Minimum detection limit (MDL) of six hyperspectral features on four modeling ratios on the 24 testing sets.

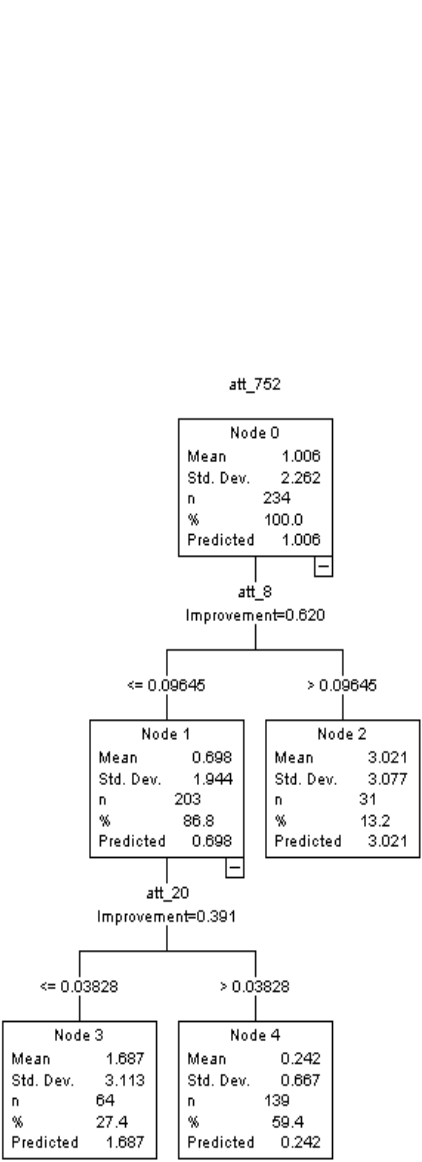1. Analysis of the MDLs for different modeling ratios under the original spectral value (R).

att_752

Node 0
Mean	1.000
Std. Dev.	2.240
n	312
%	100.0
Predicted	1.000

att_9
Improvement=0.721

<= 0.10849 | > 0.10849

Node 1
Mean	0.708
Std. Dev.	1.822
n	279
%	89.4
Predicted	0.708

Node 2
Mean	3.470
Std. Dev.	3.591
n	33
%	10.6
Predicted	3.470

att_711
Improvement=0.281

<= 0.36550 | > 0.36550

Node 3
Mean	0.103
Std. Dev.	0.464
n	129
%	41.3
Predicted	0.103

Node 4
Mean	1.228
Std. Dev.	2.327
n	150
%	48.1
Predicted	1.228

att_351
Improvement=0.638

<= 0.04795 | > 0.04795

Node 5
Mean	3.046
Std. Dev.	3.440
n	43
%	13.8
Predicted	3.046

Node 6
Mean	0.498
Std. Dev.	1.023
n	107
%	34.3
Predicted	0.498

att_752

Node 0
Mean	1.006
Std. Dev.	2.262
n	234
%	100.0
Predicted	1.006

att_8
Improvement=0.620

<= 0.09645 | > 0.09645

Node 1
Mean	0.698
Std. Dev.	1.944
n	203
%	86.8
Predicted	0.698

Node 2
Mean	3.021
Std. Dev.	3.077
n	31
%	13.2
Predicted	3.021

att_20
Improvement=0.391

<= 0.03828 | > 0.03828

Node 3
Mean	1.687
Std. Dev.	3.113
n	64
%	27.4
Predicted	1.687

Node 4
Mean	0.242
Std. Dev.	0.667
n	139
%	59.4
Predicted	0.242

Fig 1-1 The decision tree analysis in modeling 1:1   Fig 1-2 The decision tree analysis in modeling 2:1

Fig 1-3 (modeling 3:1)

att_752

Node 0
Mean	1.003
Std. Dev.	2.251
n	351
%	100.0
Predicted	1.003

att_8
Improvement=0.731

<= 0.10134 / > 0.10134

Node 1
Mean	0.684
Std. Dev.	1.857
n	308
%	87.7
Predicted	0.684

Node 2
Mean	3.292
Std. Dev.	3.303
n	43
%	12.3
Predicted	3.292

att_689
Improvement=0.316

<= 0.37374 / > 0.37374

Node 3
Mean	0.099
Std. Dev.	0.358
n	158
%	45.0
Predicted	0.099

Node 4
Mean	1.300
Std. Dev.	2.494
n	150
%	42.7
Predicted	1.300

att_106
Improvement=0.923

<= 0.04669 / > 0.04669

Node 5
Mean	3.964
Std. Dev.	3.686
n	35
%	10.0
Predicted	3.964

Node 6
Mean	0.489
Std. Dev.	1.112
n	115
%	32.8
Predicted	0.489

Fig 1-4 (modeling 4:1)

