SAS ASSOCIATION RULE MINING

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Course: Business Intelligence and Analytics
University of North Carolina at Charlotte

Association Rule Mining: Banking Case Study

DataSource: BANK

Explorations between Retail Banking Services used by customers:
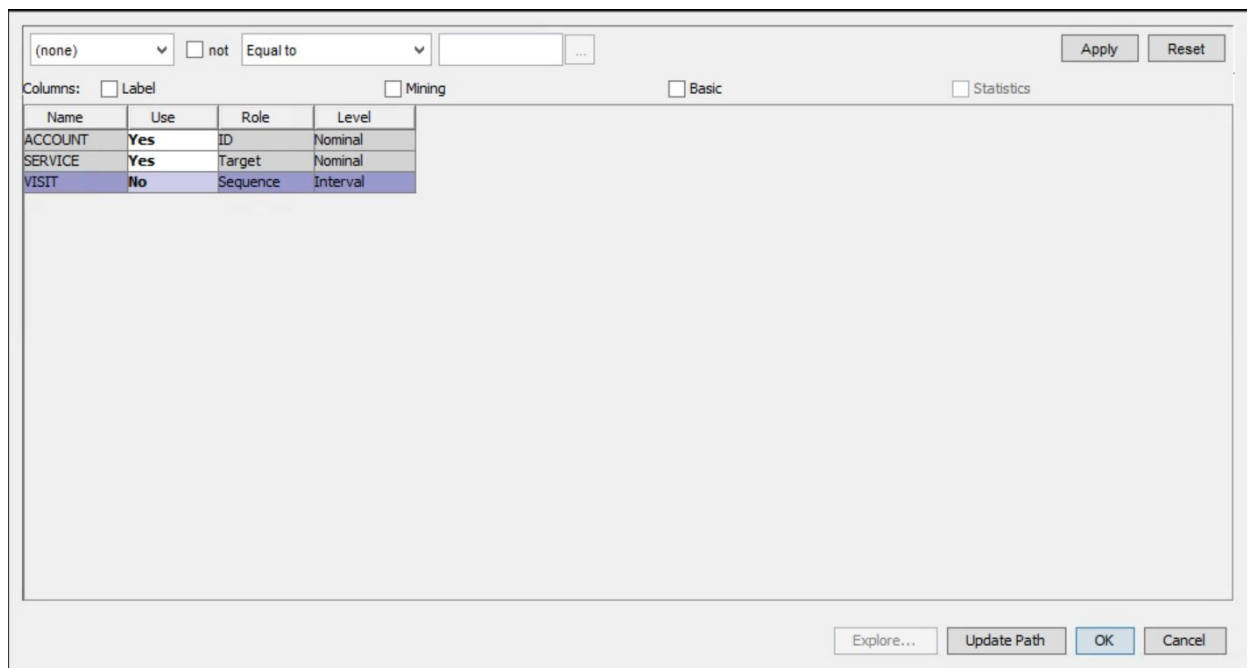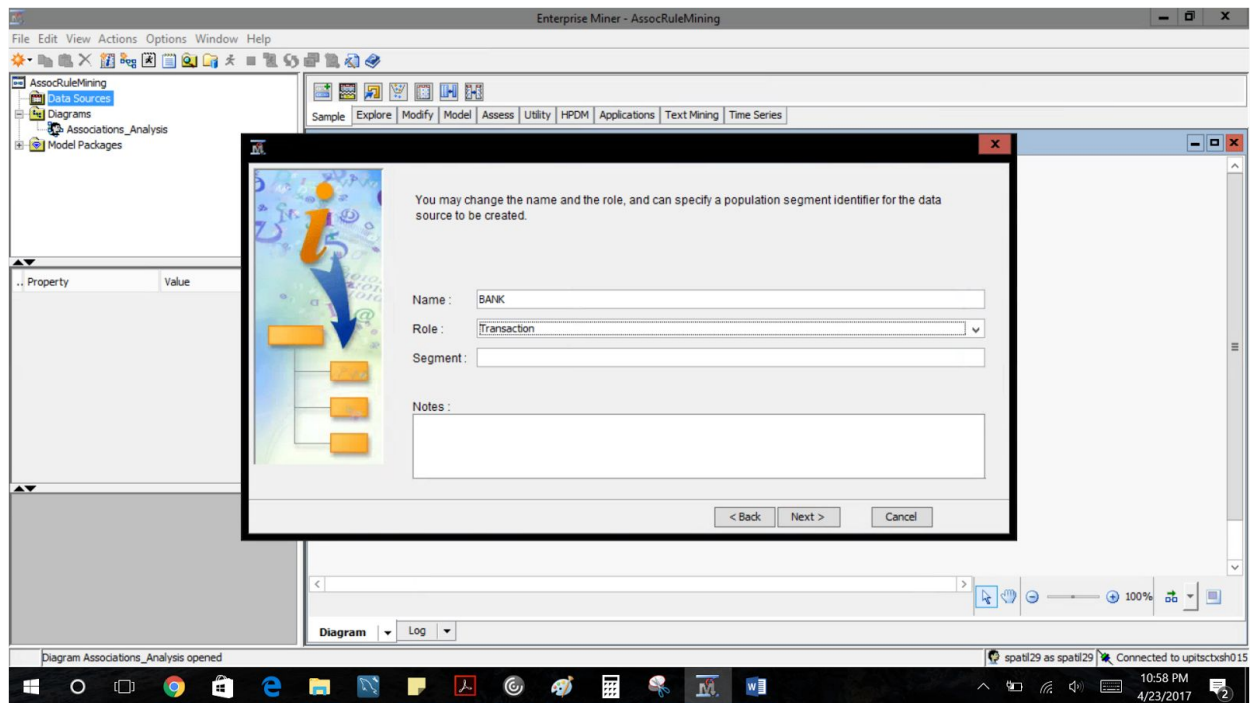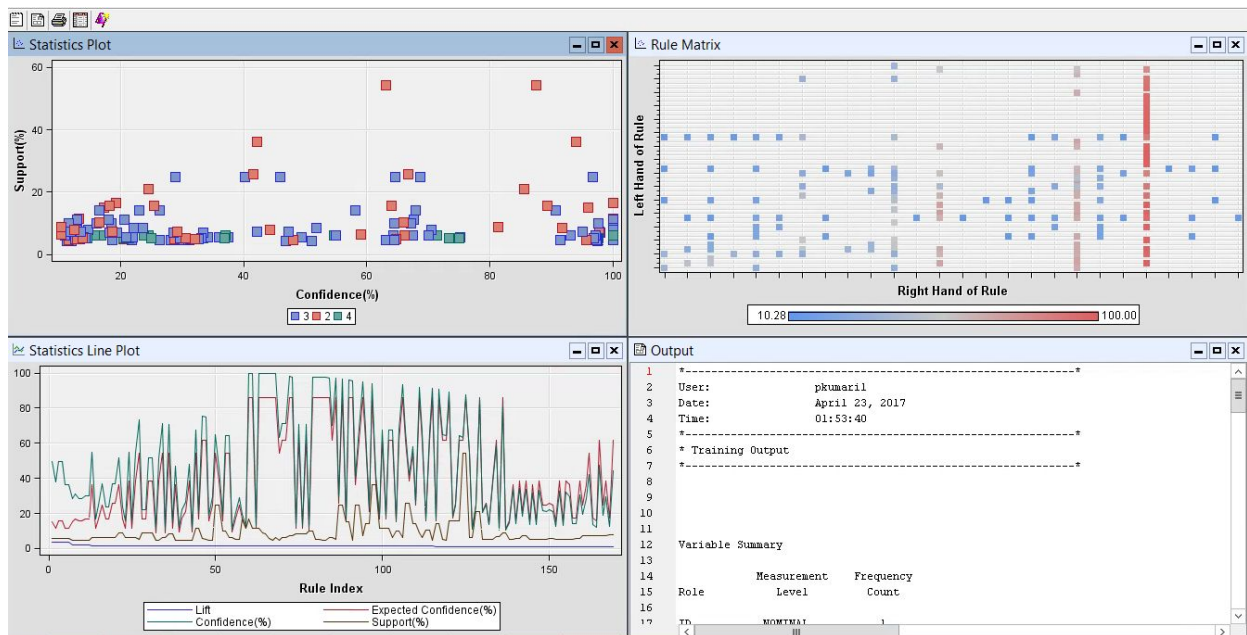
Market Basket Analysis

