

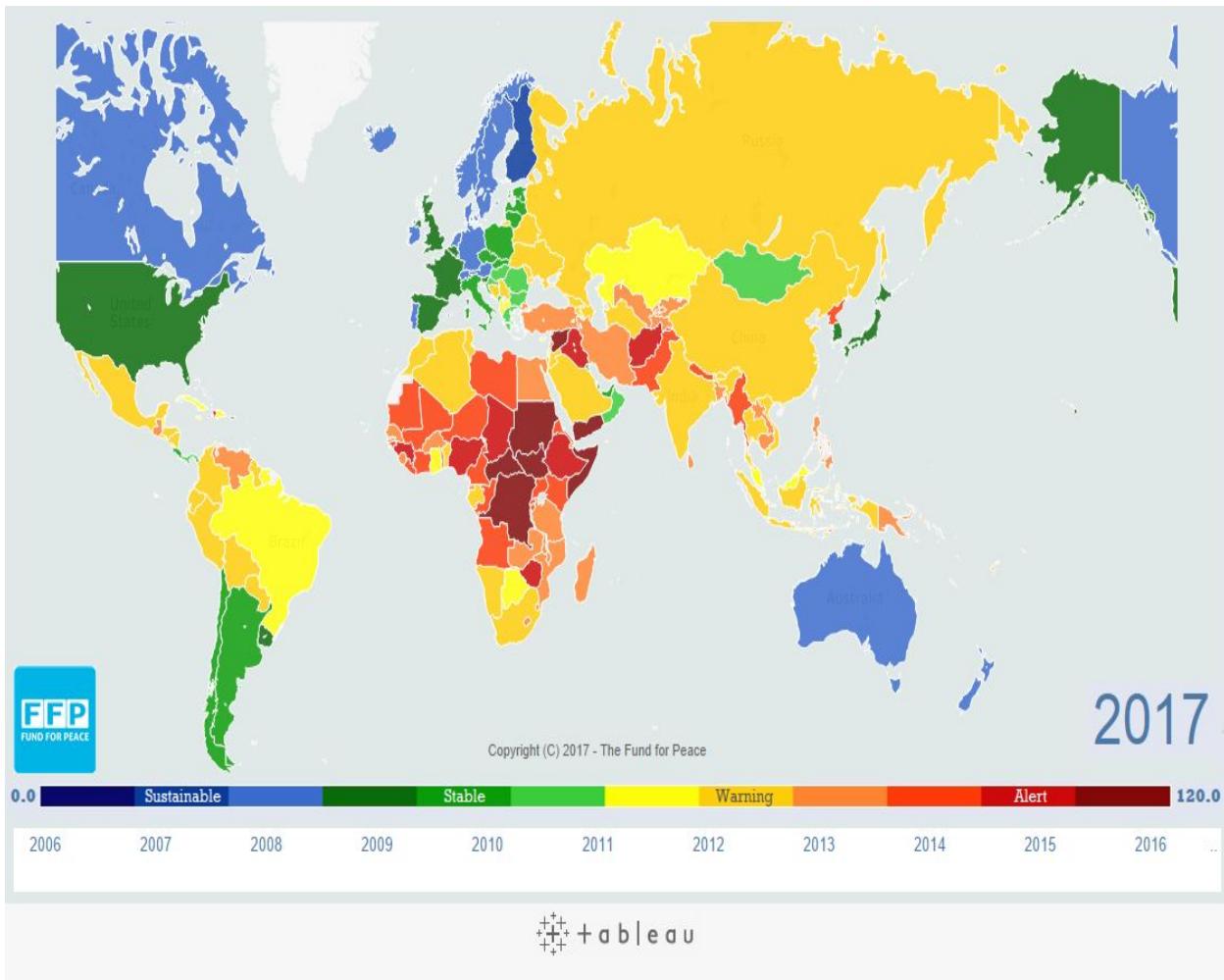
# Analysis on Fragile States Data

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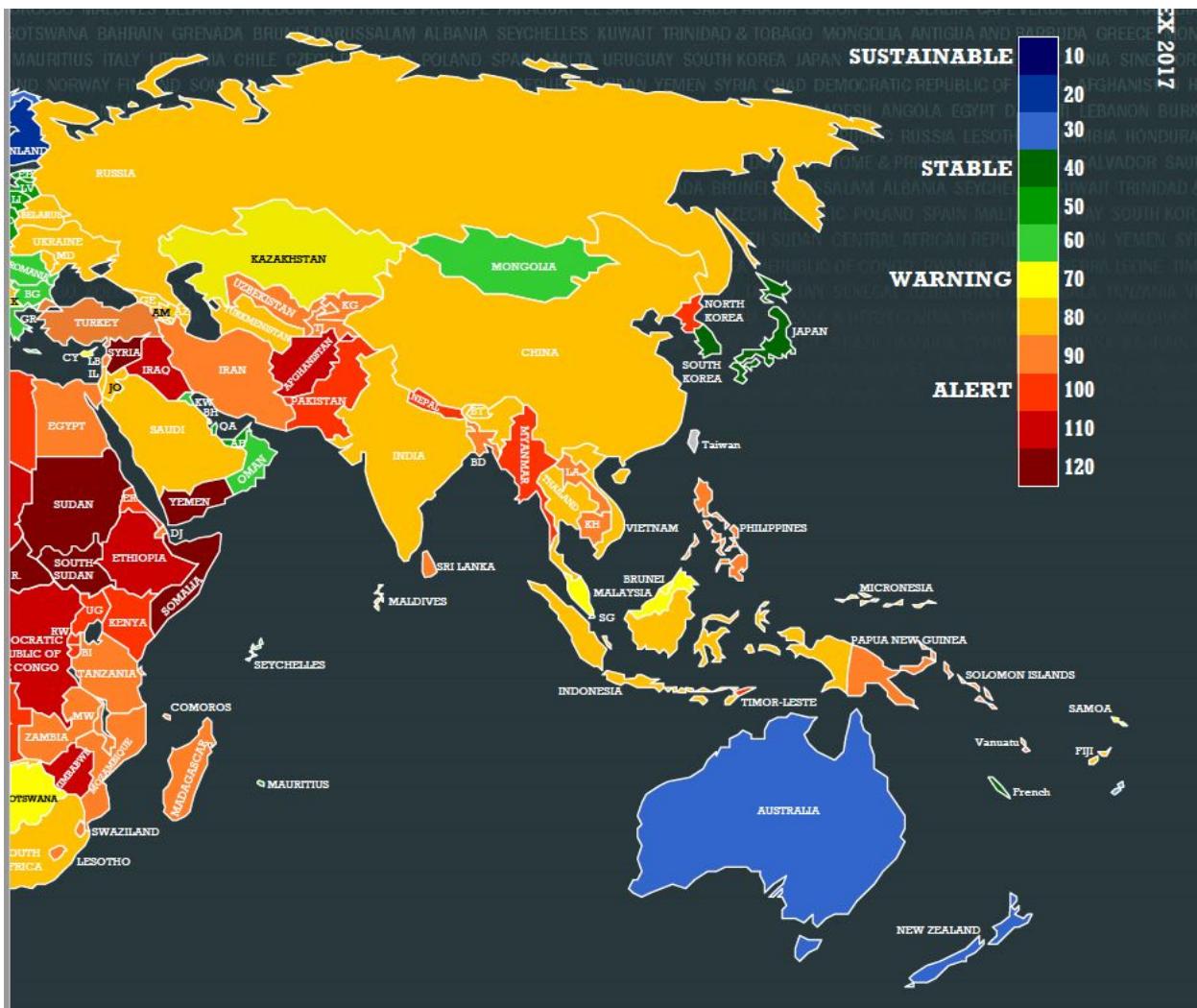


## Introduction

The motive of this project is to perform Action-Rule mining for given Fragile State Index Datasets with new extended features added to the data set and further analyse how the action rules change over the years. Using action rules, we assess how a Country can transfer from the state of Alert to Stable State. This report also discusses about the importance of each attribute in data set and how they are responsible for deciding the state for the country. Discretization and Classification of data is also done for further analysis.

# What is Fragile State Index?

The Fragile States Index (FSI) is an annual ranking of 178 countries based on the different pressures they face that impact their levels of fragility. The Index is based on The Fund for Peace's proprietary Conflict Assessment System Tool (CAST) analytical approach. Based on comprehensive social science methodology, three primary streams of data — quantitative, qualitative, and expert validation - are triangulated and subjected to critical review to obtain final scores for the FSI. Millions of documents are analyzed every year, and by applying highly specialized search parameters, scores are apportioned for every country based on twelve key political, social and economic indicators and over 100 sub-indicators that are the result of years of expert social science research.



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The FSI is the sum of scores of twelve distinctive features (namely, Demographic pressures, Refugees and IDPs, Group Grievance, Human Flight, Uneven Development, Poverty and Economic Decline, State Legitimacy, Public Services, Human Rights, Security Apparatus, Factionalized Elites, External Intervention) indicative of state's stability. These features are broadly categorized into social, economic & political groups. Each feature has its value defined within the span of 0 and 10, with a higher value demonstrating a higher degree of fragility, thus creating a scale ranging 0–120. Each of these features is explained below:

- **Social Indicators**

1. Demographic Pressures (DP): Defined by the relative ratio of high population density and other life perpetuating resources like food, water etc.
2. Refugees and IDPs: Defined by the immigration of general population that can affect security and other resources.
3. Group Grievance: Defined by the existing violence between communities that can threaten the country's security.
4. Human Flight: Defined by migration per capita especially immigration of educated people who moves out of countries for better opportunity.

- **Economic Indicators**

5. Poverty and Economic Decline: Defined by the economic decline of the society as a whole that in return affects the country's ability to provide better outcome.
6. Uneven Development: Defined by the inequality in different genres like work, education, financial that impact negatively on the social contract of a country.

- **Political Indicators**

7. State Legitimacy: Defined by the corruption in the higher level of a state's community.
8. Public Services: Defined by the lack of important services like healthcare, education, cleanliness, transportation that affects the performance of a state.
9. Human Rights: Defined by the weak protection of basic rights indicates the failure of a state to perform its primary responsibility.
10. Security Apparatus: An emergence of elite or praetorian guards that operate with impunity challenges the security apparatus' monopoly on the use of force,

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weakening the social contract. Measurements include internal conflict, riots/protests, military coups, rebel activity.

11. Fractionalized Elites: Measured by power input from elite groups and corrupted elections.

12. External Intervention: Measured by foreign assistance, presence of peacekeepers or UN missions, foreign military intervention, sanctions, and credit ratings.

## Extended Features

This project proffers discovering new patterns & trends using classification of fragility within states. We extend this analysis by adding seven new features which may allow risk assessment and early warning of conflict. The new features that have been added are:

- **Homeless People due to Natural Disaster:**

This feature represents the number of people who lacks shelter and carry their possessions along with them because of Natural Disasters like Cyclone, Earthquake etc., which is expressed per million people.

- **Life expectancy at birth:**

Number of years a newborn infant is expected to live assuming that the existing patterns of age-specific mortality rates during his infant's stay same throughout the infant's life.

- **Total unemployment rate:**

This feature represents the total number of people who are unemployed in the country .

- **Environmental Performance Index (EPI):**

This feature defines the condition of a country's environment. It can be also defined as a measure of the environment's health quality.

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- **Prison Population:**

Prison Population defines the number of adult and juvenile prisoners present per 1 million people.

- **Infant mortality rate:**

The probability that an infant might die exactly within 1 year of his birth, which is expressed per every 1,000 live births.

- **Education Index:**

In general, Education Index is calculated as the Number of expected years a child spends in a given level of education to the Average number of completed years of education of people. This feature is vital because Education is the vital criteria in assessing the development of a country.

- **Domestic credit provided by financial sector:**

This feature represents the credit given to various sectors of the country based on the gross, except that the credit of central government is not included, which is generally expressed as a percentage of GDP.

- **Global Terrorism Index(GTI):**

This feature represents the ranking of the countries which is based on the terrorist activities happened over a period of time.

## **Data Extraction:**

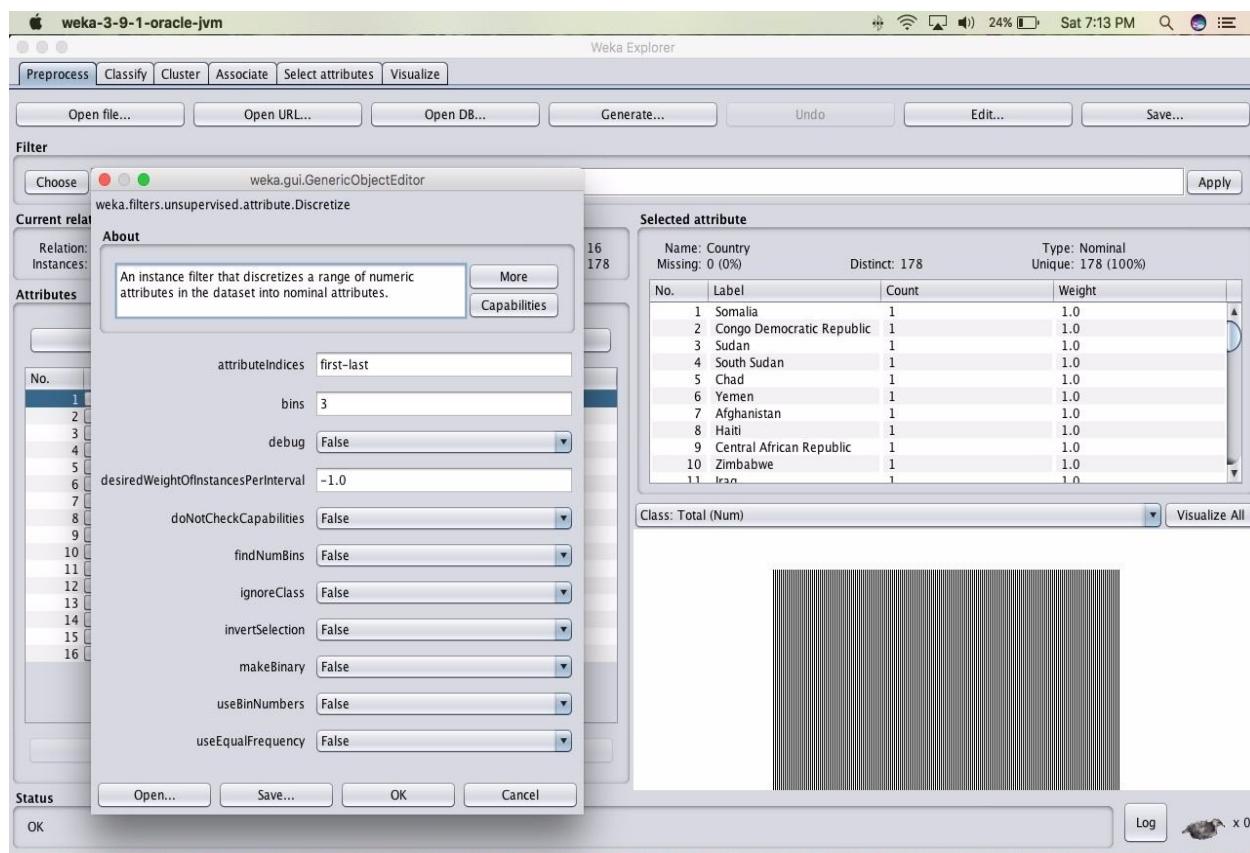
The values for these extended features have been extracted from various websites and added to the original FSI dataset. The data for four consecutive years, i.e, 2013-2016 is compiled and stored as an Excel sheet for further processing & analysis. Values for the extended features were gathered from various websites which are listed below:

- <http://hdr.undp.org/en>

- <https://data.worldbank.org>
- <http://databank.worldbank.org/data/home.aspx>
- <http://hdr.undp.org/en/data>

## Data Cleaning and Pre-Processing

The data obtained from the FSI website was not clean and hence some pre-processing was done before using it for classification. Following were the steps taken for Data Cleaning.



1. Special Characters like !, % etc. were removed so that the sheets can be parsed by WEKA tool.
2. Missing numeric values were filled by their mean values
3. Outliers were removed and replaced by mean values
4. Rows having lot of empty values were removed from the analysis.
5. Converting each numeric column value in the range of 0 to 10.

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6. Numeric values of Decision Variable Total was replaced by Nominal Values based on the following table values.

Category	Total Score
Alert	172.5–230.0
Warning	115–172.4
Stable	57.5–114.9
Sustainable	0.0–57.4

After performing all the above mentioned steps, data was ready for classification and action rules discovery.

## Data Processing using WEKA

We used WEKA to process the data sets for years 2013 to 2016. Data Processing was done in the following steps.

- 1. Data Discretization**
- 2. Data Classification**

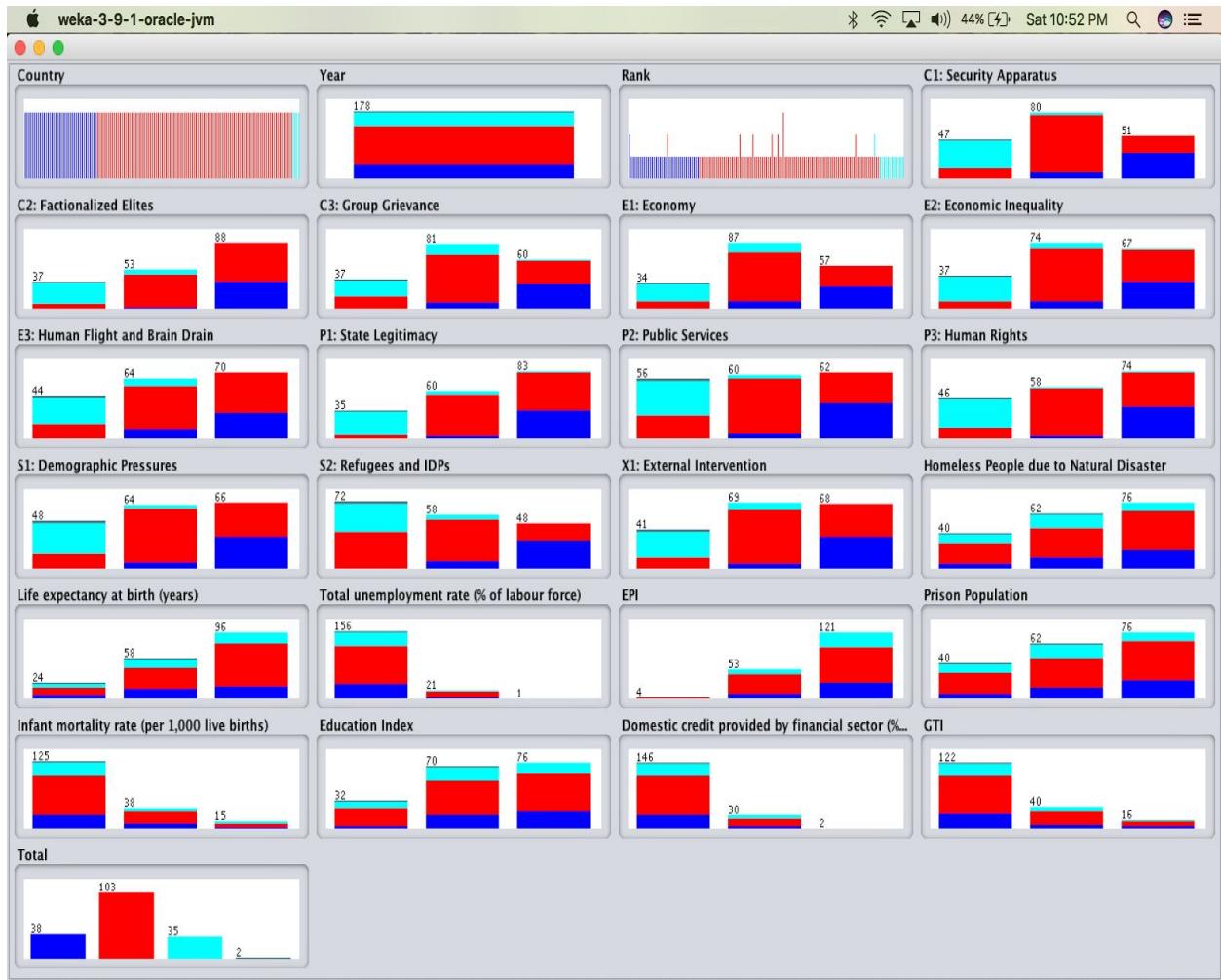
## Data Discretization using WEKA

Discretization refers to the process of converting or partitioning continuous attributes, features or variables to discretized or nominal attributes/features/variables.

The decision attribute TOTAL has various values throughout the dataset, we have used discretization to replace numeric values of TOTAL by the following concepts.

1. Alert (union of Very High Alert, High Alert, Alert)
2. Warning (union of High Warning, Elevated Warning, Warning).
3. Stable (union of Stable, More Stable, Very Stable).
4. Sustainable (union of Sustainable, Very Sustainable).

Sample screenshot of discretization:



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## DATA CLASSIFICATION USING WEKA

For Classification, we have used the following classifiers. Each classifier is run for the dataset from the year 2013 to 2016.

Also, we have calculated the accuracy for each classifier for the datasets before adding the extra-features and after adding the extra-features to compare the efficiency of both types of datasets.

Following are the Algorithms used for Classification:

### **1) BayesNet:**

Bayes Network learning using various search algorithms and quality measures. Base class for a Bayes Network classifier. Provides data structures (network structure, conditional probability distributions, etc.) and facilities common to Bayes Network learning algorithms like K2 and B.

### **2) NaiveBayes:**

Class for a Naive Bayes classifier using estimator classes. Numeric estimator precision values are chosen based on analysis of the training data. For this reason, the classifier is not an Updateable Classifier (which in typical usage are initialized with zero training instances) -- if you need the Updateable Classifier functionality, use the NaiveBayes Updateable classifier. The NaiveBayes Updateable classifier will use a default precision of 0.1 for numeric attributes when buildClassifier is called with zero training instances.

### **3) J48:**

The C4.5 algorithm for building decision trees is implemented in Weka as a classifier called J48. Classifiers, like filters, are organized in a hierarchy: J48 has the full name `weka.classifiers.trees.J48`.

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#### 4) JRip:

This class implements a propositional rule learner, Repeated Incremental Pruning to Produce Error Reduction (RIPPER), which was proposed by William W. Cohen as an optimized version of IREP.

The algorithm is briefly described as follows:

Initialize RS = {}, and for each class from the less prevalent one to the more frequent one,  
DO:

##### 1. Building stage:

Repeat 1.1 and 1.2 until the description length (DL) of the ruleset and examples is 64 bits greater than the smallest DL met so far, or there are no positive examples, or the error rate  $\geq 50\%$ .

###### 1.1. Grow phase:

Grow one rule by greedily adding antecedents (or conditions) to the rule until the rule is perfect (i.e. 100% accurate). The procedure tries every possible value of each attribute and selects the condition with highest information gain:  $p(\log(p/t)-\log(P/T))$ .

###### 1.2. Prune phase:

Incrementally prune each rule and allow the pruning of any final sequences of the antecedents; The pruning metric is  $(p-n)/(p+n)$  -- but it's actually  $2p/(p+n) - 1$ , so in this implementation we simply use  $p/(p+n)$  (actually  $(p+1)/(p+n+2)$ , thus if  $p+n$  is 0, it's 0.5).

###### 2. Optimization stage:

after generating the initial ruleset {R<sub>i</sub>}, generate and prune two variants of each rule R<sub>i</sub> from randomized data using procedure 1.1 and 1.2. But one variant is generated from an empty rule while the other is generated by greedily adding antecedents to the original rule. Moreover, the pruning metric used here is  $(TP+TN)/(P+N)$ . Then the smallest possible DL for

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each variant and the original rule is computed. The variant with the minimal DL is selected as the final representative of  $R_i$  in the ruleset. After all the rules in  $\{R_i\}$  have been examined and if there are still residual positives, more rules are generated based on the residual positives using Building Stage again.

3. Delete the rules from the ruleset that would increase the DL of the whole ruleset if it were in it. and add resultant ruleset to RS.

ENDDO

Note that there seem to be 2 bugs in the original ripper program that would affect the ruleset size and accuracy slightly. This implementation avoids these bugs and thus is a little bit different from Cohen's original implementation. Even after fixing the bugs, since the order of classes with the same frequency is not defined in ripper, there still seems to be some trivial difference between this implementation and the original ripper, especially for audiology data in UCI repository, where there are lots of classes of few instances.