att_752

Node 0
Mean	1.026
Std. Dev.	2.326
n	375
%	100.0
Predicted	1.026

att_8
Improvement=0.766

<= 0.10143 / > 0.10143

Node 1
Mean	0.699
Std. Dev.	1.859
n	329
%	87.7
Predicted	0.699

Node 2
Mean	3.367
Std. Dev.	3.659
n	46
%	12.3
Predicted	3.367

att_689
Improvement=0.285

<= 0.36688 / > 0.36688

Node 3
Mean	0.131
Std. Dev.	0.520
n	165
%	44.0
Predicted	0.131

Node 4
Mean	1.271
Std. Dev.	2.455
n	164
%	43.7
Predicted	1.271

att_341
Improvement=0.830

<= 0.05280 / > 0.05280

Node 5
Mean	3.351
Std. Dev.	3.506
n	50
%	13.3
Predicted	3.351

Node 6
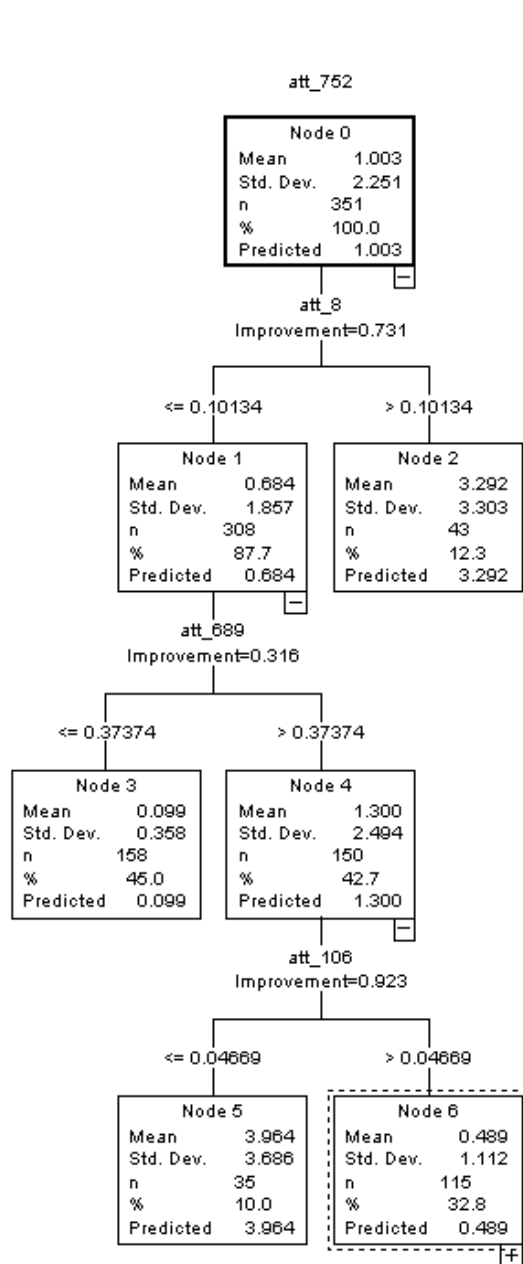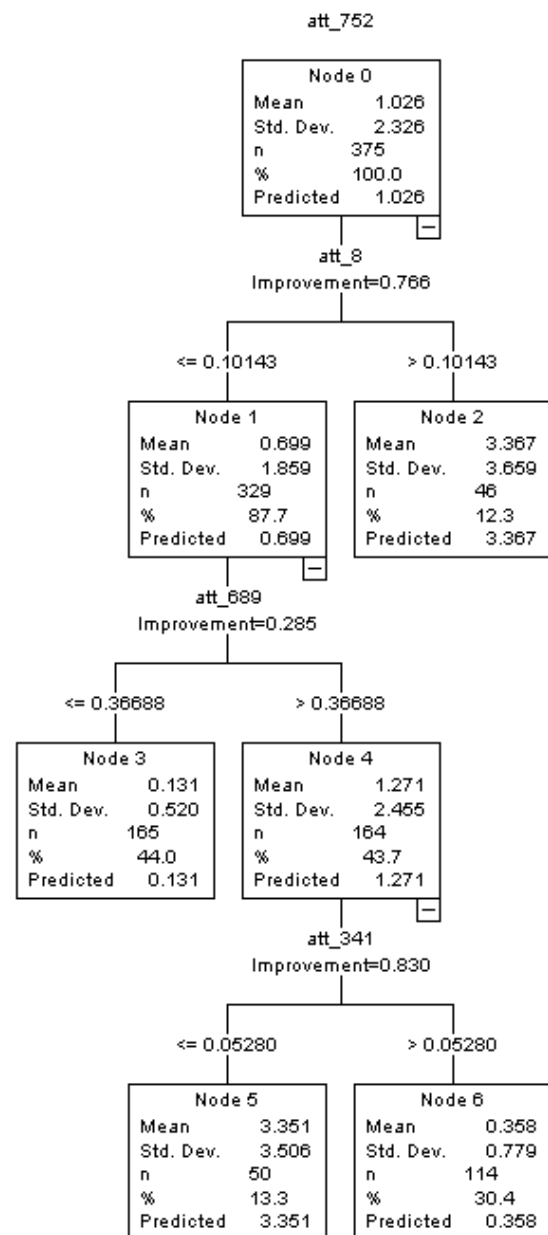|	
Mean	0.358
Std. Dev.	0.779
n	114
%	30.4
Predicted	0.358

Fig 1-3 The decision tree analysis in modeling 3:1   Fig 1-4 The decision tree analysis in modeling 4:1

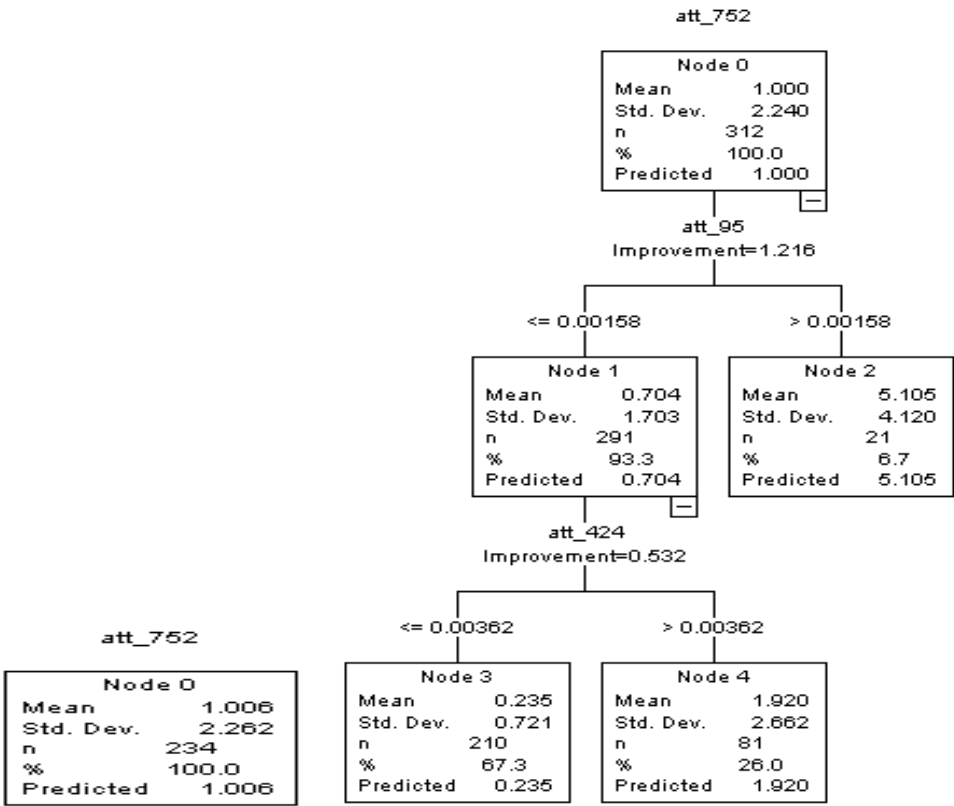2. Analysis of the MDL for different modeling ratios under the R_1st.dv.

att_752

Node 0
Mean	1.000
Std. Dev.	2.240
n	312
%	100.0
Predicted	1.000

att_95
Improvement=1.216

<= 0.00158   > 0.00158

Node 1
Mean	0.704
Std. Dev.	1.703
n	291
%	93.3
Predicted	0.704

Node 2
Mean	5.105
Std. Dev.	4.120
n	21
%	6.7
Predicted	5.105

att_424
Improvement=0.532

att_752

<= 0.00362   > 0.00362

Node 0
Mean	1.006
Std. Dev.	2.262
n	234
%	100.0
Predicted	1.006

Node 3
Mean	0.235
Std. Dev.	0.721
n	210
%	67.3
Predicted	0.235

Node 4
Mean	1.920
Std. Dev.	2.662
n	81
%	26.0
Predicted	1.920

Fig 2-1 The decision tree analysis in modeling 1:1   Fig 2-2 The decision tree analysis in modeling 2:1
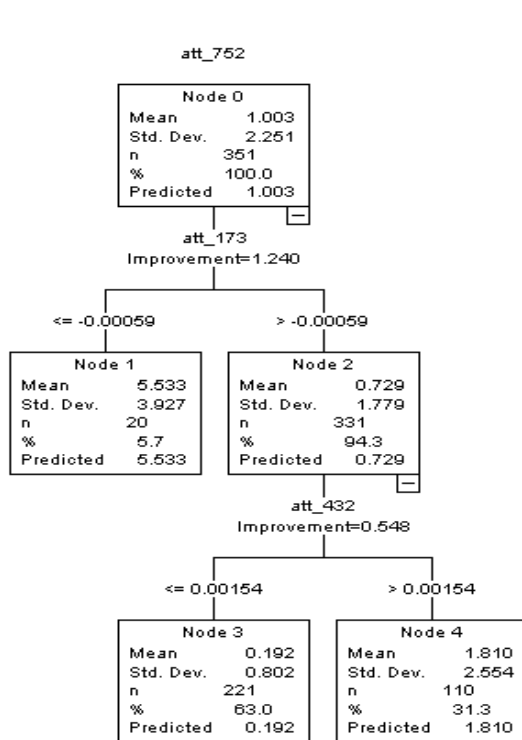
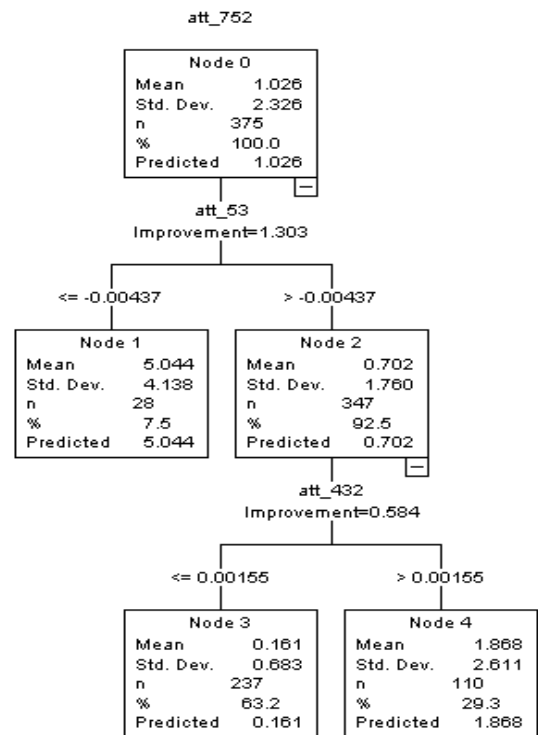Fig 2-3 The decision tree analysis in modeling 3:1   Fig 2-4 The decision tree analysis in modeling 4:1