Metadata:

Diagram Name: Association Analysis

(Note: Diagram is created in SAS Predictive Analysis Project Folder submitted as a part of SAS Eminer Predictive analysis assignment.)
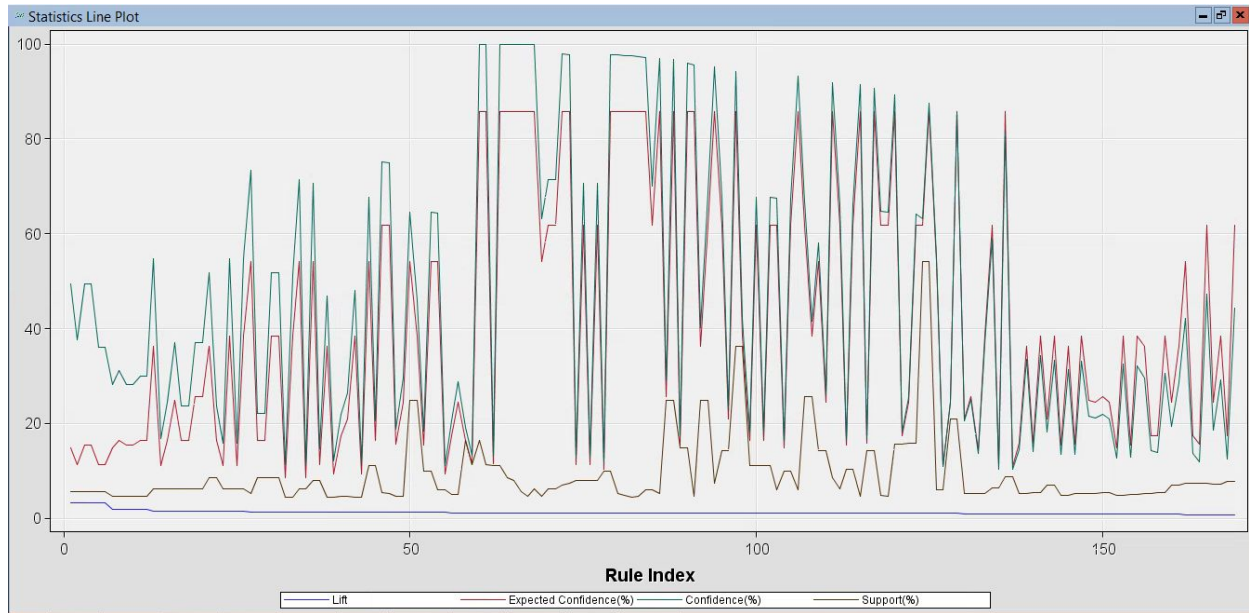

After running the Association node,

Association Node output:

Statistics Line Plot : Lift, Expected Confidence, Confidence and Support.

Rule table:

Relations	Expected Confidence(%)	Confidence(%)	Support(%)	Lift	Transaction Count	Rule	Left Hand of Rule	Right Hand of Rule	Rule Item 1	Rule Item 2	Rule Item 3	Rule Item 4	Rule Item 5	Rule Index	Transpose Rule
3	11.30	37.57	5.58	3.33	446.00	CKING & CCRD ==>...	CKING & C...	CKCRD	CKING	CCRD	=======>	CKCRD		2	1
3	14.85	49.39	5.58	3.33	446.00	CKCRD ==> CKING ...	CKCRD	CKING & C...	CKCRD	=======>	CKING	CCRD		1	1
2	15.48	49.39	5.58	3.19	446.00	CKCRD ==> CCRD	CKCRD	CCRD	CKCRD	=======>	CCRD			3	1
3	15.48	49.39	5.58	3.19	446.00	CKING & CKCRD ==...	CKING & C...	CCRD	CKING	CKCRD	=======>	CCRD		4	1
2	11.30	36.05	5.58	3.19	446.00	CCRD ==> CKCRD	CCRD	CKCRD	CCRD	=======>	CKCRD			5	1
3	11.30	36.05	5.58	3.19	446.00	CCRD ==> CKING &...	CCRD	CKING & C...	CCRD	=======>	CKING	CKCRD		6	1
3	14.85	28.12	4.63	1.89	370.00	HMEQLC ==> CKIN...	HMEQLC	CKING & C...	HMEQLC	=======>	CKING	CCRD		7	1
3	16.47	31.17	4.63	1.89	370.00	HMEQLC & CCRD ==>...	CKING & C...	HMEQLC	CKING	CCRD	=======>	HMEQLC		8	1
2	15.48	28.12	4.63	1.82	370.00	HMEQLC ==> CCRD	HMEQLC	CCRD	HMEQLC	=======>	CCRD			9	1
3	15.48	28.12	4.63	1.82	370.00	HMEQLC & CKING =...	HMEQLC & ...	CCRD	HMEQLC	CKING	=======>	CCRD		10	1
2	16.47	29.91	4.63	1.82	370.00	CCRD ==> HMEQLC	CCRD	HMEQLC	CCRD	=======>	HMEQLC			11	1
3	16.47	29.91	4.63	1.82	370.00	CCRD ==> HMEQL...	CCRD	HMEQLC &...	CCRD	=======>	HMEQLC	CKING		12	1
4	36.19	54.66	6.09	1.51	487.00	SVG & HMEQLC ==>...	SVG & HME...	CKING & A...	SVG	HMEQLC	=======>	CKING	ATM	13	1
4	11.15	16.84	6.09	1.51	487.00	CKING & ATM ==> S...	CKING & A...	SVG & HME...	CKING	ATM	=======>	SVG	HMEQLC	14	1
4	16.47	24.52	6.09	1.49	487.00	SVG & CKING & ATM...	SVG & CKI...	HMEQLC	SVG	CKING	ATM	=======>	HMEQLC	15	1
4	24.85	37.01	6.09	1.49	487.00	HMEQLC ==> SVG &...	HMEQLC	SVG & CKI...	HMEQLC	=======>	SVG	CKING	ATM	16	1
3	16.47	23.72	6.09	1.44	487.00	SVG & ATM ==> HM...	SVG & ATM	HMEQLC	SVG	ATM	=======>	HMEQLC		17	1
4	16.47	23.72	6.09	1.44	487.00	SVG & ATM ==> HM...	SVG & ATM	HMEQLC & ...	SVG	ATM	=======>	HMEQLC	CKING	18	1
3	25.69	37.01	6.09	1.44	487.00	HMEQLC ==> SVG &...	HMEQLC	SVG & ATM	HMEQLC	=======>	SVG	ATM		19	1
4	25.69	37.01	6.09	1.44	487.00	HMEQLC & CKING =...	HMEQLC & ...	SVG & ATM	HMEQLC	CKING	=======>	SVG	ATM	20	1
3	36.19	51.82	8.53	1.43	682.00	HMEQLC ==> CKIN...	HMEQLC	CKING & A...	HMEQLC	=======>	CKING	ATM		21	1
3	16.47	23.58	8.53	1.43	682.00	CKING & ATM ==> H...	CKING & A...	HMEQLC	CKING	ATM	=======>	HMEQLC		22	1
3	38.46	54.66	6.09	1.42	487.00	SVG & HMEQLC ==>...	SVG & HME...	ATM	SVG	HMEQLC	=======>	ATM		24	1
4	38.46	54.66	6.09	1.42	487.00	SVG & HMEQLC & C...	SVG & HME...	ATM	SVG	HMEQLC	CKING	=======>	ATM	26	1
3	11.15	15.85	6.09	1.42	487.00	ATM ==> SVG & HM...	ATM	SVG & HME...	ATM	=======>	SVG	HMEQLC	23	1
4	11.15	15.85	6.09	1.42	487.00	ATM ==> SVG & HM...	ATM	SVG & HME...	ATM	=======>	SVG	HMEQLC	CKING	25	1
4	54.17	73.43	5.26	1.36	420.00	CD & ATM ==> SVG ...	CD & ATM	SVG & CKI...	CD	ATM	=======>	SVG	CKING	27	1
2	16.47	22.19	8.53	1.35	682.00	ATM ==> HMEQLC	ATM	HMEQLC	ATM	=======>	HMEQLC			28	1
3	16.47	22.19	8.53	1.35	682.00	ATM ==> HMEQLC &...	ATM	HMEQLC & ...	ATM	=======>	HMEQLC	CKING	29	1
2	38.46	51.82	8.53	1.35	682.00	HMEQLC ==> ATM	HMEQLC	ATM	HMEQLC	=======>	ATM			30	1
3	38.46	51.82	8.53	1.35	682.00	HMEQLC & CKING =...	HMEQLC & ...	ATM	HMEQLC	CKING	=======>	ATM		31	1
3	38.46	51.10	4.35	1.33	348.00	CKING & AUTO ==> ...	CKING & A...	ATM	CKING	AUTO	=======>	ATM		33	1
3	8.52	11.32	4.35	1.33	348.00	ATM ==> CKING & A	ATM	CKING & A	ATM	=======>	CKING	AUTO	32	1