## **Snapshots of the Classification Results for Data before adding New Features:**

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2016 before adding features:

1)Bayesnet with split:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	39	63.9344 %
Incorrectly Classified Instances	22	36.0656 %
Kappa statistic	0.4641	
Mean absolute error	0.2344	
Root mean squared error	0.4629	
Relative absolute error	53.8767 %	
Root relative squared error	98.9893 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.933	0.196	0.609	0.933	0.737	0.655	0.939	0.832	'(-inf-3.933333]'
0.417	0.216	0.556	0.417	0.476	0.215	0.716	0.562	'(3.933333-6.966667]'
0.682	0.128	0.750	0.682	0.714	0.566	0.896	0.856	'(6.966667-inf)'
Weighted Avg.	0.639	0.179	0.639	0.639	0.626	0.450	0.836	0.734

==== Confusion Matrix ===

a	b	c	<-- classified as
14	1	0	a = '(-inf-3.933333]'
9	10	5	b = '(3.933333-6.966667]'
0	7	15	c = '(6.966667-inf)'

2)NaiveBayes with split:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

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==== Summary ====

Correctly Classified Instances	39	63.9344 %
Incorrectly Classified Instances	22	36.0656 %
Kappa statistic	0.4641	
Mean absolute error	0.2338	
Root mean squared error	0.4601	
Relative absolute error	53.7462 %	
Root relative squared error	98.3822 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ====

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.933   a = '(-inf-3.933333]'	0.933	0.196	0.609	0.933	0.737	0.655	0.939	0.832	'(-inf-3.933333]'
0.417   b = '(3.933333-6.966667]'	0.417	0.216	0.556	0.417	0.476	0.215	0.715	0.555	'(3.933333-6.966667)'
0.682   c = '(6.966667-inf)'	0.682	0.128	0.750	0.682	0.714	0.566	0.899	0.859	'(6.966667-inf)'
Weighted Avg.	0.639	0.179	0.639	0.639	0.626	0.450	0.836	0.733	

==== Confusion Matrix ====

a	b	c	<-- classified as
14	1	0	a = '(-inf-3.933333]'
9	10	5	b = '(3.933333-6.966667]'
0	7	15	c = '(6.966667-inf)'

j48 with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ====

==== Summary ====

Correctly Classified Instances	114	64.0449 %
Incorrectly Classified Instances	64	35.9551 %
Kappa statistic	0.4511	
Mean absolute error	0.2831	
Root mean squared error	0.3907	
Relative absolute error	65.2168 %	
Root relative squared error	83.8707 %	
Total Number of Instances	178	

==== Detailed Accuracy By Class ====

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TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.732	0.124	0.638	0.732	0.682	0.580	0.821	0.669	'(-inf-3.933333]'
0.710	0.404	0.527	0.710	0.605	0.299	0.641	0.450	'(3.933333-
6.966667]'								
0.515	0.027	0.921	0.515	0.660	0.578	0.830	0.727	'(6.966667-inf)'
Weighted Avg.	0.640	0.195	0.703	0.640	0.644	0.470	0.755	0.606

==== Confusion Matrix ===

```
a b c <- classified as
30 11 0 | a = '(-inf-3.933333]'
17 49 3 | b = '(3.933333-6.966667]'
0 33 35 | c = '(6.966667-inf)'
```

jRip with folds:

Time taken to build model: 0.03 seconds

==== Stratified cross-validation ===

==== Summary ===

Correctly Classified Instances	108	60.6742 %
Incorrectly Classified Instances	70	39.3258 %
Kappa statistic	0.3993	
Mean absolute error	0.3007	
Root mean squared error	0.4105	
Relative absolute error	69.265 %	
Root relative squared error	88.1163 %	
Total Number of Instances	178	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.732	0.117	0.652	0.732	0.690	0.591	0.870	0.739	'(-inf-3.933333]'
0.580	0.376	0.494	0.580	0.533	0.199	0.636	0.457	'(3.933333-
6.966667]'								
0.559	0.118	0.745	0.559	0.639	0.474	0.812	0.694	'(6.966667-inf)'
Weighted Avg.	0.607	0.218	0.626	0.607	0.610	0.394	0.757	0.612

==== Confusion Matrix ===

```
a b c <- classified as
30 11 0 | a = '(-inf-3.933333]'
16 40 13 | b = '(3.933333-6.966667]'
```

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```
0 30 38 | c = '(6.966667-inf)'
```

## 2015

1)BayesNet:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0.01 seconds

==== Summary ===

Correctly Classified Instances	46	75.4098 %
Incorrectly Classified Instances	15	24.5902 %
Kappa statistic	0.6315	
Mean absolute error	0.1636	
Root mean squared error	0.3727	
Relative absolute error	36.7749 %	
Root relative squared error	77.4529 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.900	0.098	0.818	0.900	0.857	0.784	0.959	0.910	0.910	'(-inf-4]'
0.632	0.190	0.600	0.632	0.615	0.435	0.821	0.666	0.666	'(4-7]'
0.727	0.077	0.842	0.727	0.780	0.674	0.923	0.890	0.890	'(7-inf)'
Weighted Avg.	0.754	0.119	0.759	0.754	0.754	0.636	0.903	0.827	

==== Confusion Matrix ===

a	b	c	<- classified as
18	2	0	a = '(-inf-4]'
4	12	3	b = '(4-7]'
0	6	16	c = '(7-inf)'

---

2)Naïve Bayes:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	46	75.4098 %
Incorrectly Classified Instances	15	24.5902 %
Kappa statistic	0.6315	
Mean absolute error	0.1636	
Root mean squared error	0.3703	
Relative absolute error	36.7608 %	
Root relative squared error	76.9584 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.900	0.098	0.818	0.900	0.857	0.784	0.959	0.910	'(-inf-4)'
0.632	0.190	0.600	0.632	0.615	0.435	0.818	0.626	'(4-7)'
0.727	0.077	0.842	0.727	0.780	0.674	0.924	0.889	'(7-inf)'
Weighted Avg.	0.754	0.119	0.759	0.754	0.754	0.636	0.902	0.814

==== Confusion Matrix ===

a	b	c	<-- classified as
18	2	0	a = '(-inf-4)'
4	12	3	b = '(4-7)'
0	6	16	c = '(7-inf)'

3)JRip:

Time taken to build model: 0.02 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

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Correctly Classified Instances	39	63.9344 %
Incorrectly Classified Instances	22	36.0656 %
Kappa statistic	0.4589	
Mean absolute error	0.3055	
Root mean squared error	0.4105	
Relative absolute error	68.6637 %	
Root relative squared error	85.3121 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.650	0.146	0.684	0.650	0.667	0.511	0.841	0.620	'(-inf-4]'
0.474	0.286	0.429	0.474	0.450	0.183	0.563	0.367	'(4-7]'
0.773	0.103	0.810	0.773	0.791	0.677	0.890	0.745	'(7-inf)'
Weighted Avg.	0.639	0.174	0.650	0.639	0.644	0.469	0.772	0.586

==== Confusion Matrix ===

a	b	c	<-- classified as
13	7	0	a = '(-inf-4]'
6	9	4	b = '(4-7]'
0	5	17	c = '(7-inf)'

4)J48:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	43	70.4918 %
Incorrectly Classified Instances	18	29.5082 %
Kappa statistic	0.5622	
Mean absolute error	0.2503	
Root mean squared error	0.3698	
Relative absolute error	56.2404 %	
Root relative squared error	76.8452 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

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TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.850	0.098	0.810	0.850	0.829	0.743	0.866	0.799	'(-inf-4]'
0.789	0.333	0.517	0.789	0.625	0.423	0.747	0.487	'(4-7]'
0.500	0.000	1.000	0.500	0.667	0.624	0.895	0.791	'(7-inf)'
Weighted Avg.	0.705	0.136	0.787	0.705	0.707	0.601	0.839	0.699

==== Confusion Matrix ===

```
a b c <- classified as
17 3 0 | a = '(-inf-4]'
4 15 0 | b = '(4-7]'
0 11 11 | c = '(7-inf)'
```

#### 2014:

1) Bayesnet:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	42	68.8525 %
Incorrectly Classified Instances	19	31.1475 %
Kappa statistic	0.5327	
Mean absolute error	0.2118	
Root mean squared error	0.442	
Relative absolute error	47.5108 %	
Root relative squared error	92.2788 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.762	0.075	0.842	0.762	0.800	0.705	0.936	0.839	'(-inf-4.166667]'
0.571	0.250	0.545	0.571	0.558	0.318	0.731	0.507	'(4.166667-
7.033333]'								
0.737	0.143	0.700	0.737	0.718	0.586	0.898	0.797	'(7.033333-inf)'
Weighted Avg.	0.689	0.156	0.696	0.689	0.691	0.535	0.854	0.712

==== Confusion Matrix ===

---

```
a b c <- classified as
16 5 0 | a = '(-inf-4.166667]'
3 12 6 | b = '(4.166667-7.033333]'
0 5 14 | c = '(7.033333-inf)'
```

2)NaiveBayes:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	42	68.8525 %
Incorrectly Classified Instances	19	31.1475 %
Kappa statistic	0.5327	
Mean absolute error	0.2109	
Root mean squared error	0.4398	
Relative absolute error	47.3274 %	
Root relative squared error	91.8263 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0	0.762	0.075	0.842	0.762	0.800	0.705	0.936	0.839	'(-inf-4.166667]'
1	0.571	0.250	0.545	0.571	0.558	0.318	0.735	0.515	'(4.166667-
2	0.737	0.143	0.700	0.737	0.718	0.586	0.900	0.801	'(7.033333-inf)'
Weighted Avg.	0.689	0.156	0.696	0.689	0.691	0.535	0.855	0.716	

==== Confusion Matrix ===

```
a b c <- classified as
16 5 0 | a = '(-inf-4.166667]'
3 12 6 | b = '(4.166667-7.033333]'
0 5 14 | c = '(7.033333-inf)'
```

3)j48:

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Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	43	70.4918 %
Incorrectly Classified Instances	18	29.5082 %
Kappa statistic	0.5573	
Mean absolute error	0.2629	
Root mean squared error	0.377	
Relative absolute error	58.9855 %	
Root relative squared error	78.7097 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.762	0.050	0.889	0.762	0.821	0.742	0.915	0.799	'(-inf-4.166667]'
0.619	0.250	0.565	0.619	0.591	0.362	0.725	0.509	'(4.166667-
7.033333]'								
0.737	0.143	0.700	0.737	0.718	0.586	0.853	0.632	'(7.033333-inf)'
Weighted Avg.	0.705	0.148	0.719	0.705	0.710	0.562	0.831	0.647

==== Confusion Matrix ===

a	b	c	<-- classified as
16	5	0	a = '(-inf-4.166667]'
2	13	6	b = '(4.166667-7.033333]'
0	5	14	c = '(7.033333-inf)'

4)JRip:

Time taken to build model: 0.02 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

---

==== Summary ====

Correctly Classified Instances	38	62.2951 %
Incorrectly Classified Instances	23	37.7049 %
Kappa statistic	0.4352	
Mean absolute error	0.2925	
Root mean squared error	0.4088	
Relative absolute error	65.6133 %	
Root relative squared error	85.3587 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ====

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
16 4 1   a = '(-inf-4.166667]'	0.762	0.050	0.889	0.762	0.821	0.742	0.896	0.791	'(-inf-4.166667]'
2 10 9   b = '(4.166667-7.033333]'	0.476	0.275	0.476	0.476	0.476	0.201	0.671	0.449	'(4.166667-7.033333]'
0 7 12   c = '(7.033333-inf)'	0.632	0.238	0.545	0.632	0.585	0.379	0.776	0.507	'(7.033333-inf)'
Weighted Avg.	0.623	0.186	0.640	0.623	0.629	0.443	0.781	0.585	

==== Confusion Matrix ====

a b c <-- classified as			
16 4 1   a = '(-inf-4.166667]'			
2 10 9   b = '(4.166667-7.033333]'			
0 7 12   c = '(7.033333-inf)'			

### **2013:**

1)BayesNet:

Time taken to build model: 0 seconds

==== Evaluation on test split ====

Time taken to test model on test split: 0 seconds

==== Summary ====

Correctly Classified Instances	45	73.7705 %
Incorrectly Classified Instances	16	26.2295 %
Kappa statistic	0.6065	
Mean absolute error	0.1803	

---

Root mean squared error	0.4109
Relative absolute error	40.57 %
Root relative squared error	84.6617 %
Total Number of Instances	61

==== Detailed Accuracy By Class ====

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.850	0.024	0.944	0.850	0.895	0.850	0.977	0.965	'(-inf-4]'
0.650	0.220	0.591	0.650	0.619	0.421	0.817	0.671	'(4-7]'
0.714	0.150	0.714	0.714	0.714	0.564	0.876	0.746	'(7-inf)'
Weighted Avg.	0.738	0.132	0.749	0.738	0.742	0.611	0.890	0.793

==== Confusion Matrix ====

a b c	<-- classified as
17 3 0	a = '(-inf-4]'
1 13 6	b = '(4-7]'
0 6 15	c = '(7-inf)'

2)NaiveBayes:

Time taken to build model: 0 seconds

==== Evaluation on test split ====

Time taken to test model on test split: 0 seconds

==== Summary ====

Correctly Classified Instances	44	72.1311 %
Incorrectly Classified Instances	17	27.8689 %
Kappa statistic	0.5819	
Mean absolute error	0.1797	
Root mean squared error	0.4037	
Relative absolute error	40.4253 %	
Root relative squared error	83.1686 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ====

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.850	0.049	0.895	0.850	0.872	0.812	0.976	0.964	'(-inf-4]'
0.600	0.220	0.571	0.600	0.585	0.376	0.820	0.695	'(4-7]'
0.714	0.150	0.714	0.714	0.714	0.564	0.890	0.791	'(7-inf)'

---

```
Weighted Avg. 0.721 0.140 0.727 0.721 0.724 0.584 0.895 0.816
```

```
==== Confusion Matrix ===
```

```
a b c <- classified as  
17 3 0 | a = '(-inf-4]'  
2 12 6 | b = '(4-7]'  
0 6 15 | c = '(7-inf)'
```

```
3)jRip:
```

```
Time taken to build model: 0.01 seconds
```

```
==== Evaluation on test split ===
```

```
Time taken to test model on test split: 0 seconds
```

```
==== Summary ===
```

Correctly Classified Instances	45	73.7705 %
Incorrectly Classified Instances	16	26.2295 %
Kappa statistic	0.6068	
Mean absolute error	0.2405	
Root mean squared error	0.3696	
Relative absolute error	54.108 %	
Root relative squared error	76.1428 %	
Total Number of Instances	61	

```
==== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.800	0.000	1.000	0.800	0.889	0.854	0.946	0.895	0.895	'(-inf-4]'
0.750	0.268	0.577	0.750	0.652	0.457	0.790	0.544	0.544	'(4-7]'
0.667	0.125	0.737	0.667	0.700	0.556	0.838	0.647	0.647	'(7-inf)'
Weighted Avg.	0.738	0.131	0.771	0.738	0.746	0.621	0.857	0.694	

```
==== Confusion Matrix ===
```

```
a b c <- classified as  
16 4 0 | a = '(-inf-4]'  
0 15 5 | b = '(4-7]'  
0 7 14 | c = '(7-inf)'
```

---

4)j48:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	45	73.7705 %
Incorrectly Classified Instances	16	26.2295 %
Kappa statistic	0.6065	
Mean absolute error	0.24	
Root mean squared error	0.3694	
Relative absolute error	54.003 %	
Root relative squared error	76.1031 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.800	0.000	1.000	0.800	0.889	0.854	0.951	0.900	'(-inf-4]'
0.700	0.244	0.583	0.700	0.636	0.438	0.787	0.542	'(4-7]'
0.714	0.150	0.714	0.714	0.714	0.564	0.839	0.644	'(7-inf)'
Weighted Avg.	0.738	0.132	0.765	0.738	0.746	0.618	0.859	0.694

==== Confusion Matrix ===

a b c	<-- classified as
16 4 0	a = '(-inf-4]'
0 14 6	b = '(4-7]'
0 6 15	c = '(7-inf)'

---

## **Snapshots of the Classification Results for Data after adding New Features:**

---

## 2016:

1)Bayesnet with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ====  
==== Summary ===

Correctly Classified Instances	148	83.1461 %
Incorrectly Classified Instances	30	16.8539 %
Kappa statistic	0.718	
Mean absolute error	0.0884	
Root mean squared error	0.2688	
Relative absolute error	30.2203 %	
Root relative squared error	70.5118 %	
Total Number of Instances	178	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.816	0.079	0.738	0.816	0.775	0.711	0.953	0.860	Alert
0.835	0.120	0.905	0.835	0.869	0.708	0.935	0.949	Warning
0.886	0.056	0.795	0.886	0.838	0.797	0.971	0.813	Stable
0.000	0.011	0.000	0.000	0.000	-0.011	0.741	0.032	Sustainable
Weighted Avg.	0.831	0.097	0.838	0.831	0.833	0.718	0.944	0.893

==== Confusion Matrix ===

a	b	c	d	<-- classified as
31	7	0	0	a = Alert
11	86	6	0	b = Warning
0	2	31	2	c = Stable
0	0	2	0	d = Sustainable

2)Naive Bayes with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ====  
==== Summary ===

Correctly Classified Instances	149	83.7079 %
Incorrectly Classified Instances	29	16.2921 %
Kappa statistic	0.7269	
Mean absolute error	0.0853	
Root mean squared error	0.2608	
Relative absolute error	29.155 %	
Root relative squared error	68.4145 %	
Total Number of Instances	178	

---

**pu**

---

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	44	72.1311 %
Incorrectly Classified Instances	17	27.8689 %
Kappa statistic	0.5081	
Mean absolute error	0.1678	
Root mean squared error	0.3526	
Relative absolute error	56.0177 %	
Root relative squared error	88.9348 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.462	0.042	0.750	0.462	0.571	0.509	0.762	0.486	Alert
0.906	0.448	0.690	0.906	0.784	0.494	0.720	0.680	Warning
0.600	0.043	0.818	0.600	0.692	0.623	0.818	0.642	Stable
0.000	0.000	0.000	0.000	0.000	0.000	0.933	0.111	Sustainable
Weighted Avg.	0.721	0.255	0.723	0.721	0.703	0.521	0.756	0.620

==== Confusion Matrix ===

a	b	c	d	<- classified as
6	7	0	0	a = Alert
2	29	1	0	b = Warning
0	6	9	0	c = Stable
0	0	1	0	d = Sustainable

## 2015:

1)Bayesnet with split :

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	55	90.1639 %
Incorrectly Classified Instances	6	9.8361 %
Kappa statistic	0.8426	
Mean absolute error	0.0528	
Root mean squared error	0.21	
Relative absolute error	17.3913 %	
Root relative squared error	51.9663 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	Alert
0.968	0.067	0.938	0.968	0.952	0.902	0.978	0.971	Warning
0.789	0.048	0.882	0.789	0.833	0.766	0.966	0.935	Stable
0.875	0.038	0.778	0.875	0.824	0.797	0.983	0.924	Sustainable

---

```
Weighted Avg. 0.902 0.054 0.902 0.902 0.901 0.851 0.976 0.955
```

```
==== Confusion Matrix ===
```

```
a b c d <- classified as  
3 0 0 0 | a = Alert  
0 30 1 0 | b = Warning  
0 2 15 2 | c = Stable  
0 0 1 7 | d = Sustainable
```

2)Naive Bayes with split:

```
Time taken to build model: 0 seconds
```

```
==== Evaluation on test split ===
```

```
Time taken to test model on test split: 0 seconds
```

```
==== Summary ===
```

Correctly Classified Instances	55	90.1639 %
Incorrectly Classified Instances	6	9.8361 %
Kappa statistic	0.8426	
Mean absolute error	0.0545	
Root mean squared error	0.2058	
Relative absolute error	17.955 %	
Root relative squared error	50.9232 %	
Total Number of Instances	61	

```
==== Detailed Accuracy By Class ===
```

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	Alert
0.968	0.067	0.938	0.968	0.952	0.902	0.980	0.973	Warning
0.789	0.048	0.882	0.789	0.833	0.766	0.964	0.927	Stable
0.875	0.038	0.778	0.875	0.824	0.797	0.981	0.919	Sustainable
Weighted Avg.	0.902	0.054	0.902	0.902	0.901	0.851	0.976	0.953

```
==== Confusion Matrix ===
```

```
a b c d <- classified as  
3 0 0 0 | a = Alert  
0 30 1 0 | b = Warning  
0 2 15 2 | c = Stable  
0 0 1 7 | d = Sustainable
```

3)Rip with 10 fold cross validation:

```
Time taken to build model: 0.02 seconds
```

```
==== Stratified cross-validation ===
```

```
==== Summary ===
```

Correctly Classified Instances	147	82.5843 %
Incorrectly Classified Instances	31	17.4157 %

---

Kappa statistic                    0.683  
 Mean absolute error                0.1118  
 Root mean squared error           0.2833  
 Relative absolute error           38.1805 %  
 Root relative squared error     74.288 %  
 Total Number of Instances        178

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class	
0.727	0.012	0.800	0.727	0.762	0.748	0.919	0.613	Alert	
0.943	0.288	0.825	0.943	0.880	0.688	0.819	0.793	Warning	
0.537	0.044	0.786	0.537	0.638	0.570	0.753	0.577	Stable	
0.857	0.013	0.900	0.857	0.878	0.863	0.935	0.813	Sustainable	
Weighted Avg.		0.826	0.182	0.823	0.826	0.817	0.685	0.824	0.734

==== Confusion Matrix ===

a	b	c	d	<-- classified as
8	3	0	0	a = Alert
2	99	4	0	b = Warning
0	17	22	2	c = Stable
0	1	2	18	d = Sustainable

4)j48 with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ===

==== Summary ===

Correctly Classified Instances    150                    84.2697 %  
 Incorrectly Classified Instances    28                    15.7303 %  
 Kappa statistic                    0.7171  
 Mean absolute error              0.1203  
 Root mean squared error        0.2623  
 Relative absolute error        41.1018 %  
 Root relative squared error   68.7975 %  
 Total Number of Instances       178

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class	
0.636	0.000	1.000	0.636	0.778	0.788	0.872	0.712	Alert	
0.943	0.219	0.861	0.943	0.900	0.744	0.871	0.873	Warning	
0.659	0.073	0.730	0.659	0.692	0.608	0.877	0.668	Stable	
0.810	0.013	0.895	0.810	0.850	0.832	0.965	0.907	Sustainable	
Weighted Avg.		0.843	0.148	0.843	0.843	0.839	0.726	0.883	0.820

==== Confusion Matrix ===

a	b	c	d	<-- classified as
7	4	0	0	a = Alert
0	99	6	0	b = Warning
0	12	27	2	c = Stable
0	0	4	17	d = Sustainable

---

## 2014:

1)Bayes net with split :

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	55	90.1639 %
Incorrectly Classified Instances	6	9.8361 %
Kappa statistic	0.8426	
Mean absolute error	0.0528	
Root mean squared error	0.21	
Relative absolute error	17.3913 %	
Root relative squared error	51.9663 %	
Total Number of Instances	61	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	Alert
0.968	0.067	0.938	0.968	0.952	0.902	0.978	0.971	Warning
0.789	0.048	0.882	0.789	0.833	0.766	0.966	0.935	Stable
0.875	0.038	0.778	0.875	0.824	0.797	0.983	0.924	Sustainable
Weighted Avg.	0.902	0.054	0.902	0.902	0.901	0.851	0.976	0.955

==== Confusion Matrix ===

a	b	c	d	<-- classified as
3	0	0	0	a = Alert
0	30	1	0	b = Warning
0	2	15	2	c = Stable
0	0	1	7	d = Sustainable

2)Naive Bayes with 66% split:

Time taken to build model: 0 seconds

==== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

==== Summary ===

Correctly Classified Instances	55	90.1639 %
Incorrectly Classified Instances	6	9.8361 %

---

Kappa statistic 0.8426  
 Mean absolute error 0.0545  
 Root mean squared error 0.2058  
 Relative absolute error 17.955 %  
 Root relative squared error 50.9232 %  
 Total Number of Instances 61

==== Detailed Accuracy By Class ====

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	Alert
0.968	0.067	0.938	0.968	0.952	0.902	0.980	0.973	Warning
0.789	0.048	0.882	0.789	0.833	0.766	0.964	0.927	Stable
0.875	0.038	0.778	0.875	0.824	0.797	0.981	0.919	Sustainable
Weighted Avg.	0.902	0.054	0.902	0.902	0.901	0.851	0.976	0.953

==== Confusion Matrix ====

a	b	c	d	<-- classified as
3	0	0	0	a = Alert
0	30	1	0	b = Warning
0	2	15	2	c = Stable
0	0	1	7	d = Sustainable

3)j48 with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ====

==== Summary ====

Correctly Classified Instances 150 84.2697 %  
 Incorrectly Classified Instances 28 15.7303 %  
 Kappa statistic 0.7171  
 Mean absolute error 0.1203  
 Root mean squared error 0.2623  
 Relative absolute error 41.1018 %  
 Root relative squared error 68.7975 %  
 Total Number of Instances 178

==== Detailed Accuracy By Class ====

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.636	0.000	1.000	0.636	0.778	0.788	0.872	0.712	Alert
0.943	0.219	0.861	0.943	0.900	0.744	0.871	0.873	Warning
0.659	0.073	0.730	0.659	0.692	0.608	0.877	0.668	Stable
0.810	0.013	0.895	0.810	0.850	0.832	0.965	0.907	Sustainable
Weighted Avg.	0.843	0.148	0.843	0.843	0.839	0.726	0.883	0.820

==== Confusion Matrix ====

a	b	c	d	<-- classified as
7	4	0	0	a = Alert
0	99	6	0	b = Warning
0	12	27	2	c = Stable
0	0	4	17	d = Sustainable

4)jRip:

---

Time taken to build model: 0.03 seconds

==== Stratified cross-validation ===

==== Summary ===

Correctly Classified Instances	147	82.5843 %
Incorrectly Classified Instances	31	17.4157 %
Kappa statistic	0.683	
Mean absolute error	0.1118	
Root mean squared error	0.2833	
Relative absolute error	38.1805 %	
Root relative squared error	74.288 %	
Total Number of Instances	178	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.727	0.012	0.800	0.727	0.762	0.748	0.919	0.613	Alert
0.943	0.288	0.825	0.943	0.880	0.688	0.819	0.793	Warning
0.537	0.044	0.786	0.537	0.638	0.570	0.753	0.577	Stable
0.857	0.013	0.900	0.857	0.878	0.863	0.935	0.813	Sustainable
Weighted Avg.	0.826	0.182	0.823	0.826	0.817	0.685	0.824	0.734

==== Confusion Matrix ===

a	b	c	d	<-- classified as
8	3	0	0	a = Alert
2	99	4	0	b = Warning
0	17	22	2	c = Stable
0	1	2	18	d = Sustainable

## 2013:

1)BayesNet with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ===

==== Summary ===

Correctly Classified Instances	162	91.0112 %
Incorrectly Classified Instances	16	8.9888 %
Kappa statistic	0.8426	
Mean absolute error	0.0488	
Root mean squared error	0.1925	
Relative absolute error	17.5835 %	
Root relative squared error	51.9127 %	
Total Number of Instances	178	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
---------	---------	-----------	--------	-----------	-----	----------	----------	-------

---

1.000	0.029	0.375	1.000	0.545	0.604	0.987	0.514	Alert
0.908	0.043	0.971	0.908	0.938	0.852	0.986	0.991	Warning
0.884	0.044	0.864	0.884	0.874	0.833	0.987	0.965	stable
0.957	0.013	0.917	0.957	0.936	0.927	0.999	0.991	Sustainable
Weighted Avg.	0.910	0.040	0.928	0.910	0.916	0.853	0.988	0.977

==== Confusion Matrix ===

a	b	c	d	<-- classified as
3	0	0	0	a = Alert
5	99	5	0	b = Warning
0	3	38	2	c = stable
0	0	1	22	d = Sustainable

2)NaiveBayes with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ===  
==== Summary ===

Correctly Classified Instances	161	90.4494 %
Incorrectly Classified Instances	17	9.5506 %
Kappa statistic	0.8302	
Mean absolute error	0.0471	
Root mean squared error	0.1871	
Relative absolute error	16.9674 %	
Root relative squared error	50.4347 %	
Total Number of Instances	178	

==== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.667	0.023	0.333	0.667	0.444	0.459	0.983	0.444	Alert
0.917	0.072	0.952	0.917	0.935	0.837	0.987	0.992	Warning
0.860	0.044	0.860	0.860	0.860	0.816	0.986	0.961	stable
0.957	0.013	0.917	0.957	0.936	0.927	0.999	0.991	Sustainable
Weighted Avg.	0.904	0.057	0.915	0.904	0.909	0.837	0.988	0.975

==== Confusion Matrix ===

a	b	c	d	<-- classified as
2	1	0	0	a = Alert
4	100	5	0	b = Warning
0	4	37	2	c = stable
0	0	1	22	d = Sustainable

3)J48 with 10 fold cross validation:

Time taken to build model: 0 seconds

==== Stratified cross-validation ===  
==== Summary ===

Correctly Classified Instances	160	89.8876 %
Incorrectly Classified Instances	18	10.1124 %
Kappa statistic	0.8033	
Mean absolute error	0.0768	
Root mean squared error	0.2052	

---

Relative absolute error        27.692 %  
 Root relative squared error    55.3109 %  
 Total Number of Instances     178

==== Detailed Accuracy By Class ====

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class	
0.000	0.000	0.000	0.000	0.000	0.000	0.908	0.112	Alert	
1.000	0.217	0.879	1.000	0.936	0.829	0.896	0.907	Warning	
0.698	0.015	0.938	0.698	0.800	0.761	0.897	0.841	stable	
0.913	0.006	0.955	0.913	0.933	0.924	0.996	0.955	Sustainable	
Weighted Avg.		0.899	0.138	0.888	0.899	0.887	0.811	0.909	0.884

==== Confusion Matrix ====

a	b	c	d	<- classified as
0	3	0	0	a = Alert
0	109	0	0	b = Warning
0	12	30	1	c = stable
0	0	2	21	d = Sustainable

4) Rip with 10 fold cross validation:

Time taken to build model: 0.02 seconds

==== Stratified cross-validation ====  
==== Summary ====

Correctly Classified Instances    151        84.8315 %  
 Incorrectly Classified Instances    27        15.1685 %  
 Kappa statistic                    0.7211  
 Mean absolute error              0.0894  
 Root mean squared error        0.2676  
 Relative absolute error        32.2237 %  
 Root relative squared error   72.1516 %  
 Total Number of Instances     178

==== Detailed Accuracy By Class ====

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class	
0.667	0.017	0.400	0.667	0.500	0.506	0.827	0.339	Alert	
0.917	0.188	0.885	0.917	0.901	0.738	0.860	0.857	Warning	
0.674	0.059	0.784	0.674	0.725	0.649	0.801	0.639	stable	
0.870	0.019	0.870	0.870	0.870	0.850	0.932	0.813	Sustainable	
Weighted Avg.		0.848	0.132	0.850	0.848	0.848	0.727	0.855	0.790

==== Confusion Matrix ====

a	b	c	d	<- classified as
2	1	0	0	a = Alert
3	100	6	0	b = Warning
0	11	29	3	c = stable
0	1	2	20	d = Sustainable

---

## **GENERATION OF ACTION RULES USING LispMiner**

### **Attributes :**

We have classified our attributes into 3 categories - stable, flexible and decision attributes.

We have chosen the stable attributes as :

Country

Rank

year

We have chosen the flexible attributes as :

Homeless people due to natural disaster

Public services

Human rights

Refugees and IDPs

External intervention

The decision attributes are chosen as :

Stable

Alert

Warning

Sustainable

---

### **Antecedente stable part :**

We assign all the stable attributes to this set.

### **Antecedent variable part :**

We assign all the flexible attributes to this set.

### **Succedent variable part :**

We assign the decision variable to this set.

Attribute type = nominal

Coefficient type = one category

### **Quantifiers :**

a(BASE)Before : 2

a(BASE)After : 2

### **ACTION RULES FOR 2016 :**

First we set the decision attribute as alert to warning.

