

PROJECT 1 - Association Rule Mining

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Market Bank Analysis

Objective of the Project - Explore associations between retail banking services used by customers

Analysis Plan

- Create an Analysis
- Run an analysis association
- Interpret the association
- Run the sequence analysis
- Interpret the sequence rules

Extending from the knowledge gained in the banking segmentation, a bank's Marketing Department is interested in examining associations between various retail banking services used by customers. This project hopes to improve cross-sell and up-sell opportunities by determining typical and atypical service combinations as well as the order in which the services were first used . This can be helpful in suggesting, for new and existing customers, services that match their personal banking habits. These requirements suggest both a market basket analysis and a sequence analysis.

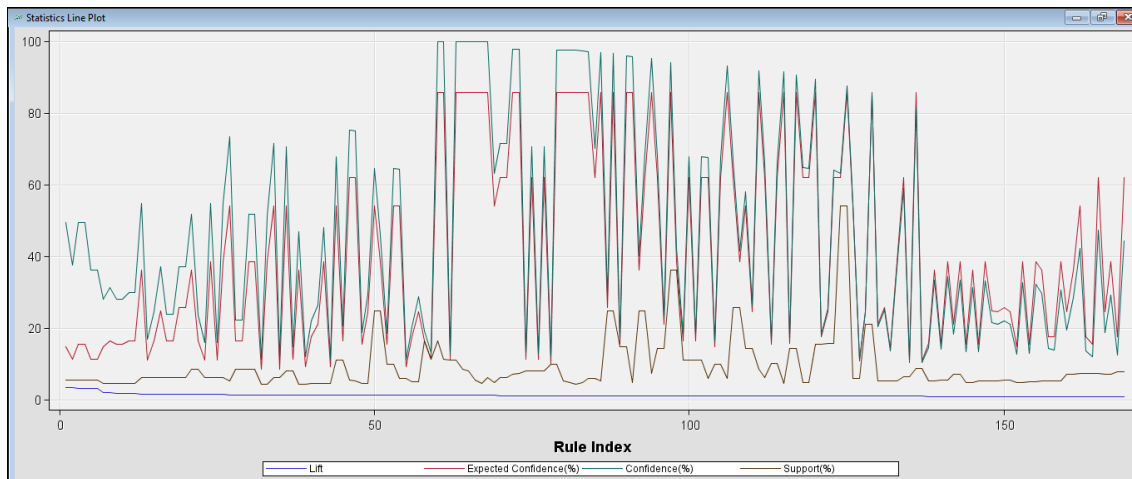
Data : Bank Data has 3 variables and 32367 observations

Interpreting the results of the Market Bank Analysis

The Market Basket Analysis shows the following graph



Rule Index Graph



This graph shows the lift, expected confidence, confidence and support for each of the rules by the rule index number

Rule 1 :- Checking and Credit Card implies Check/Debit Card

A person having a checking account and a credit card will have a check/debit card

Rule 1 has a confidence of 49.39%

Interpretation - It means that there is a probability for a person to have a check/debit card provided he/she has a checking account and a credit card

Expected Confidence of 15.48%

Interpretation – Probability of the person having a check/debit card

Support of 5.58 and Lift of 3.33

Support of 5.58 means that the customer has checking account , credit card also has a check/debit card

Lift of 3.33 means that customer having a checking account and credit card is 3.33 times as likely to have a check/debit card. A lift value greater than 1 indicates that the customer having a checking account, credit card is more likely to have a check/debit card than expected.

A good cross-sell opportunity would be to sell credit card if the customer has a checking account.

When we go to the rule description, there are approximately 169 rules and the screenshot shows the first few rules.