Rule Description:

Rule Description

Map	Rule
RULE1	CKING & CCRD ==> CKCRD
RULE2	CKCRD ==> CKING & CCRD
RULE3	CKCRD ==> CCRD
RULE4	CKING & CKCRD ==> CCRD
RULE5	CCRD ==> CKCRD
RULE6	CCRD ==> CKING & CKCRD
RULE7	HMEQLC ==> CKING & CCRD
RULE8	CKING & CCRD ==> HMEQLC
RULE9	HMEQLC ==> CCRD
RULE10	HMEQLC & CKING ==> CCRD
RULE11	CCRD ==> HMEQLC
RULE12	CCRD ==> HMEQLC & CKING
RULE13	SVG & HMEQLC ==> CKING & ATM
RULE14	CKING & ATM ==> SVG & HMEQLC
RULE15	SVG & CKING & ATM ==> HMEQLC
RULE16	HMEQLC ==> SVG & CKING & ATM
RULE17	SVG & ATM ==> HMEQLC
RULE18	SVG & ATM ==> HMEQLC & CKING
RULE19	HMEQLC ==> SVG & ATM
RULE20	HMEQLC & CKING ==> SVG & ATM
RULE21	HMEQLC ==> CKING & ATM
RULE22	CKING & ATM ==> HMEQLC
RULE23	SVG & HMEQLC ==> ATM
RULE24	SVG & HMEQLC & CKING ==> ATM
RULE25	ATM ==> SVG & HMEQLC
RULE26	ATM ==> SVG & HMEQLC & CKING
RULE27	CD & ATM ==> SVG & CKING
RULE28	ATM ==> HMEQLC
RULE29	ATM ==> HMEQLC & CKING
RULE30	HMEQLC ==> ATM
RULE31	HMEQLC & CKING ==> ATM
RULE32	CKING & AUTO ==> ATM
RULE33	ATM ==> CKING & AUTO
RULE34	HMEQLC & ATM ==> SVG & CKING
RULE35	SVG & CKING ==> HMEQLC & ATM
RULE36	CKCRD ==> SVG & CKING
RULE37	SVG & CKING ==> CKCRD

Few of the highest rule are explained in the given pdf. Let's examine the Rule 13. It says Saving account and Home equity line of credit implies checking account and atm debit card. A customer having a savings account and home equity line of credit, who doesn't have atm debit card should be offered one along with opening a checking account. Rule 13 and rule 14 are symmetric as lift is symmetric.
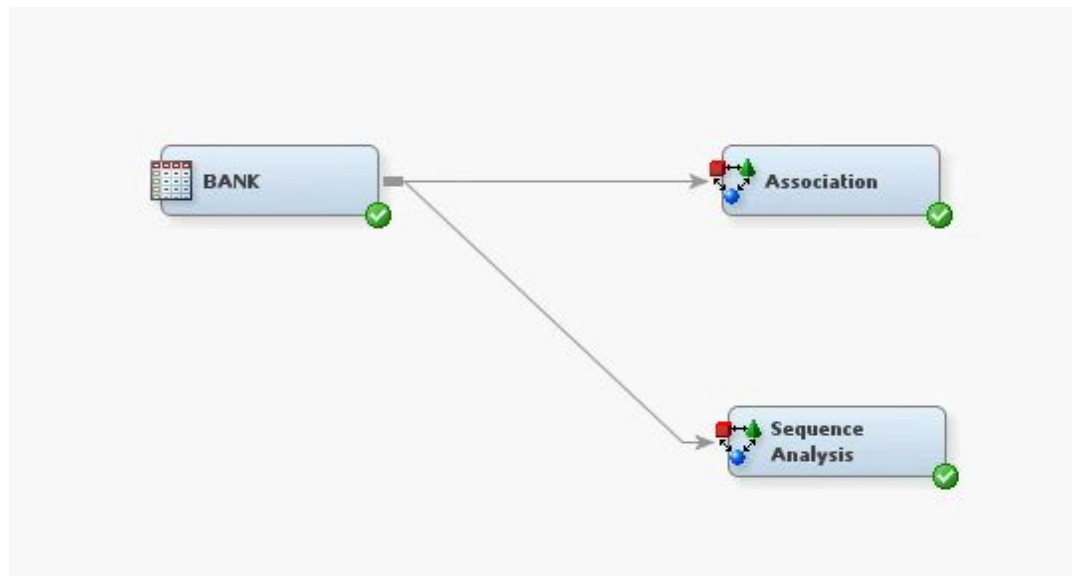
Rule Matrix:

Rule matrix with values:
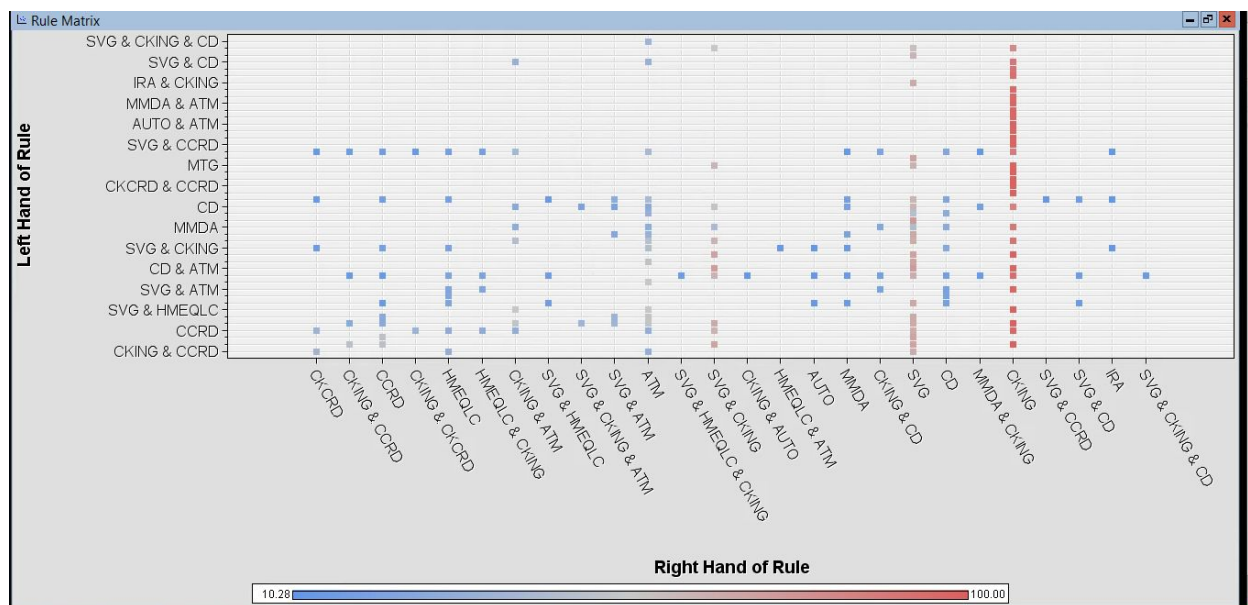
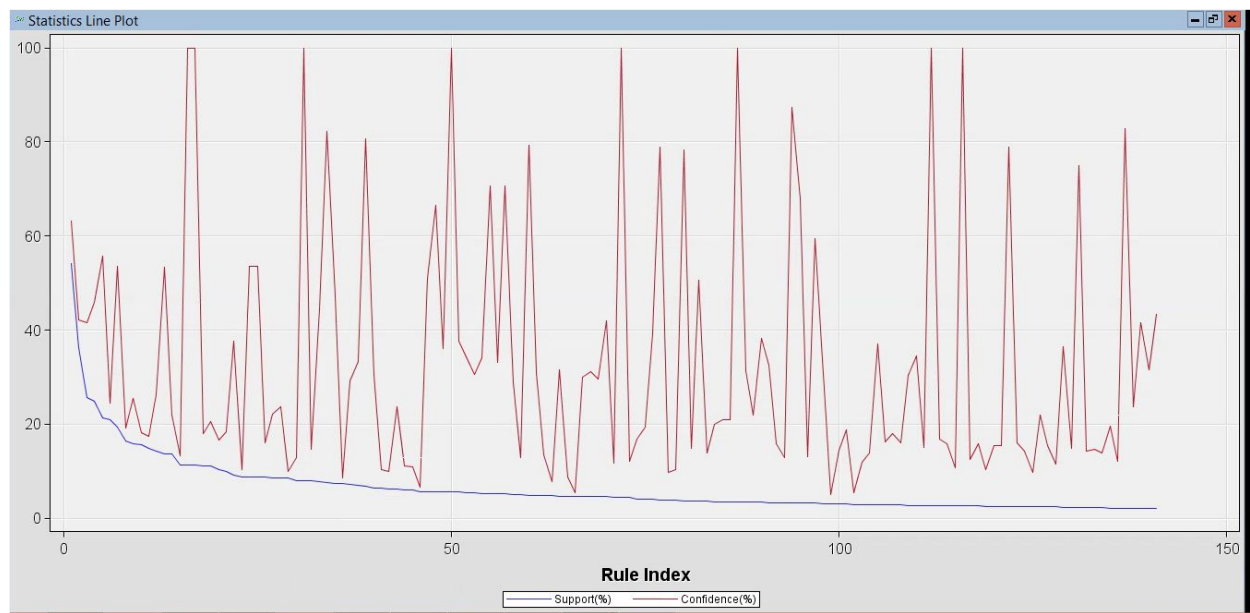We can say that all these rules have checking in the right hand of rule.