LM 2016\_new2 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- Total
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- rules
- Task Results
- Task Settings
- Hypothesis (4)
- E. Domain knowledge
- F. Workspace

Tables Attributes Tasks Overview rules rules Hypothesis (4) Total

Matrix x\_2016\_new2

Groups of attributes tree Attribute Used DBColumn Categories XCat Sample categories

Root group of attributes	S2_Refugees_and_IDPs	+ S2_Refugees_and_IDPs	5	<14.3(12), <3.12(4.84), <4.84(6.56), <6.56(8.28), <8.28
decision	X1_External Intervention	+ X1_External Intervention	5	<14.3(12), <3.12(4.84), <4.84(6.56), <6.56(8.28), <8.28
Flexible				
stable				

Show Attribute Show Matrix Add attribute Del Attribute Clone

Export Group detail Quick Assign Add group Del group

Ready Type here to search 12:49 AM 12/2/2017 NUM

LM 2016\_new2 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- Total
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- rules
- Task Results
- Task Settings
- Hypothesis (4)
- E. Domain knowledge
- F. Workspace

Tables Attributes Tasks Overview rules rules Hypothesis (4) Total

Data-mining Task basic parameters

Name: rules ID: 1

Comment:

Taskgroup: Default group of tasks

Task type: Act4B-Miner Data matrix: x\_2016\_new2

**ANTECEDENT STABLE PART**

Default Partial Cedent	Con. 0 - 5
County (subset), 1 - 1	B, pos
Rank, (subset), 1 - 1	B, pos
Year_(subset), 1 - 1	B, pos

**QUANTIFIERS**

Type	Ref.	Value	Units
a (BASE) Before	>=	20.00	Abs
a (BASE) After	>=	20.00	Abs

**SUCCEDENT STABLE PART**

Default Partial Cedent	Con. 0 - 5
------------------------	------------

**Generation information**

Status: Solved, 3 run(s)  
Mode: Standard

Total length: 0 - 5 (0 - 3)

**ANTECEDENT VARIABLE PART**

Default Partial Cedent	Con. 1 - 5
S2_Refugees_and_IDPs (subset)	B, pos
X1_External Intervention (subset)	B, pos

**CONDITION**

Default Partial Cedent	Con. 0 - 5
------------------------	------------

**SUCCEDENT VARIABLE PART**

Default Partial Cedent	Con. 1 - 5
Total(Alert->Warning)	B, pos

Total length: 0

Total length: 1

**Task parameters**

Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)  
Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)  
Maximal number of hypotheses: 1000

Params Switch Validate Task Clone

Run Bkgrnd Run Grid Run Show Results

Ready Type here to search 12:49 AM 12/2/2017 NUM

LM 2016, new2 MB - USp-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- ⊕ A. Data Introduction
- ⊖ B. Data Preprocessing
- ⊖ Total
- ⊖ C. Interactive Analysis
- ⊖ D. Data-mining Tasks
- ⊖ Overview
- ⊖ rules
- ⊖ Task Results
- ⊖ Task Settings
- ⊖ Hypothesis (4)
- ⊖ E. Domain knowledge
- ⊖ W. Workspace

Tables Attributes Tasks Overview Tasks rules rules Hypothesis (4) Total

Task: rules  
Comment: -  
Taskgroup: Default group of tasks  
Data matrix: x\_2016\_new2  
Task type: Ac4B-Miner

Task run  
Start: 12.2.2017 03:29:34 Total time: 0h 0m 0s  
Number of verifications: 64 Mode: Standard  
Number of hypotheses: 4

Show all Show not in group Show hypotheses and from group Highlight

Add group Delete group Edit group

Actual group of hypotheses: All hypotheses  
Hypotheses in group: 4 Shown hypotheses: 4 Highlighted: 0 Delete hypotheses

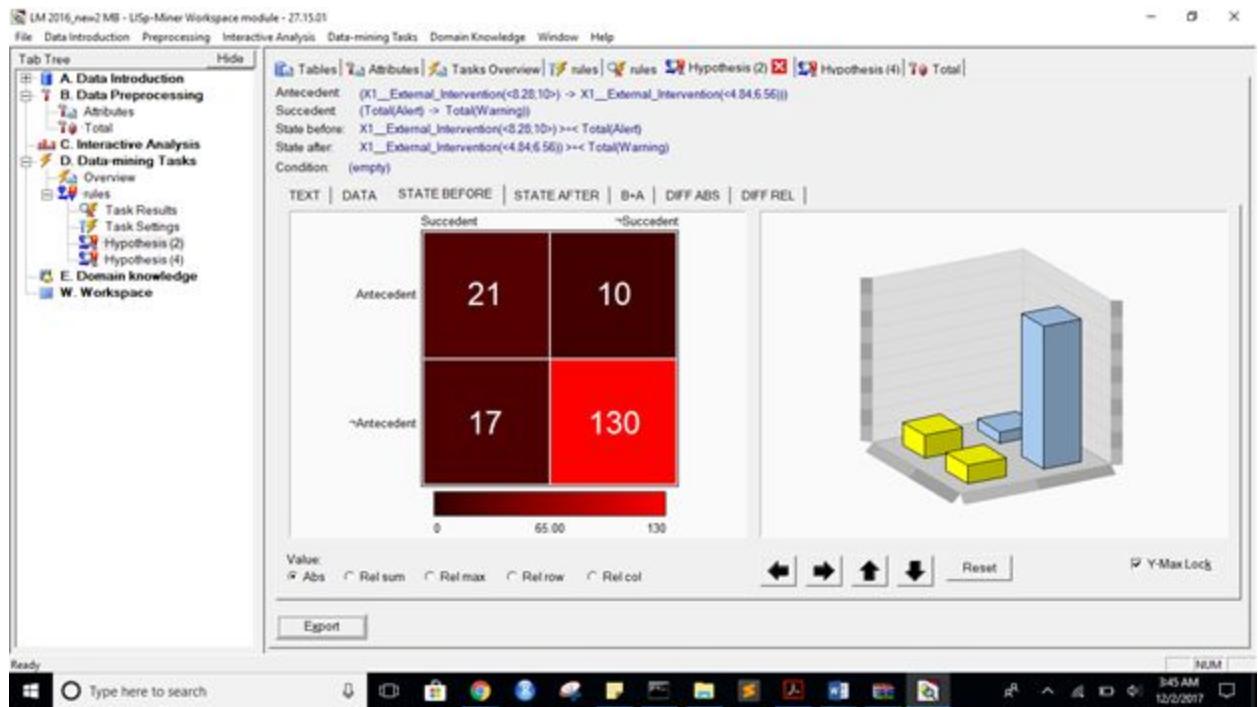
Nr.	Id	D-Conf	B-Conf	A-Conf	Hypothesis
1	1	-0.068	0.677	0.745	(empty): (X1_External_Intervention(>=8.28) → X1_External_Intervention(<6.56;8.28))) >=< (empty): (Total Alert) → Total Warning
2	3	-0.068	0.677	0.745	Year_(2016): (X1_External_Intervention(>=8.28) → X1_External_Intervention(<6.56;8.28))) >=< (empty): (Total Alert) → Total Warning
3	2	-0.138	0.677	0.816	(empty): (X1_External_Intervention(>=8.28) → X1_External_Intervention(<6.56;8.28))) >=< (empty): (Total Alert) → Total Warning
4	4	-0.138	0.677	0.816	Year_(2016): (X1_External_Intervention(>=8.28) → X1_External_Intervention(<6.56;8.28))) >=< (empty): (Total Alert) → Total Warning

Detail Goto ID Copy Remove Filter Sorting Export

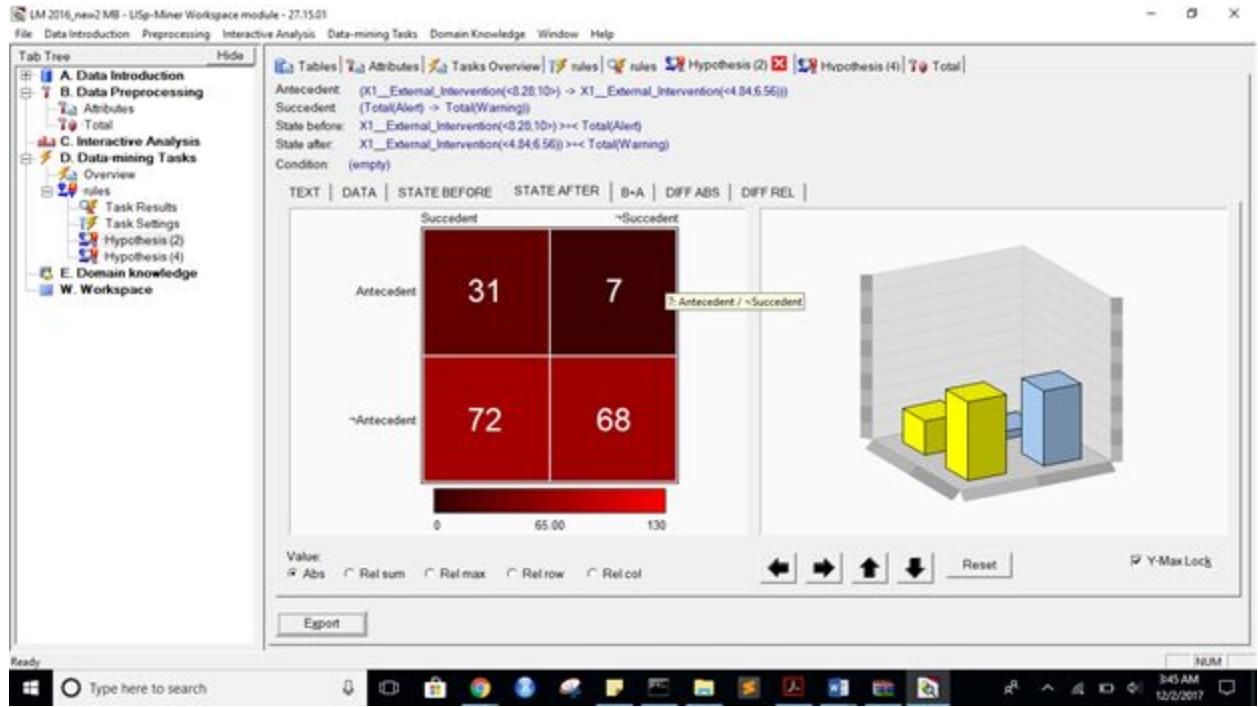
Ready Type here to search 8:44 AM 12/2/2017

**Year\_(2016) : (X1\_External\_Intervention(<8.28;10) → X1\_External\_Intervention(<6.56;8.28))) >=< (Total(Alert) → Total(Warning))**

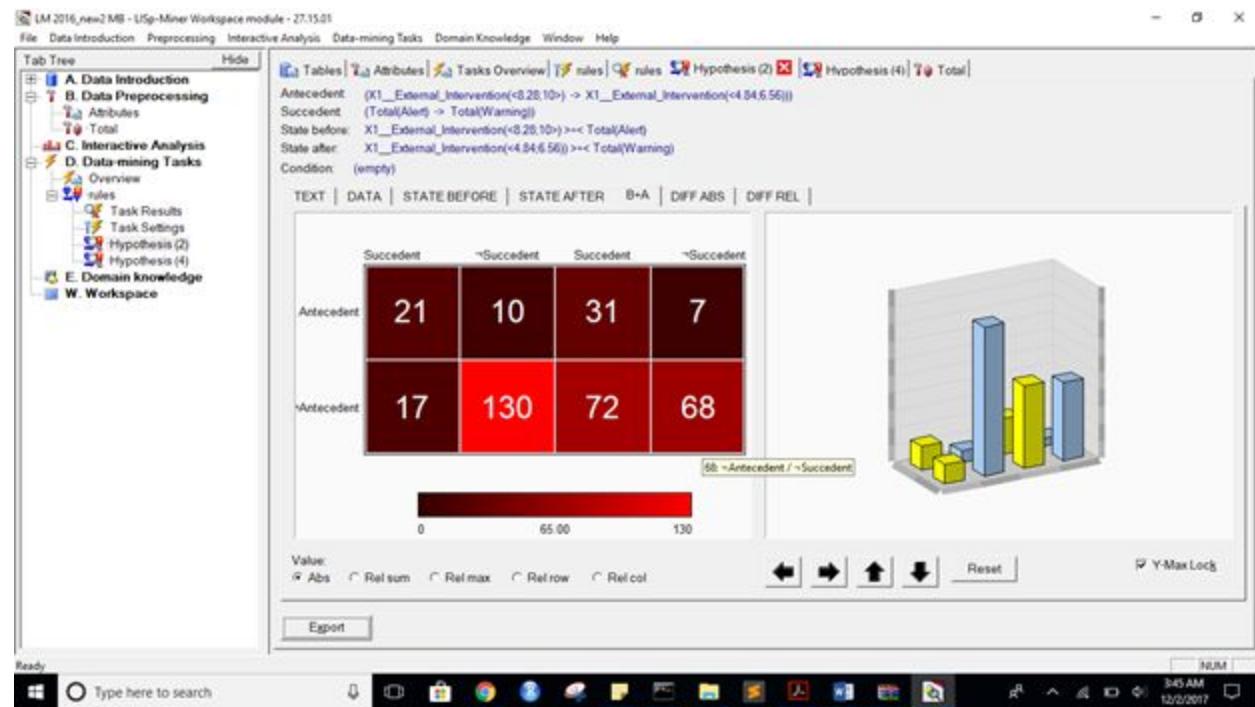
**State before :**



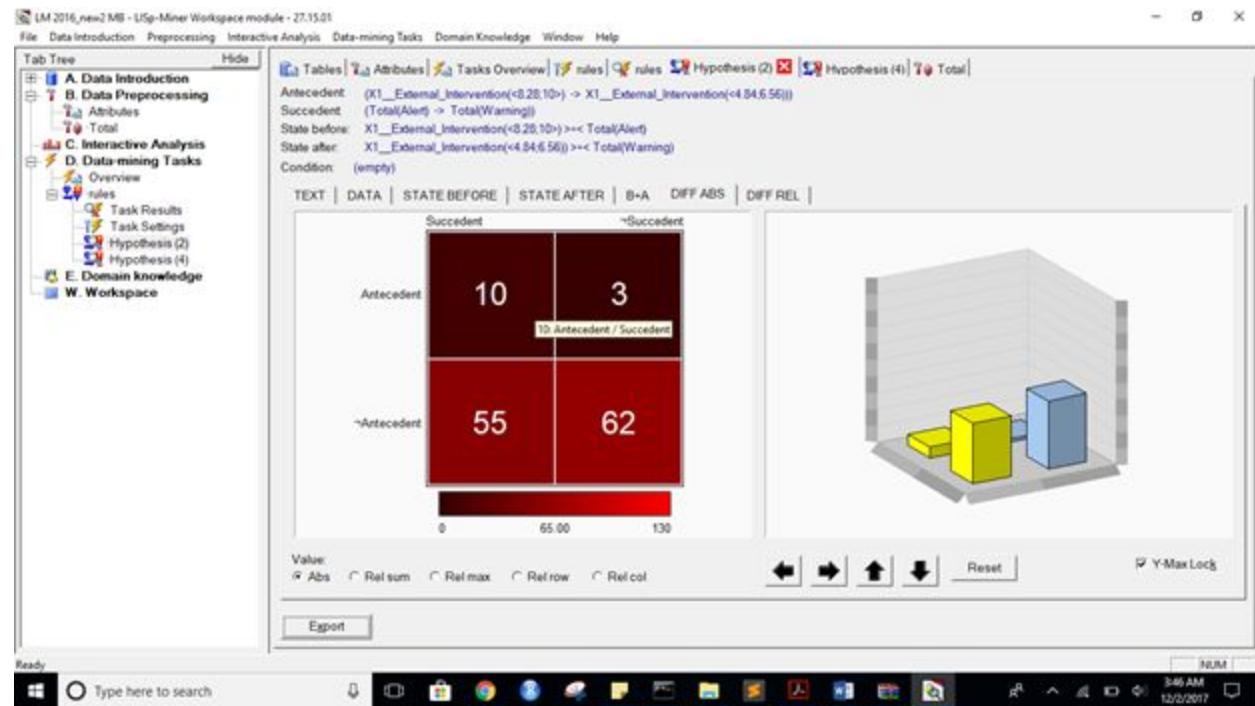
## State after :



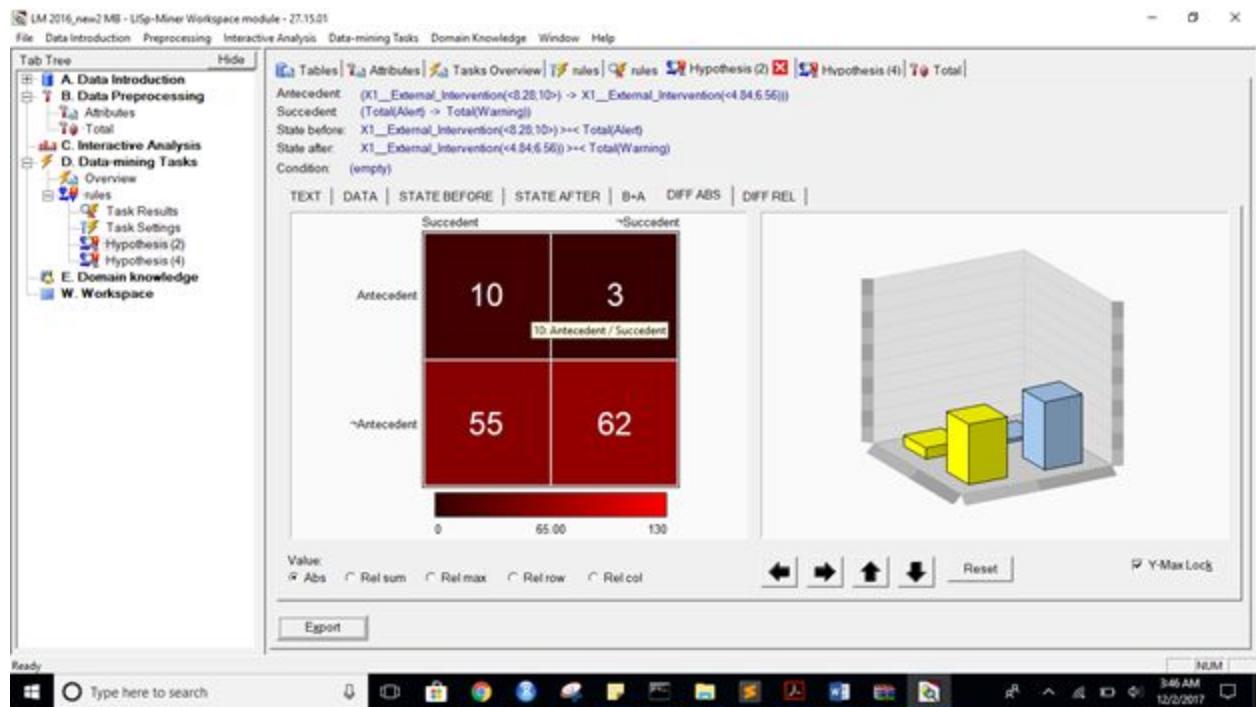
B + A :



Diff ABS:



## DIFF REL :



## 2) Now we tried Alert to Warning with more flexible attributes

Year\_(2016) : (P2\_Public\_Services(<8.2;10>) -> P2\_Public\_Services(<2.8;4.6)))  
> $\div$ < (Total(Alert) -> Total(Warning))

LM 2016,new2 MB - USp-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- E. Domain knowledge
- F. Workspace

Tables Attributes P3 Human Rights P2 Public Services Homeless People due ... Tasks Overview rules Total

Matrix x\_2016\_new2

Groups of attributes tree Attribute Used DBColumn Categories XCat Sample categories

Root group of attributes			
decision	Homeless_People_due_to_Natural_Disaster	+ Homeless_People_C	5 <-3.52(4.714), <4.714(5.908), <-5.908(7.102), <-7.102(8.21) <-1.2(8), <-2.5(4), <-4.6(4), <-6.8(2), <-8.2(10)
flexible	P2_Public_Services	+ P2_Public_Services	5 <-0.7(2.56), <-2.56(4.42), <-4.42(6.28), <-6.28(8.14)
stable	P3_Human_Rights	+ P3_Human_Rights	5 <-1.4(3.12), <-3.12(4.84), <-4.84(6.56), <-6.56(8.28), <-8.28(14)
	S2_Refugees_and_IDPs	+ S2_Refugees_and_IDPs	5 <-1.4(3.12), <-3.12(4.84), <-4.84(6.56), <-6.56(8.28), <-8.28(14)
	X1_External_Intervention	+ X1_External_Intervention	5 <-1.4(3.12), <-3.12(4.84), <-4.84(6.56), <-6.56(8.28), <-8.28(14)

Show Attribute Show Matrix Add attribute Del Attribute Clone Export Group detail Quick Assign Add group Del group

Ready Type here to search 10:55 AM 12/2/2017 NUM

LM 2016,new2 MB - USp-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- E. Domain knowledge
- F. Workspace

Tables Attributes P3 Human Rights P2 Public Services Homeless People due ... Tasks Overview rules Total

Data-mining Task basic parameters

Name: rules ID: 1

Comment:

Taskgroup: Default group of tasks

Task type: AdH-Miner Data matrix: x\_2016\_new2

**ANTECEDENT STABLE PART**

Default Partial Cedent	Con. 0 - 5	Type	Rel.	Value	Units
> County (subset), 1 - 1	B_pos	a (BASE) Before	>=	20.00	Abs
> Rank_ (subset), 1 - 1	B_pos	a (BASE) After	>=	20.00	Abs
> Year_ (subset), 1 - 1	B_pos				

Generation information

Status: Solved, 6 run(s)  
Mode: Standard

Total length: 0 - 5 [0 - 3]

**QUANTIFIERS**

**SUCCEDENT STABLE PART**

Default Partial Cedent	Con. 0 - 5
------------------------	------------

Total length: 0

**ANTECEDENT VARIABLE PART**

Default Partial Cedent	Con. 1 - 5
> S2_Refugees_and_IDPs (subset)	B_pos
> Homeless_People_due_to_Natura	B_pos
> P2_Public_Services (subset), 1 - 1	B_pos
> P3_Human_Rights (subset), 1 - 1	B_pos

Total length: 0 - 5 [1 - 4]

**CONDITION**

Default Partial Cedent	Con. 0 - 5
------------------------	------------

Total length: 0

**SUCCEDENT VARIABLE PART**

Default Partial Cedent	Con. 1 - 5
> Total( Alert > Warning)	B_pos

Total length: 1

Task parameters

Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)

Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)

Maximal number of hypotheses: 1000

Params Search Validate Task Clone Run Bkgnd Run Grid Run Show Results

Ready Type here to search 10:56 AM 12/2/2017 NUM

LM 2016\_new2 MB - UG-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- E. Domain knowledge
- F. Workspace

Tables Attributes P3\_Human\_Rights P2\_Public\_Services P\_Homeless\_People\_due\_to\_Na Total

Taskgroup: Default group of tasks Task run Start: 12.2.2017 03:54:17 Total time: 0h 0m 0s Number of verifications: 144 Number of hypotheses: 6 Mode: Standard

Show all Show not in group Show hypotheses and from group

Add group Del group Edit group

Actual group of hypotheses: All hypotheses Hypotheses in group: 6 Shown hypotheses: 6 Highlighted: 0 Delete hypotheses

Nr.	Id	Di-Conf	B-Conf	A-Conf	Hypothesis
1	1	-0.137	0.634	0.771	(empty): (P2_Public_Services(><3.2)) ><(empty): (Total Alert) > Total Warning)
2	4	-0.137	0.634	0.771	Year_(2016): (P2_Public_Services(<2.84.6)) ><(empty): (Total Alert) > Total Warning)
3	3	-0.154	0.634	0.768	(empty): (P2_Public_Services(><3.2)) ><(empty): (Total Alert) > Total Warning)
4	6	-0.154	0.634	0.768	Year_(2016): (P2_Public_Services(><3.2)) ><(empty): (Total Alert) > Total Warning)
5	2	-0.219	0.634	0.853	(empty): (P2_Public_Services(><3.2)) ><(empty): (Total Alert) > Total Warning)
6	5	-0.219	0.634	0.853	Year_(2016): (P2_Public_Services(><3.2)) ><(empty): (Total Alert) > Total Warning)

Detail Goto ID Copy Remove Filter Sorting Export

Ready Type here to search 10:56 AM 12/2/2017

## State before :

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File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- E. Domain knowledge
- F. Workspace

P2\_Public\_Services | P\_Homeless\_People\_due\_to\_Na | Tasks Overview | rules | rules | Hypothesis (2) | Total

Antecedent: (P2\_Public\_Services(<2.10)) > P2\_Public\_Services(<4.6.4))  
 Succedent: (Total|Alert) > Total|Warning)  
 State before: P2\_Public\_Services(<2.10) >< Total|Alert  
 State after: P2\_Public\_Services(<4.6.4)) >< Total|Warning  
 Condition: (empty)

TEXT DATA STATE BEFORE STATE AFTER B+A DIFF ABS DIFF REL

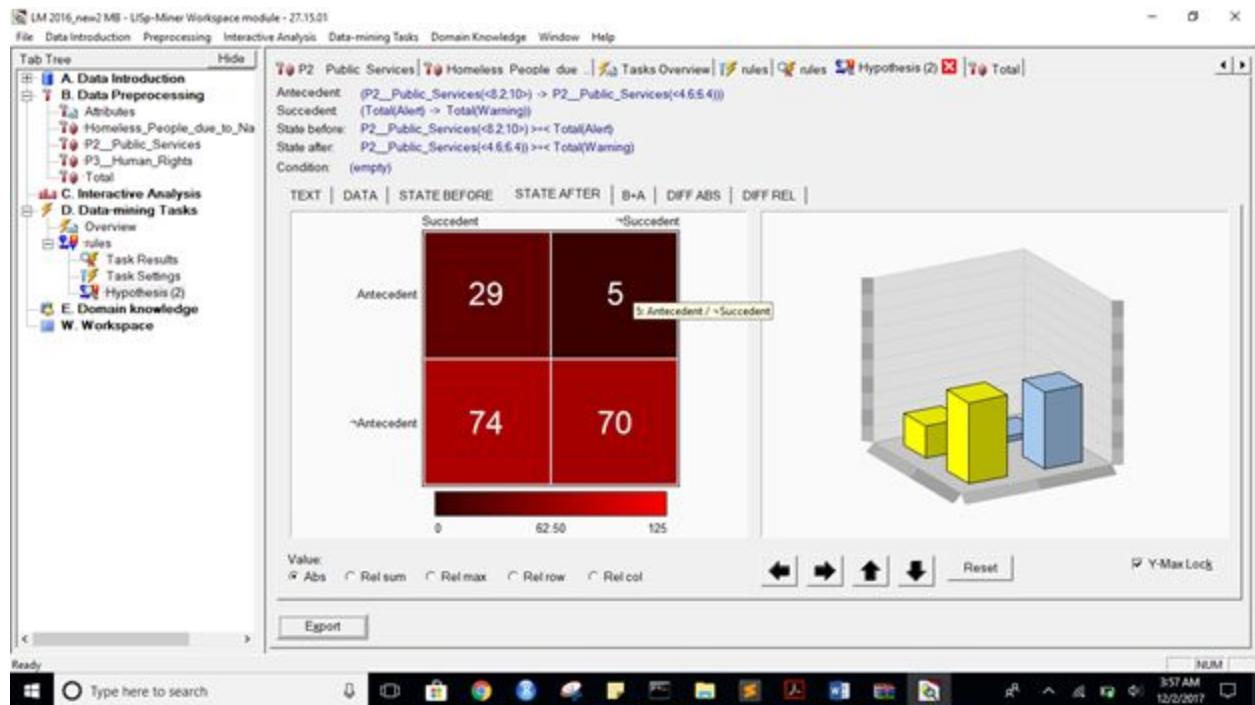
		Succedent		~Succedent	
		Antecedent		~Antecedent	
		26	15	12	125
Antecedent		26	15	12	125
~Antecedent				125	