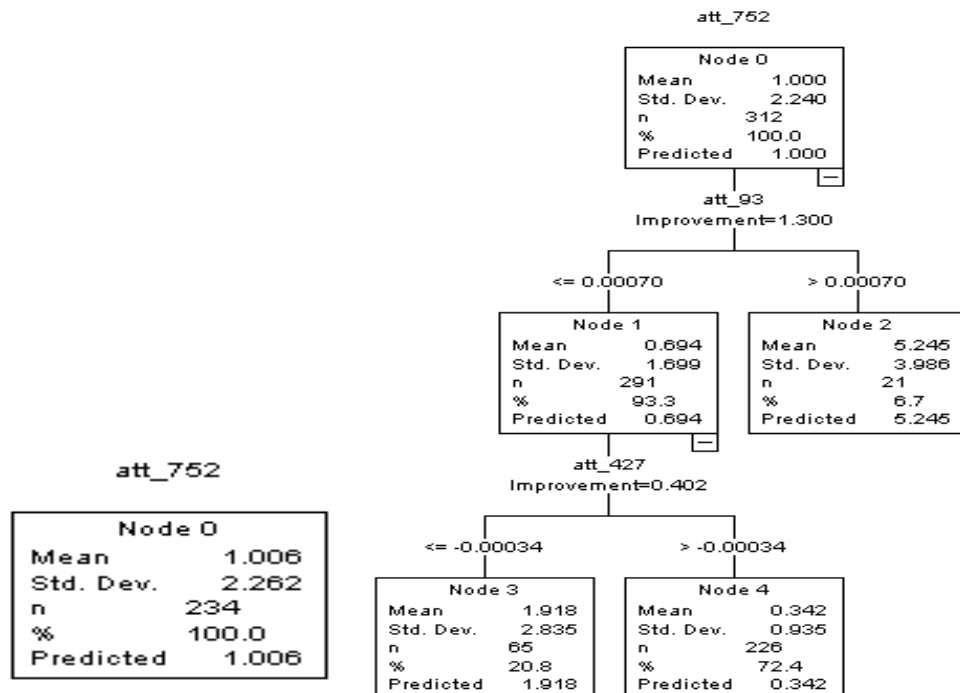3. Analysis of the MDL for different modeling ratios under the R_2nd.dv.

Fig 3-1 The decision tree analysis in modeling 1:1   Fig 3-2 The decision tree analysis in modeling 2:1

4

att_752

Node 0
Mean	1.003
Std. Dev.	2.251
n	351
%	100.0
Predicted	1.003

att_69
Improvement=1.174

<= -0.00130   > -0.00130

Node 1
Mean	5.297
Std. Dev.	3.994
n	21
%	6.0
Predicted	5.297

Node 2
Mean	0.730
Std. Dev.	1.780
n	330
%	94.0
Predicted	0.730

att_399
Improvement=0.435

<= 0.00014   > 0.00014

Node 3
Mean	0.239
Std. Dev.	0.840
n	217
%	61.8
Predicted	0.239

Node 4
Mean	1.673
Std. Dev.	2.565
n	113
%	32.2
Predicted	1.673

att_752

Node 0
Mean	1.026
Std. Dev.	2.326
n	375
%	100.0
Predicted	1.026

att_51
Improvement=1.265

<= -0.00210   > -0.00210

Node 1
Mean	5.531
Std. Dev.	4.280
n	22
%	5.9
Predicted	5.531

Node 2
Mean	0.746
Std. Dev.	1.819
n	353
%	94.1
Predicted	0.746

att_399
Improvement=0.538

<= 0.00015   > 0.00015

Node 3
Mean	0.223
Std. Dev.	0.831
n	239
%	63.7
Predicted	0.223

Node 4
Mean	1.841
Std. Dev.	2.658
n	114
%	30.4
Predicted	1.841

att_598
Improvement=0.485

<= 0.00053   > 0.00053

Node 5
Mean	1.258
Std. Dev.	1.954
n	94
%	25.1
Predicted	1.258

Node 6
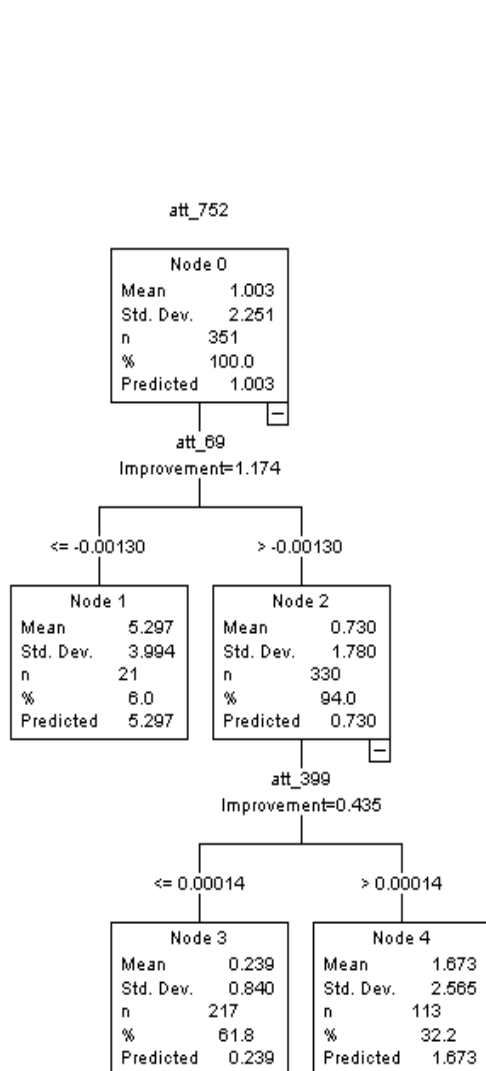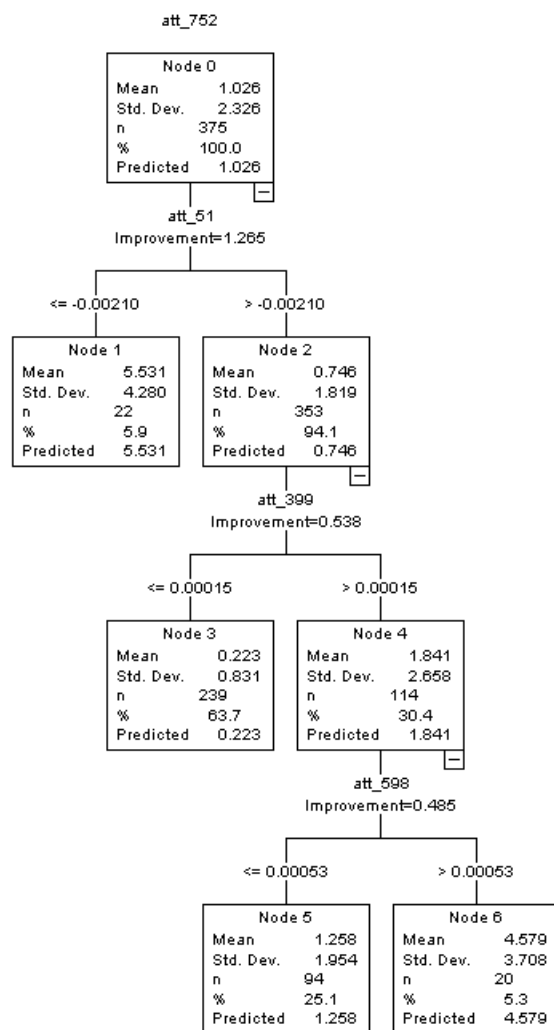|	
Mean	4.579
Std. Dev.	3.708
n	20
%	5.3
Predicted	4.579

