Smart Party Ware
JMP Instructions

Scenario

Applichem is interested in diversifying its portfolio, one of the company it is interested in is Smart Partyware Company. Smart Partyware Company (SPW) is in the niche party ware business, currently with a fixed customer base, and that they sell innovative plastic party ware to their members. Since they sell a plastic product, they may be a good vertical acquisition target.

The Smart Partyware Company's business model is direct-to-consumer marketing. Over the years they have gained dedicated upscale customers and currently have 500,000 members in their database.

In the direct-marketing industry, the response rate is measured as a percentage of customers who buy the directly mailed product. Smart Partyware's historical response rate for direct mail to selected members is approximately 10%—far above the industry average. SPW was using RFM (Recency-Frequency-Monetary) analysis to target customers. Smart Partyware wants to increase the response rate well beyond the 10% rate.

SPW designs new party ware for every campaign, gives a new name to its party ware, and broadly classifies the party ware under one of its many party themes. Most of the designs cut across many themes but are classified into a particular category based on the main design theme in the party ware. The recent product to be marketed is Celebrating American Arts. It has famous American art works printed in the party ware, and even though it falls under the Art Party theme the party ware can be used as well for pool or barbeque or one of the other parties. For analysis purposes, if the member bought the American Arts package, the value of the Art Party variable increases by one.

Exhibit 1: Partial List of Variables in SPW Database

Variable Name	**Description**
Seq#	Sequence number in the partition
ID#	Identification number in the full (partitioned) market test data set
Gender	O = Male 1 = Female
M	Monetary—total money spent on Partyware
R	Recency—months since last purchase
F	Frequency—total number of purchases
FirstPurch	Months since first purchase
Sports Party	Number of purchases from the category: Sports Party
Pool Party	Number of purchases from the category: Pool Party
Barbeque Party	Number of purchases from the category: Pool Party
Birthday Party	Number of purchases from the category: Birthday Party
End-of-School-Term Party	Number of purchases from the category: End-of-School-Year Party
Art Party	Number of purchases from the category: Art Party
Block Party	Number of purchases from the category: Block Party
Cooking Party	Number of purchases of the category: Cooking Party
Get Together	Number of purchases of the category: Get Together
Movie Night	Number of purchases of the category: Movie night
Success	=1 Celebrating American Arts was bought, = 0 if not

Each marketing campaign starts with a trial marketing of 2,000 members: the newly designed party ware is sent to 2,000 randomly selected members from the database, and they have one week to respond. The

packages come with paid return postage; if the member likes it, he or she can keep it, otherwise they have to return it within one week. After two weeks, SPW has all the data it needs to go for mass marketing. The current company policy is not to send packages to more than 100,000 members so that the members do not become tired of repeated marketing campaigns. The members always have the opportunity to visit the SPW Website and buy current and old packages. Most of the old packages are returned packages from marketing campaigns and are sold at discounted values. After analyzing the recent Celebrating American Arts trial marketing data, it is found that 11.2% of the members have bought the new package.

The selling price for the package is $60, the mailing cost is $4.50, and the return mail cost is the same. The total cost of producing the package is $10. If the package is returned, it can be sold at discounted rate or destroyed—historically the expected salvage value has been $15. Based on these assumptions, it is calculated that if the package is mailed to 100,000 randomly selected members then the profit from the marketing campaign will be $154,000, and if they can mine the data perfectly and send only to the members interested in the package they will make $2,548,000. The range is extremely wide—currently, SPW is making an average profit of $700,000 per marketing campaign and a yearly profit of $8.4 million.

Selling price per Product	60
Cost per Product	10
Salvage Value per Product	15
Cost of Mailing the Product	4.5
Cost of Returning the Product	4.5

Based on the Training Data Set,

Level	Count	Prob
Non Buyer	888	0.88800
Buyer	112	0.11200
Total	1000	1.00000

Buyers = 11.2% buyers for this Product and if we assume there are 500,000 potential members, then the total number of Buyers in the 500,000 members is 500,000 * 0.112 = 56,000 Buyers

Profit per Product after mailing cost	60-10-4.5= 45.5
Cost of Mailing the Product to not a buyer	-10-4.5-4.5+15 = -4

The Maximum profit that can be made is 56,000 * 45.5 = $2,548,000, if we mail Product only to the buyers.

If we mail more Products than some of the Products will be returned and it will cost us money. This cost is $4 = (Product cost – Salvage +postage both ways) = (10-15 +9)

Marketing department has suggested it is prudent to mail the Products only to maximum of 100,000 members so the Product club members do not become tired of repeated marketing campaign.

Let us calculate the Baseline profit if we mail Product randomly.

= 100,000 * 0.112 * 45.5 + 100,000 *0.888* (-4) = 154,000

The Low case Scenario is 154,000 and the best case Scenario is $2,548,000

There are two ways to increase our baseline profit, increase the percentage of identification of buyers and reduce the number of Products shipped (the range will be between 56,000 to 100,000).

Our objective is to beat the average profit of $700,000 by using decision tree method or by using the logistic regression method.

Plan of action

Use the recent Celebrating American Arts trial marketing data to prove we can do a better job than RFM analysis.

1. Provide calculations to show that the Maximum profit based on the training data is $2.548 Million
2. Provide calculations to show that the profit based on the training data is $0.154 Million, if 100,000 packages are mailed randomly to members.
3. Build the Best Decision tree Model using JMP (**Go option**) on the following conditions,
   Y = Success
   X = All predictors
   Cutoff Probability for mailing = 0.15
   These Questions are for your reference.
   a. Interpret the decision tree?
   b. Interpret R^2 and how many splits did you have in the model?
   c. Examine each of the split variables to explain whether they make business sense?
   d. Create the confusion matrix for the testing data set. (cutoff Prob. = 0.15)
   e. What is the expected profit based on the confusion matrix.
4. Build the Best Decision tree Model using JMP on the following conditions,
   Y = Success
   X = Any subset of predictors (you can enrich your predictors using transformation or summation or other meaningful methods)
   Cutoff Probability for mailing = any value between 0.12 to 0.25
   These Questions are for your reference.
   a. Interpret the decision tree?
   b. Interpret R^2 and how many splits did you have in the model?
   c. Explain important parts of JMP printout
   d. Examine each of the split variables to explain whether they make business sense?
   e. Create the confusion matrix for the testing data set. (cutoff Prob. = 0.15)
   f. What is the expected profit based on the confusion matrix for training and testing data sets (use the given profit calculator Excel Sheet).
5. Provide your business insight about your best model.

PART 1 – Decision Tree Model(s)

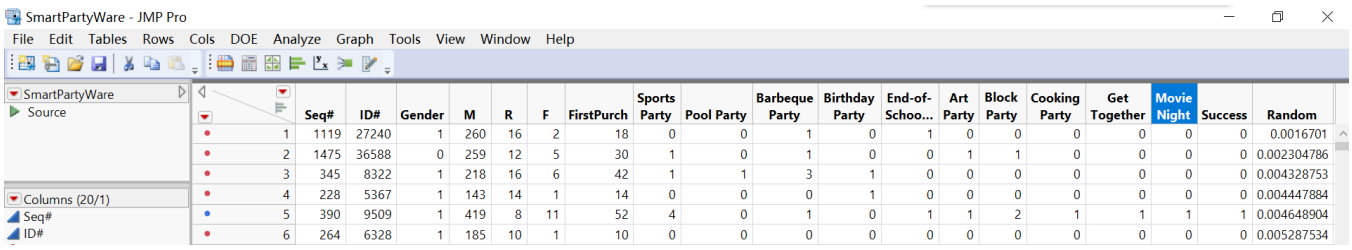
Note 1: The data has been colored based on buyer and non-buyer and divided into training and testing datasets. To create testing and training data set from raw data set, refer to Appendix 1.

Note 2: The process of building a good model is long; it involves the following steps,

a. **Build a decision tree model on the training data set**
b. **Use the decision tree to predict the propensity(probability) of a member buying the product and store it in JMP as columns (for both training & testing data set)**
c. **Use the propensity to decide who will be mailed the product.**
d. **Switch to testing dataset to get confusion matrix.**
e. **Get Confusion matrix.**
f. **Use the confusion matrix to find out how many members were sent the product and how many bought the product**
g. **Use the confusion matrix to get the profit estimate.**

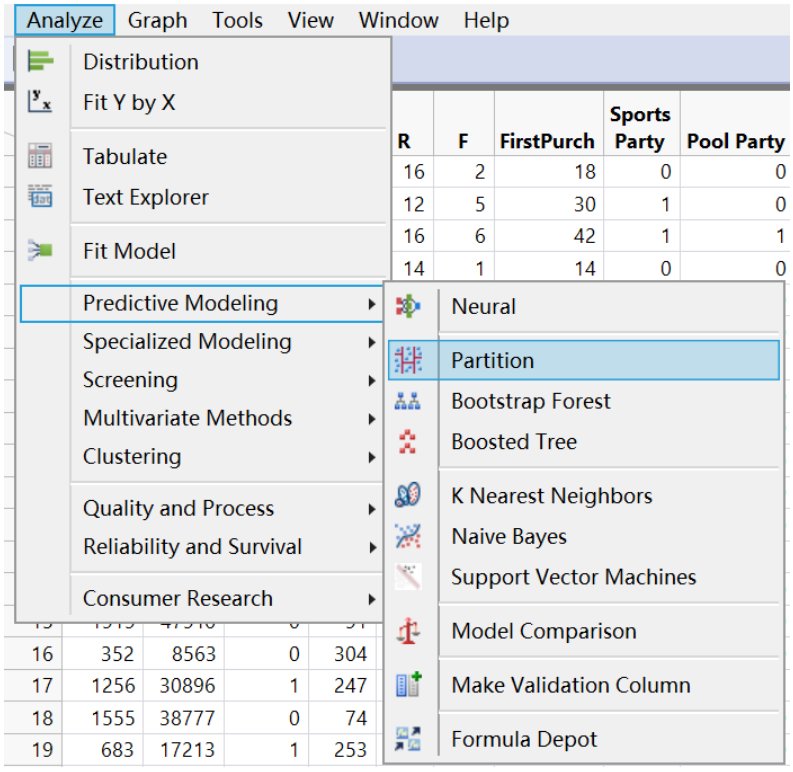
Step A: Build a decision tree model on the training data set (for the first 1000 rows of data)

1. Open the SmartPartyWare_Case2.jmp file in JMP, you should see the following file in JMP
2. You should get a Screen like this.