Value:  Abs  Rel sum  Rel max  Rel row  Rel col

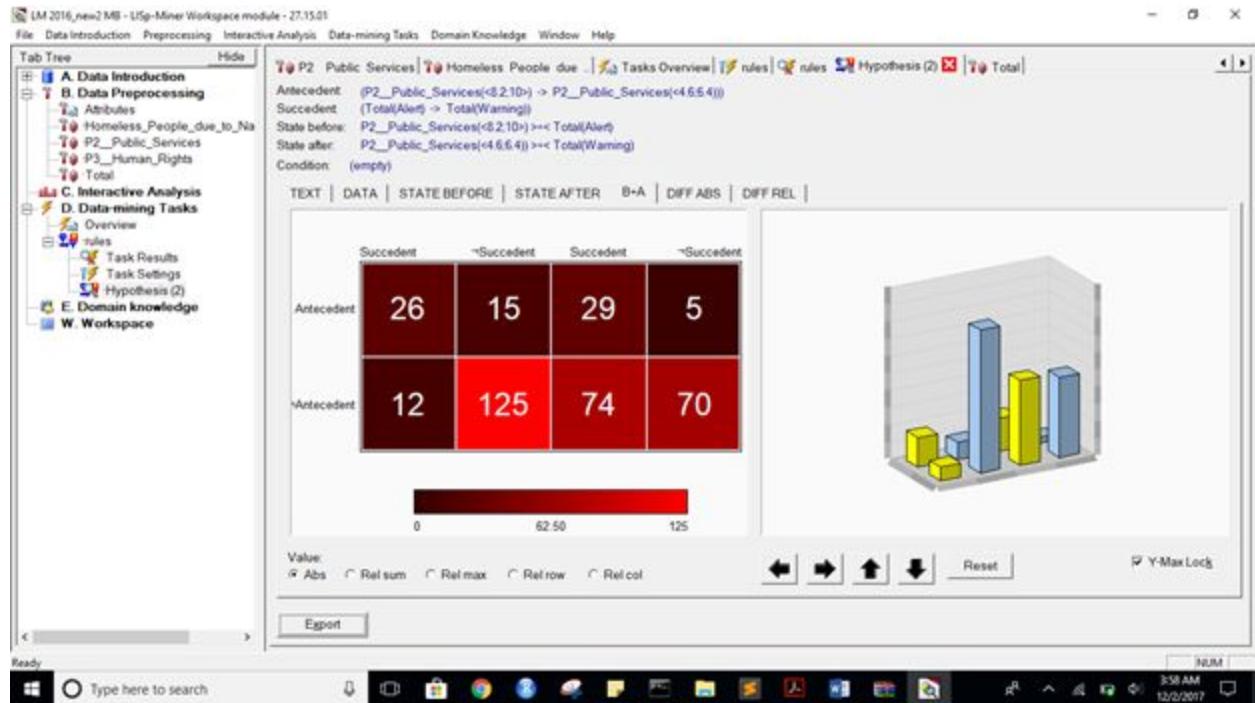
Export Reset Y-Max Lock

Ready Type here to search 10:57 AM 12/2/2017

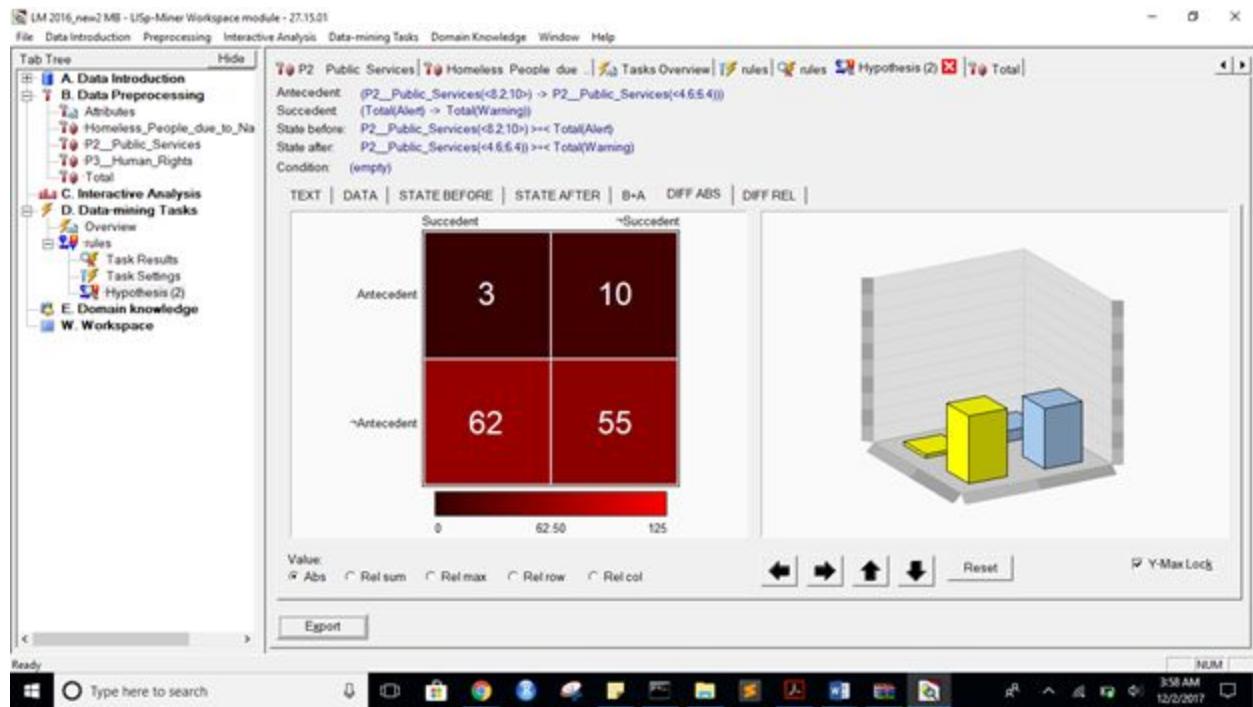
## State after :



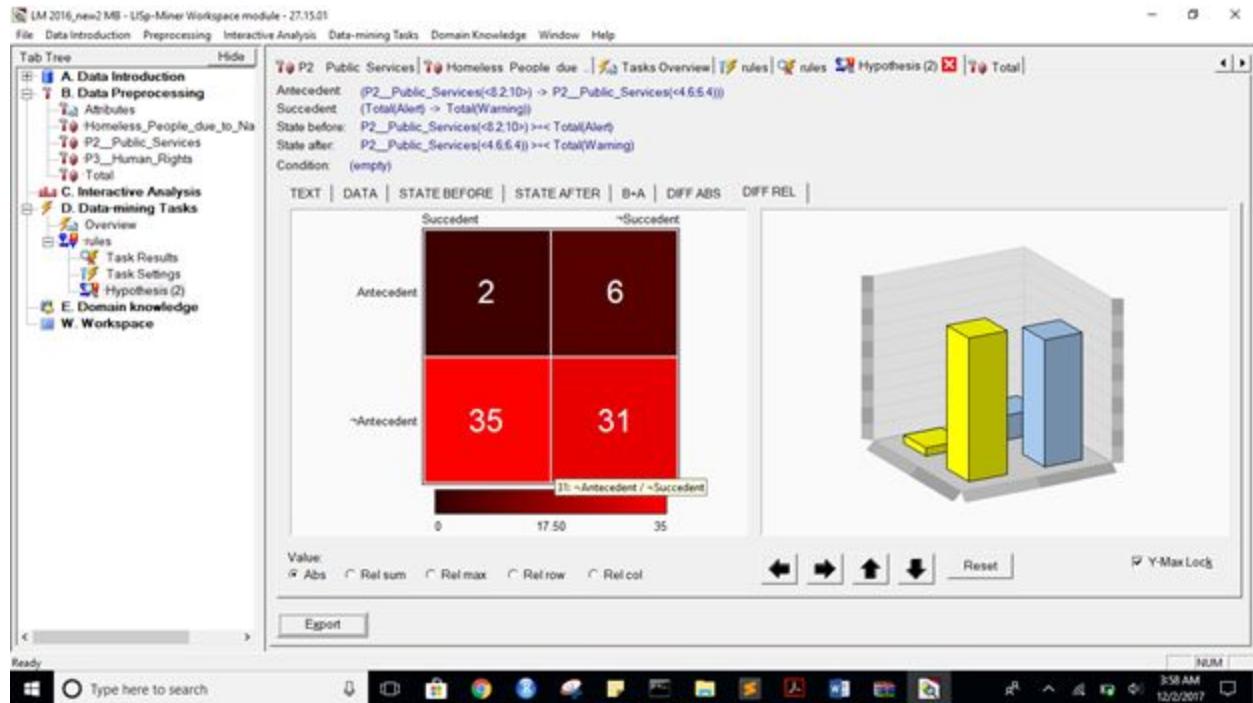
**B + A:**



## DIFF ABS:



## DIFF REL :



## ALERT To STABLE:

## Same attributes like above, just changed alert to stable

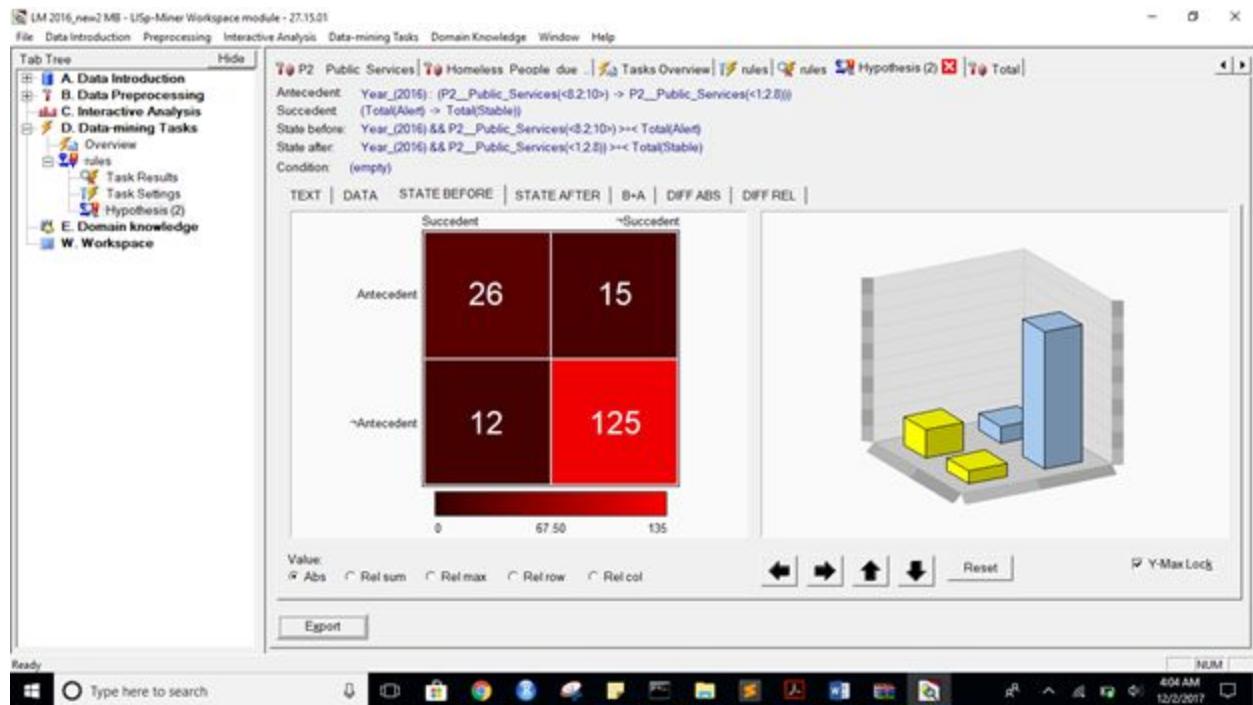
Year\_(2016) : (P2\_Public\_Services(<8.2;10>) -> P2\_Public\_Services(<2.8;4.6)))  
><(Total(Alert) -> Total(Stable))

The screenshot shows the Uip-Miner Workspace module interface. The left sidebar (Tab Tree) includes sections for Data Introduction, Data Preprocessing, Interactive Analysis, Data-mining Tasks, Domain Knowledge, and Workspace. The main area displays a table of hypotheses:

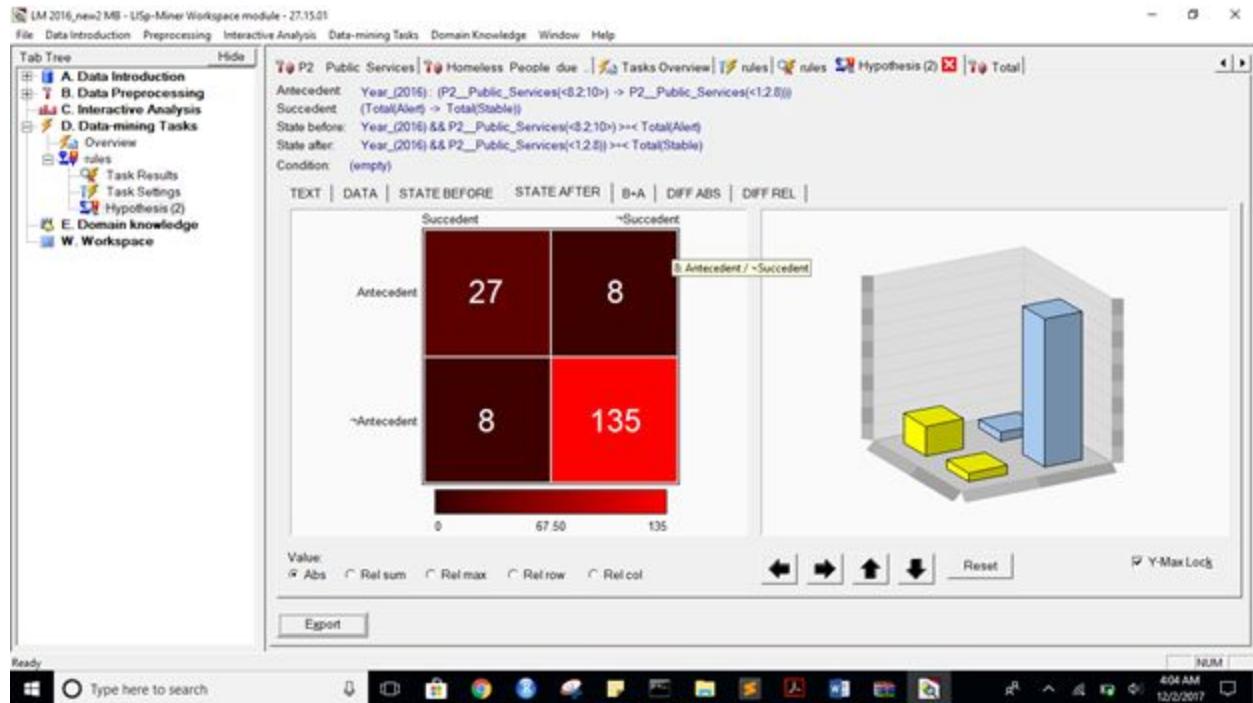
Nr. Id	Df-Conf	B-Conf	A-Conf	Hypothesis
1	1	-0.137	0.634	0.771 (empty): (P2_Public_Services(<8.2) -> P2_Public_Services(<2.8)) >< (empty) : (Total(Alert) -> Total(Stable))
2	2	-0.137	0.634	0.771 Year_(2016): (P2_Public_Services(<8.2) -> P2_Public_Services(<2.8)) >< (empty) : (Total(Alert) -> Total(Stable))

Below the table are buttons for Detail, Goto ID, Copy, Remove, Filter, Sorting, and Export. The status bar at the bottom shows "Ready", "Type here to search", and the date/time "12/2/2017 4:03 AM".

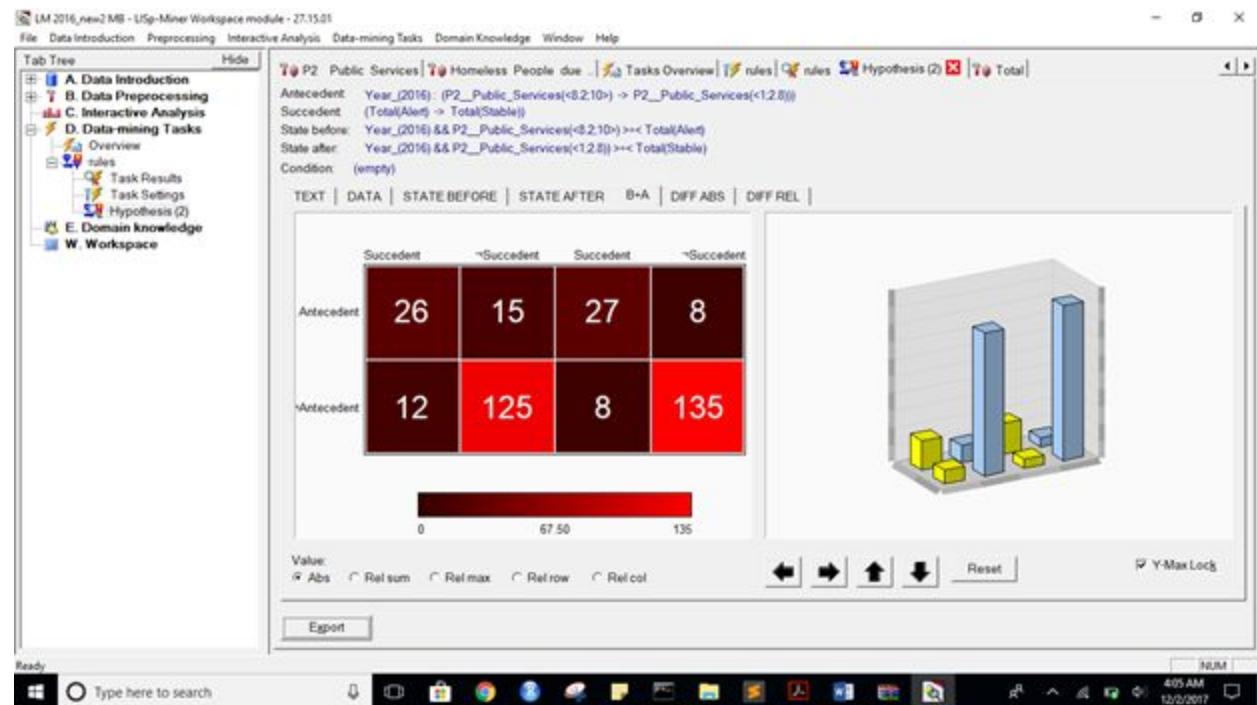
BEFORE :



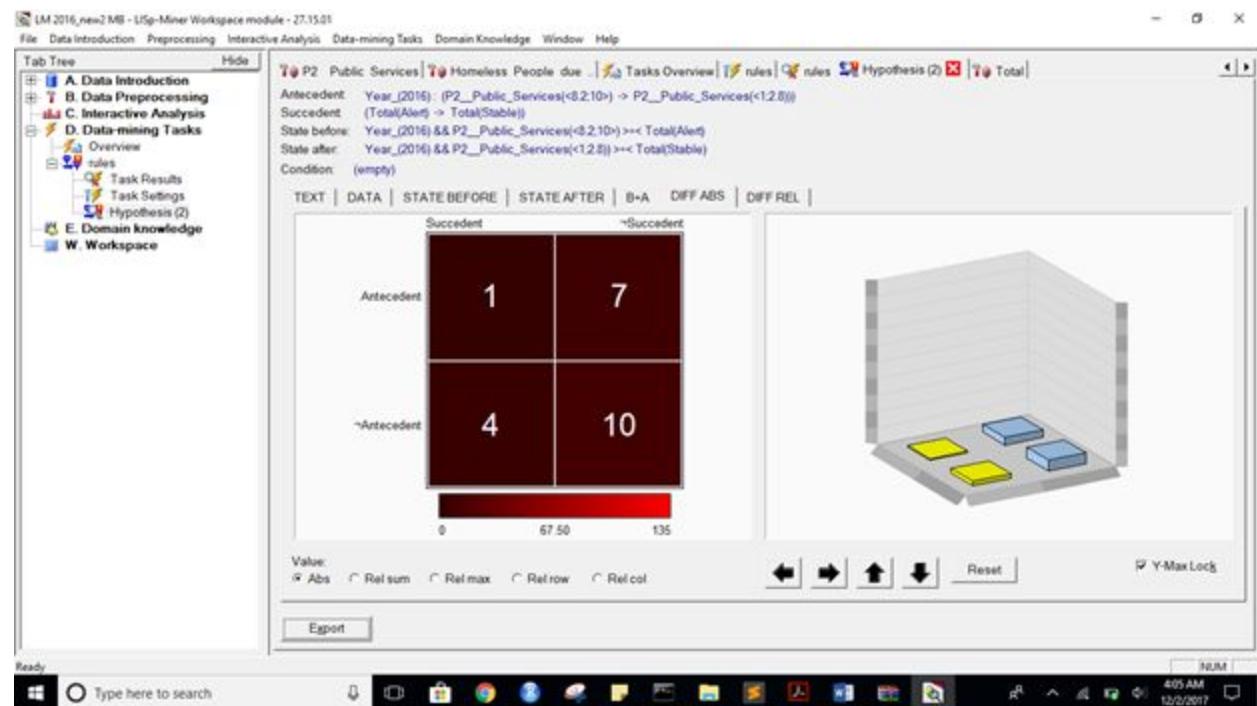
AFTER :



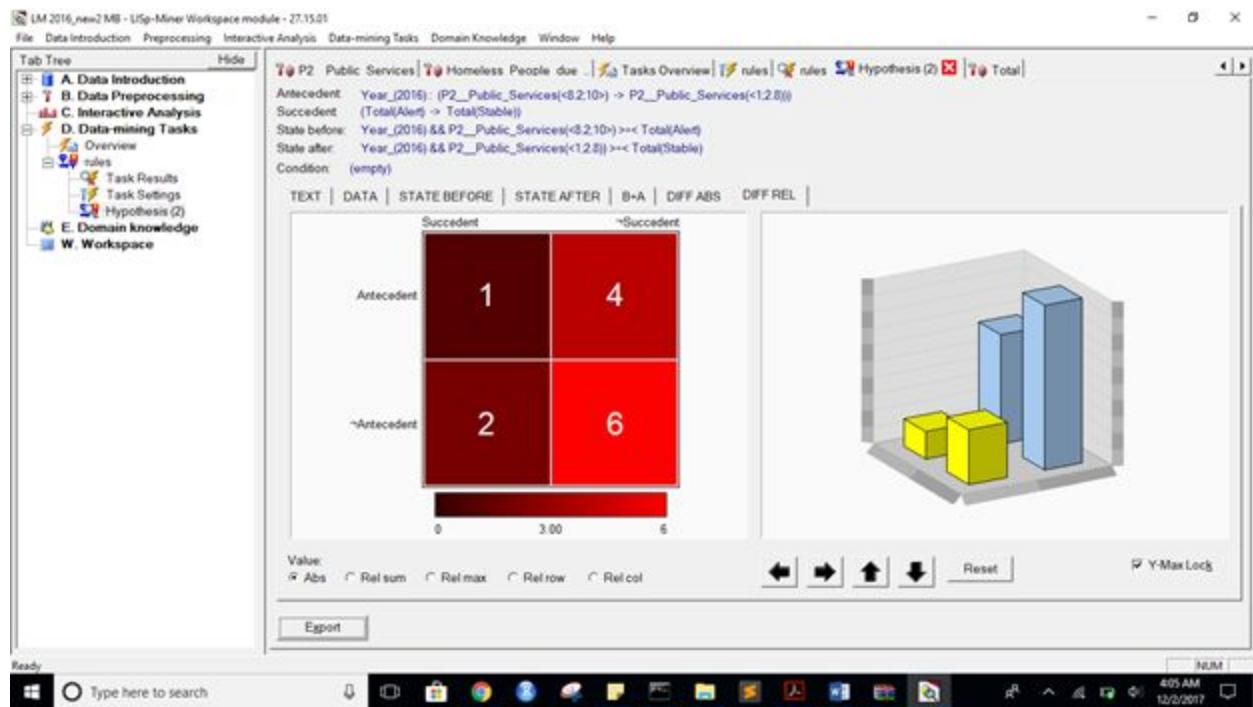
## B + A :



## DIFF ABS :



## REL :



## ACTION RULES FOR THE YEAR 2015 :

### Alert to Stable :

LM 2015\_Book MB - LiSp-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- 2015rules
- Task Results
- Task Settings
- E. Domain knowledge
- F. Workspace

Tables Attributes 2015rules 2015rules Tasks Overview

Matrix x\_2015\_Book

Groups of attributes tree Attribute Used DBColumn Categories XCat Sample categories

Root group of attributes	P2_Public_Services	+ P2_Public_Services	5	<1.22.96), <2.96.4.72), <4.72.6.48), <6.48.5.24), <8.24,
decision	S2_Refugees_and_IDPs	+ S2_Refugees_and_IDPs	5	<1.22.96), <2.96.4.72), <4.72.6.48), <6.48.5.24), <8.24,
Flexible	X1_External_Intervention	+ X1_External_Intervention	5	<1.22.96), <2.96.4.72), <4.72.6.48), <6.48.5.24), <8.24,
stable				

Show Attribute Show Matrix Add attribute Del Attribute Clone

Export Group detail Quick Assign Add group Del group

Ready Type here to search 4:32 PM 12/2/2017 NUM

LM 2015\_Book MB - LiSp-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- 2015rules
- Task Results
- Task Settings
- E. Domain knowledge
- F. Workspace

Tables Attributes 2015rules 2015rules Tasks Overview

Data-mining Task basic parameters

Name: 2015rules ID: 1

Comment:

Taskgroup: Default group of tasks

Task type: AdH-Miner Data matrix: x\_2015\_Book

ANTECEDENT STABLE PART QUANTITYERS SUCCEDENT STABLE PART

Default Partial Cedent	Con. 0 - 5	Type	Rel.	Value	Units	Default Partial Cedent	Con. 0 - 5
> D____ (subset), 1 - 1	B_pos	a (BASE) Before	>=	20.00	Abs		
		a (BASE) After	>=	20.00	Abs		
Generation information							
Status: Solved, 3 run(s)							
Mode: Standard							

Total length: 0 - 5 [0 - 1] Total length: 0 Total length: 0

(1) ANTECEDENT VARIABLE PART CONDITION (2) SUCCEDENT VARIABLE PART

Default Partial Cedent	Con. 1 - 5	Default Partial Cedent	Con. 0 - 5	Default Partial Cedent	Con. 1 - 5
> P2_Public_Service (subset), 1 - 1	B_pos			> Total( Alert > stable)	B_pos
> X1_External_Intervention (subset),	B_pos				
> S2_Refugees_and_IDPs (subset),	B_pos				

Total length: 0 - 5 [1 - 3] Total length: 0 Total length: 1

Task parameters

Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)

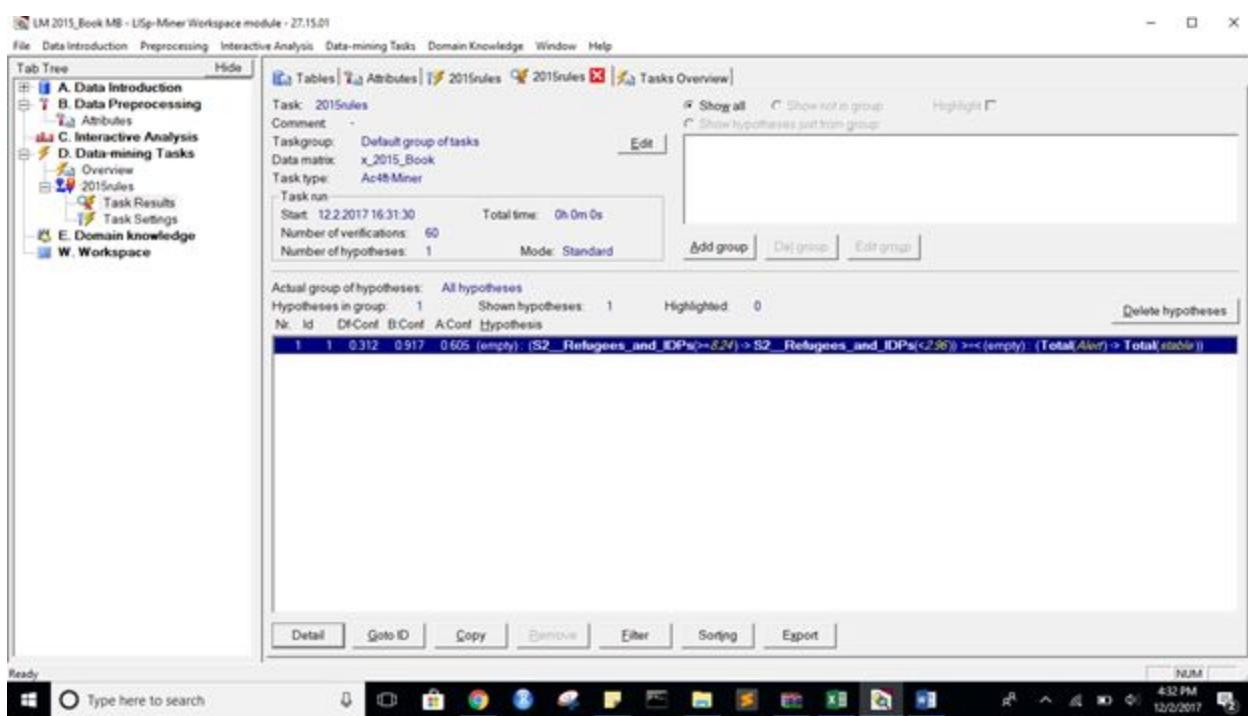
Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)