Fig 3-3 The decision tree analysis in modeling 3:1   Fig 3-4   The decision tree analysis in modeling 4:1

4. Analysis of the MDL for different modeling ratios under the lg(1/R).

att_752

Node 0	
Mean	1.000
Std. Dev.	2.240
n	312
%	100.0
Predicted	1.000

att_9
Improvement=0.721

<= 0.96463   > 0.96463

Node 1	
Mean	3.470
Std. Dev.	3.591
n	33
%	10.6
Predicted	3.470

Node 2	
Mean	0.708
Std. Dev.	1.822
n	279
%	89.4
Predicted	0.708

att_711
Improvement=0.281

<= 0.43711   > 0.43711

Node 3	
Mean	1.228
Std. Dev.	2.327
n	150
%	48.1
Predicted	1.228

Node 4	
Mean	0.103
Std. Dev.	0.464
n	129
%	41.3
Predicted	0.103

att_351
Improvement=0.638

<= 1.31919   > 1.31919

Node 5	
Mean	0.498
Std. Dev.	1.023
n	107
%	34.3
Predicted	0.498

Node 6	
Mean	3.046
Std. Dev.	3.440
n	43
%	13.8
Predicted	3.046

att_752

Node 0	
Mean	1.006
Std. Dev.	2.262
n	234
%	100.0
Predicted	1.006

att_8
Improvement=0.620

<= 1.01570   > 1.01570

Node 1	
Mean	3.021
Std. Dev.	3.077
n	31
%	13.2
Predicted	3.021

Node 2	
Mean	0.698
Std. Dev.	1.944
n	203
%	86.8
Predicted	0.698

att_20
Improvement=0.391

<= 1.41708   > 1.41708

Node 3	
Mean	0.242
Std. Dev.	0.667
n	139
%	59.4
Predicted	0.242

Node 4	
Mean	1.687
Std. Dev.	3.113
n	64
%	27.4
Predicted	1.687

Fig 4-1 The decision tree analysis in modeling 1:1   Fig 4-2 The decision tree analysis in modeling 2:1

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att_752

Node 0
Mean	1.003
Std. Dev.	2.251
n	351
%	100.0
Predicted	1.003

att_8
Improvement=0.731

<= 0.99421   > 0.99421

Node 1
Mean	3.292
Std. Dev.	3.303
n	43
%	12.3
Predicted	3.292

Node 2
Mean	0.684
Std. Dev.	1.857
n	308
%	87.7
Predicted	0.684

att_689
Improvement=0.316

<= 0.42743   > 0.42743

Node 3
Mean	1.300
Std. Dev.	2.494
n	150
%	42.7
Predicted	1.300

Node 4
Mean	0.099
Std. Dev.	0.358
n	158
%	45.0
Predicted	0.099

att_106
Improvement=0.923

<= 1.33074   > 1.33074

Node 5
Mean	0.489
Std. Dev.	1.112
n	115
%	32.8
Predicted	0.489

Node 6
Mean	3.964
Std. Dev.	3.686
n	35
%	10.0
Predicted	3.964

att_752

Node 0
Mean	1.026
Std. Dev.	2.326
n	375
%	100.0
Predicted	1.026

att_8
Improvement=0.766

<= 0.99384   > 0.99384

Node 1
Mean	3.367
Std. Dev.	3.659
n	46
%	12.3
Predicted	3.367

Node 2
Mean	0.699
Std. Dev.	1.859
n	329
%	87.7
Predicted	0.699

att_689
Improvement=0.285

<= 0.43548   > 0.43548

Node 3
Mean	1.271
Std. Dev.	2.455
n	164
%	43.7
Predicted	1.271

Node 4
Mean	0.131
Std. Dev.	0.520
n	165
%	44.0
Predicted	0.131

att_341
Improvement=0.830

<= 1.27739   > 1.27739

Node 5
Mean	0.358
Std. Dev.	0.779
n	114
%	30.4
Predicted	0.358

Node 6
Mean	3.351
Std. Dev.	3.506
n	50
%	13.3
Predicted	3.351

Fig 4-3 The decision tree analysis in modeling 3:1   Fig 4-4 The decision tree analysis in modeling 4:1