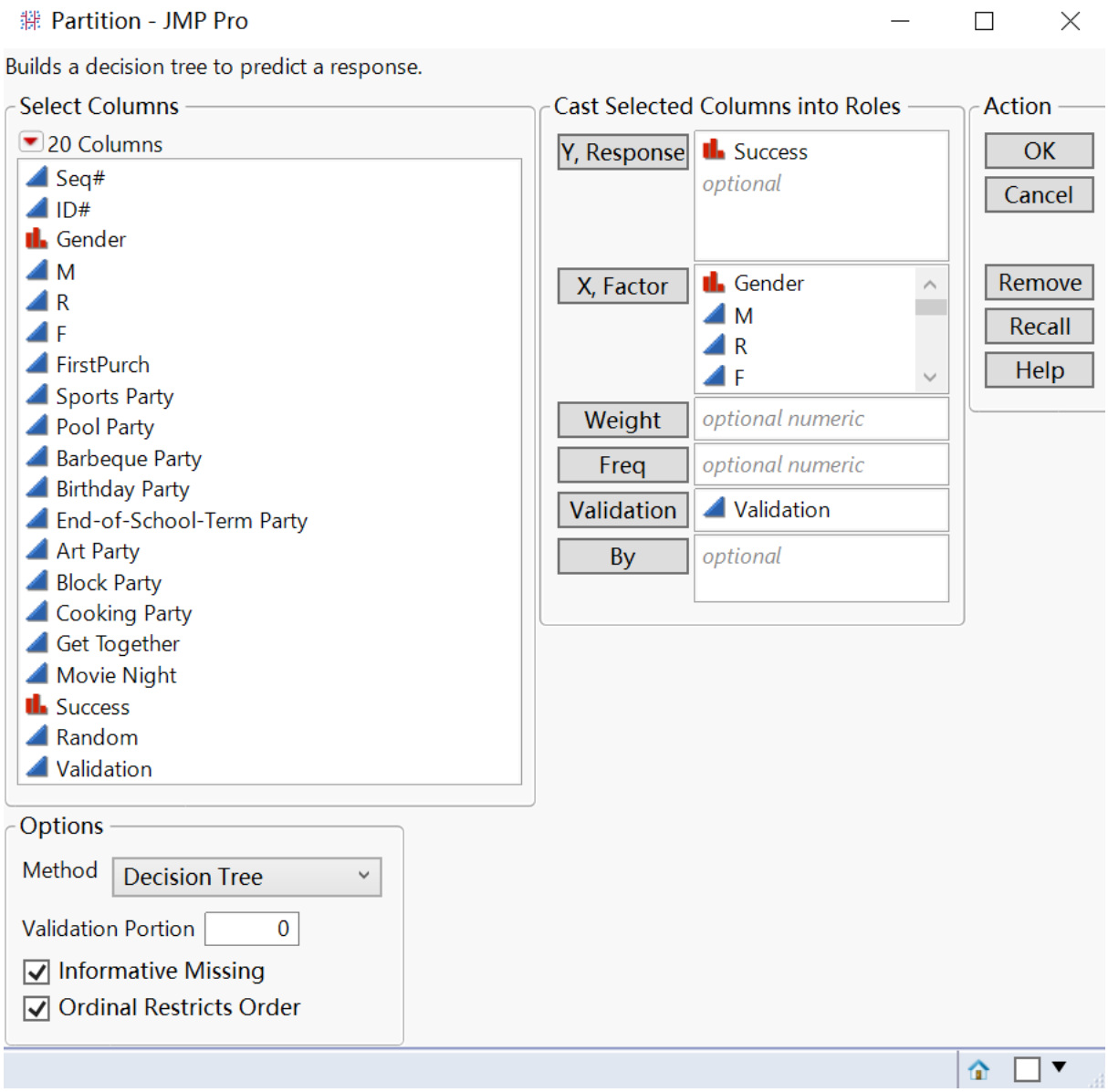
	Seq#	ID#	Gender	M	R	F	FirstPurch	Sports Party	Pool Party	Barbeque Party	Birthday Party	End-of-Schoo...	Art Party	Block Party	Cooking Party	Get Together	Movie Night	Success	Random
1	1119	27240	1	260	16	2	18	0	0	1	0	1	0	0	0	0	0	0	0.0016701
2	1475	36588	0	259	12	5	30	1	0	1	0	0	1	1	0	0	0	0	0.002304786
3	345	8322	1	218	16	6	42	1	1	3	1	0	0	0	0	0	0	0	0.004328753
4	228	5367	1	143	14	1	14	0	0	0	1	0	0	0	0	0	0	0	0.004447884
5	390	9509	1	419	8	11	52	4	0	1	0	1	1	2	1	1	1	1	0.004648904
6	264	6328	1	185	10	1	10	0	0	0	0	0	0	0	0	0	0	0	0.005287534

3. Click,
   Analyze menu→ Predictive Modeling → Partition

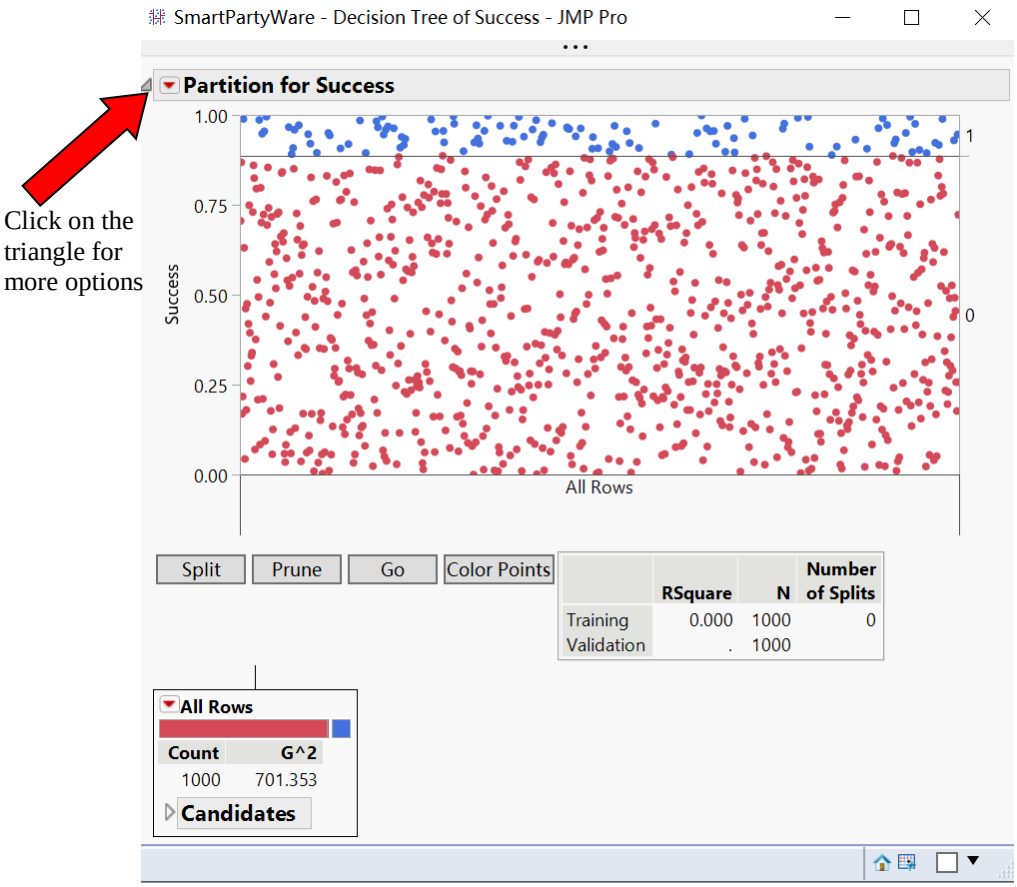


R	F	FirstPurch	Sports Party	Pool Party
16	2	18	0	0
12	5	30	1	0
16	6	42	1	1
14	1	14	0	0
16	352	8563	0	304
17	1256	30896	1	247
18	1555	38777	0	74
19	683	17213	1	253

4. For Y, Response, select Success; for X columns, select from Gender, M, R, F, Movie Night (select all the predictors)， for Validation, select Validation→ OK. (Note: In JMP pro14, you can exclude the last 1000 rows of the dataset, then run the partition without selecting Validation.)