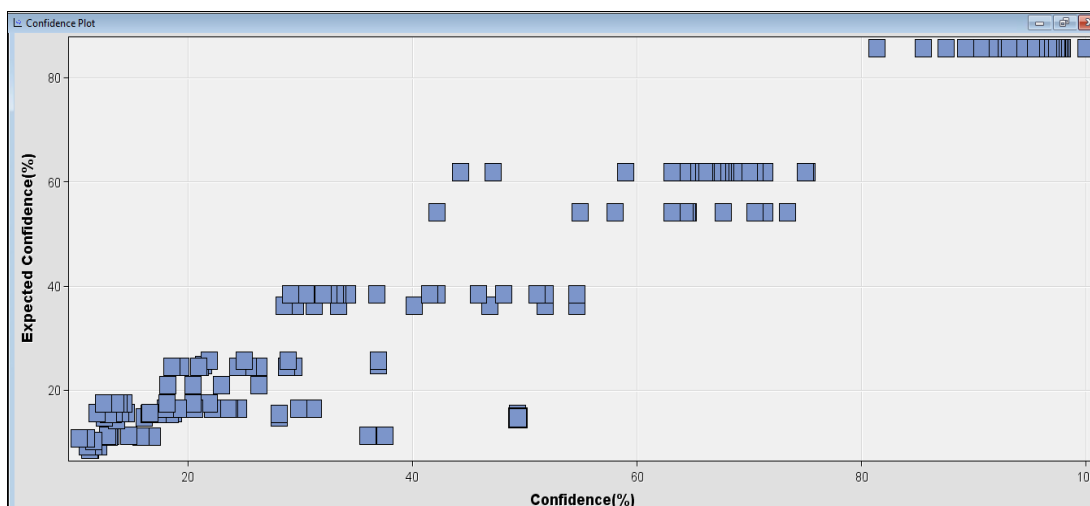
Map	Rule
RULE1	CKING & CCRD ==> CKCRD
RULE2	CKCRD ==> CKING & CCRD
RULE3	CKCRD ==> CCRD
RULE4	CKING & CKCRD ==> CCRD
RULE5	CCRD ==> CKCRD
RULE6	CCRD ==> CKING & CKCRD
RULE7	HMEQLC ==> CKING & CCRD
RULE8	CKING & CCRD ==> HMEQLC
RULE9	HMEQLC ==> CCRD
RULE10	HMEQLC & CKING ==> CCRD
RULE11	CCRD ==> HMEQLC
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

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
85.78	100.00	11.30	1.17	903.00	CKCRD ==> CKING	CKCRD	CKING	CKCRD	=====	CKING		
85.78	100.00	11.15	1.17	891.00	SVG & HMEQLC ==> CKING	SVG & HM...	CKING	SVG	HMEQLC	=====	CKING	
85.78	100.00	8.53	1.17	682.00	HMEQLC & ATM ==> CKING	HMEQLC &...	CKING	HMEQLC	ATM	=====	CKING	
85.78	100.00	7.97	1.17	637.00	SVG & CKCRD ==> CKING	SVG & CK...	CKING	SVG	CKCRD	=====	CKING	
85.78	100.00	5.58	1.17	446.00	CKCRD & CCRD ==> CKING	CKCRD & ...	CKING	CKCRD	CCRD	=====	CKING	
85.78	100.00	4.63	1.17	370.00	HMEQLC & CCRD ==> CKING	HMEQLC &...	CKING	HMEQLC	CCRD	=====	CKING	
85.78	100.00	6.09	1.17	487.00	SVG & HMEQLC & ATM ==> CKING	SVG & HM...	CKING	SVG	HMEQLC	ATM	=====	CKING
11.15	13.00	11.15	1.17	891.00	CKING ==> SVG & HMEQLC	CKING	SVG & HMEQLC	CKING	=====	SVG	HMEQLC	
54.17	63.13	4.69	1.17	375.00	MTG ==> SVG & CKING	MTG	SVG & CKING	MTG	=====	SVG	CKING	
61.87	71.41	6.09	1.15	487.00	HMEQLC & ATM ==> SVG	HMEQLC &...	SVG	HMEQLC	ATM	=====	SVG	
61.87	71.41	6.09	1.15	487.00	HMEQLC & CKING & ATM ==> SVG	HMEQLC &...	SVG	HMEQLC	CKING	ATM	=====	SVG
85.78	97.90	7.01	1.14	560.00	CD & ATM ==> CKING	CD & ATM	CKING	CD	ATM	=====	CKING	
85.78	97.81	7.27	1.14	581.00	MTG ==> CKING	MTG	CKING	MTG	=====	CKING		

- After further analysis, we see that the rule (SVG & HMEQLC implies CKING) has a very high expected confidence , confidence, support and lift.
- This rule states how likely the customer having savings account and home equity line of credit has a checking account. It is quite normal for banks to open a checking account when the customer has a home equity line of credit. An incredible opportunity would be to upsell home equity line of credit when the customer has a savings or a checking account.