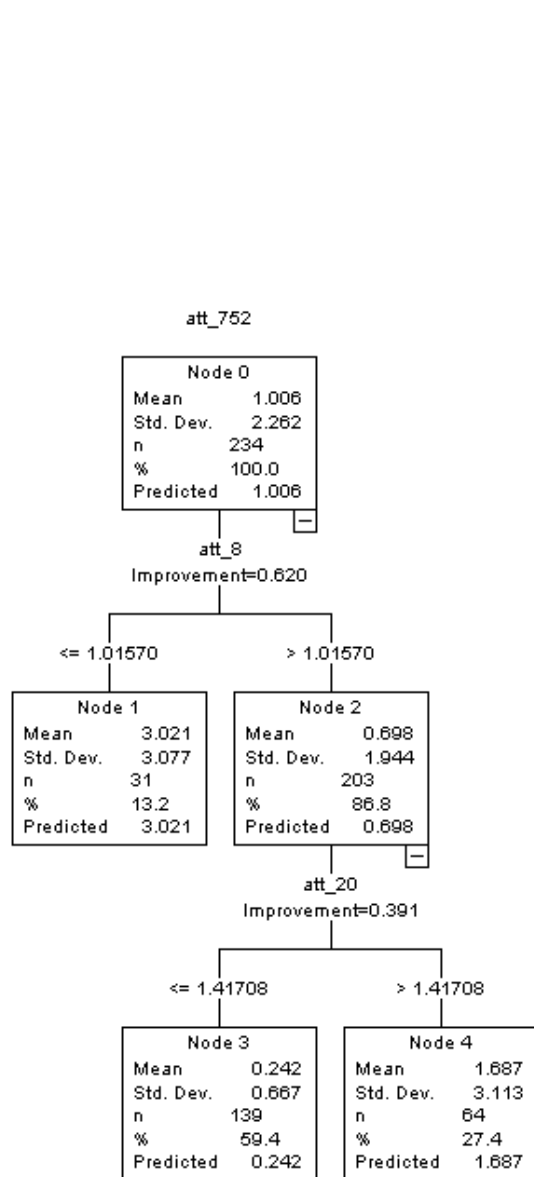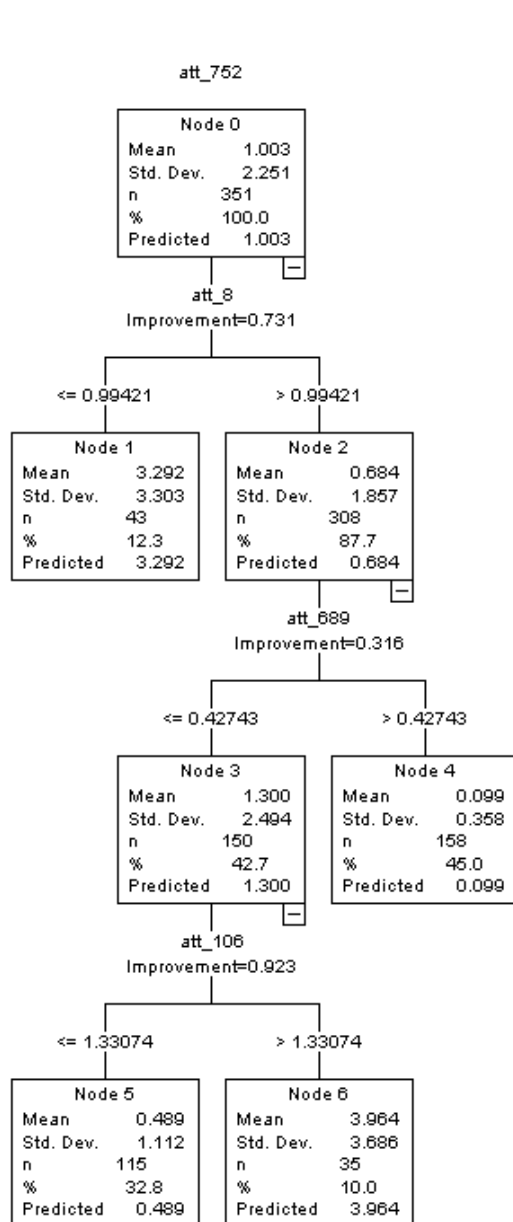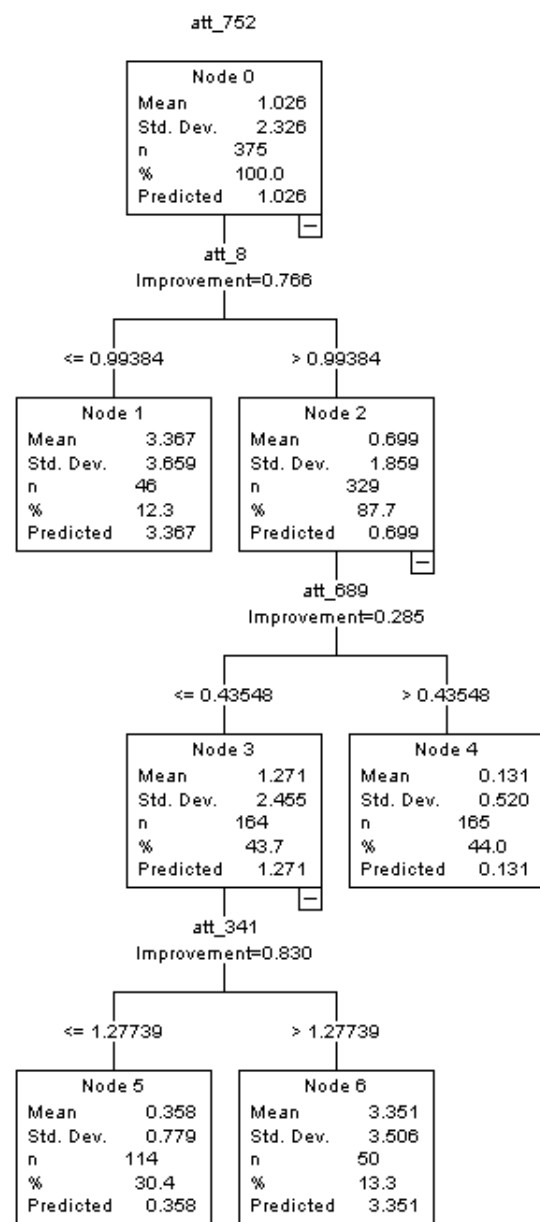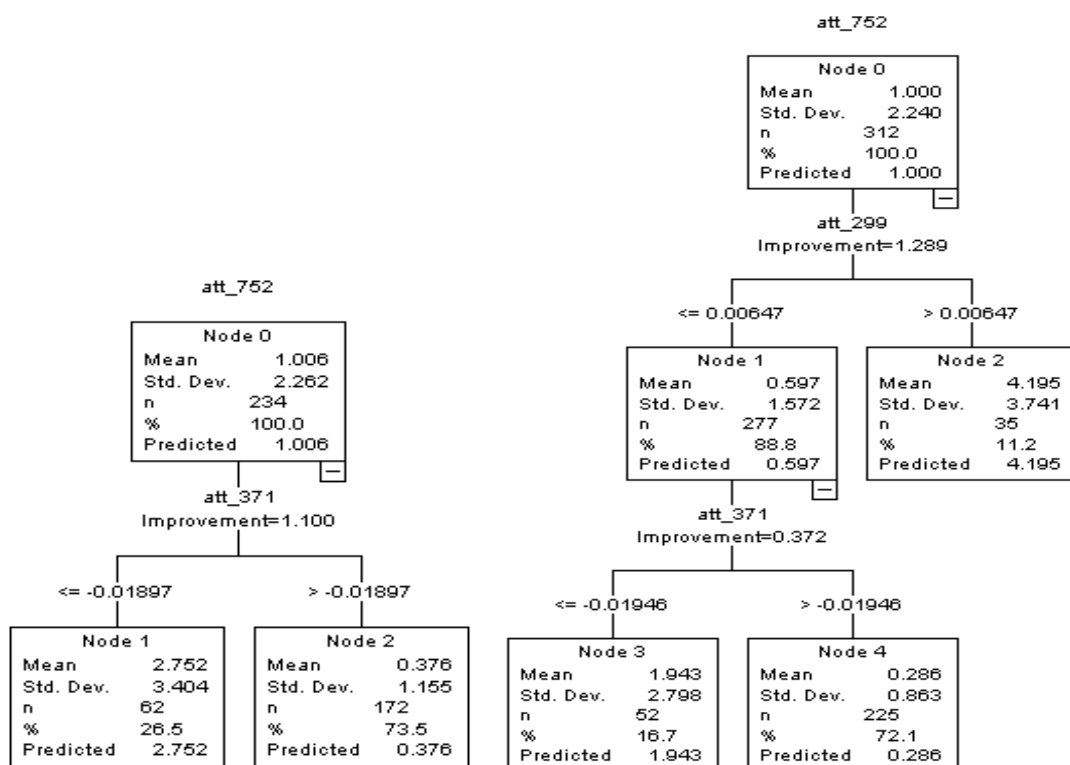5. Analysis of the MDL for different modeling ratios under the lg(1/R)_1st.dv]:

att_752

Node 0	
Mean	1.000
Std. Dev.	2.240
n	312
%	100.0
Predicted	1.000

att_299
Improvement=1.289

<= 0.00647   > 0.00647

Node 1			Node 2	
Mean	0.597		Mean	4.195
Std. Dev.	1.572		Std. Dev.	3.741
n	277		n	35
%	88.8		%	11.2
Predicted	0.597		Predicted	4.195

att_371
Improvement=0.372

<= -0.01946   > -0.01946

Node 3			Node 4	
Mean	1.943		Mean	0.286
Std. Dev.	2.798		Std. Dev.	0.863
n	52		n	225
%	16.7		%	72.1
Predicted	1.943		Predicted	0.286

att_752

Node 0	
Mean	1.006
Std. Dev.	2.262
n	234
%	100.0
Predicted	1.006

att_371
Improvement=1.100

<= -0.01897   > -0.01897

Node 1			Node 2	
Mean	2.752		Mean	0.376
Std. Dev.	3.404		Std. Dev.	1.155
n	62		n	172
%	26.5		%	73.5
Predicted	2.752		Predicted	0.376