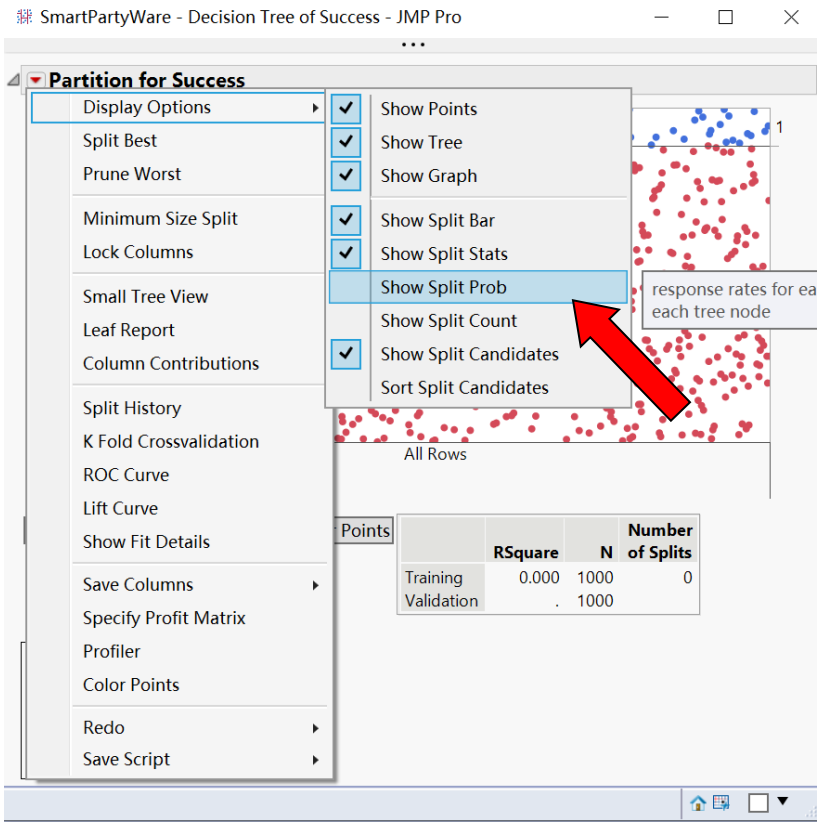


5. The following screen will show up

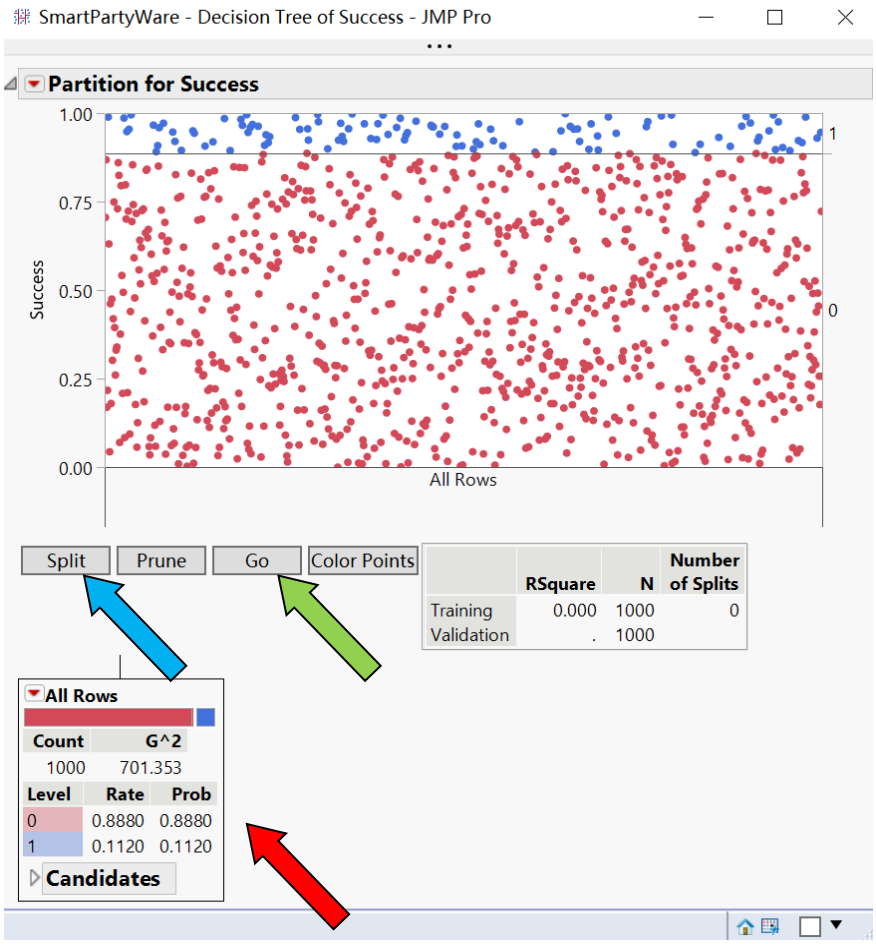


Click on the triangle for more options

6. Click on the red triangle and at the upper left corner → Display options → show Split Prob



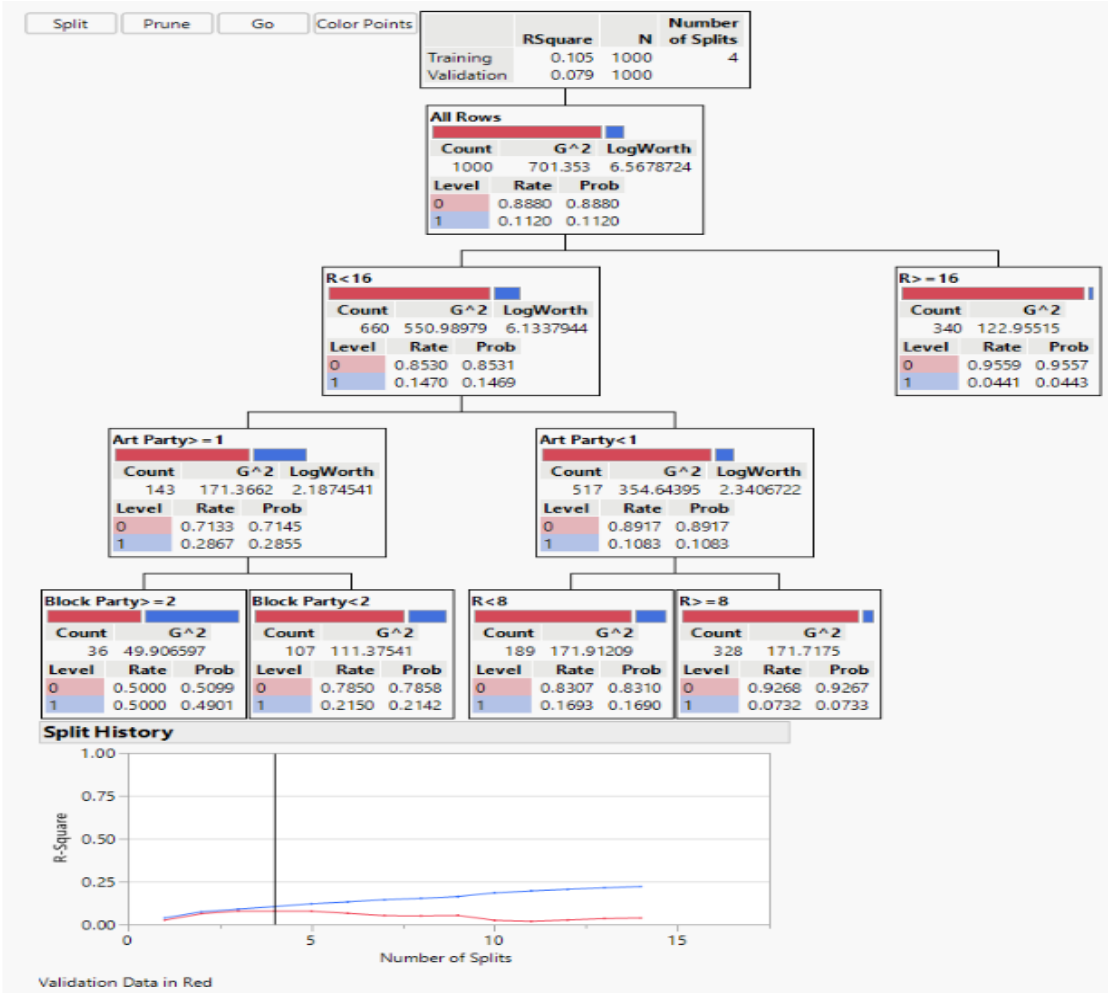
7. The following screen will show up, note the split probabilities are show in the decision tree.