- A customer having an Auto-installment loan has a very high probability of having a checking account. Another upselling opportunity would be to sell auto-installment loans when a customer has a savings or a checking account with the bank.
- A cross-sell opportunity for an individual retirement account is present when the customer has a savings account with the bank. It appears that an IRA and a savings account almost often appear together.
- If a customer has a personal trust account with the bank, then there is a high probability that the customer will have the savings account in the bank. We can cross-sell trust account when the customer has a savings account with the bank.

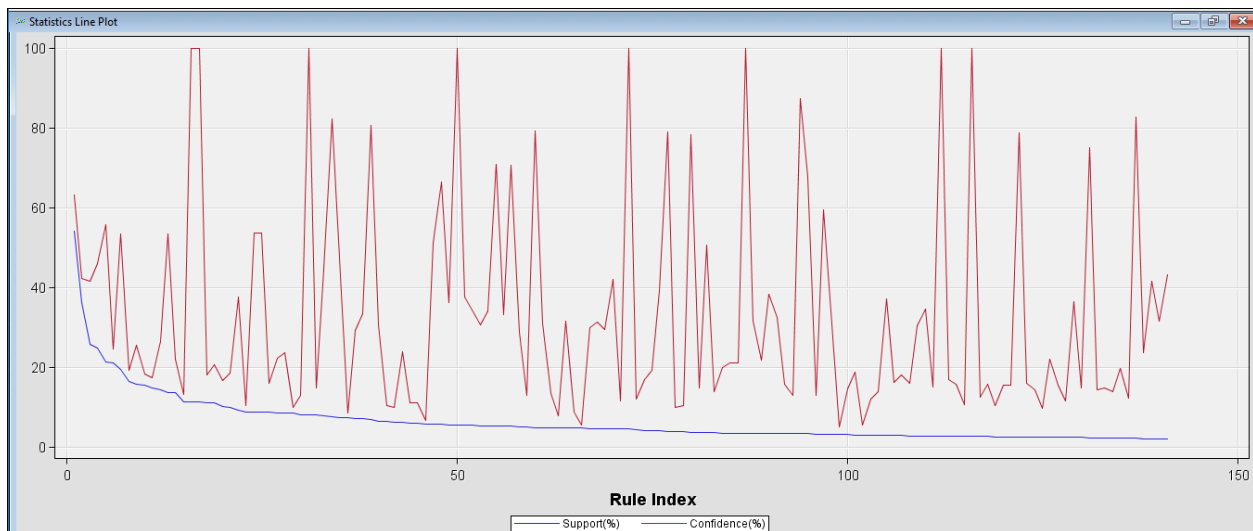
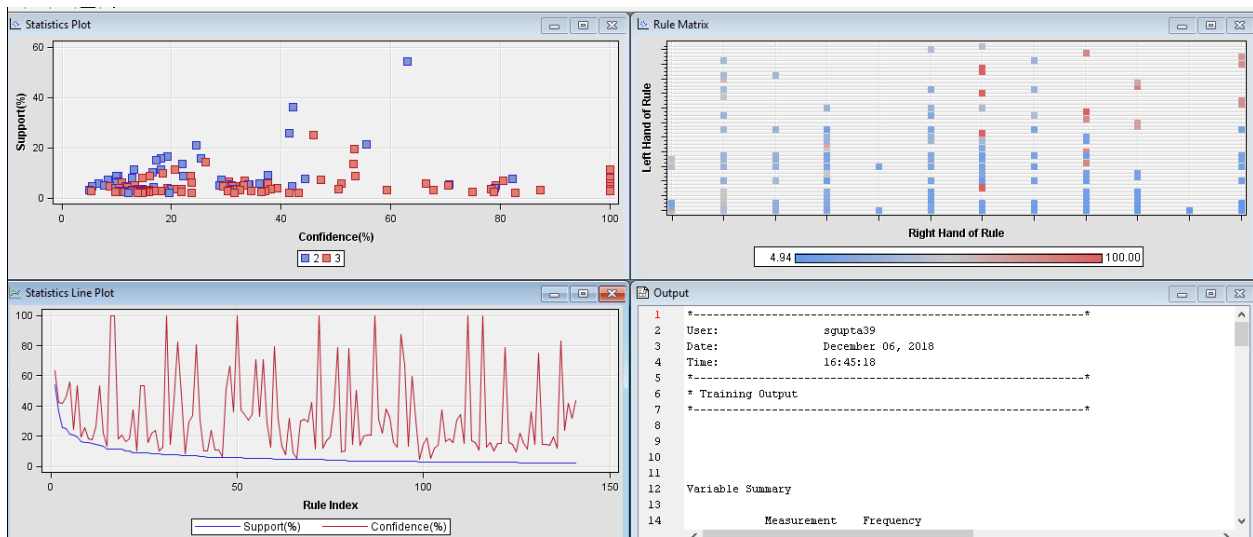
When we plot Expected Confidence against Confidence, we get the following graph. The Confidence/ Expected Confidence gives the measurement of Lift. We should target those products which have a lift of over 1 and cross-sell or up-sell them in order to increase the bank's cross-sell and upsell opportunities.