Fig 5-1 The decision tree analysis in modeling 1:1   Fig 5-2 The decision tree analysis in modeling 2:1

att_752

Node 0	
Mean	1.003
Std. Dev.	2.251
n	351
%	100.0
Predicted	1.003

att_330
Improvement=1.026

<= 0.00598   > 0.00598

Node 1			Node 2	
Mean	0.448		Mean	2.853
Std. Dev.	1.313		Std. Dev.	3.445
n	270		n	81
%	76.9		%	23.1
Predicted	0.448		Predicted	2.853

att_752

Node 0	
Mean	1.026
Std. Dev.	2.326
n	375
%	100.0
Predicted	1.026

att_208
Improvement=1.188

<= -0.01257   > -0.01257

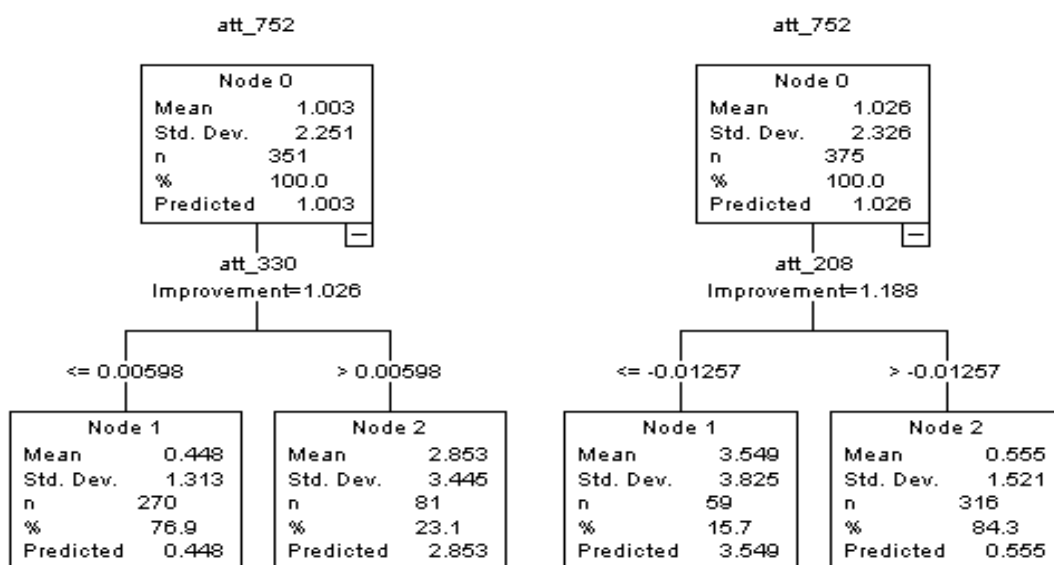| Node 1			Node 2	
Mean	3.549		Mean	0.555
Std. Dev.	3.825		Std. Dev.	1.521
n	59		n	316
%	15.7		%	84.3
Predicted	3.549		Predicted	0.555

Fig 5-3 The decision tree analysis in modeling 3:1   Fig 5-4 The decision tree analysis in modeling 4:1

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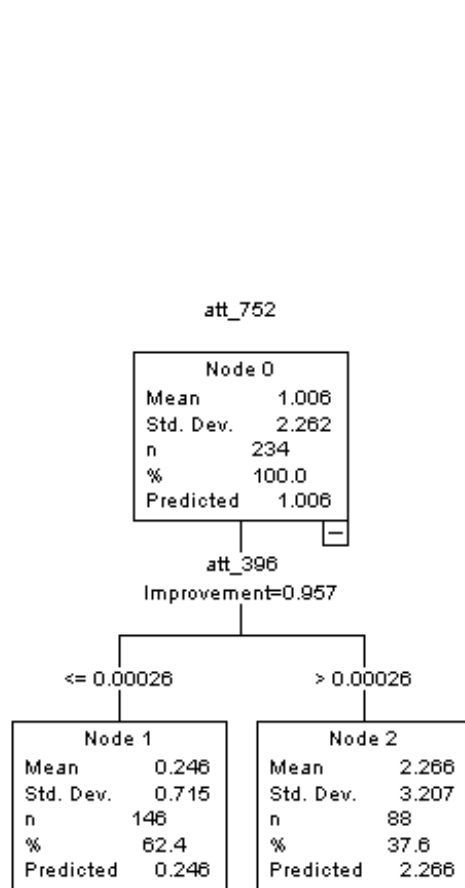6. Analysis of the MDL for different modeling ratios under the lg(1/R)_2nd.dv：

att_752

```
           Node 0
Mean            1.000
Std. Dev.       2.240
n                312
%              100.0
Predicted       1.000
```

att_266
Improvement=1.154

<= -0.00170   > -0.00170

```
       Node 1                    Node 2
Mean        4.809        Mean        0.697
Std. Dev.   3.905        Std. Dev.   1.733
n             23         n            289
%            7.4         %           92.6
Predicted   4.809        Predicted   0.697
```

att_368
Improvement=0.421

<= -0.00228   > -0.00228

```
       Node 3                    Node 4
Mean        1.846        Mean        0.302
Std. Dev.   2.635        Std. Dev.   1.028
n             74         n            215
%           23.7         %           68.9
Predicted   1.846        Predicted   0.302
```

att_752

```
           Node 0
Mean            1.006
Std. Dev.       2.262
n                234
%              100.0
Predicted       1.006
```

att_396
Improvement=0.957

<= 0.00026   > 0.00026

```
       Node 1                    Node 2
Mean        0.246        Mean        2.266
Std. Dev.   0.715        Std. Dev.   3.207
n            146         n             88
%           62.4         %           37.6
Predicted   0.246        Predicted   2.266
```

Fig 6-1 The decision tree analysis in modeling 1:1   Fig 6-2 The decision tree analysis in modeling 2:1