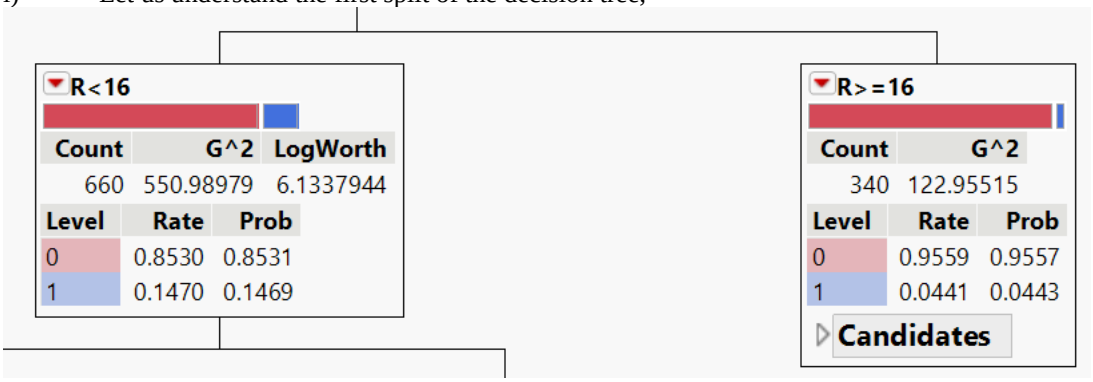
Based on the above printout, the percentage of buyers in the 1000 training dataset is 0.112 or 11.2%

Now we can build the decision tree using "In-built JMP algorithm or manually" , if you click the "Split" repeatedly you will be building the algorithm manually and if you click on Go then JMP will build the decision tree for you.

1. Click on Go and you will get the following decision tree. The JMP algorithm finds the best decision tree that will do a good job on the training data set and testing data set based on the "R-square" KPI, the decision tree algorithm may not be the best choice for our objective of maximizing the profit. To maximize the profit you have to send as many products as possible (at most 100,000) at the same time select members with high propensity.



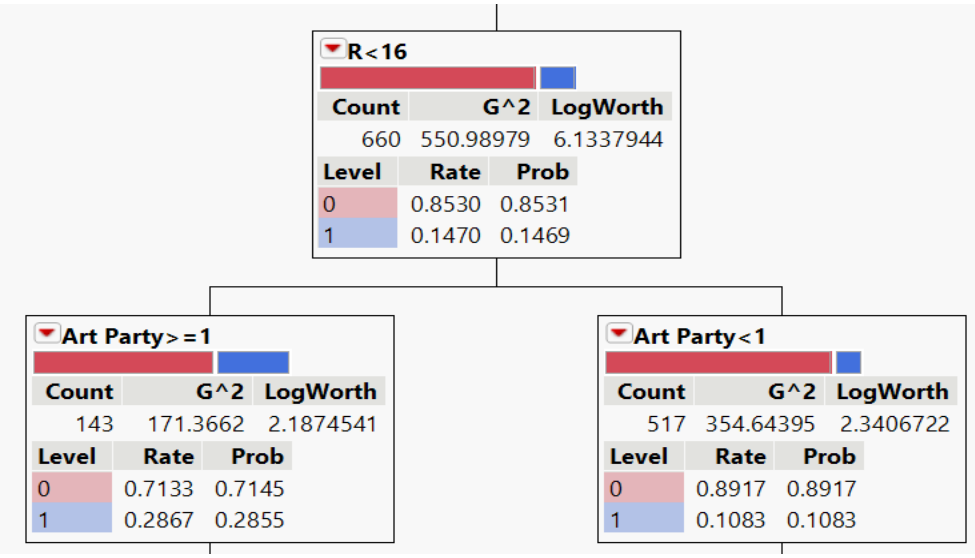
i) Let us understand the first split of the decision tree,



The first split states that if you mail books to members with

a. Recency of less than 16 then the propensity to buy the product is 0.1469 (14.69%)
b. Recency of more than or equal to16 then the propensity to buy the product is 0.0443 (4.43%)

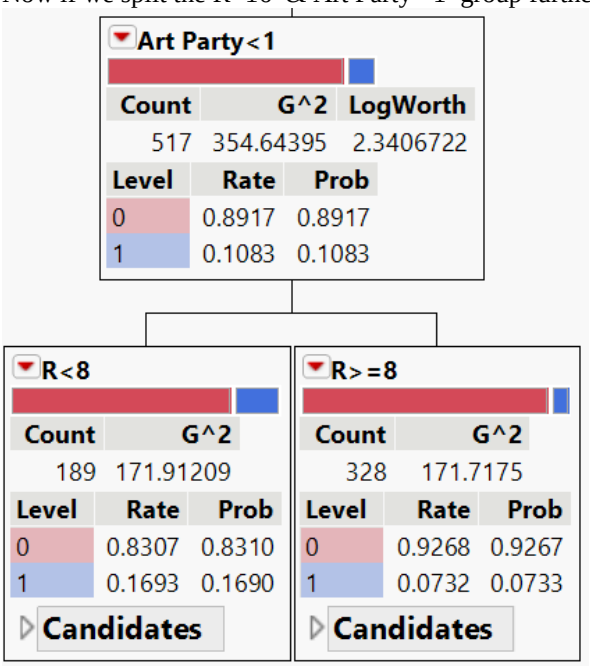
ii) Now if we split the R<16 group further, then we get the following groups,



a. If you mail the books to members with R < 16 and Art Party >=1 then the propensity to buy the product is 0.2867 (28.67%)
b. If you mail the books to members with R < 16 and Art Party <1 then the propensity to buy the product is 0.1083 (10.83%)

Note: R<16 is a profitable group, among the profitable group we were able to find an unprofitable segment (ArtParty <1).

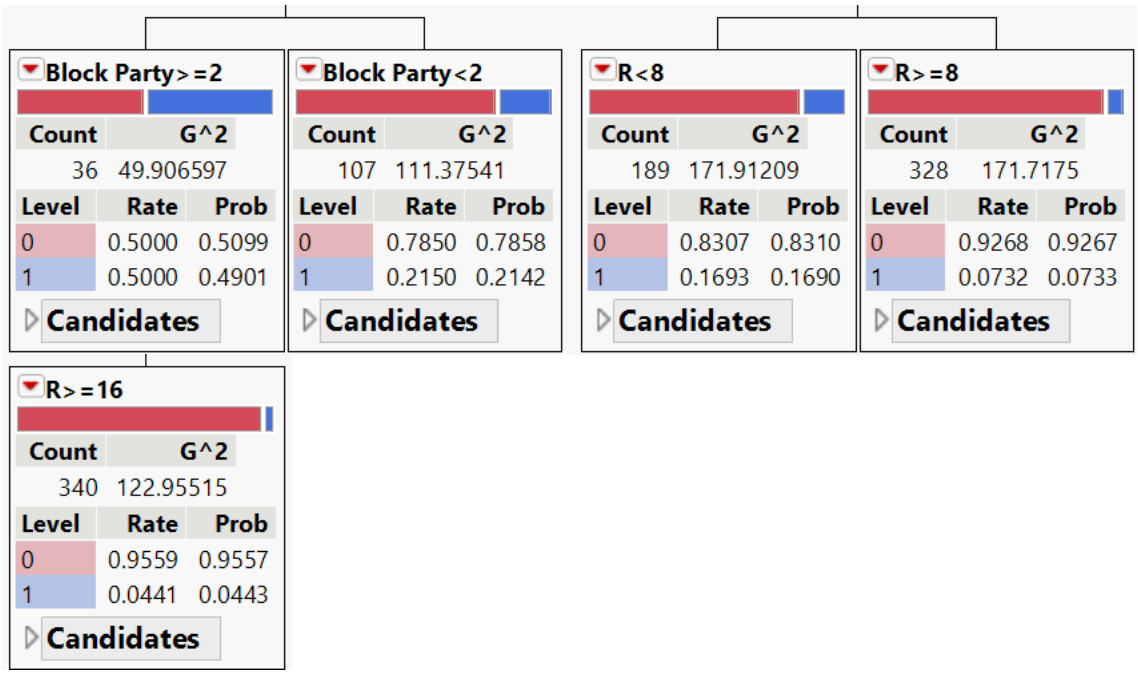
iii) Now if we split the R<16 & Art Party <1 group further, then we get the following groups,



a. If you mail the books to members with R < 16 and Art Party < 1 & Recency <8 then the propensity to buy the product is 0.1693 (16.93%)
b. If you mail the books to members with R < 16 and Art Party < 1 & Recency >= 8 then the propensity to buy the product is 0.0733 (7.33%)

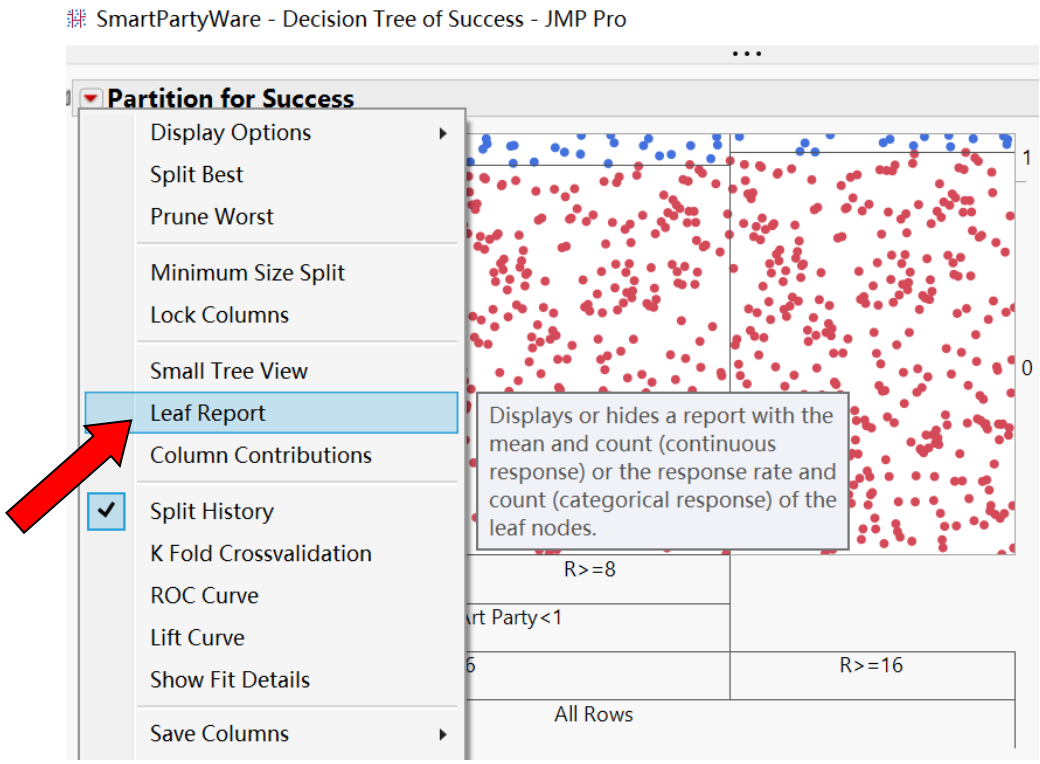
Note: R<16 & Art Party <1 is an unprofitable subgroup, among the unprofitable subgroup we were able to find an profitable segment (Recency <8).