Sequence Analysis:

Setting all variables Use=Yes

Name	Use	Role	Level
ACCOUNT	Yes	ID	Nominal
SERVICE	Yes	Target	Nominal
VISIT	Yes	Sequence	Interval

Statistics Line Plot:

View→ Rules→ Rules Description

Rule Description

Map	Rule
RULE1	CKING ==> SVG
RULE2	CKING ==> ATM
RULE3	SVG ==> ATM
RULE4	CKING ==> SVG ==> ATM
RULE5	ATM ==> ATM
RULE6	CKING ==> CD
RULE7	CKING ==> ATM ==> ATM
RULE8	CKING ==> HMEQLC
RULE9	SVG ==> CD
RULE10	CKING ==> MMDA
RULE11	CKING ==> CCRD
RULE12	CKING ==> SVG ==> CD
RULE13	SVG ==> ATM ==> ATM
RULE14	SVG ==> SVG
RULE15	CKCRD ==> CKCRD
RULE16	CKING ==> CKCRD
RULE17	CKING ==> CKCRD ==> CKCRD
RULE18	SVG ==> HMEQLC
RULE19	CKING ==> SVG ==> HMEQLC
RULE20	SVG ==> CCRD
RULE21	CKING ==> SVG ==> CCRD
RULE22	CD ==> CD
RULE23	CKING ==> IRA
RULE24	HMEQLC ==> HMEQLC
RULE25	CKING ==> HMEQLC ==> HMEQLC
RULE26	CKING ==> SVG ==> SVG
RULE27	ATM ==> HMEQLC
RULE28	CKING ==> ATM ==> HMEQLC
RULE29	CKING ==> AUTO
RULE30	SVG ==> CKCRD
RULE31	SVG ==> CKCRD ==> CKCRD
RULE32	CKING ==> SVG ==> CKCRD
RULE33	MMDA ==> SVG
RULE34	AUTO ==> AUTO
RULE35	CKING ==> MMDA ==> SVG
RULE36	CKING ==> MTG
RULE37	CD ==> ATM

The confidence of many rules changes after the variable 'Order of Product Purchase' is considered. From one of the above rules, a person having checking account and saving accounts tends to go for certificate of deposit next.Also, after opening a checking and saving accounts, a customer is likely to go for home equity line of credit. Bank can try to offer additional products with home equity line of credit for cross sell.