att_752

Node 0

Mean	1.026
Std. Dev.	2.326
n	375
%	100.0
Predicted	1.026

att_266
Improvement=1.503

<= -0.00169   > -0.00169

Node 1

Mean	5.342
Std. Dev.	4.200
n	28
%	7.5
Predicted	5.342

Node 2

Mean	0.678
Std. Dev.	1.686
n	347
%	92.5
Predicted	0.678

att_396
Improvement=0.439

<= 0.00026   > 0.00026

Node 3

Mean	0.246
Std. Dev.	0.745
n	249
%	66.4
Predicted	0.246

Node 4

Mean	1.775
Std. Dev.	2.650
n	98
%	26.1
Predicted	1.775

att_120
Improvement=0.069

<= -0.00154   > -0.00154

Node 5

Mean	1.191
Std. Dev.	1.578
n	26
%	6.9
Predicted	1.191

Node 6

Mean	0.136
Std. Dev.	0.472
n	223
%	59.5
Predicted	0.136

att_752

Node 0

Mean	1.003
Std. Dev.	2.251
n	351
%	100.0
Predicted	1.003

att_439
Improvement=0.960

<= 0.00040   > 0.00040

Node 1

Mean	0.704
Std. Dev.	1.764
n	321
%	91.5
Predicted	0.704

Node 2

Mean	4.207
Std. Dev.	3.895
n	30
%	8.5
Predicted	4.207

att_396
Improvement=0.431

<= 0.00026   > 0.00026

Node 3

Mean	0.272
Std. Dev.	0.824
n	230
%	65.5
Predicted	0.272

Node 4

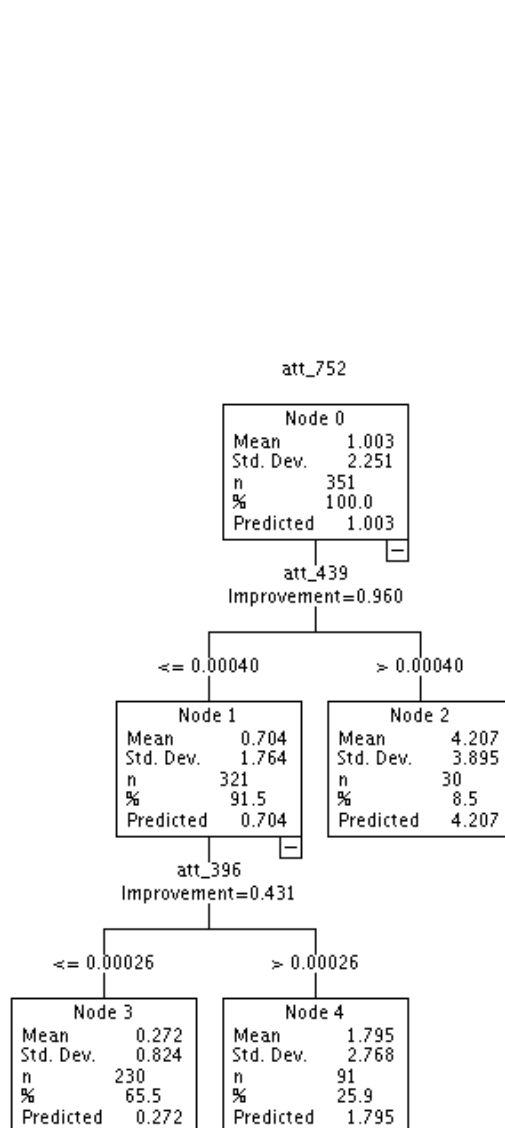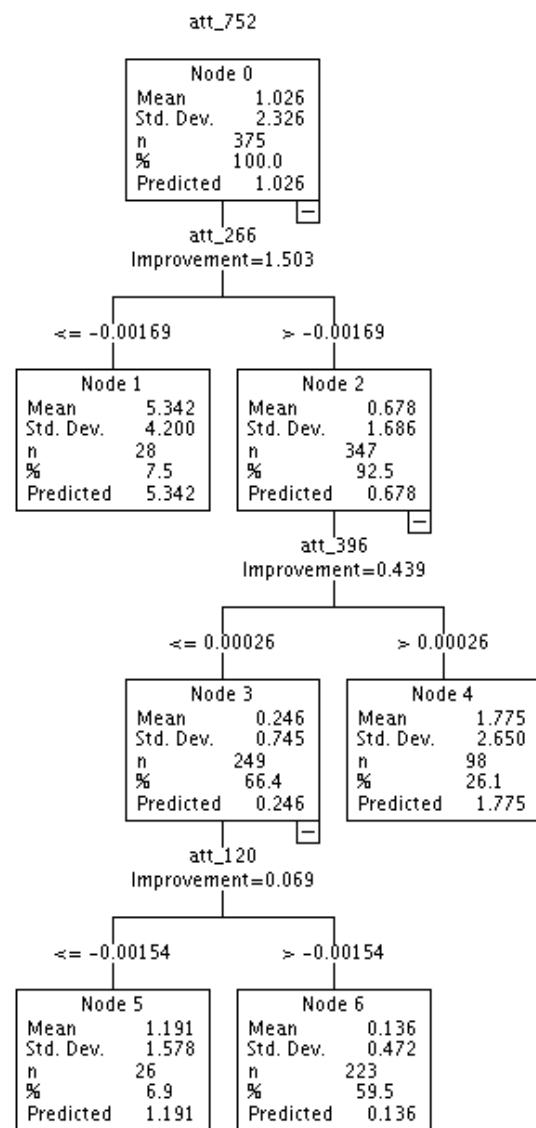| Mean | 1.795 |
Std. Dev.	2.768
n	91
%	25.9
Predicted	1.795

Fig 6-3 The decision tree analysis in modeling 3:1   Fig 6-4 The decision tree analysis in modeling 4:1

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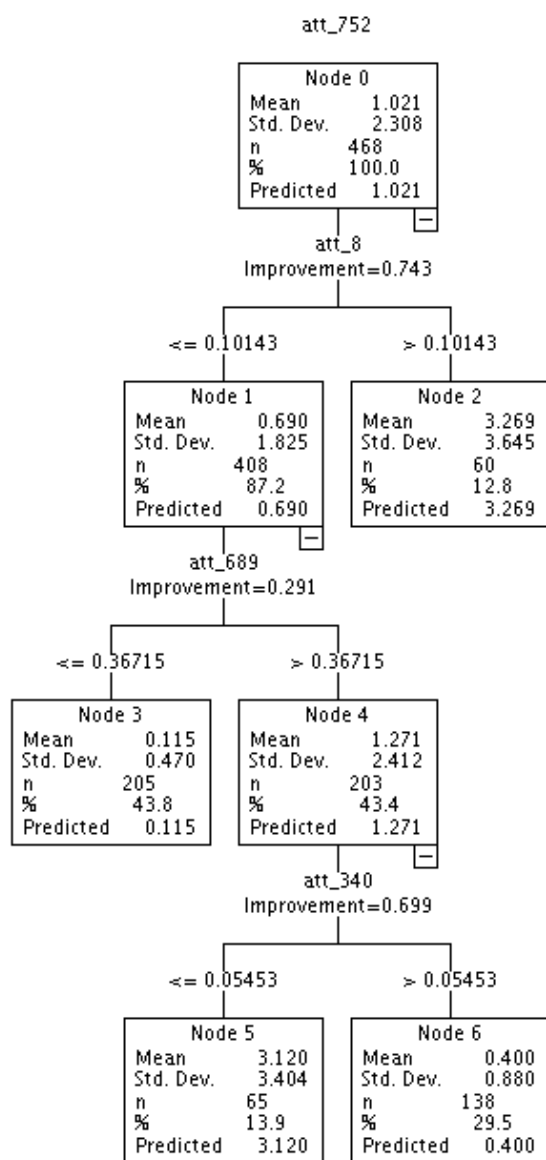**MDLs of different hyperspectral features on the six complete datasets：**