iv) Let us understand the bottom blocks of the decision tree,

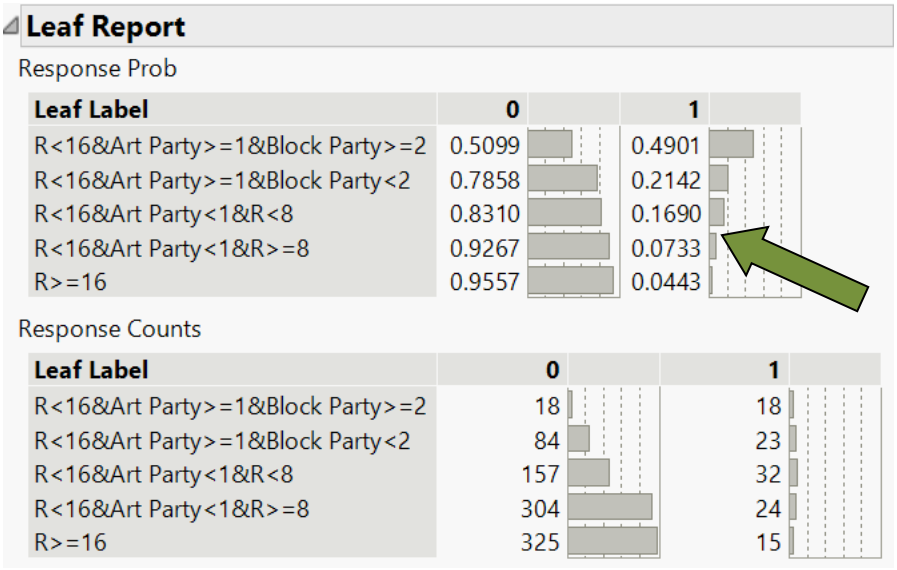


There are 5 groups and we can get the additional information about the groups from the leaf diagram,

v) Click on the red triangle and at the upper left corner → Leaf Report



You will get the following screen,



Leaf Report

Response Prob

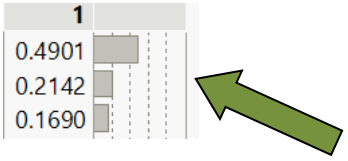
Leaf Label	0	1
R<16&Art Party>=1&Block Party>=2	0.5099	0.4901
R<16&Art Party>=1&Block Party<2	0.7858	0.2142
R<16&Art Party<1&R<8	0.8310	0.1690
R<16&Art Party<1&R>=8	0.9267	0.0733
R>=16	0.9557	0.0443

Response Counts

Leaf Label	0	1
R<16&Art Party>=1&Block Party>=2	18	18
R<16&Art Party>=1&Block Party<2	84	23
R<16&Art Party<1&R<8	157	32
R<16&Art Party<1&R>=8	304	24
R>=16	325	15

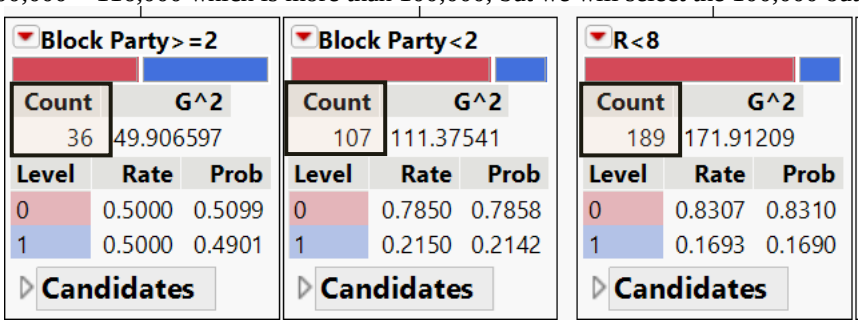
The above Leaf Report gives you the propensity to buy for the various groups (5 groups for this decision tree). Now you have to decide which group you will select to mail the product.

vi) We know the basic response rate is 11.2%, if you select 15% as cut off then, these groups will be selected for mailing,



1
0.4901
0.2142
0.1690

Note: The number of mailing will be (36 + 107 + 189) = 232 per thousand members, so approximately 23.2% which is 0.232*500,000 = 116,000 which is more than 100,000, but we will select the 100,000 out of 116,000 to mail.



Block Party>=2

Count	G^2
36	49.906597

Level	Rate	Prob
0	0.5000	0.5099
1	0.5000	0.4901

Candidates

Block Party<2

Count	G^2
107	111.37541

Level	Rate	Prob
0	0.7850	0.7858
1	0.2150	0.2142

Candidates

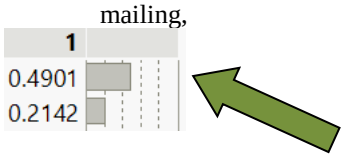
R<8

Count	G^2
189	171.91209

Level	Rate	Prob
0	0.8307	0.8310
1	0.1693	0.1690

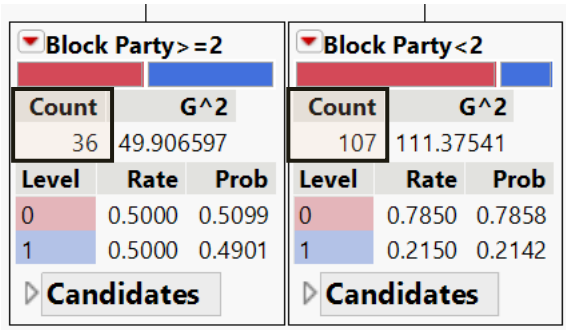
Candidates

vii) We know the basic response rate is 11.2%, if you select 19 % as cut off then, these groups will be selected for mailing,



1
0.4901
0.2142

Note: The number of mailing will be (36 + 107) = 143 per thousand members, so approximately 14.3% which is 0.143*500,00 0 = 71,500 which is less than 100,000.



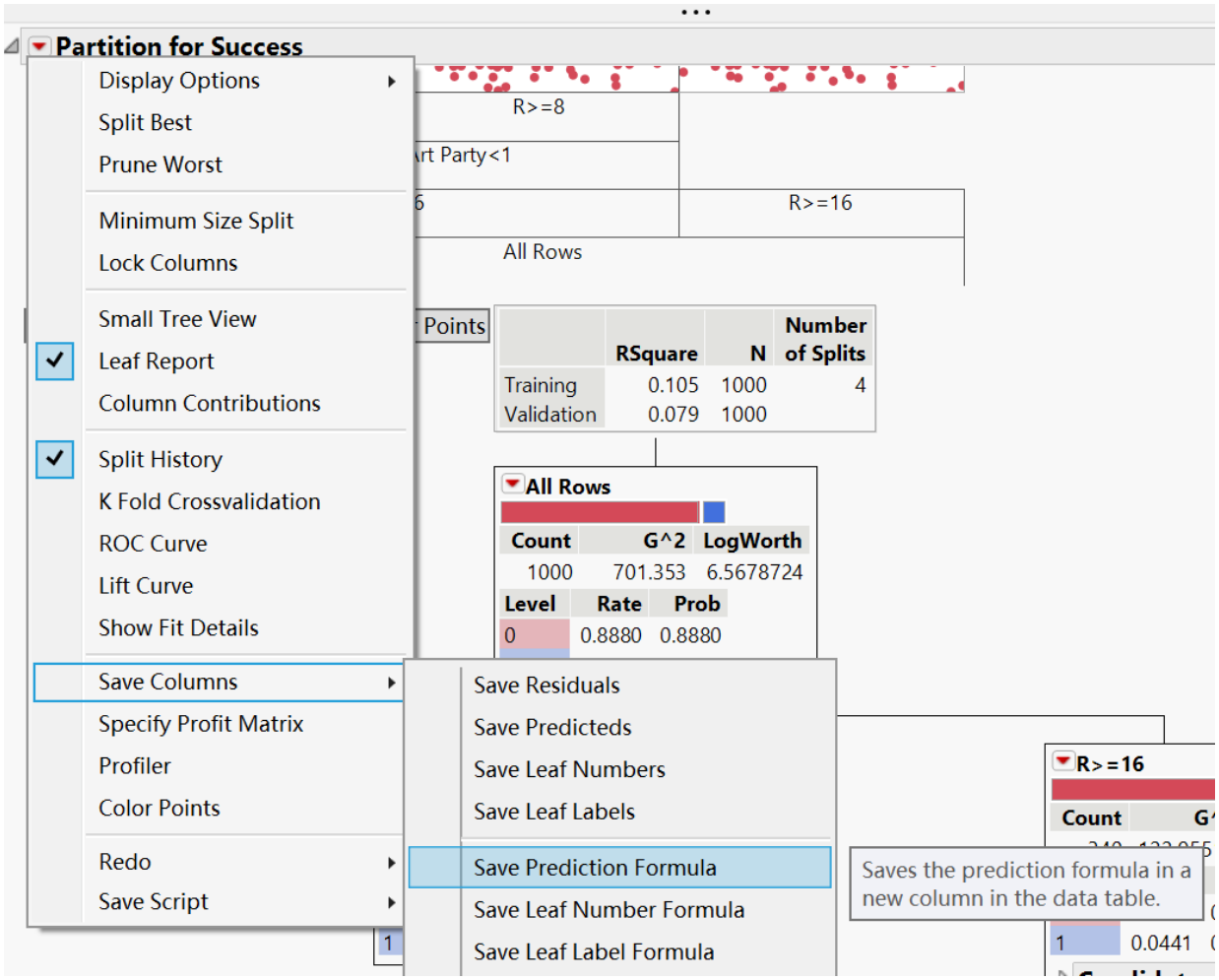
As you can see the higher the cutoff, lower number of members will be sent the products.