Maximal number of hypotheses: 1000

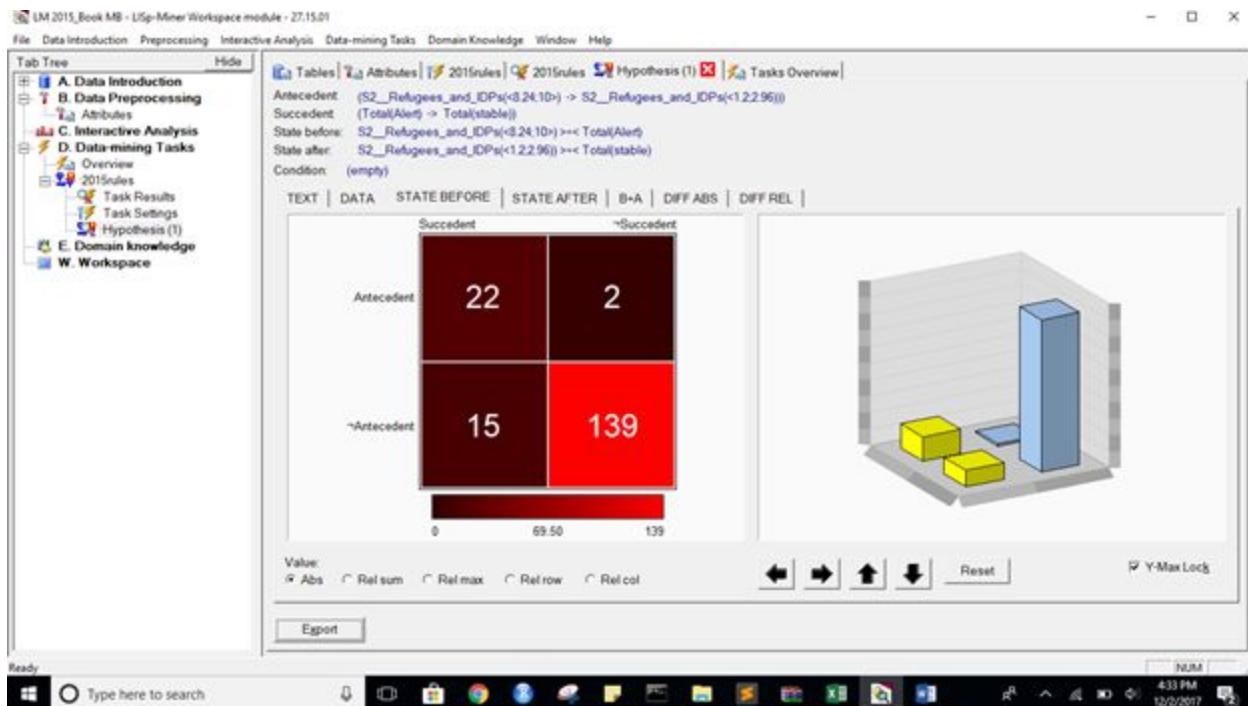
Params Search Validate Task Clone

Run Bkgnd Run Grid Run Show Results

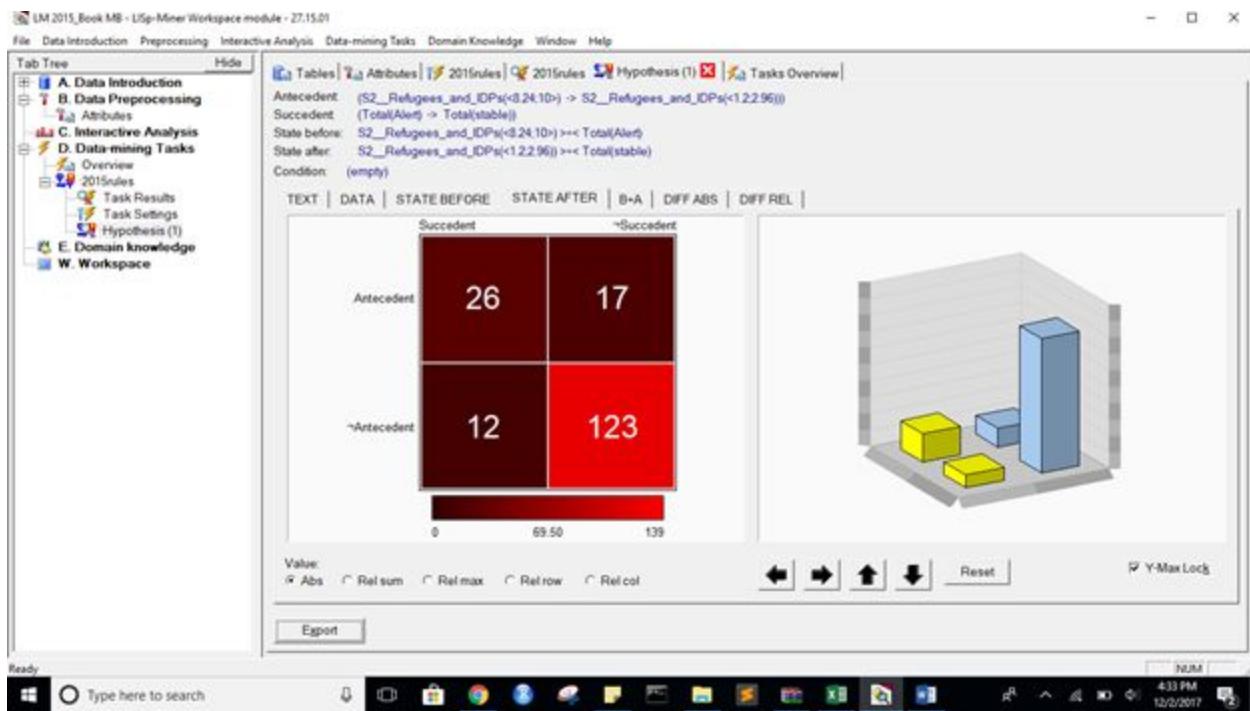
Ready Type here to search 4:32 PM 12/2/2017 NUM



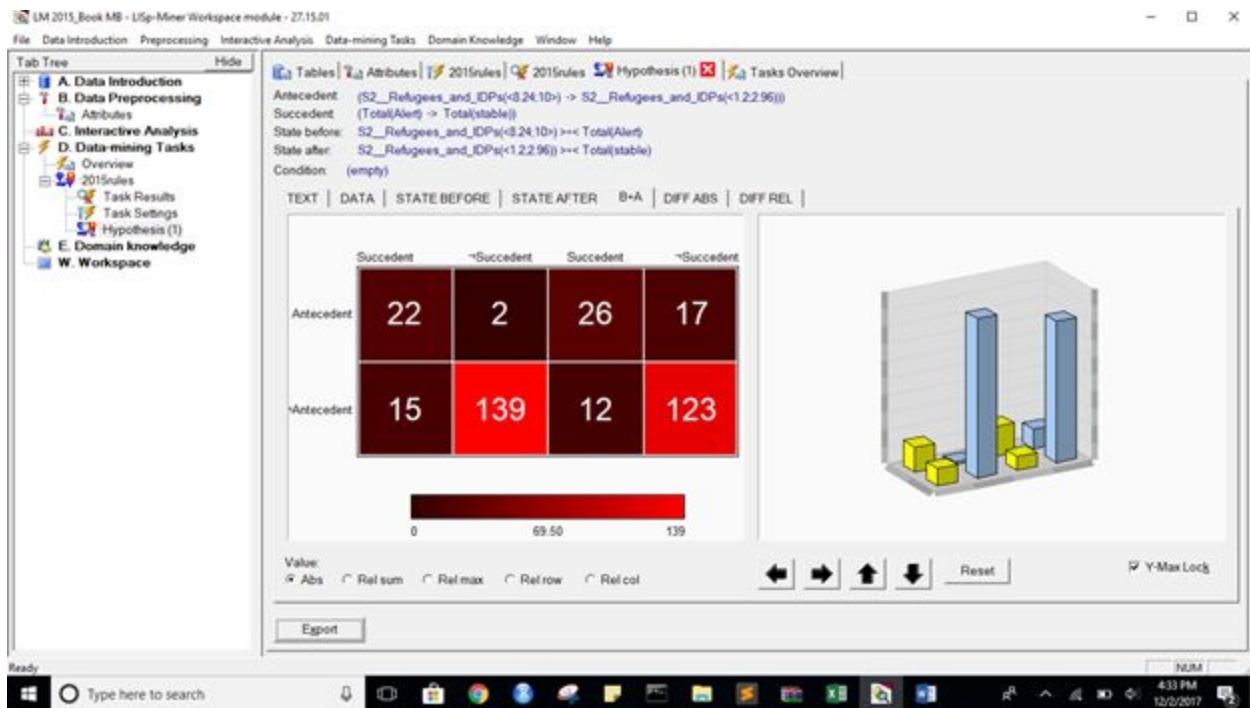
## STATE BEFORE :



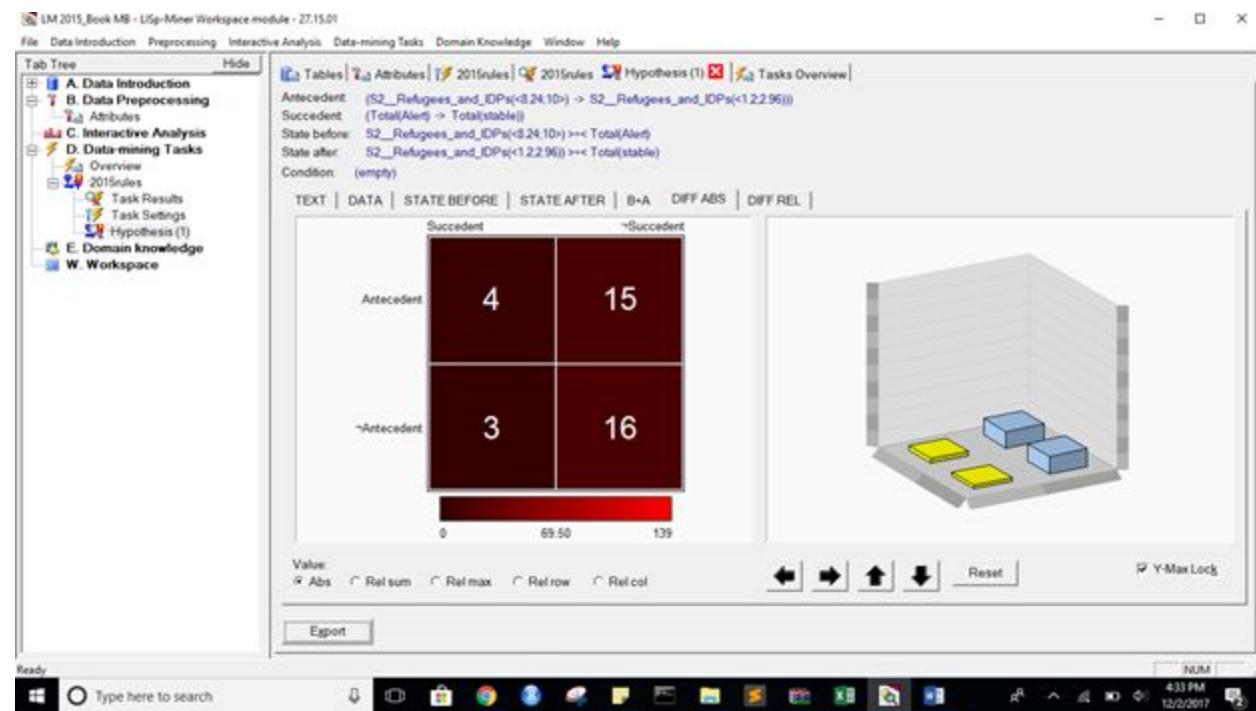
## STATE AFTER :



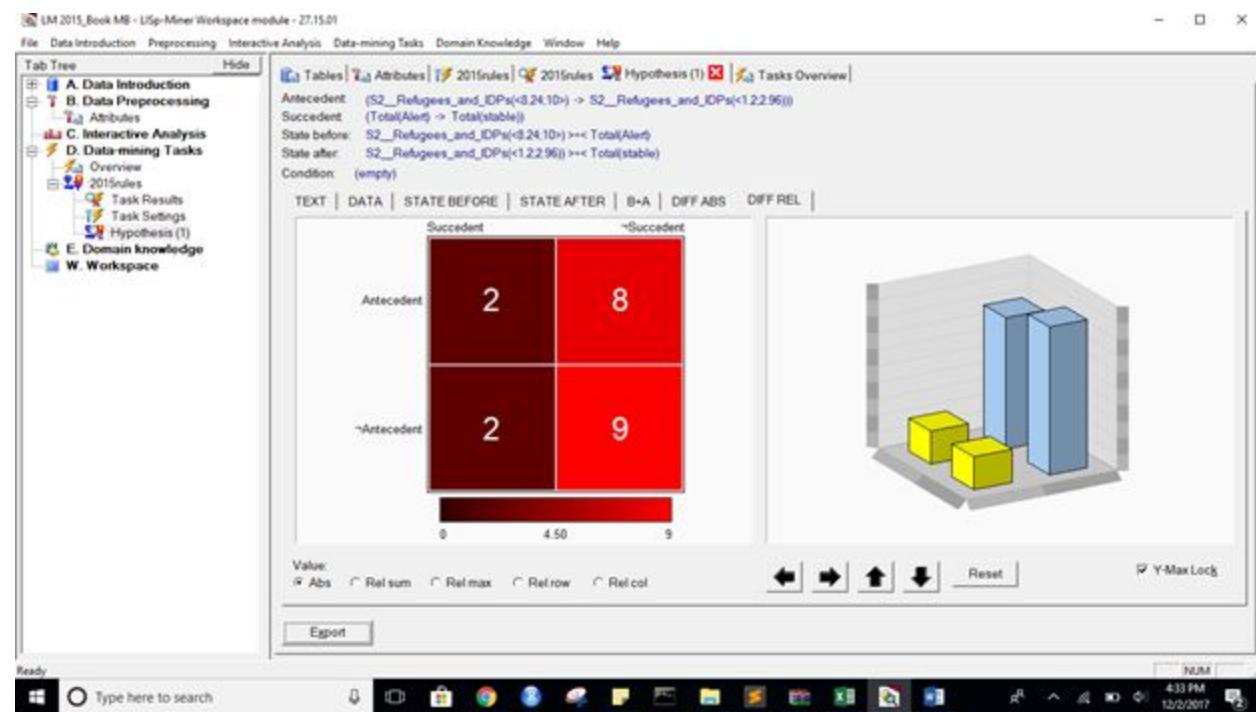
B + A :



## DIFF ABS :



## DIFF REL :



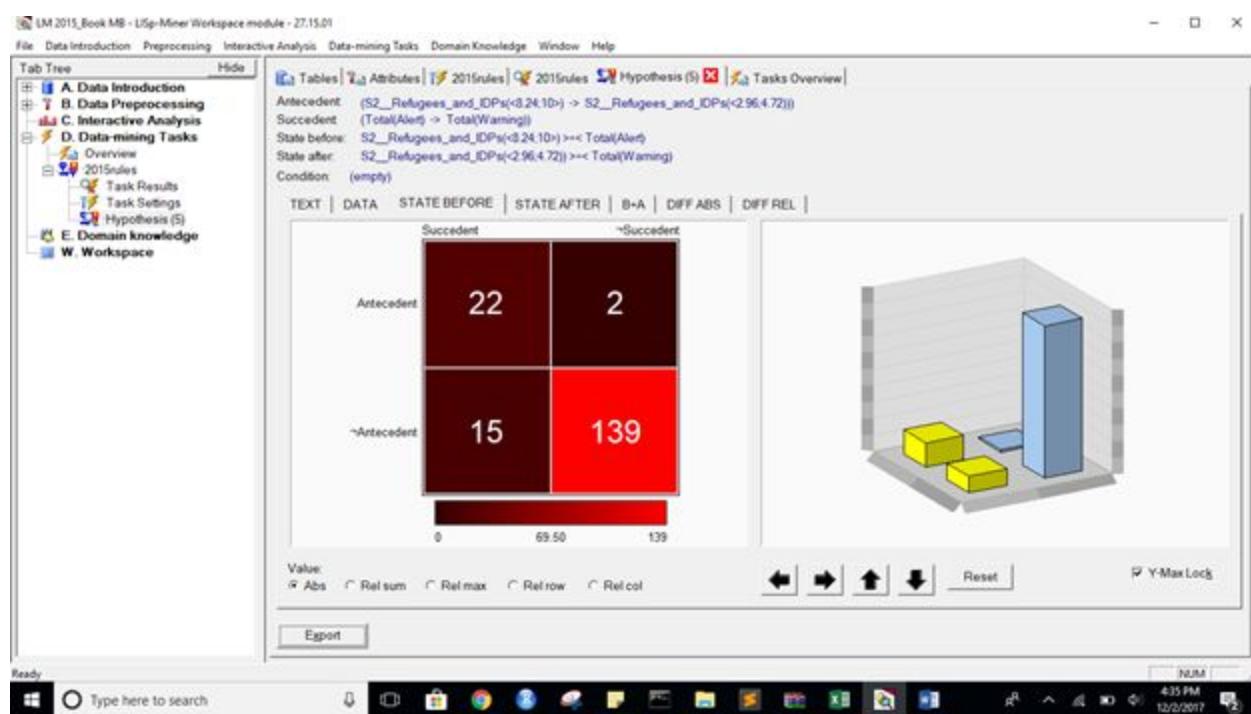
$(S2\_Refugees\_and\_IDPs(<8.24;10>) \rightarrow S2\_Refugees\_and\_IDPs(<1.2;2.96))) >\div< (\text{Total}(Alert) \rightarrow \text{Total(stable)))}$

**Alert to Warning with same flexible attributes as above:**

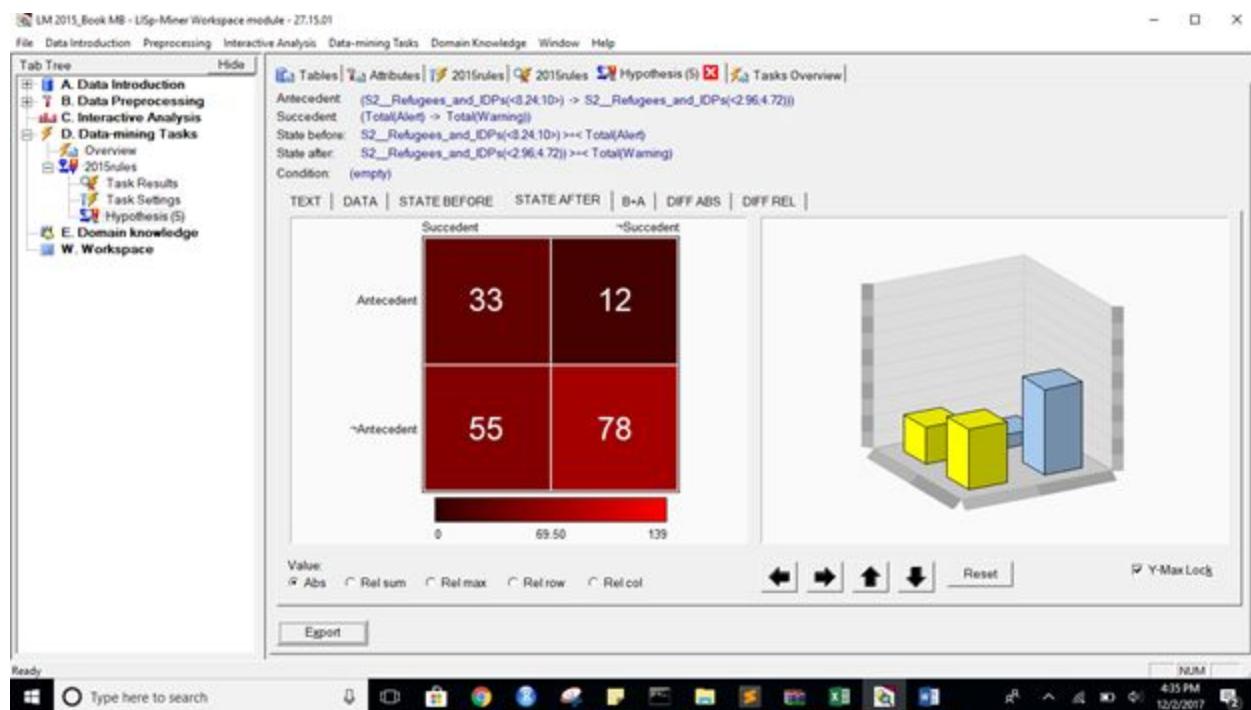
$(S2\_Refugees\_and\_IDPs(<8.24;10>) \rightarrow S2\_Refugees\_and\_IDPs(<2.96;4.72))) >\div< (\text{Total}(Alert) \rightarrow \text{Total(Warning)))}$

Nr.	Id	D-Conf	B-Conf	A-Conf	Hypothesis
1	5	0.183	0.917	0.733	(empty); ( $S2\_Refugees\_and\_IDPs(<8.24)$ ) $\rightarrow S2\_Refugees\_and\_IDPs(<2.96;4.72)$ ) $\rightarrow$ (empty); ( $\text{Total}(Alert)$ ) $\rightarrow \text{Total(Warning)}$
2	4	0.063	0.786	0.722	(empty); ( $X1\_External\_Intervention(<8.24)$ ) $\rightarrow X1\_External\_Intervention(<4.72;6.48)$ ) $\rightarrow$ (empty); ( $\text{Total}(Alert)$ ) $\rightarrow \text{Total(Warning)}$
3	3	0.014	0.786	0.772	(empty); ( $X1\_External\_Intervention(<8.24)$ ) $\rightarrow X1\_External\_Intervention(<4.72;2.24)$ ) $\rightarrow$ (empty); ( $\text{Total}(Alert)$ ) $\rightarrow \text{Total(Warning)}$
4	1	0.008	0.771	0.763	(empty); ( $P2\_Public\_Services(<8.24)$ ) $\rightarrow P2\_Public\_Services(<6.48;8.24)$ ) $\rightarrow$ (empty); ( $\text{Total}(Alert)$ ) $\rightarrow \text{Total(Warning)}$
5	6	-0.052	0.917	0.969	(empty); ( $S2\_Refugees\_and\_IDPs(<8.24)$ ) $\rightarrow S2\_Refugees\_and\_IDPs(<4.72;6.48)$ ) $\rightarrow$ (empty); ( $\text{Total}(Alert)$ ) $\rightarrow \text{Total(Warning)}$
6	2	-0.117	0.771	0.889	(empty); ( $P2\_Public\_Services(<8.24)$ ) $\rightarrow P2\_Public\_Services(<4.72;6.48)$ ) $\rightarrow$ (empty); ( $\text{Total}(Alert)$ ) $\rightarrow \text{Total(Warning)}$

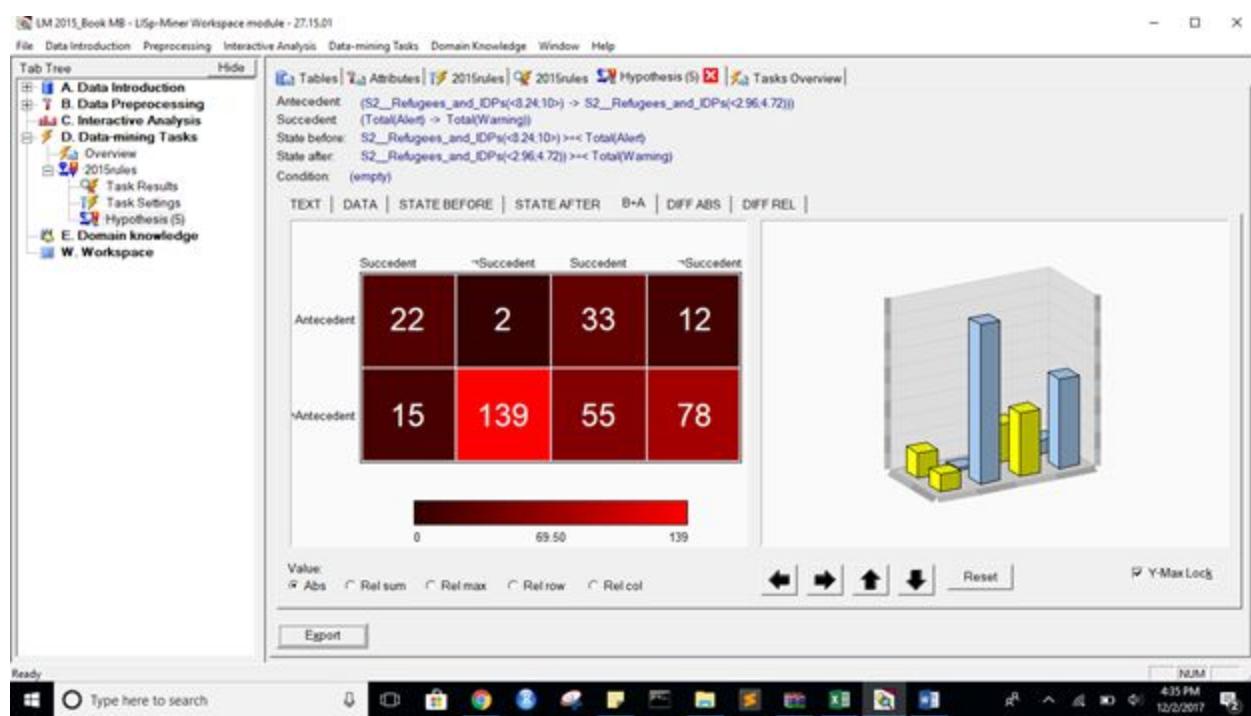
**STATE BEFORE :**



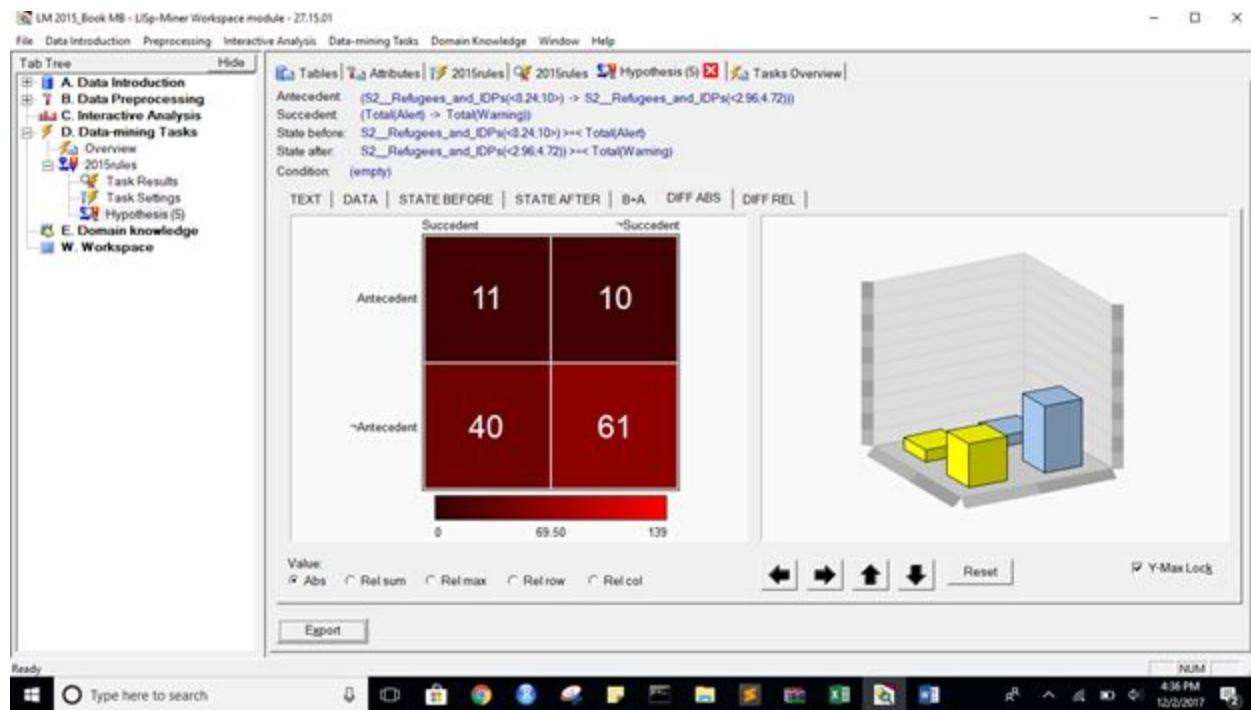
## State After:



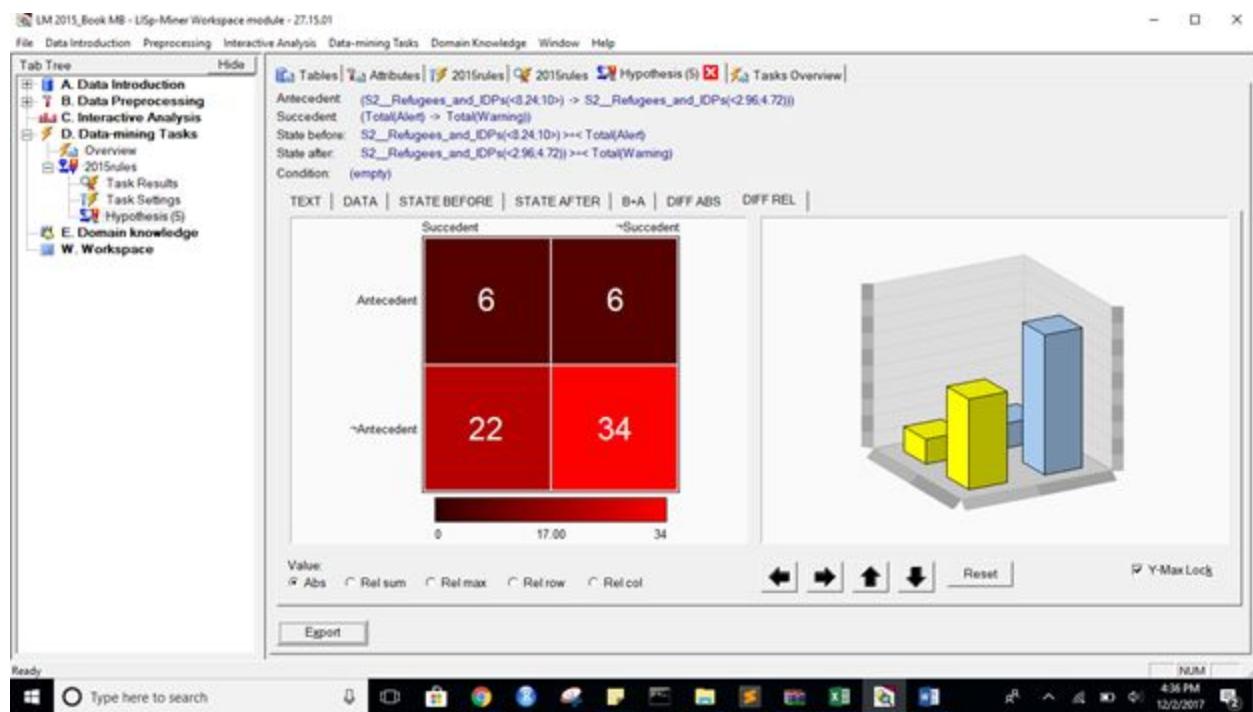
B + A :



## DIFF ABS :



## DIFF REL :



## ACTION RULES FOR 2014 :

Alert to stable :

Flexible attributes :

LM 2014\_modified1 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- 2014rules
- Task Results
- Task Settings
- E. Domain knowledge
- F. Workspace

Tables Attributes 2014rules 2014rules Tasks Overview Matrix x\_2014\_modified1

Groups of attributes tree Attribute Used DBColumn Categories XCat Sample categories

Root group of attributes	P2_Public_Services	+ P2_Public_Services	\$	<1.4.3.12), <3.12.4.84), <4.84.6.56), <6.56.8.28), <8.28)
decision	S2_Refugees_and_IDPs	+ S2_Refugees_and_IDPs	\$	<1.4.3.12), <3.12.4.84), <4.84.6.56), <6.56.8.28), <8.28)
stable	X1_External_Intervention	+ X1_External_Intervention	\$	<1.4.3.12), <3.12.4.84), <4.84.6.56), <6.56.8.28), <8.28)

Show Attribute Show Matrix Add attribute Del Attribute Clone Export Group detail Quick Assign Add group Del group

Ready Type here to search NUM 3:18 PM 12/2/2017

LM 2014\_modified1 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- 2014rules
- Task Results
- Task Settings
- E. Domain knowledge
- F. Workspace

Tables Attributes 2014rules 2014rules Tasks Overview Matrix x\_2014\_modified1

Data-mining Task basic parameters

Name:	2014rules	ID:	1
Comment:	-		
Taskgroup:	Default group of tasks		
Task type:	Ac4B-Miner	Data matrix:	x_2014_modified1

**ANTECEDENT STABLE PART**

Default Partial Credent	Con. 0 - 5	Type	Ref.	Value	Units
> d__Country (subset), 1 - 1	B_pos	a (BASE) Before	>=	20.00	Abs
		a (BASE) After	>=	20.00	Abs
Generation information					
Status: Solved, 1 run(s)					
Mode: Standard					

Total length: 0 - 5 [0 - 1]

**SUCCESSION STABLE PART**

Default Partial Credent	Con. 0 - 5
-------------------------	------------

Total length: 0

**ANTECEDENT VARIABLE PART**

Default Partial Credent	Con. 1 - 5
> P2_Public_Services (subset), 1 - 1	B_pos
> X1_External_Intervention (subset)	B_pos

Total length: 0 - 5 [1 - 2]

**CONDITION**

Default Partial Credent	Con. 0 - 5
-------------------------	------------

Total length: 0

**SUCCESSION VARIABLE PART**

Default Partial Credent	Con. 1 - 5
> Total(Alert > stable)	B_pos

Total length: 1

Task parameters

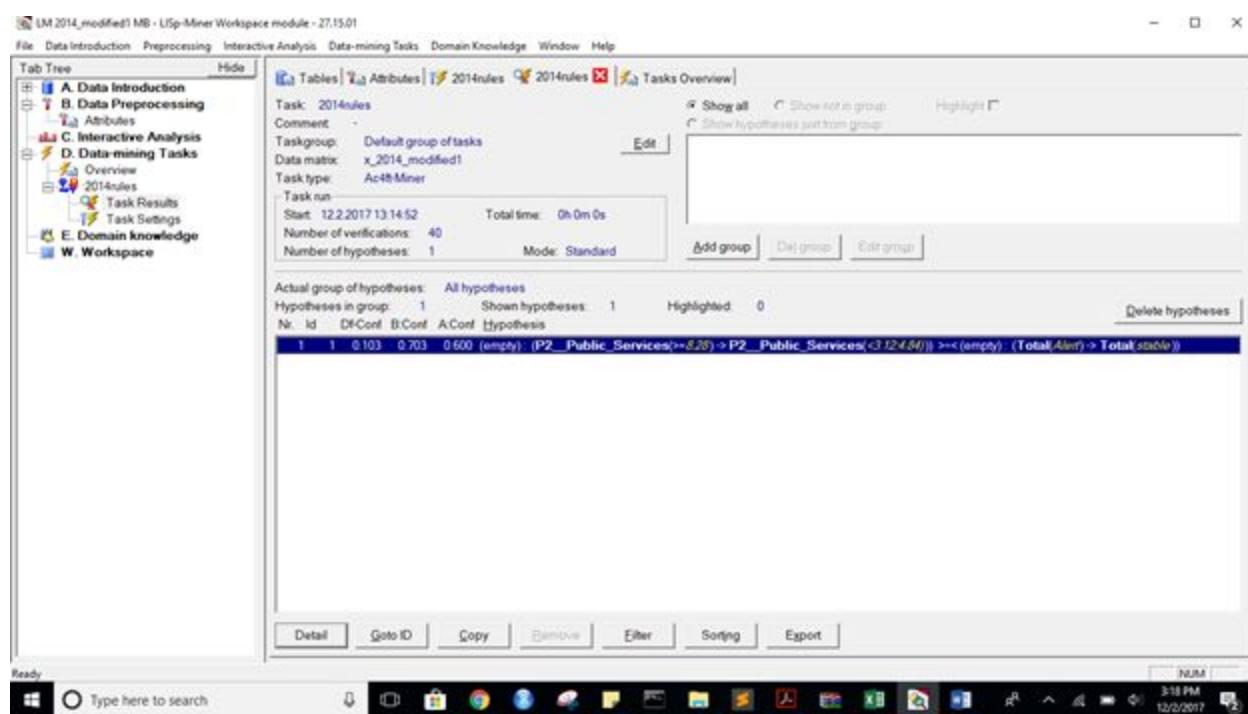
Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)

Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)

Maximal number of hypotheses: 1000

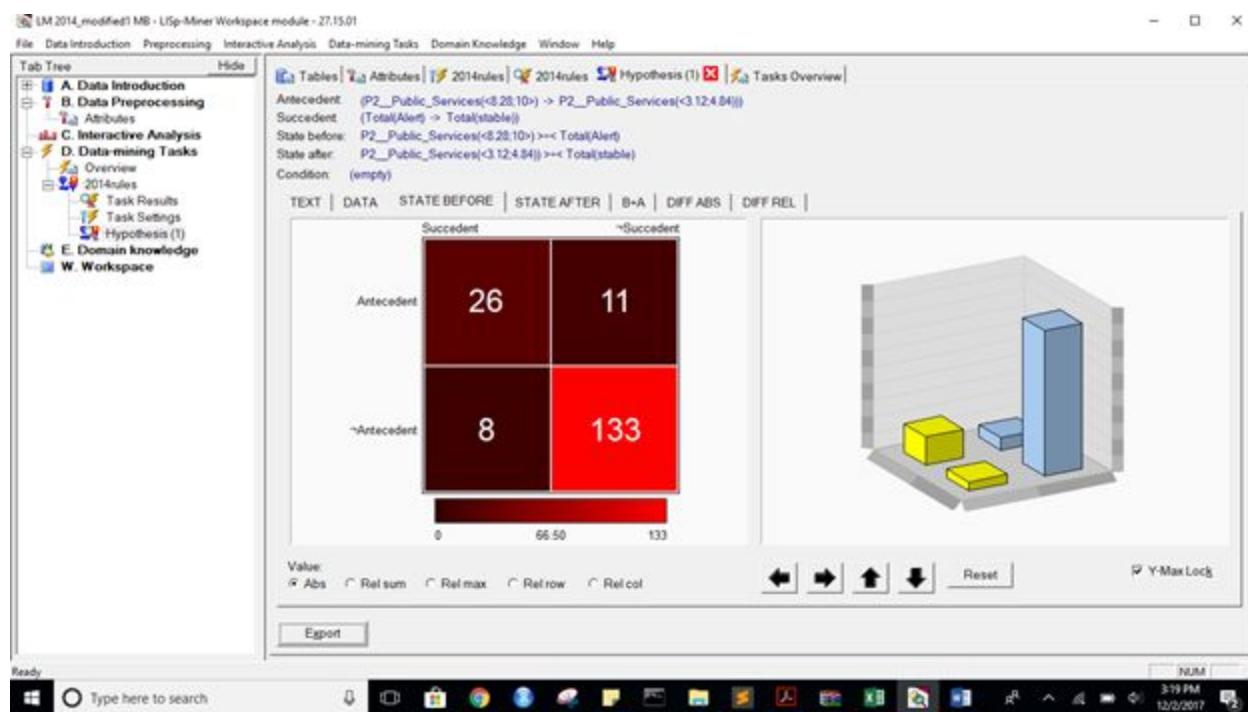
Params Sketch Validate Task Clone Run Bkgnd Run Grid Run Show Results

Ready Type here to search NUM 3:18 PM 12/2/2017

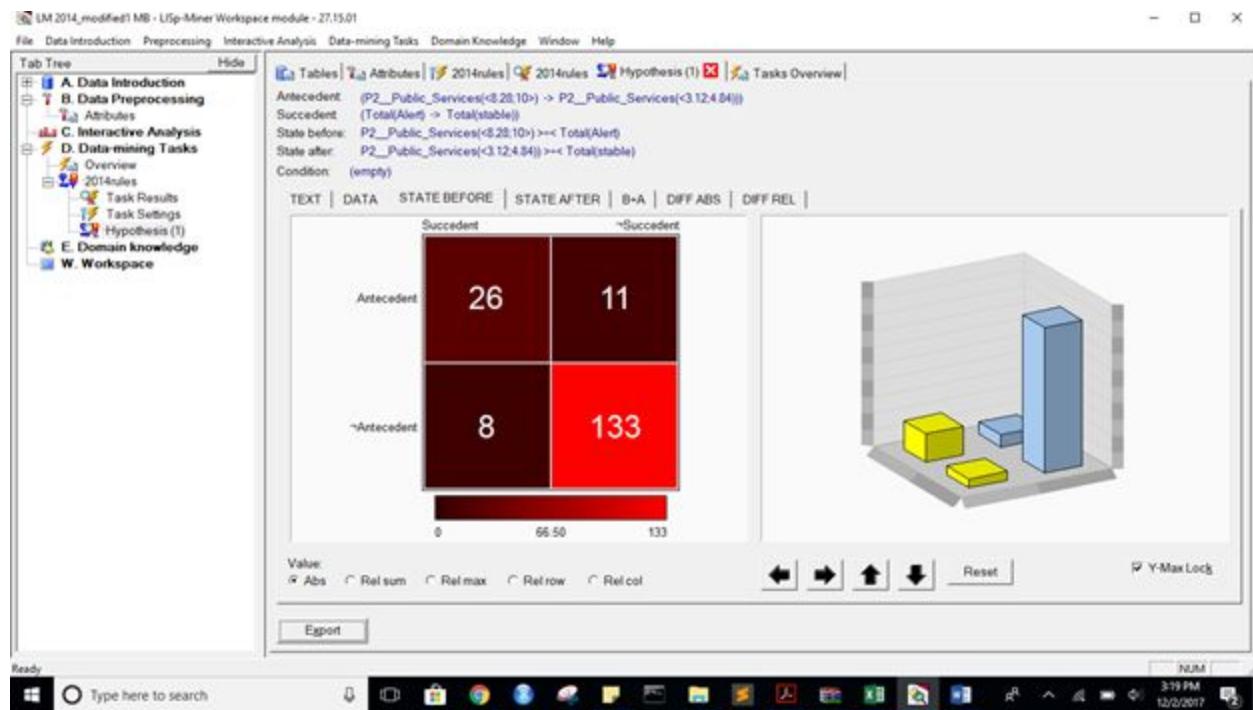


$(P2\_{\text{Public\_Services}}(<8.28;10)) \rightarrow P2\_{\text{Public\_Services}}(<3.12;4.84))) \rightarrow< (\text{Total(Alert)} \rightarrow \text{Total(stable)})$

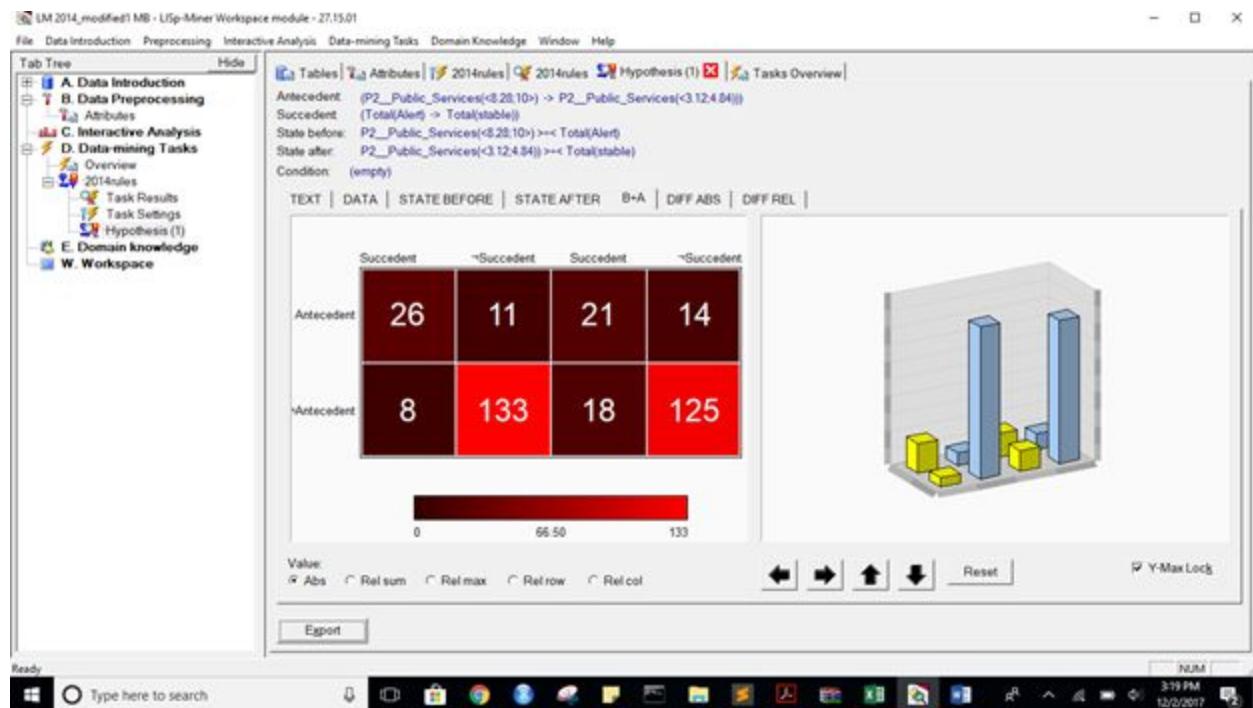
#### STATE BEFORE :



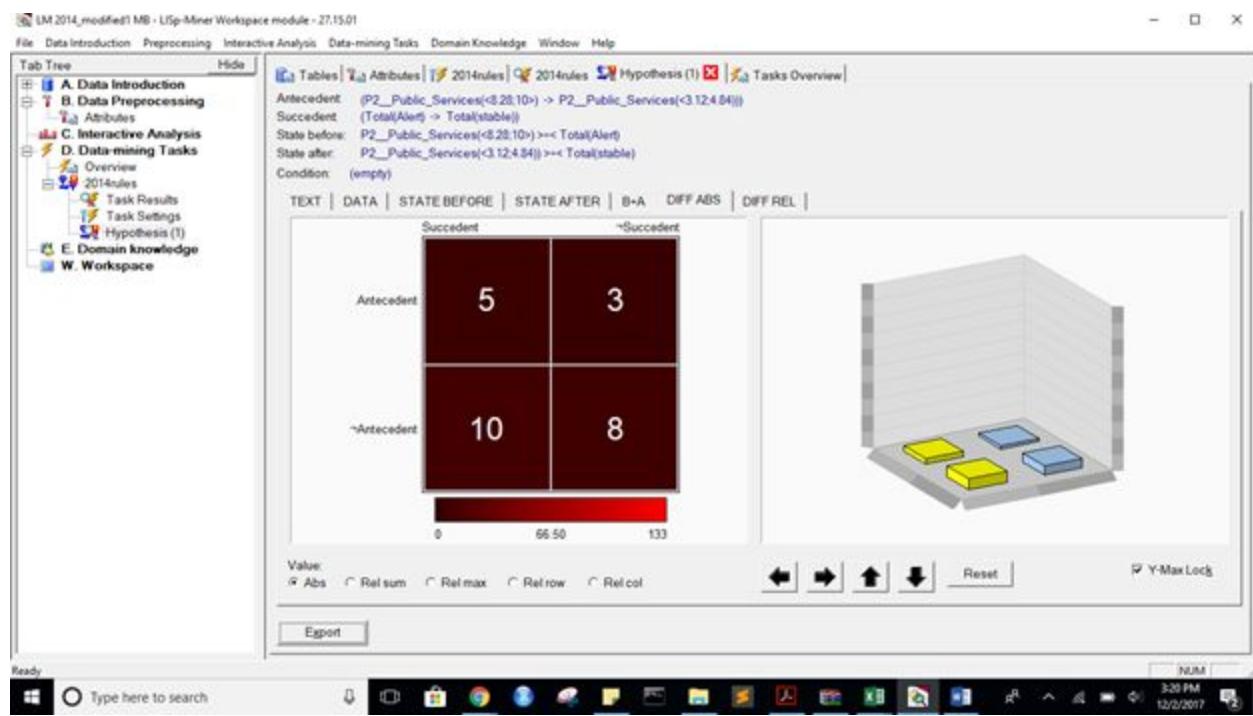
## STATE AFTER :



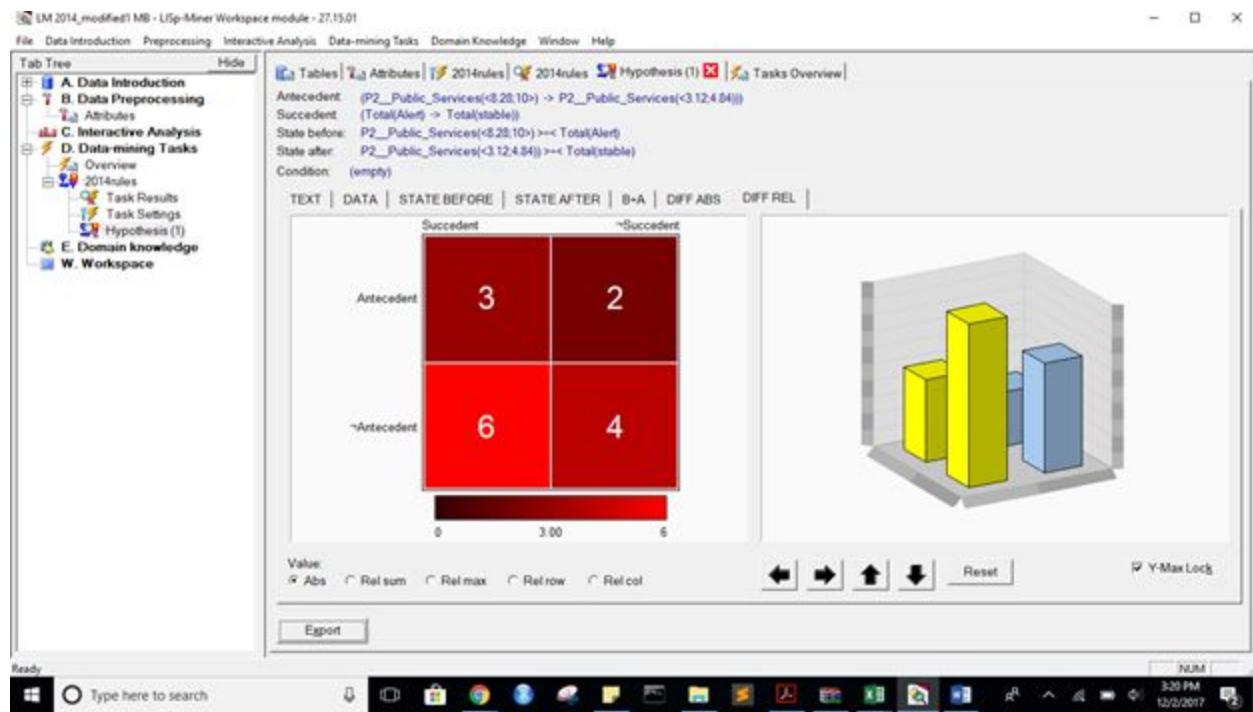
## B + A :



## Diff ABS :



## DIFF Rel :



Alert to Warning with same attributes as above:

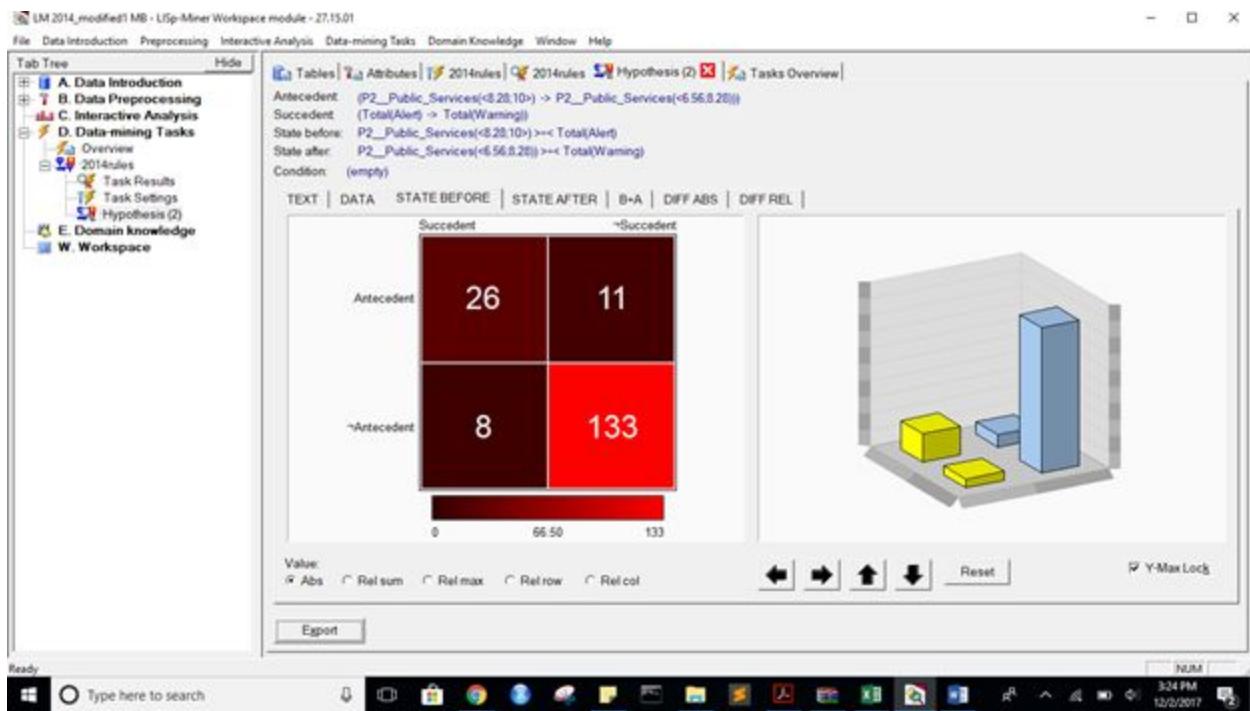
(P2\_\_Public\_Services(<8.28;10>) → P2\_\_Public\_Services(<4.84;6.56))) >÷< (Total(Alert) → Total(Warning))

The screenshot shows the LISp-Miner workspace interface. The left sidebar contains a 'Tab Tree' with sections A through W. The main area displays a table titled 'Tables' under 'Interactive Analysis'. The table has columns for 'Nr.', 'Id', 'Di-Conf', 'B-Conf', 'A-Conf', and 'Hypothesis'. There are two rows of data:

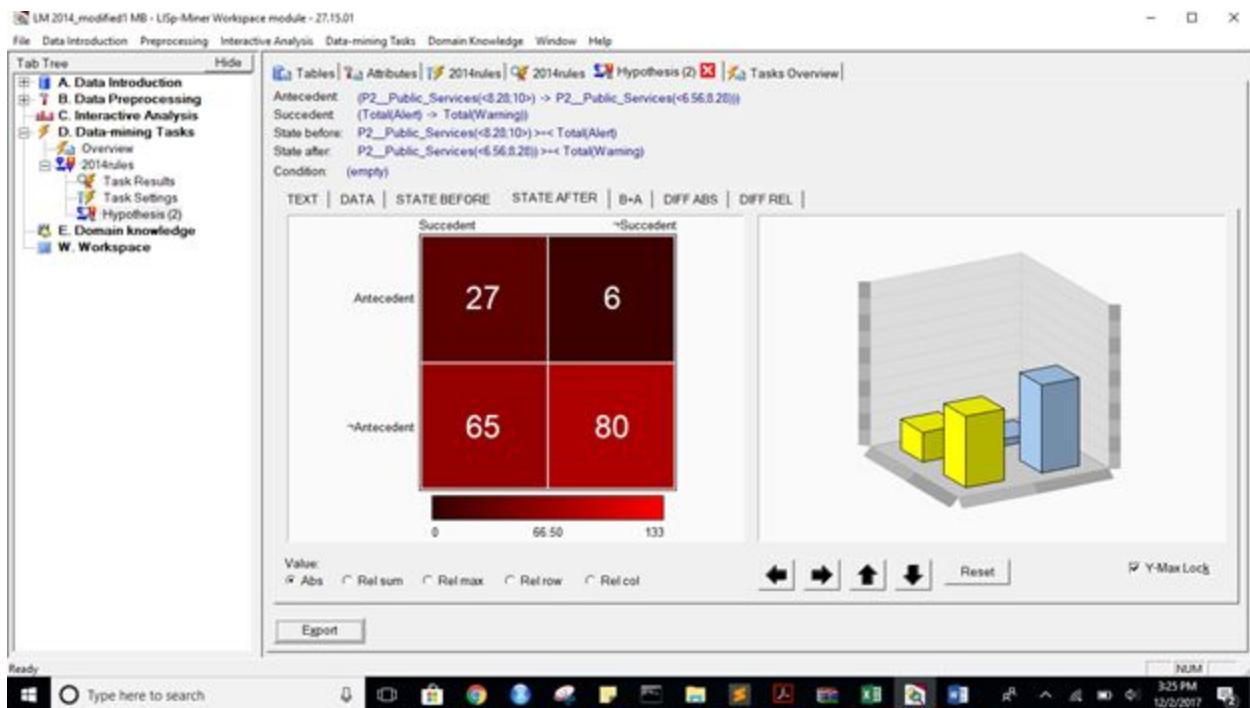
Nr.	Id	Di-Conf	B-Conf	A-Conf	Hypothesis
1	2	0.115	0.703	0.818	(empty): (P2__Public_Services(>=8.28) → P2__Public_Services(<6.56;8.28)) ><(empty): (Total(Alert) → Total(Warning))
2	1	-0.202	0.703	0.905	(empty): (P2__Public_Services(>=8.28) → P2__Public_Services(<4.84;6.56))) ><(empty): (Total(Alert) → Total(Warning))

Below the table are buttons for 'Detail', 'Goto ID', 'Copy', 'Remove', 'Filter', 'Sorting', and 'Export'. The status bar at the bottom shows 'Ready' and the system tray includes icons for battery, signal, volume, and date/time.