Sequence Analysis

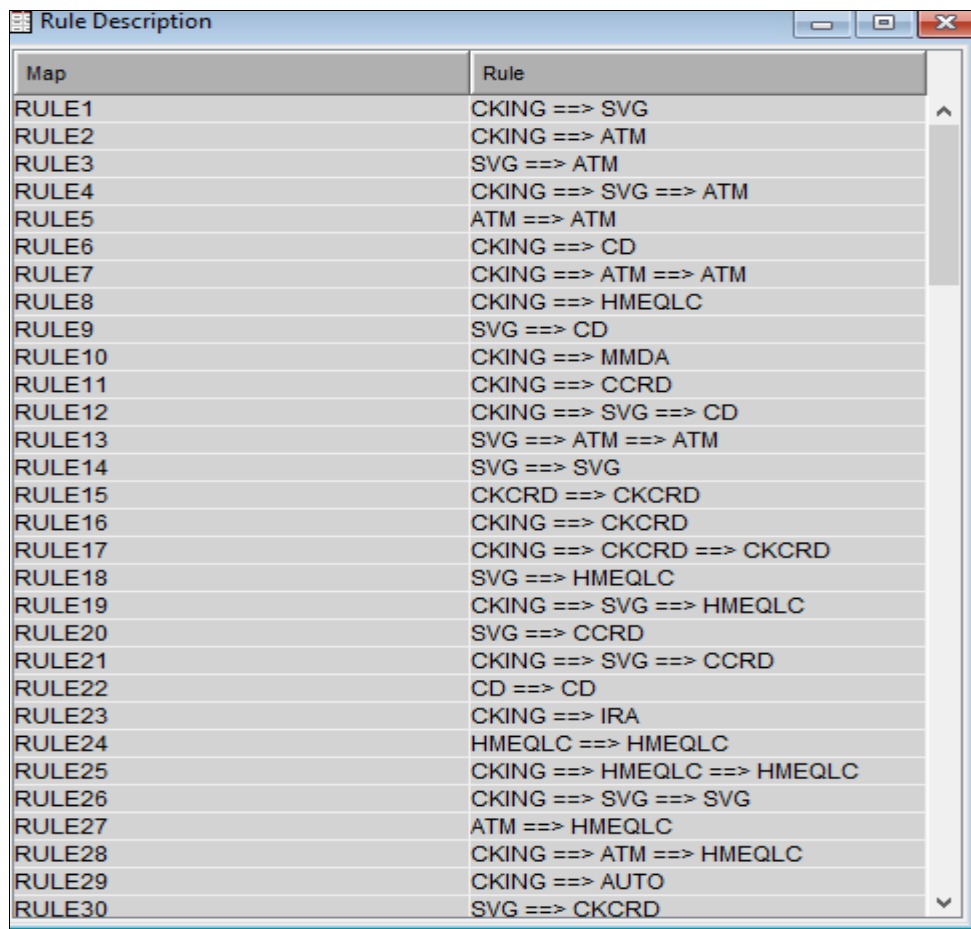
The sequence analysis enables the Bank the order in which the customers are buying the products which will help the bank to come up with a best-next-offer (up-sell) campaign.

The results of the sequence analysis are as follows :-



The percentage support depicts the maximum transaction count i.e. the transaction count divided by the total number of customers

The percentage confidence depicts the transaction count divided by the transaction count on the left side of the sequence.