Our objective is to find the maximum number of members (close to 100,000) with high propensity to buy.

So, you can split further and find the groups with high propensity and/or play with the cutoff probabilities to select groups.

Step B: Use the decision tree to predict the propensity (probability) of a member buying the product and store it in JMP as columns (for both training & testing data set)

1. Click the red triangle at the upper left corner → Save Columns → Save Prediction Formula.
   Note: if you do Save Predicteds, it only saves values for the first 1000 rows. If you do Save Prediction Formula, it saves values for all the rows.



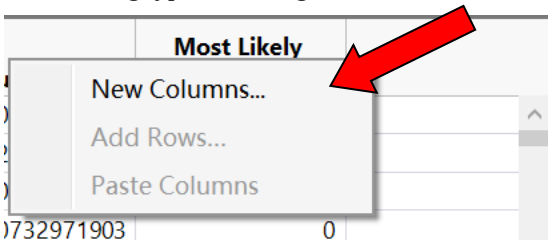
2. The following columns will be created in the JMP file **Note: it will not show up in the decision tree window ***

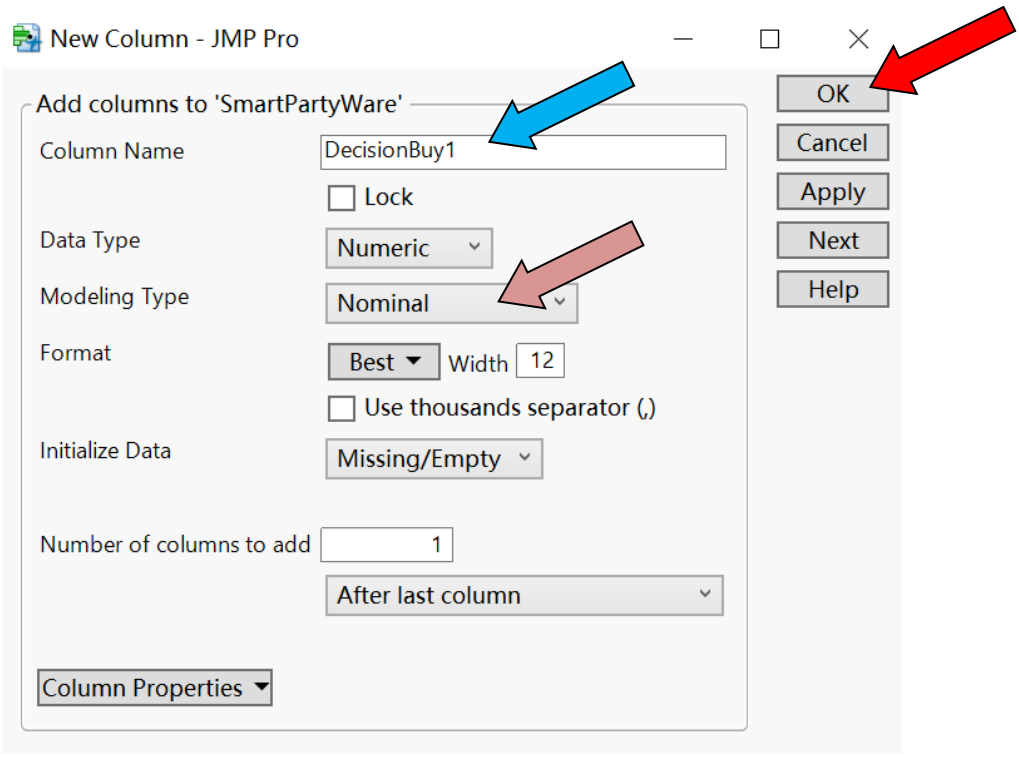
Success	Random	Validation	Prob(Success==0)	Prob(Success==1)	Most Likely Success
0	0.0016701	1	0.9556832845	0.0443167155	0
0	0.002304786	1	0.7858102321	0.2141897679	0
0	0.004328753	1	0.9556832845	0.0443167155	0
0	0.004447884	1	0.9267028097	0.0732971903	0
1	0.004648904	1	0.5099325693	0.4900674307	0
0	0.005287534	1	0.9267028097	0.0732971903	0

The main column is the Prob(Success == 1) column, it estimates the members propensity to buy the product.

Step C: Use the propensity to decide who will be mailed the product.

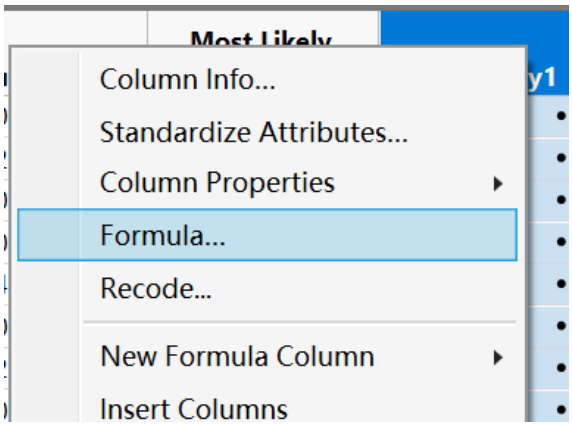
1) Create a new column named DecisionBuy (any name is ok – I selected DecisionBuy1 to inform it is the first algorithm I had built to predict the buyer using Decision Tree)
Right click the empty column space → New Column → DecisionBuy1 (Give a name for the new column) →click on Modeling type and change it to Nominal → Click OK.





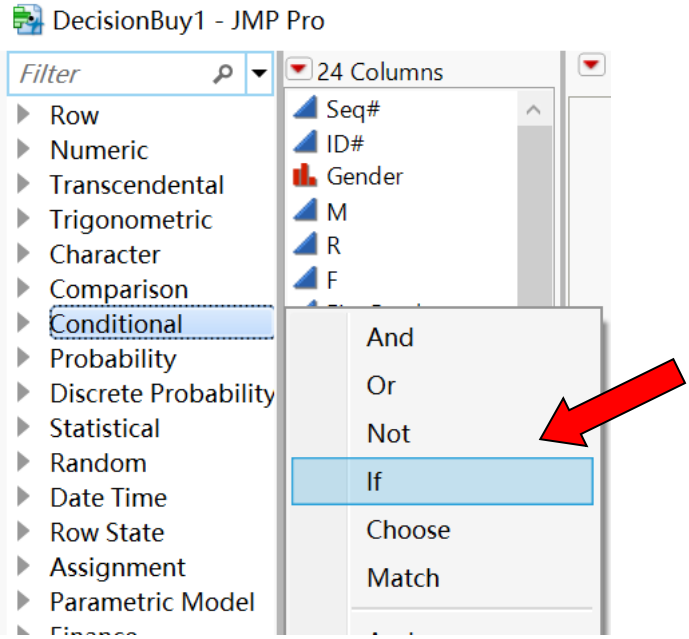
A new Column “DecisionBuy1” is created.