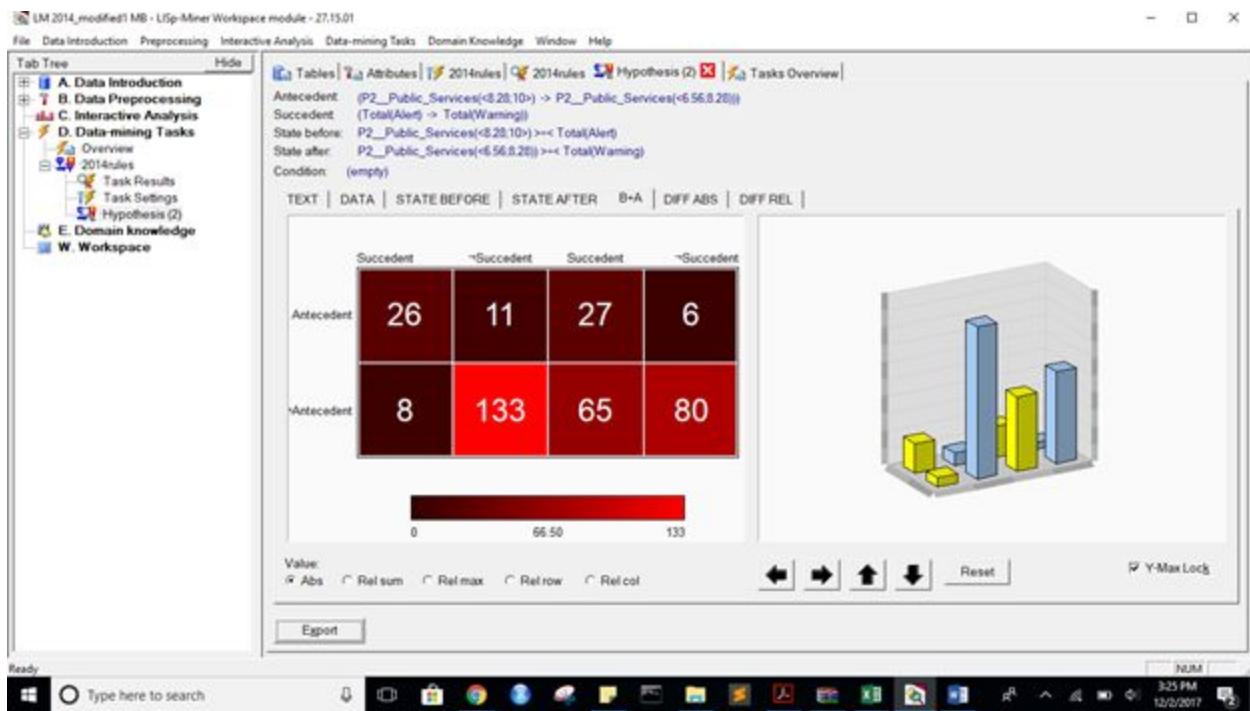
State before :



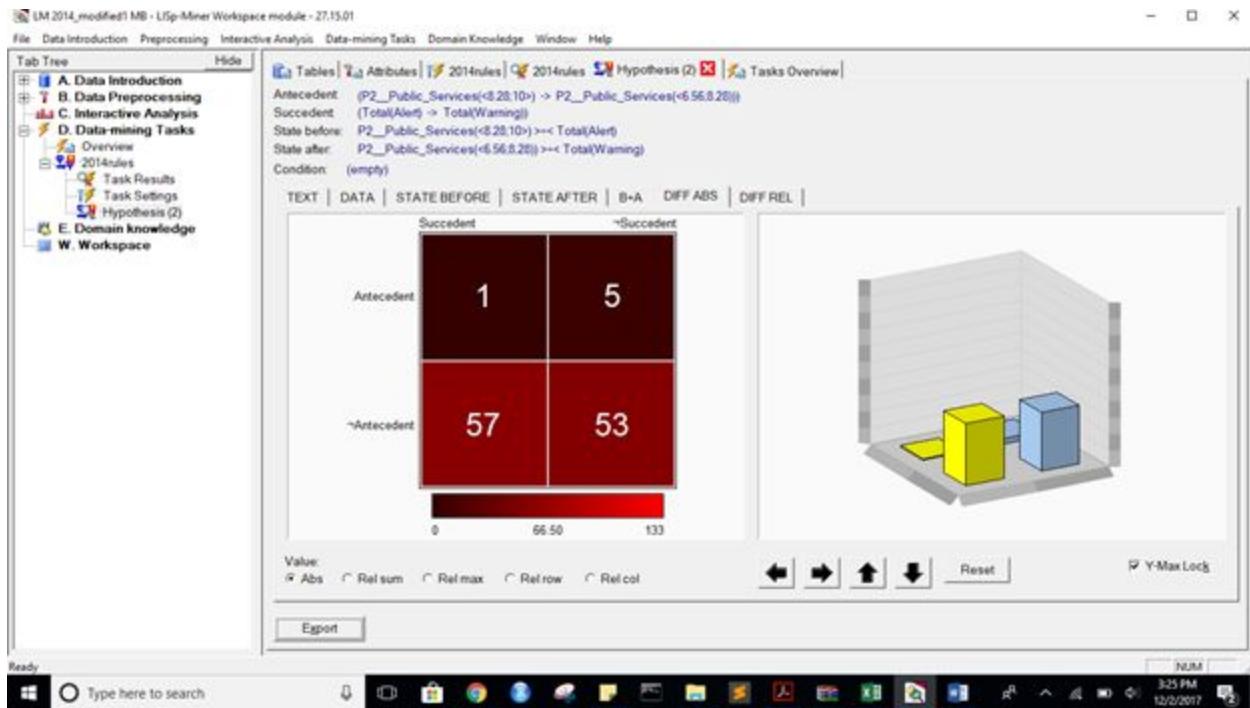
State after :



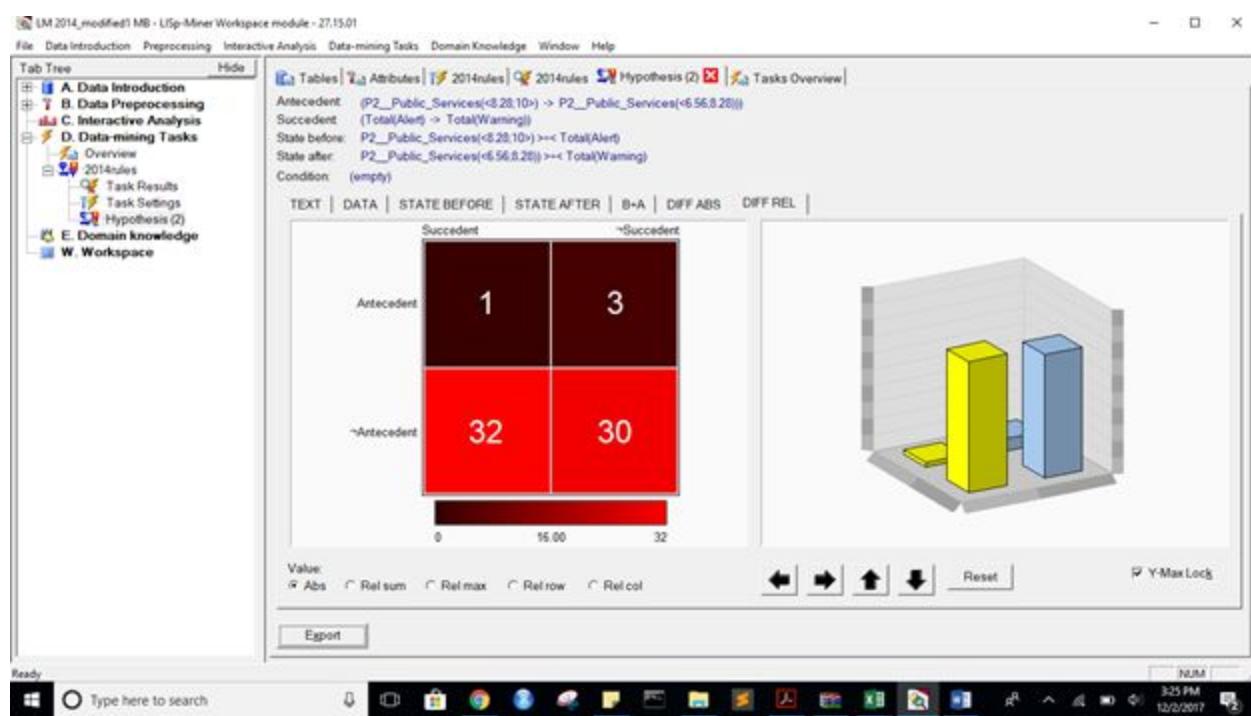
B + a :



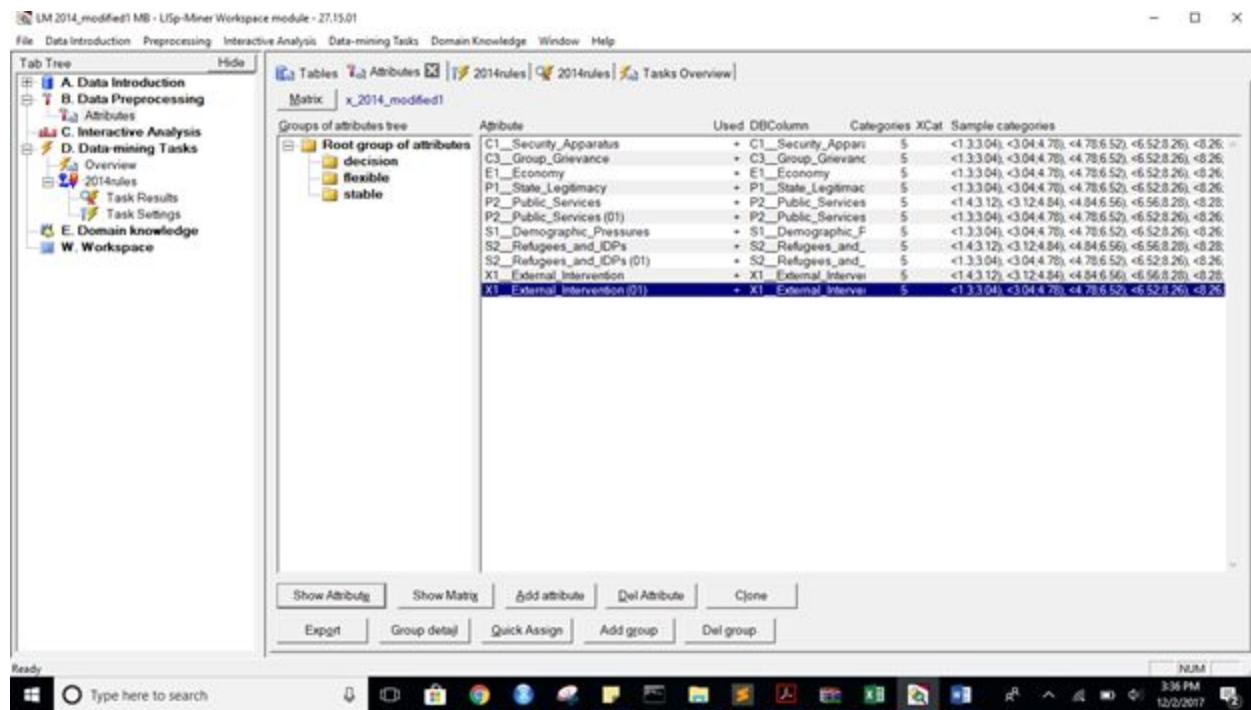
Diff abs :



Diff rel :



## ALERT TO STABLE WITH MORE ATTRIBUTES:



LM 2014\_modified1 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

A. Data Introduction  
B. Data Preprocessing  
C. Interactive Analysis  
D. Data-mining Tasks  
Overview  
2014rules  
Task Results  
Task Settings  
E. Domain knowledge  
W. Workspace

Tables Attributes 2014rules 2014rules Tasks Overview

Data-mining Task basic parameters  
Name: 2014rules  
Comment:  
Taskgroup: Default group of tasks  
Task type: Ac48-Miner  
Data matrix: x\_2014\_modified1  
ID: 1 Edit

**ANTECEDENT STABLE PART**

Default Partial Credent Cov. 0 - 5  
+ d\_Country (subset), 1 - 1 B, pos

**QUANTIFIERS**

Type Rel. Value Units  
a (BASE) Before >= 20.00 Abs  
a (BASE) After >= 20.00 Abs

Generation information  
Status: Solved, 3 run(s)  
Mode: Standard

Total length: 0 - 5 [0 - 1]

**SUCCESSION STABLE PART**

Default Partial Credent Cov. 0 - 5

**ANTECEDENT VARIABLE PART**

Default Partial Credent Cov. 1 - 5  
+ P2\_Public\_Services (subset), 1 - 1 B, pos  
+ X1\_External\_Intervention (subset), 1 - 1 B, pos  
+ C1\_Security\_Apparatus (subset), 1 - 1 B, pos  
+ C3\_Group\_Grievance (subset), 1 - 1 B, pos

**CONDITION**

Default Partial Credent Cov. 0 - 5

Total length: 0

**SUCCESSION VARIABLE PART**

Default Partial Credent Cov. 1 - 5  
+ Total(Alert > stable) B, pos

Total length: 1

Task parameters  
Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)  
Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)  
Maximal number of hypotheses: 1000

Params Switch Validate Task Cjone  
Run Bkgrnd Run Grid Run Show Results

Ready Type here to search 12:38 PM 12/2/2017

LM 2014\_modified1 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

A. Data Introduction  
B. Data Preprocessing  
C. Interactive Analysis  
D. Data-mining Tasks  
Overview  
2014rules  
Task Results  
Task Settings  
E. Domain knowledge  
W. Workspace

Tables Attributes 2014rules 2014rules Tasks Overview

Task: 2014rules  
Comment:  
Taskgroup: Default group of tasks  
Data matrix: x\_2014\_modified1  
Task type: Ac48-Miner  
Edit

Show all Show not in group Highlight

Task run  
Start: 12.2.2017 15:31:17 Total time: 0h 0m 1s  
Number of verifications: 346 Number of hypotheses: 9 Mode: Standard Add group Del group Edit group

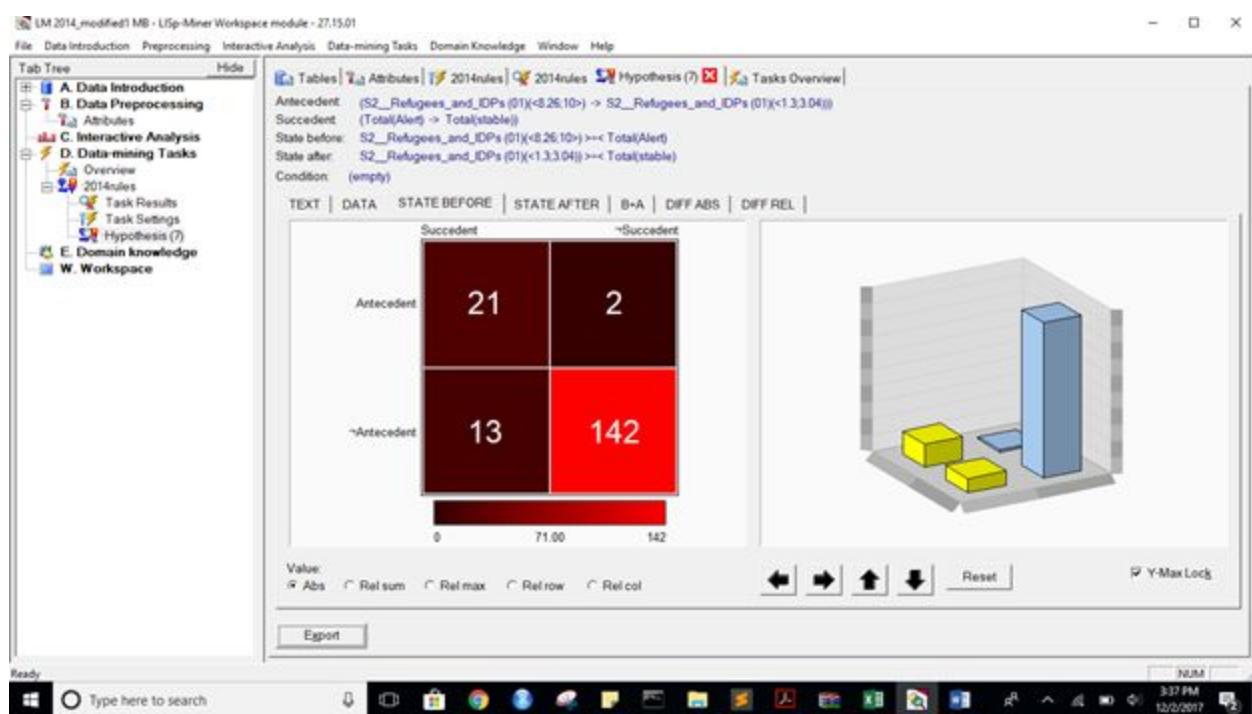
Actual group of hypotheses: All hypotheses  
Hypotheses in group: 9 Show hypotheses: 9 Highlighted: 0 Delete hypotheses

Nr.	ID	Dif-Conf	B.Corr	A.Conf	Hypothesis
1	9	0.303	0.913	0.610	(S2_Refugees_and_IDPs(<=S2)) & S2_Refugees_and_IDPs(01)>=S2 > S2_Refugees_and_IDPs(<3.12) & S2_Refugees_and_IDPs(<3.12)
2	7	0.303	0.913	0.610	(S2_Refugees_and_IDPs(01)>=S2) > S2_Refugees_and_IDPs(01)<3.04) ><(empty): (Total.Alert) > Total(stable)
3	8	0.294	0.913	0.619	(S2_Refugees_and_IDPs(<=S2)) > S2_Refugees_and_IDPs(<3.12) ><(empty): (Total.Alert) > Total(stable)
4	6	0.267	0.767	0.500	(C3_Group_Grievance(<=S2)) > C3_Group_Grievance(<3.04.4.70)) ><(empty): (Total.Alert) > Total(stable))
5	3	0.103	0.703	0.600	(P2_Public_Services(<=S2)) > P2_Public_Services(<3.12.4.84)) ><(empty): (Total.Alert) > Total(stable))
6	4	0.036	0.703	0.667	(P2_Public_Services(<=S2) & P2_Public_Services(01))>=S2) > P2_Public_Services(<3.12.4.84) & P2_Public_Services(<3.12.4.84)
7	5	0.033	0.710	0.676	(S1_Demographic_Pressures(<=S2)) > S1_Demographic_Pressures(<3.04.4.70)) ><(empty): (Total.Alert) > Total(stable))
8	2	0.025	0.703	0.677	(P2_Public_Services(01)>=S2) > P2_Public_Services(01)<3.04.4.70)) ><(empty): (Total.Alert) > Total(stable))
9	1	-0.094	0.431	0.525	(E1_Economy(<=S2)) > E1_Economy(<3.04.4.70)) ><(empty): (Total.Alert) > Total(stable))

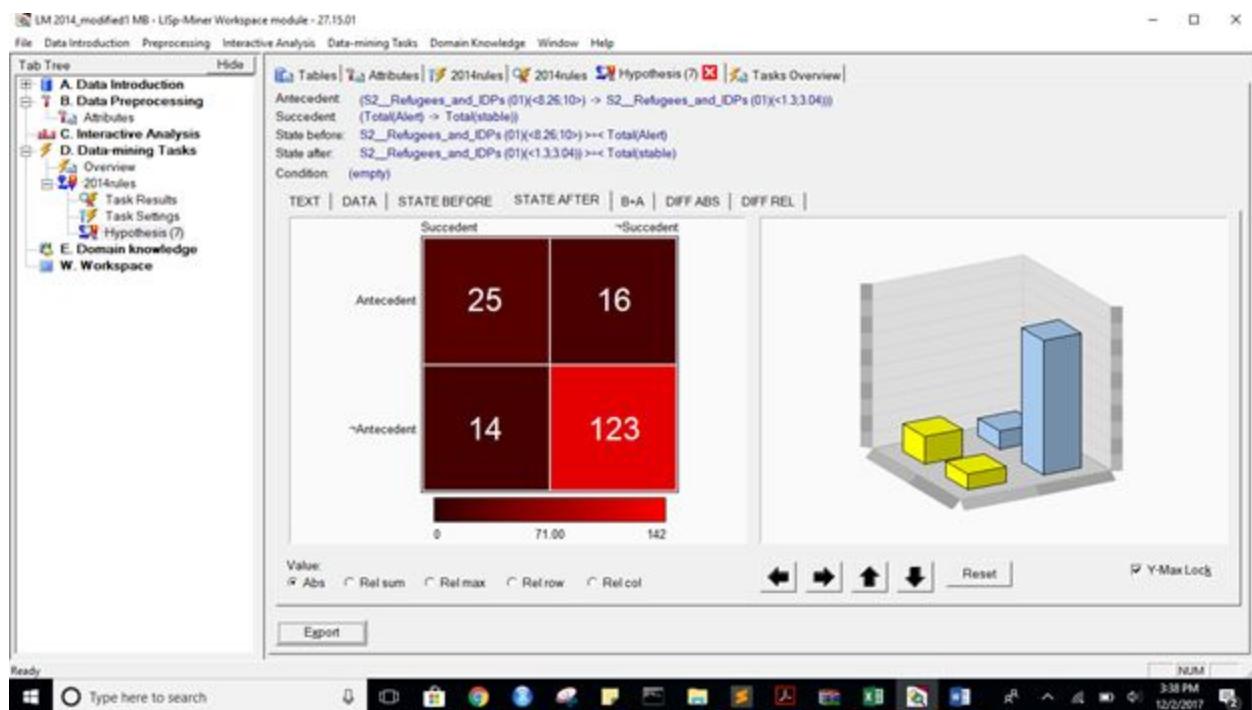
Detail Goto ID Copy Remove Filter Sorting Export

Ready Type here to search 12:37 PM 12/2/2017

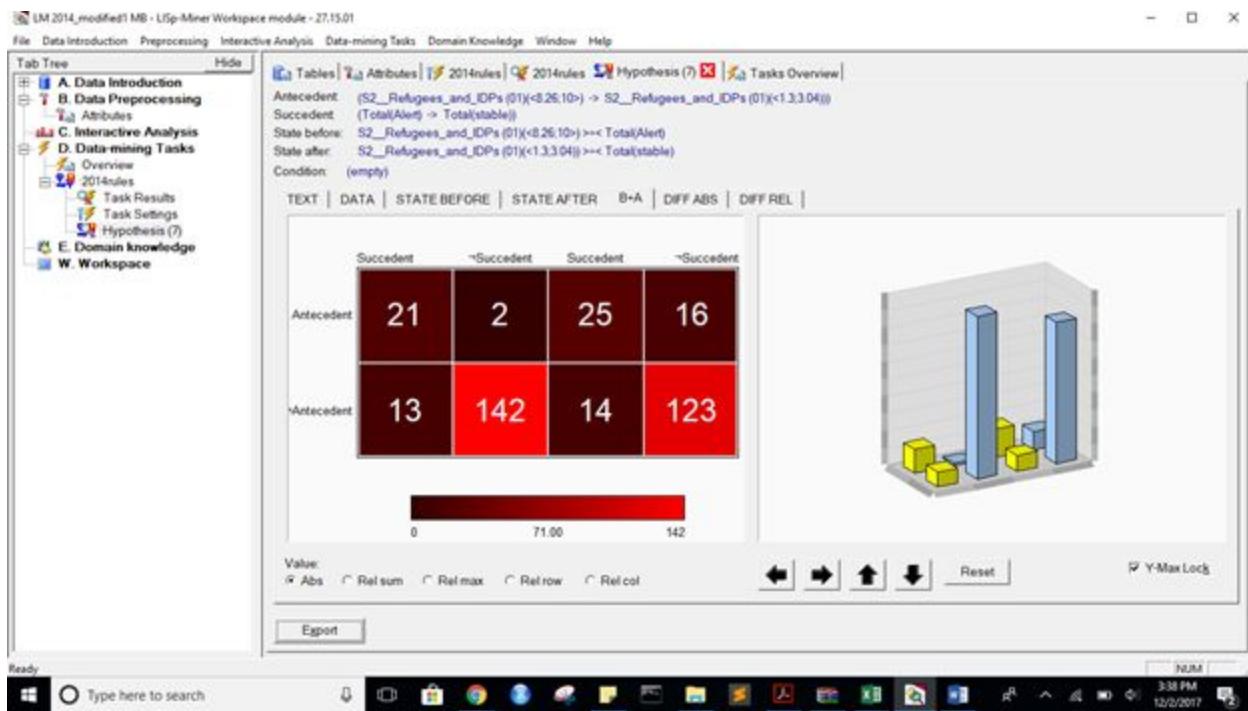
State before :



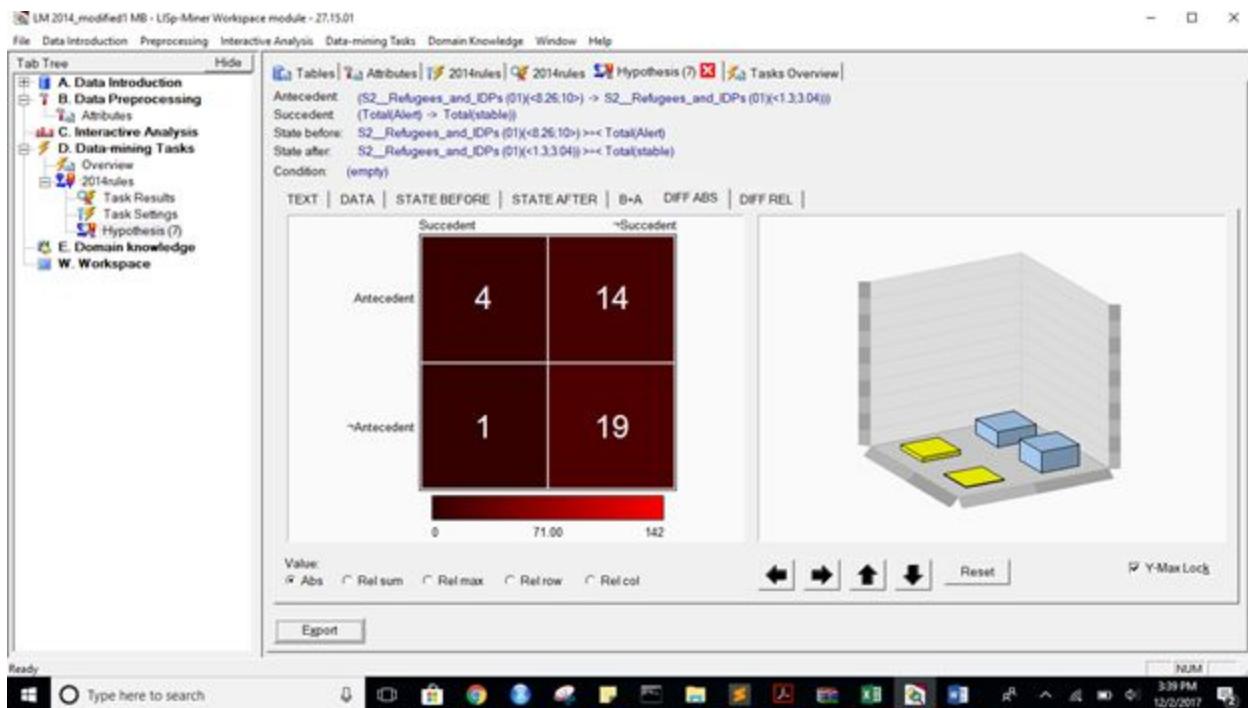
State after :