att_752

Node 0
Mean	1.021
Std. Dev.	2.308
n	468
%	100.0
Predicted	1.021

att_8
Improvement=0.743

<= 0.10143   > 0.10143

Node 1
Mean	0.690
Std. Dev.	1.825
n	408
%	87.2
Predicted	0.690

Node 2
Mean	3.269
Std. Dev.	3.645
n	60
%	12.8
Predicted	3.269

att_689
Improvement=0.291

<= 0.36715   > 0.36715

Node 3
Mean	0.115
Std. Dev.	0.470
n	205
%	43.8
Predicted	0.115

Node 4
Mean	1.271
Std. Dev.	2.412
n	203
%	43.4
Predicted	1.271

att_340
Improvement=0.699

<= 0.05453   > 0.05453

Node 5
Mean	3.120
Std. Dev.	3.404
n	65
%	13.9
Predicted	3.120

Node 6
Mean	0.400
Std. Dev.	0.880
n	138
%	29.5
Predicted	0.400

att_752

Node 0
Mean	1.021
Std. Dev.	2.308
n	468
%	100.0
Predicted	1.021

att_53
Improvement=1.294

<= -0.00443   > -0.00443

Node 1
Mean	5.021
Std. Dev.	4.302
n	35
%	7.5
Predicted	5.021

Node 2
Mean	0.698
Std. Dev.	1.703
n	433
%	92.5
Predicted	0.698

att_432
Improvement=0.518

<= 0.00154   > 0.00154

Node 3
Mean	0.177
Std. Dev.	0.751
n	292
%	62.4
Predicted	0.177

Node 4
Mean	1.775
Std. Dev.	2.459
n	141
%	30.1
Predicted	1.775

Fig 7-1 The decision tree analysis of R   Fig 7-2   The decision tree analysis of R-dv1

att_752

```
           Node 0
Mean            1.021
Std. Dev.       2.308
n               468
%               100.0
Predicted       1.021
```

att_171
Improvement=1.354

<= -0.00022   > -0.00022

```
           Node 1                        Node 2
Mean            5.113          Mean            0.690
Std. Dev.       4.229          Std. Dev.       1.699
n               35             n               433
%               7.5            %               92.5
Predicted       5.113          Predicted       0.690
```

att_399
Improvement=0.350

<= 0.00015   > 0.00015

```
           Node 3                        Node 4
Mean            0.260          Mean            1.571
Std. Dev.       0.939          Std. Dev.       2.422
n               291            n               142
%               62.2           %               30.3
Predicted       0.260          Predicted       1.571
```

att_752

```
           Node 0
Mean            1.021
Std. Dev.       2.308
n               468
%               100.0
Predicted       1.021
```

att_8
Improvement=0.743

<= 0.99384   > 0.99384

```
           Node 1                        Node 2
Mean            3.269          Mean            0.690
Std. Dev.       3.645          Std. Dev.       1.825
n               60             n               408
%               12.8           %               87.2
Predicted       3.269          Predicted       0.690
```

att_689
Improvement=0.291

<= 0.43516   > 0.43516

```
           Node 3                        Node 4
Mean            1.271          Mean            0.115
Std. Dev.       2.412          Std. Dev.       0.470
n               203            n               205
%               43.4           %               43.8
Predicted       1.271          Predicted       0.115
```

att_340
Improvement=0.699

<= 1.26338   > 1.26338

```
           Node 5                        Node 6
Mean            0.400          Mean            3.120
Std. Dev.       0.880          Std. Dev.       3.404
n               138            n               65
%               29.5           %               13.9
Predicted       0.400          Predicted       3.120
```

Fig 7-3 The decision tree analysis of R-dv2   Fig 7-4 The decision tree analysis of R-abs

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att_752

Node 0
Mean	1.021
Std. Dev.	2.308
n	468
%	100.0
Predicted	1.021

att_209
Improvement=1.215

<= -0.01334   > -0.01334

Node 1
Mean	5.390
Std. Dev.	4.505
n	28
%	6.0
Predicted	5.390

Node 2
Mean	0.743
Std. Dev.	1.768
n	440
%	94.0
Predicted	0.743

att_491
Improvement=0.441

<= 0.00007   > 0.00007

Node 3
Mean	1.967
Std. Dev.	2.775
n	105
%	22.4
Predicted	1.967

Node 4
Mean	0.359
Std. Dev.	1.044
n	335
%	71.6
Predicted	0.359

att_136
Improvement=0.394

<= -0.00304   > -0.00304

Node 5
Mean	4.277
Std. Dev.	3.659
n	26
%	5.6
Predicted	4.277

Node 6
Mean	1.206
Std. Dev.	1.901
n	79
%	16.9
Predicted	1.206

att_752

Node 0
Mean	1.021
Std. Dev.	2.308
n	468
%	100.0
Predicted	1.021

att_266
Improvement=1.225

<= -0.00166   > -0.00166

Node 1
Mean	4.798
Std. Dev.	4.388
n	37
%	7.9
Predicted	4.798

Node 2
Mean	0.697
Std. Dev.	1.686
n	431
%	92.1
Predicted	0.697

att_396
Improvement=0.339

<= 0.00026   > 0.00026

Node 3
Mean	0.309
Std. Dev.	0.913
n	306
%	65.4
Predicted	0.309

Node 4
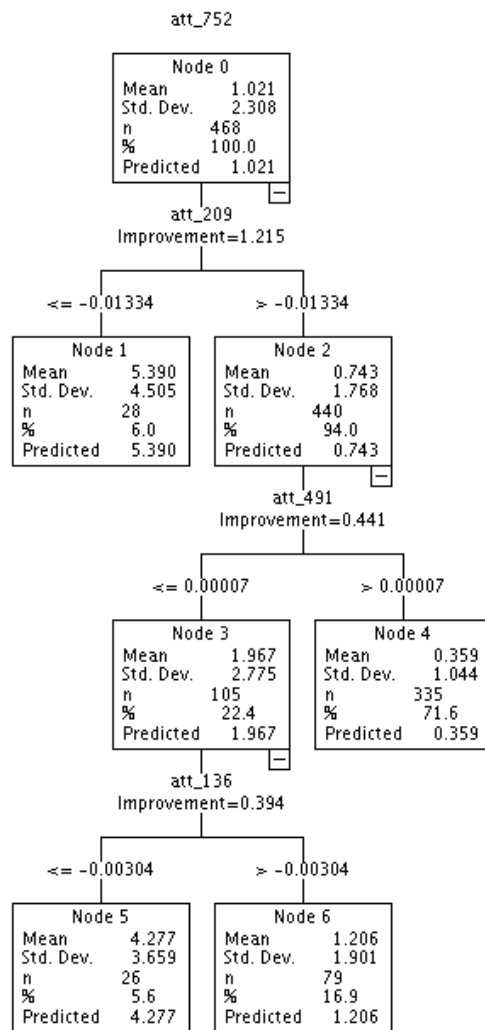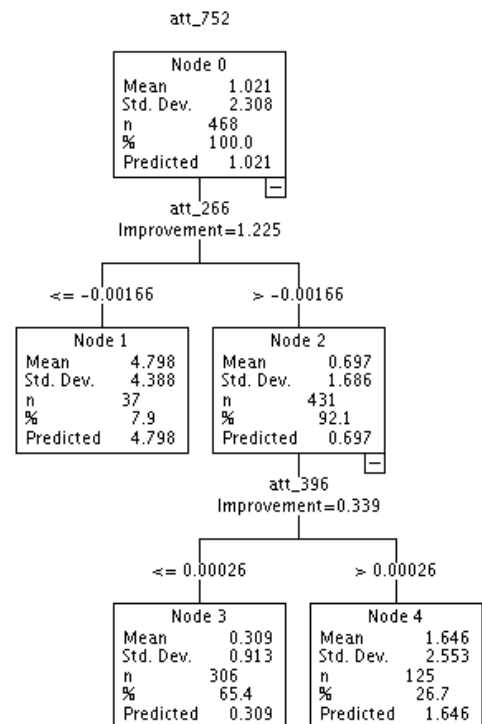| Mean | 1.646 |
Std. Dev.	2.553
n	125
%	26.7
Predicted	1.646

Fig 7-5 The decision tree analysis of R-abs-dv1   Fig 7-6The decision tree analysis of R-abs-dv2