2) Right click DecisionBuy1 column→ Formula

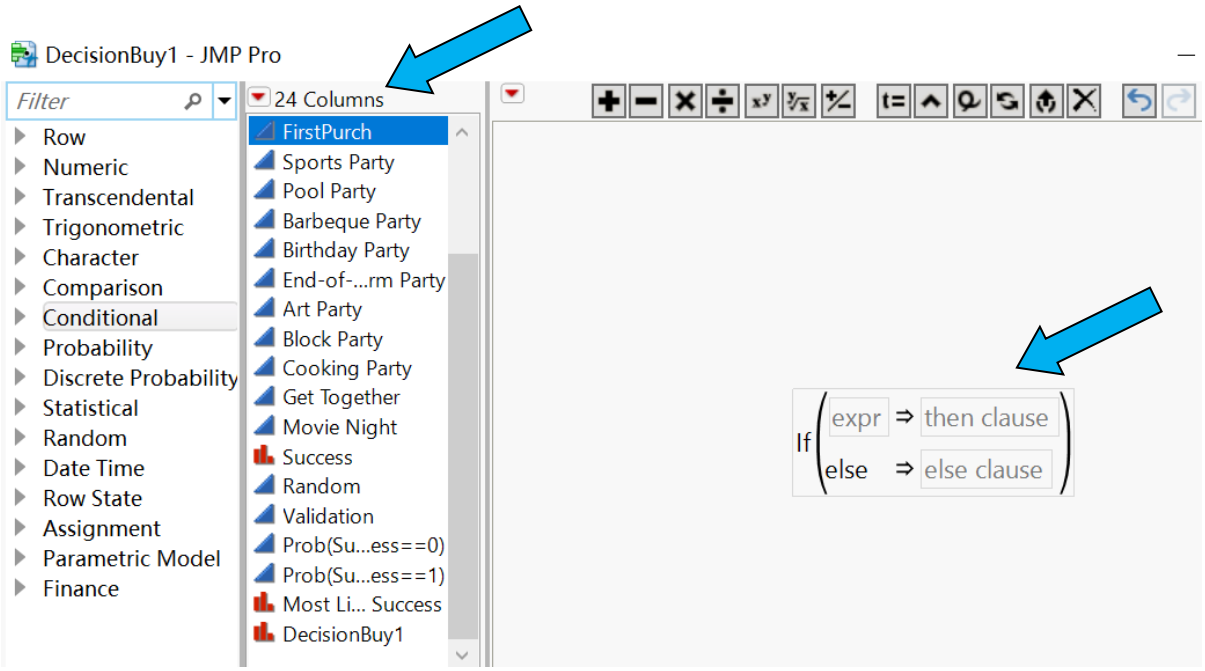


3) New window opens,

Set the Functions as Conditional → If



4) The following will show in the formula window,



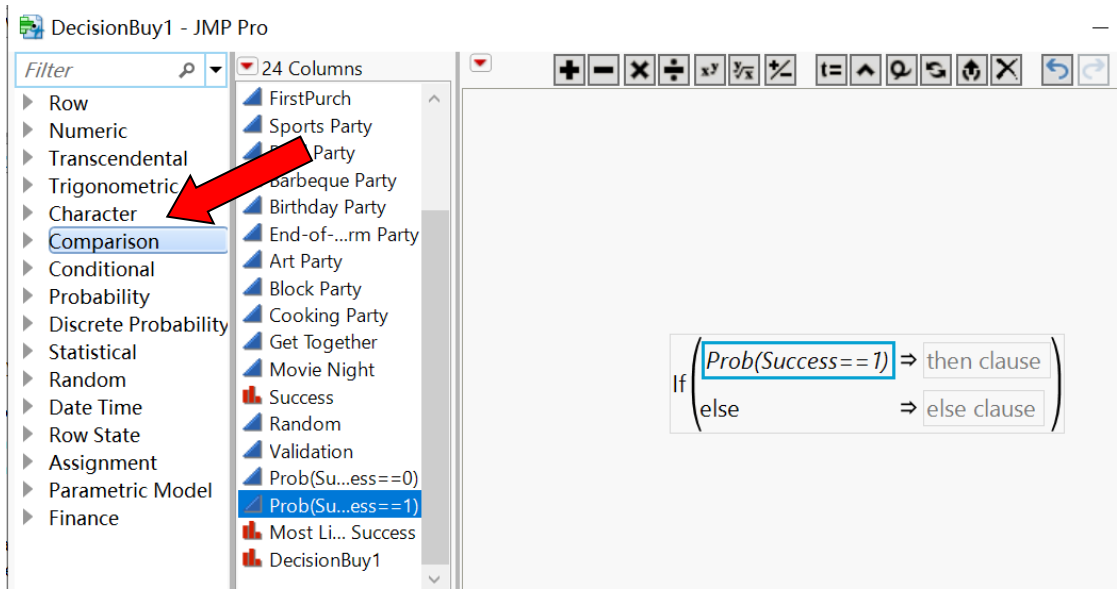
Note: JMP restricts the formulas, you have to select the functions given in the formula window to create desired formulas. Our Objective is to create the following formula,

If Prob(Success = =1) > 0.15, then DecisionBuy1 =1

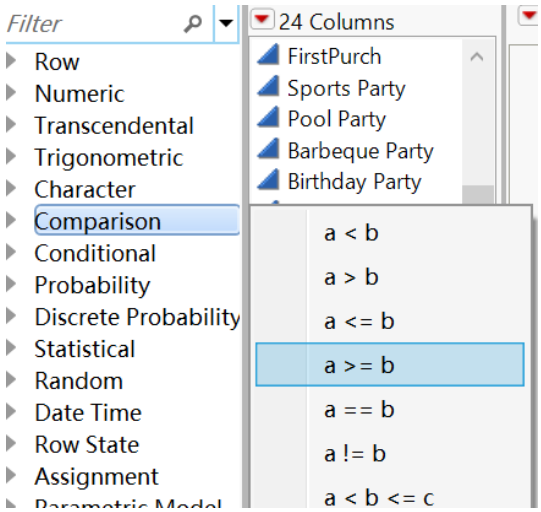
Else, DecisionBuy1 =0

This step involves steep learning curve, so practice it.

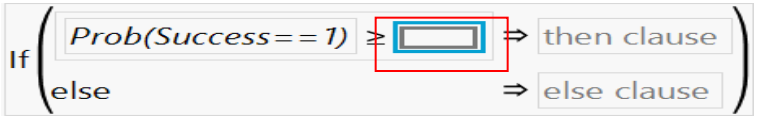
5) Now Select Prob(Success==1) from the table column and click it. The following window will show up.



6) The next step is to compare the Prob(Success=1), Select the comparison on the function group shown above and select a >= b option, The following will show in the formula window,

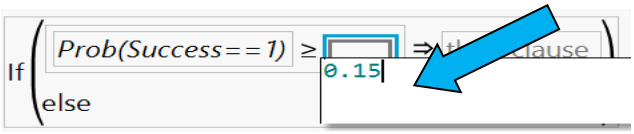


The following will show in the formula window,

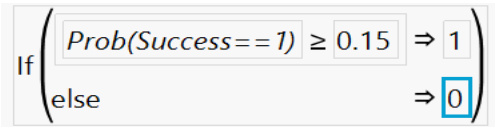


The Red rectangle is the active window in the formula window, whatever you type will be entered here,

7) Type in 0.15 (the propensity you have selected), you will see the following on the formula screen,



8) Click on the "then clause" window and type in 1and Click on the "else clause" window and type in 0 and You will see the following on the formula screen,



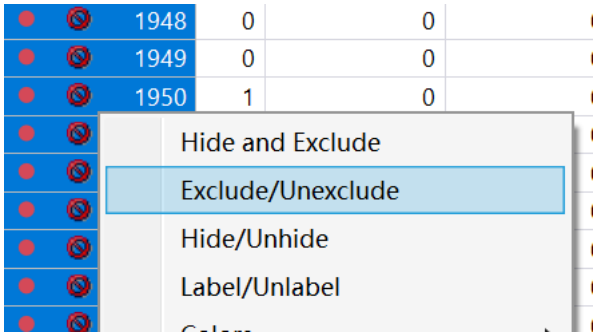
9) Now click ok and the "DecisionBuy1" column will be updated.

Most Likely Success	DecisionBuy1
0	0
0	1
0	0
0	0
0	1
0	0
0	1
0	0
0	0
0	0
0	0

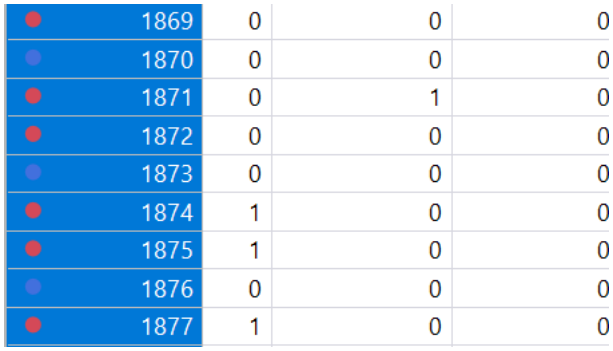
Step D: Switch to testing dataset

1) Currently the first 1000 rows form the "Training data" for analysis we have to study the effectiveness of the Decision tree algorithm on the "Testing data" which is the bottom 1000 rows. We will switch the dataset as follows,

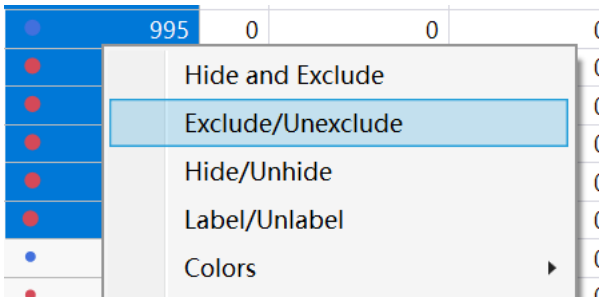
2) Highlight the rows from 1001 to 2000, by left click on row 1001 and scrolling to 2000 row, then right click to get the menu given below, and then select Exclude/Unexclude option as show below, (Note: If you did not exclude the last 1000 rows in Step A, jump to 4) directly.)



