.161	0.163	0.376	0.389	0.383
30	323	0.115	0.119	0.117	0.155	0.161	0.161	0.375	0.388	0.382
31	335	0.115	0.119	0.117	0.157	0.160	0.161	0.375	0.388	0.382
32	344	0.115	0.119	0.117	0.156	0.160	0.160	0.375	0.388	0.382
33	357	0.115	0.119	0.117	0.157	0.161	0.159	0.375	0.389	0.382
34	366	0.115	0.119	0.117	0.157	0.162	0.161	0.375	0.389	0.382
35	378	0.115	0.119	0.117	0.157	0.161	0.159	0.375	0.389	0.382
36	384	0.115	0.120	0.118	0.157	0.161	0.161	0.376	0.389	0.383
37	388	0.115	0.120	0.118	0.157	0.161	0.162	0.377	0.390	0.383
38	397	0.115	0.120	0.118	0.157	0.162	0.162	0.377	0.390	0.384
39	407	0.115	0.120	0.118	0.158	0.162	0.163	0.377	0.390	0.384
40	415	0.115	0.120	0.118	0.155	0.162	0.160	0.377	0.389	0.384
41	428	0.115	0.119	0.118	0.155	0.159	0.158	0.377	0.389	0.383
42	436	0.115	0.119	0.118	0.155	0.161	0.162	0.377	0.389	0.384
43	445	0.115	0.119	0.119	0.155	0.160	0.159	0.377	0.389	0.384
44	451	0.115	0.119	0.119	0.152	0.162	0.163	0.377	0.389	0.384
45	460	0.115	0.119	0.118	0.155	0.160	0.160	0.377	0.389	0.384
46	470	0.115	0.120	0.118	0.155	0.161	0.161	0.377	0.389	0.384
47	483	0.115	0.119	0.118	0.158	0.161	0.163	0.377	0.389	0.384
48	494	0.115	0.119	0.117	0.157	0.161	0.162	0.377	0.389	0.384
49	501	0.115	0.120	0.118	0.158	0.161	0.163	0.378	0.389	0.385
50	507	0.115	0.120	0.118	0.159	0.162	0.163	0.378	0.390	0.385
51	522	0.115	0.119	0.118	0.158	0.161	0.162	0.378	0.389	0.385
52	528	0.115	0.119	0.118	0.158	0.161	0.162	0.378	0.389	0.385
53	535	0.115	0.120	0.118	0.158	0.161	0.162	0.377	0.389	0.385
54	541	0.115	0.119	0.118	0.153	0.160	0.161	0.377	0.389	0.385
55	554	0.115	0.119	0.119	0.155	0.162	0.161	0.378	0.389	0.385
56	564	0.115	0.118	0.118	0.157	0.160	0.161	0.377	0.388	0.385

## Classification Table

Data Role=TRAIN Target Variable=Churn Target Label=Churn

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	84.3087	99.1398	2305	81.8828
1	0	15.6913	87.5510	429	15.2398
0	1	24.6914	0.8602	20	0.7105
1	1	75.3086	12.4490	61	2.1670

Data Role=VALIDATE Target Variable=Churn Target Label=Churn

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	83.9397	99.4220	1892	82.0468
1	0	16.0603	89.8263	362	15.6982
0	1	21.1538	0.5780	11	0.4770
1	1	78.8462	10.1737	41	1.7780

#### Event Classification Table

Data Role=TRAIN Target=Churn Target Label=Churn

False Negative	True Negative	False Positive	True Positive
429	2305	20	61

Data Role=VALIDATE Target=Churn Target Label=Churn

False Negative	True Negative	False Positive	True Positive
362	1892	11	41

### Best Model: Decision Tree

Metrics	Decision Tree 55:45	
	Train	Validate
Precision	0.670	0.740
Recall	0.253	0.233
F1-Score	0.367	0.355
Accuracy	0.848	0.852
Specificity	0.974	0.983

### Analysis:

My model's ability to predict non-churning customers far exceeds its ability to predict churning customers, indicating that non-churning customers likely exhibit some consistent characteristics, while predicting churn may involve a broader spectrum of factors. To improve predictions, a more complex analysis incorporating additional attributes is needed.

In terms of ensemble methods, both Gradient Boosting and HP Forest models utilize collections of weak prediction models to enhance accuracy. These models usually excel in handling complex datasets and uncovering non-linear relationships. However, in my case, a single decision tree model outperformed these more complex ensemble models in predicting customer churn. This finding emphasizes that model complexity does not always lead to better outcomes, and sometimes the intuitiveness and interpretability of simpler models better meet business needs.

The decision tree model, with its principle of finding the most significant split

points within data features, identified 'LastPurchaseDate', 'Complain', 'PreferredOrderCat', 'MaritalStatus', and others as significant predictors of customer churn. Relying on the efficiency of the decision tree in choosing branch points and the interpretability of the results, it is more suitable for providing clear action directions for businesses to reduce customer churn rates.