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

Chain Length	Transaction Count	Support(%)	Confidence(%)	PseudoLift	Rule	Chain Item 1	Chain Item 2	Chain Item 3	Rule Index	Left Hand of Rule	Right Hand of Rule	Transpose Rule
2	4329	54.17	63.15	1.02	CKING ==> ...	CKING	SVG		1	CKING	SVG	1
2	2892	36.19	42.19	1.10	CKING ==> ...	CKING	ATM		2	CKING	ATM	1
2	2053	25.69	41.53	1.08	SVG ==> ATM	SVG	ATM		3	SVG	ATM	1
3	1986	24.85	45.88	1.19	CKING ==> ...	CKING	SVG	ATM	4	CKING ==> ...	ATM	1
2	1709	21.39	55.61	1.45	ATM ==> ATM	ATM			5	ATM	ATM	1
2	1677	20.99	24.46	1.00	CKING ==> ...	CKING	CD		6	CKING	CD	1
3	1546	19.35	53.46	1.39	CKING ==> ...	CKING	ATM	ATM	7	CKING ==> ...	ATM	1
2	1316	16.47	19.20	1.17	CKING ==> ...	CKING	HMEQLC		8	CKING	HMEQLC	1
2	1256	15.72	25.40	1.04	SVG ==> CD	SVG	CD		9	SVG	CD	1
2	1245	15.58	18.16	1.04	CKING ==> ...	CKING	MMDA		10	CKING	MMDA	1
2	1187	14.85	17.32	1.12	CKING ==> ...	CKING	CCRD		11	CKING	CCRD	1
3	1139	14.25	26.31	1.07	CKING ==> ...	CKING	SVG	CD	12	CKING ==> ...	CD	1
3	1094	13.69	53.29	1.39	SVG ==> AT...	SVG	ATM	ATM	13	SVG ==> ATM	ATM	1
2	1085	13.58	21.95	0.35	SVG ==> S...	SVG	SVG		14	SVG	SVG	1
2	903	11.30	100.00	8.85	CKCRD ==...	CKCRD	CKCRD		16	CKCRD	CKCRD	1
2	903	11.30	13.17	1.17	CKING ==> ...	CKING	CKCRD		15	CKING	CKCRD	1
3	903	11.30	100.00	8.85	CKING ==> ...	CKING	CKCRD	CKCRD	17	CKING ==> ...	CKCRD	1
2	891	11.15	18.02	1.09	SVG ==> H...	SVG	HMEQLC		18	SVG	HMEQLC	1
3	891	11.15	20.58	1.25	CKING ==> ...	CKING	SVG	HMEQLC	19	CKING ==> ...	HMEQLC	1
2	817	10.22	16.53	1.07	SVG ==> C...	SVG	CCRD		20	SVG	CCRD	1
3	798	9.99	18.43	1.19	CKING ==> ...	CKING	SVG	CCRD	21	CKING ==> ...	CCRD	1
2	736	9.21	37.55	1.53	CD ==> CD	CD	CD		22	CD	CD	1
2	705	8.82	10.28	0.95	CKING ==> ...	CKING	IRA		23	CKING	IRA	1
2	704	8.81	53.50	3.25	HMEQLC ==...	HMEQLC	HMEQLC		24	HMEQLC	HMEQLC	1
3	704	8.81	53.50	3.25	CKING ==> ...	CKING	HMEQLC	HMEQLC	25	CKING ==> ...	HMEQLC	1
3	692	8.66	15.99	0.26	CKING ==> ...	CKING	SVG	SVG	26	CKING ==> ...	SVG	1
2	682	8.53	22.19	1.35	ATM ==> H...	ATM	HMEQLC		27	ATM	HMEQLC	1
3	682	8.53	23.58	1.43	CKING ==> ...	CKING	ATM	HMEQLC	28	CKING ==> ...	HMEQLC	1
2	681	8.52	9.93	1.07	CKING ==> ...	CKING	AUTO		29	CKING	AUTO	1
2	637	7.97	12.88	1.14	SVG ==> C...	SVG	CKCRD		30	SVG	CKCRD	1
3	637	7.97	100.00	8.85	SVG ==> C...	SVG	CKCRD	CKCRD	31	SVG ==> C...	CKCRD	1

Interpretation of sequence analysis

- A customer who has a savings account, checking account is likely to get an ATM card next.
- A customer who has a checking account is likely to get a home equity line of credit or an individual retirement account or a mortgage. There is an opportunity of upselling home equity line of credit, IRA or mortgage to a person who has a checking account.
- A customer who has a money market deposit account is likely to get an ATM card next. Maybe there is an opportunity for the Bank to upsell an Auto Installment Loan to the customer.