3) The Highlighted rows from 1001 to 2000 will now be Unexcluded as shown below,



4) Now, highlight the rows from 1 to 1000, by left click on row 1 and scrolling to 1000 row, then right click to get the menu given below, and then select Exclude/Unexclude option as show below,



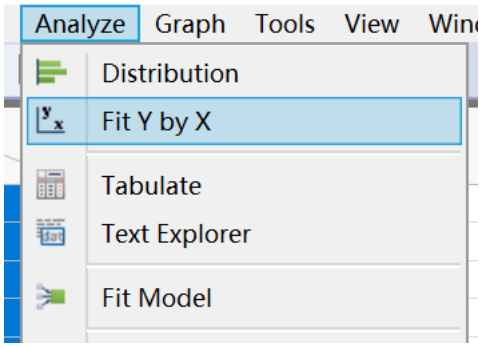
5) The Highlighted rows from 1 to 1000 will now be Excluded as shown below,

988	603	14976	1
989	795	19719	1
990	1783	44307	1
991	766	19028	0
992	1194	29309	1
993	636	16064	1
994	615	15194	1
995	560	14158	1
996	214	5108	1
997	1773	43976	1
998	1312	32441	1
999	946	22883	1
1000	1455	36019	1
1001	1812	45106	0
1002	1723	43010	0
1003	1239	30331	0
1004	1598	39603	1
1005	427	10531	1

Now we have switched from “Training Data set” to “Testing Dataset”

Step E: Get Confusion matrix

1) Go to the Analyze Menu and select Fit Y by X as shown below,

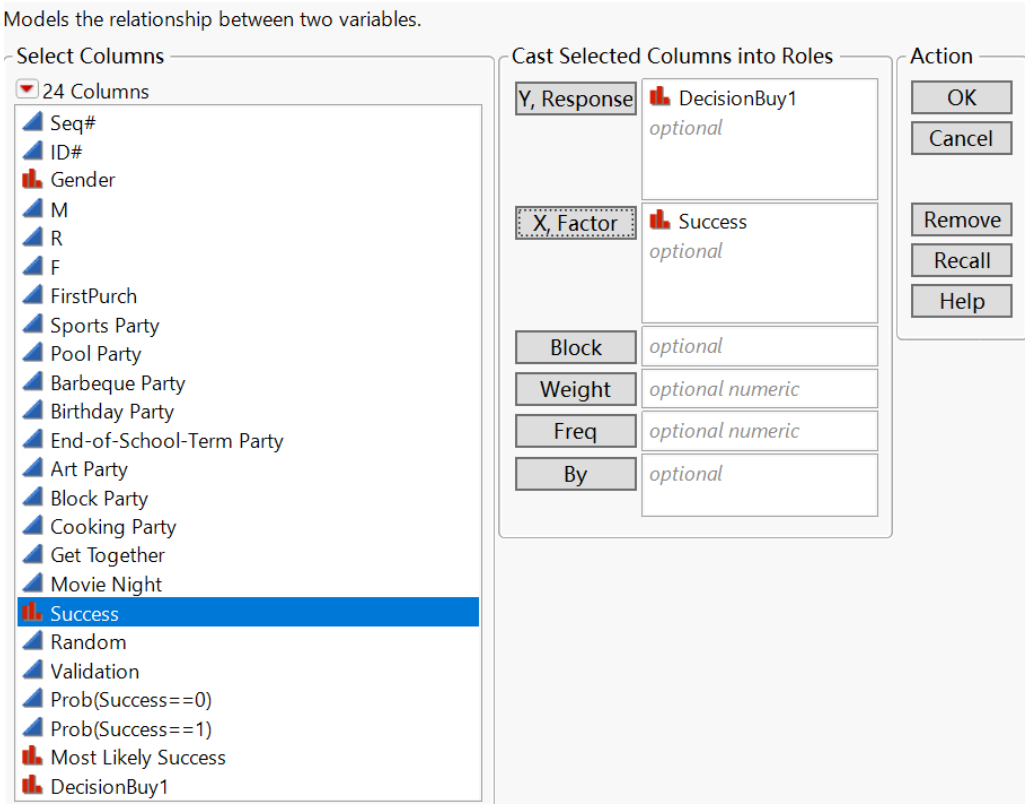


2) A new screen will open up as follows,

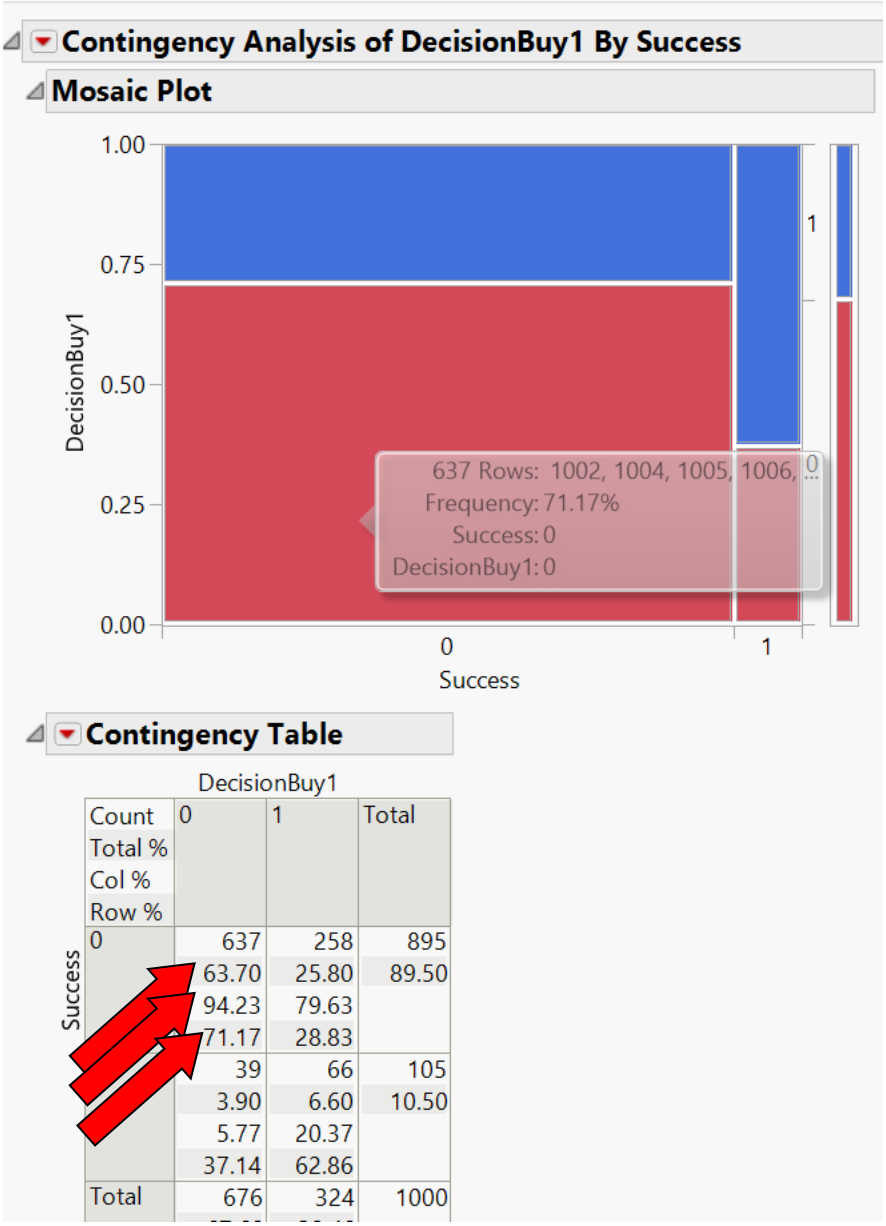
Now select DecisionBuy1 column for Y, Response and click | Y, response |

Now select Success Column for X and click | X, Factor |

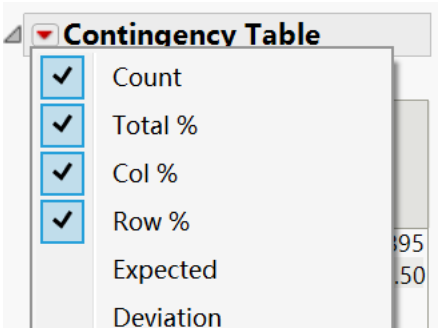
And Click OK



3) You should have the following screen,



4) You can now make the confusion matrix simpler by clicking on the red triangle and unselect the following.



Unselect Total %, Col % and Row %.

5) Now the result will look like

Contingency Table

Success	Count	DecisionBuy1 0	1	Total
	0	637	258	895
	1	39	66	105
	Total	676	324	1000

Note: now you have got the confusion matrix for the testing dataset.

Step F: Use the confusion matrix to find out how many members were sent the product and how many bought the product

1) From the above Confusion Matrix, we get the following information,

Based on the Testing Data Set,

Level	Count	Percentage
Members Selected for Mailing	324	324/1000 = 32.4%
Total Members Mailed based on Algorithm	(324/1000) * 500,000 = 162,000	32.4%
Actual number of Members Mailed based on Restriction	100,000	1.00000
Probability of Buying for the mailed members		= (66/324) = 20.3704 %
Probability of Non-Buying for the mailed members		== (258/324) = 79.6296 %

Marketing department has suggested it is prudent to mail the Products only to maximum of 100,000 members so the Product club members do not become tired of repeated marketing campaign.

Let us calculate the Profit for the selected Decision Tree,

= 100,000 * 0.203704 * 45.5 + 100,000 *0.796296* (-4) = 608,333

We did not beat the bench mark of $700,000, maybe we need to split further to reduce the mailing percentage and increase the propensity of buy.