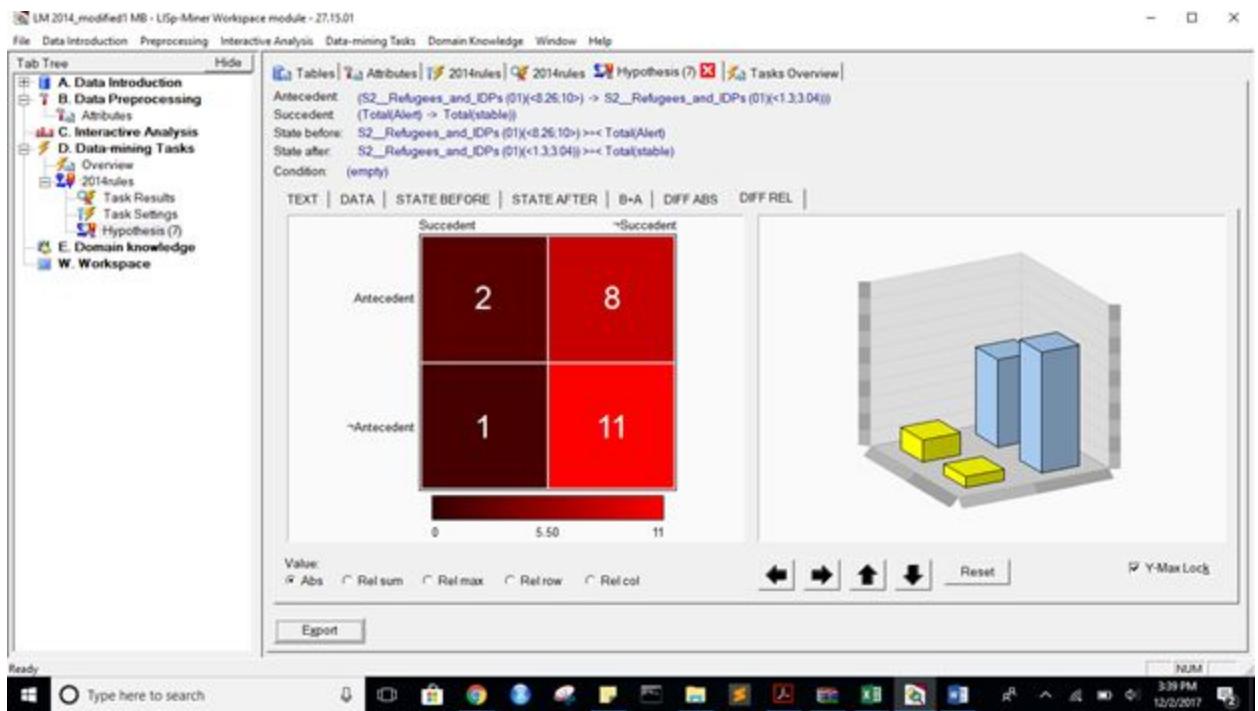
B+A :



DIFF ABS :



DIFF REL :



Alert to warning :

**(S2\_Refugees\_and\_IDPs(<8.28;10>) → S2\_Refugees\_and\_IDPs(<6.56;8.28))) >÷< (Total(Alert) → Total(Warning))**

same attributes as above

LM 2014\_modified1 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

A. Data Introduction  
B. Data Preprocessing  
C. Interactive Analysis  
D. Data-mining Tasks  
Overview  
Task Results  
Task Settings  
E. Domain knowledge  
W. Workspace

Tables Attributes 2014rules 2014rules Tasks Overview

Data-mining Task basic parameters  
Name: 2014rules  
Comment:  
Taskgroup: Default group of tasks  
Task type: Ac48-Miner  
Data matrix: x\_2014\_modified1  
ID: 1 Edit

**ANTECEDENT STABLE PART**

Default Partial Cedent Cov. 0-5  
+ d\_\_Country (subset), 1-1 B, pos

**QUANTIFIERS**

Type Rel. Value Units  
a (BASE) Before >= 20.00 Abs  
a (BASE) After >= 20.00 Abs

Generation information  
Status: Solved, 4 run(s)  
Mode: Standard

Total length: 0-5 [0-1]

**SUCCESSION STABLE PART**

Default Partial Cedent Cov. 0-5  
+ Con. 0-5

**ANTECEDENT VARIABLE PART**

Default Partial Cedent Cov. 1-5  
+ P2\_Public\_Services (subset), 1-1 B, pos  
+ X1\_External\_Intervention (subset), 1-1 B, pos  
+ C1\_Security\_Apparatus (subset), 1-1 B, pos  
+ C3\_Group\_Grievance (subset), 1-1 B, pos

**CONDITION**

Default Partial Cedent Cov. 0-5  
+ Total(Alert > Warning)

Total length: 0-5 [1-5]

**SUCCESSION VARIABLE PART**

Default Partial Cedent Cov. 1-5  
+ Total(Alert > Warning)

Total length: 0-5 [1-5]

Task parameters  
Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)  
Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)  
Maximal number of hypotheses: 1000

Params Switch Validate Task Cjone  
Run Bkgrnd Run Grid Run Show Results

Ready Type here to search 341 PM 12/2/2017

LM 2014\_modified1 MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

A. Data Introduction  
B. Data Preprocessing  
C. Interactive Analysis  
D. Data-mining Tasks  
Overview  
Task Results  
Task Settings  
E. Domain knowledge  
W. Workspace

Tables Attributes 2014rules 2014rules Tasks Overview

Task: 2014rules  
Comment:  
Taskgroup: Default group of tasks  
Data matrix: x\_2014\_modified1  
Task type: Ac48-Miner  
Task run  
Start: 12.2.2017 15:39:59 Total time: 0h 0m 1s  
Number of verifications: 346  
Number of hypotheses: 25 Mode: Standard

Show all Show not in group Highlight

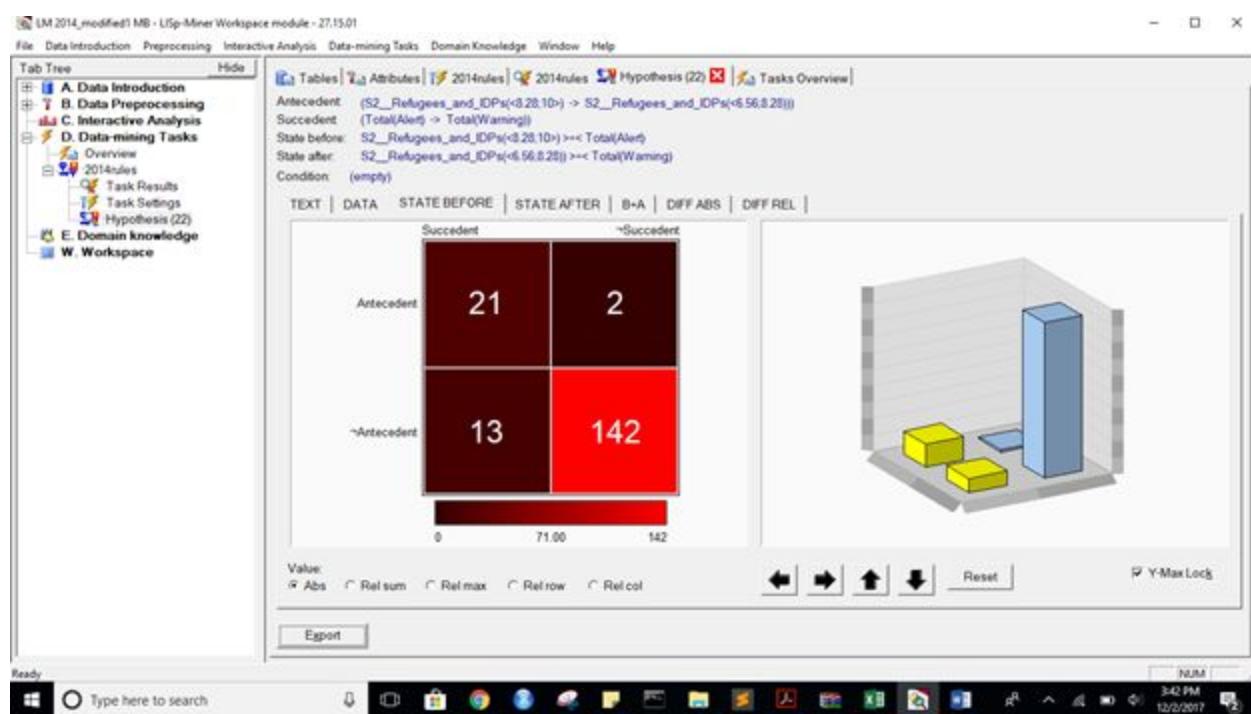
Actual group of hypotheses: All hypotheses  
Hypotheses in group: 25 Show hypotheses: 25 Highlighted: 0 Delete hypotheses

Nr.	ID	Diff-Cont	B-Conf	A-Conf	Hypothesis
1	22	0.246	0.913	0.667	(empty): (S2_Refugees_and_IDPs(<.26)) >< (empty): (Total_Alert) > Total_Warn
2	25	0.246	0.913	0.667	(empty): (S2_Refugees_and_IDPs(<.26)) & S2_Refugees_and_IDPs(01)><.26) > S2_Refugees_and_IDPs(<.56.826)
3	19	0.246	0.913	0.667	(empty): (S2_Refugees_and_IDPs(01)><.26) > S2_Refugees_and_IDPs(01)(<.52.826)) >< (empty): (Total_Alert) > To
4	18	0.229	0.913	0.684	(empty): (S2_Refugees_and_IDPs(<.26)) > S2_Refugees_and_IDPs(01)(<.04.826)) >< (empty): (Total_Alert) > To
5	21	0.221	0.913	0.692	(empty): (S2_Refugees_and_IDPs(<.26)) > S2_Refugees_and_IDPs(01)(<.12.4.84)) >< (empty): (Total_Alert) > Total_Warn
6	24	0.210	0.913	0.703	(empty): (S2_Refugees_and_IDPs(<.26)) & S2_Refugees_and_IDPs(01)><.26) > S2_Refugees_and_IDPs(<.12.4.84)
7	12	0.059	0.767	0.698	(empty): (C3_Group_Grievance)><.26) > C3_Group_Grievance(<.78.652)) >< (empty): (Total_Alert) > Total_Warning
8	17	0.008	0.913	0.905	(empty): (S2_Refugees_and_IDPs(01)><.26) > S2_Refugees_and_IDPs(01)(<.78.652)) >< (empty): (Total_Alert) > To
9	20	-0.012	0.913	0.925	(empty): (S2_Refugees_and_IDPs(<.26)) > S2_Refugees_and_IDPs(01)><.26) > S2_Refugees_and_IDPs(<.84.656)
10	23	-0.012	0.913	0.925	(empty): (S2_Refugees_and_IDPs(<.26)) & S2_Refugees_and_IDPs(01)><.26) > S2_Refugees_and_IDPs(<.84.656)
11	13	-0.016	0.767	0.783	(empty): (C3_Group_Grievance)><.26) > C3_Group_Grievance(<.52.826)) >< (empty): (Total_Alert) > Total_Warning
12	11	-0.064	0.710	0.776	(empty): (S1_Demographic_Pressures)><.26) > S1_Demographic_Pressures(<.52.826)) >< (empty): (Total_Alert) > To
13	7	-0.115	0.703	0.818	(empty): (P2_Public_Services)><.26) > P2_Public_Services(<.56.826)) >< (empty): (Total_Alert) > Total_Warning
14	9	-0.115	0.703	0.818	(empty): (P2_Public_Services)><.26) & P2_Public_Services(01)><.26) > P2_Public_Services(<.56.826) & P2_Public_Services(01)><.26)
15	5	-0.115	0.703	0.818	(empty): (P2_Public_Services(01)><.26) > P2_Public_Services(01)(<.52.826)) >< (empty): (Total_Alert) > Total_Warn
16	10	-0.120	0.710	0.830	(empty): (S1_Demographic_Pressures)><.26) > S1_Demographic_Pressures(<.78.652)) >< (empty): (Total_Alert) > To

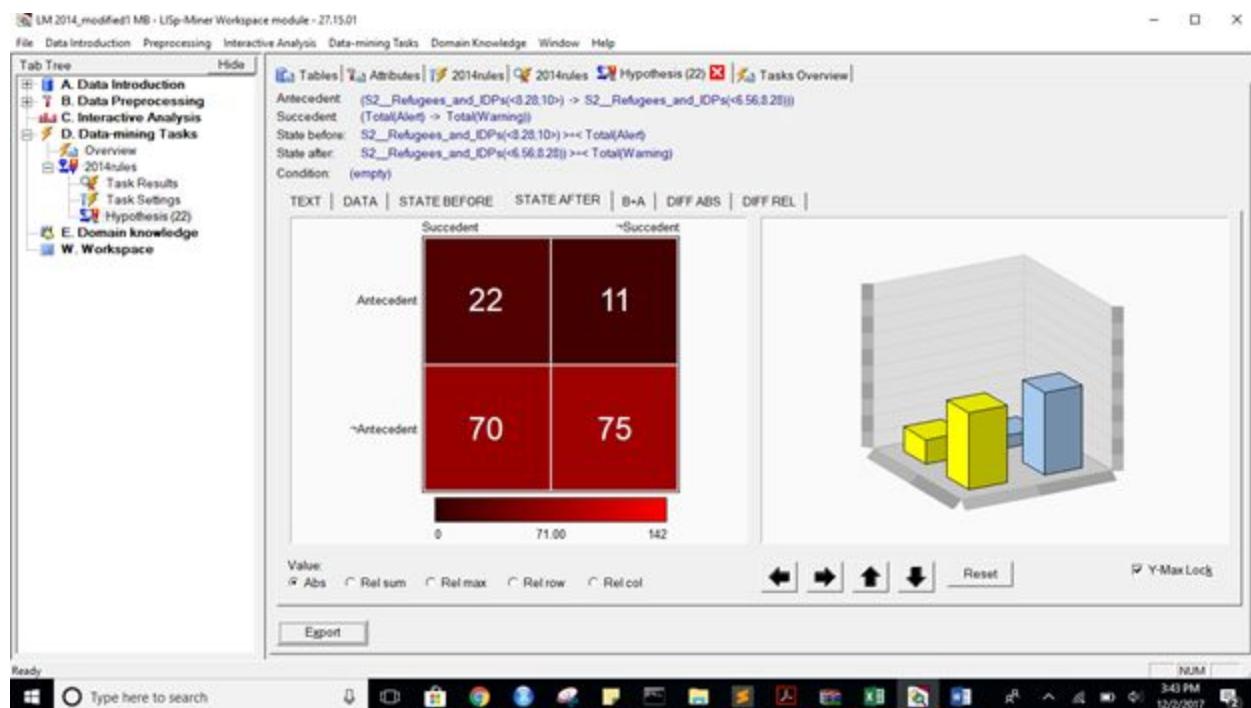
Detail Goto ID Copy Remove Filter Sorting Export

Ready Type here to search 342 PM 12/2/2017

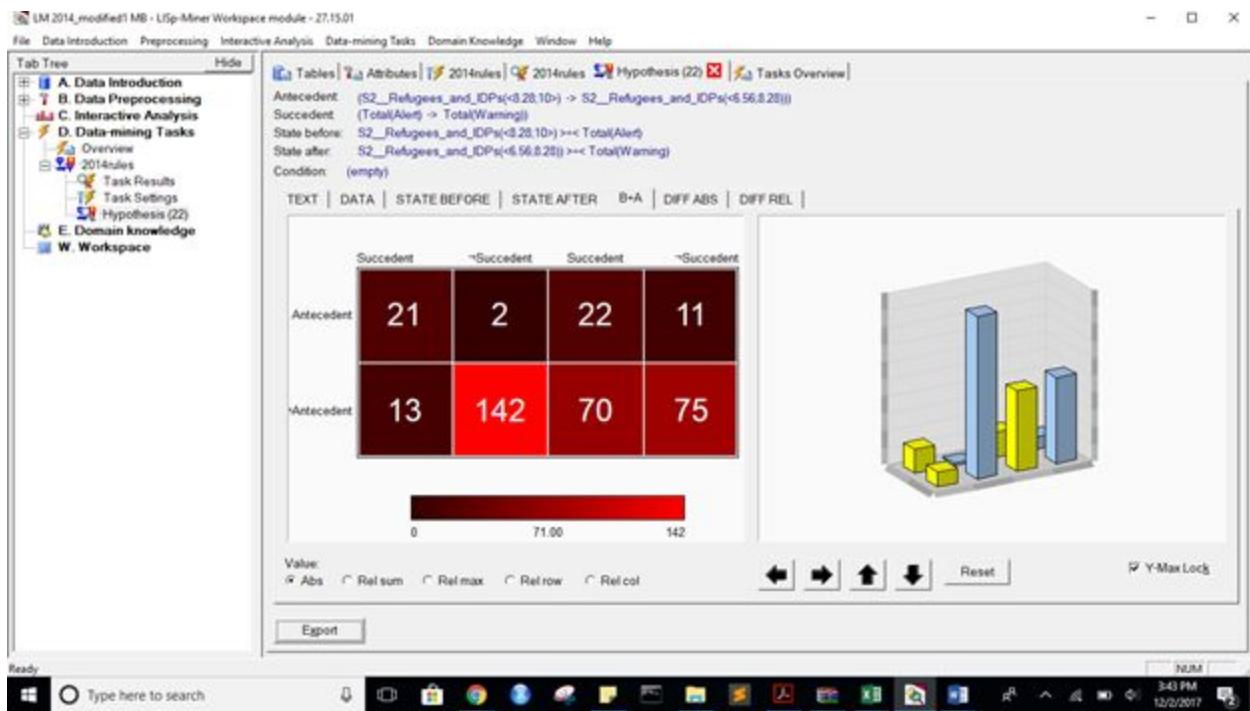
State before :



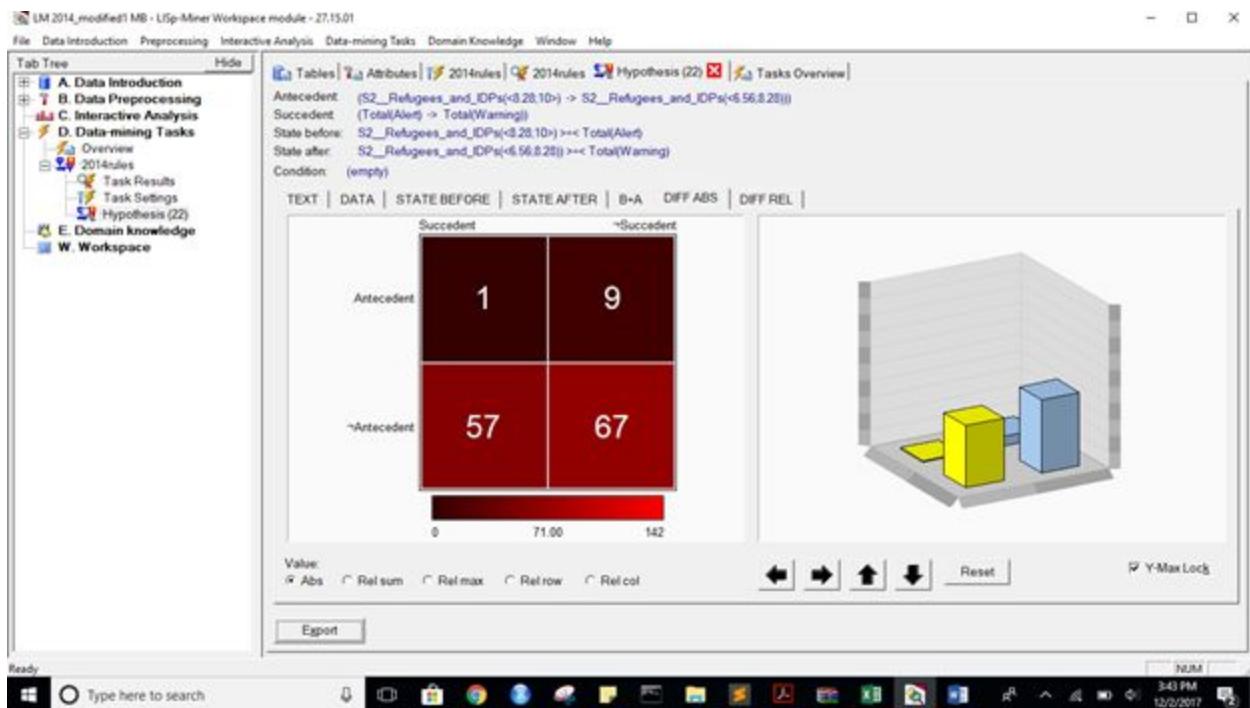
State after :



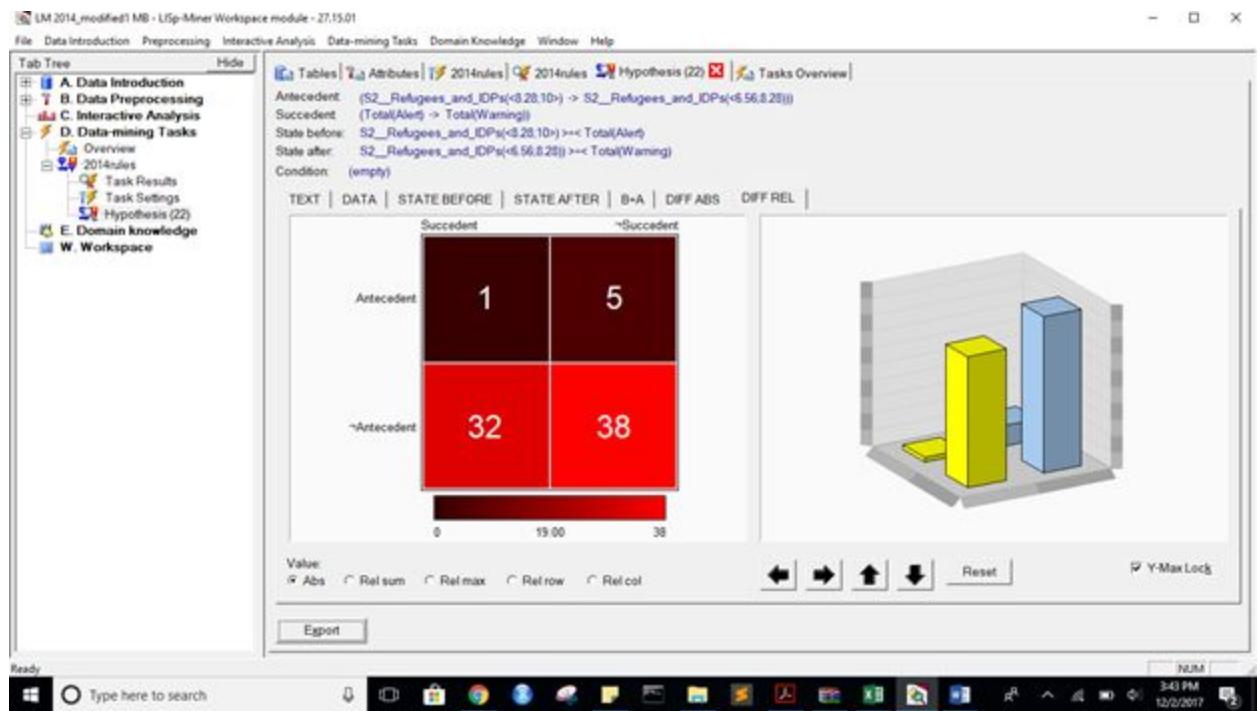
B + A :



Diff ABS :



DIFF REL :



## ACTION RULES FOR 2013 :

Alert to Warning:

$(P2\_Public\_Services(<8.18;9.9>) \rightarrow P2\_Public\_Services(<6.46;8.18))) \rightarrow \div < (Total(Alert) \rightarrow Total(Warning))$

LM 2013\_book MB - Uip-Miner Workspace module - 27.15.01

File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- E. Domain knowledge
- W. Workspace

Tables Attributes 13rules 13rules Tasks Overview

Matrix x\_2013\_book

Groups of attributes tree Attribute Used DBColumn Categories XCat Sample categories

Root group of attributes	P2_Public_Services	+ P2_Public_Services	5	<1.3.02), <3.02.4.74), <4.74.6.46), <6.46.8.16), <8.18)
decision	X1_External Intervention	+ X1_External Intervention	5	<1.3.02), <3.02.4.74), <4.74.6.46), <6.46.8.16), <8.18)
flexible				
stable				

Show Attribute Show Matrix Add attribute Del Attribute Clone Export Group detail Quick Assign Add group Del group

Ready Type here to search NUM 12:34 PM 12/2/2017

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File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
- Overview
- 13rules
- Task Results
- Task Settings
- E. Domain knowledge
- W. Workspace

Tables Attributes 13rules 13rules Tasks Overview

Data-mining Task basic parameters

Name: 13rules ID: 1

Comment: -

Taskgroup: Default group of tasks

Task type: Ac4B-Miner Data matrix: x\_2013\_book Edit

ANTECEDENT STABLE PART QUANTIFIERS SUCCESSION STABLE PART

Default Partial Credent	Con. 0 - 5	Type Ref. Value Units	Default Partial Credent	Con. 0 - 5
> d__Country (subset), 1 - 1	B. pos	a (BASE) Before >= 20.00 Abs		
		a (BASE) After >= 20.00 Abs		
Generation information				
Status: Solved, 2 run(s)				
Mode: Standard				

Total length: 0 - 5 [0 - 1]

ANTECEDENT VARIABLE PART CONDITION SUCCESSION VARIABLE PART

Default Partial Credent	Con. 1 - 5	Default Partial Credent	Con. 0 - 5	Default Partial Credent	Con. 1 - 5
> P2_Public_Services (subset), 1 - 1	B. pos			> Total(Alert > Warning)	B. pos
> X1_External Intervention (subset)	B. pos				

Total length: 0 - 5 [1 - 2] Total length: 0 Total length: 1

Task parameters

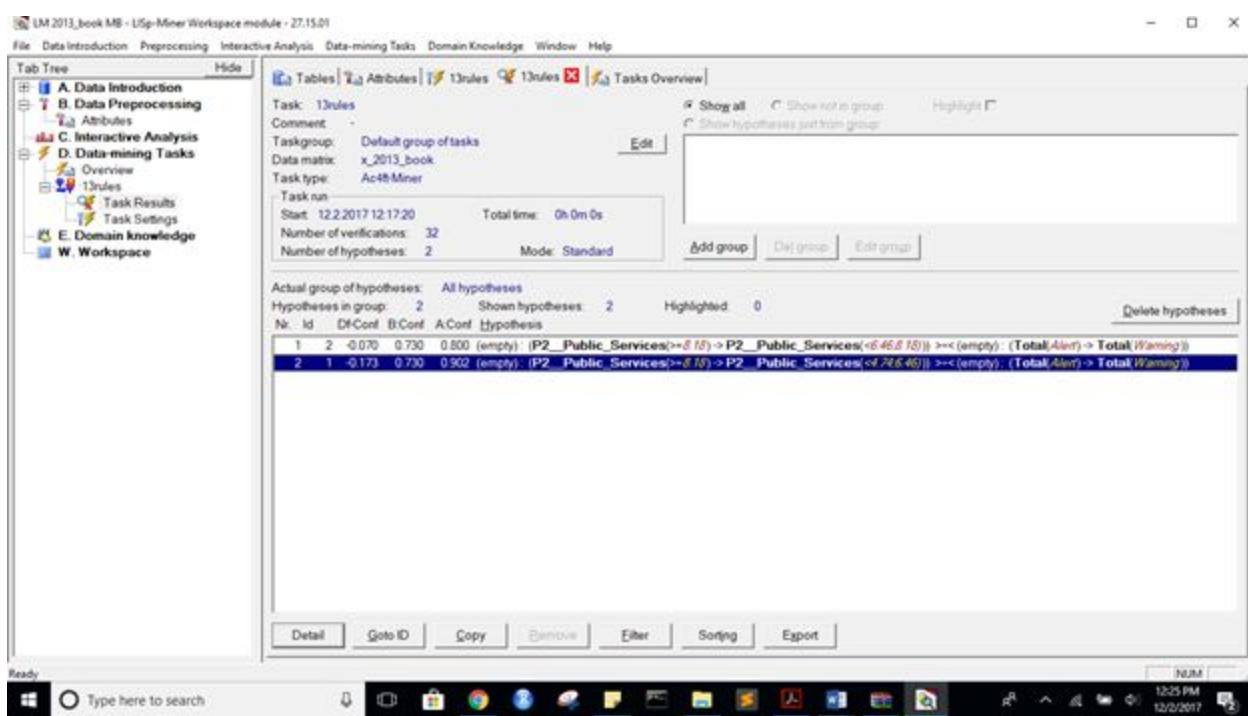
Strict action: States must be represented by the same sets of attributes which differ in coefficients only (the strict meaning of an action)

Sets overlapping: Sets must differ in all rows (i.e. not overlapping sets)

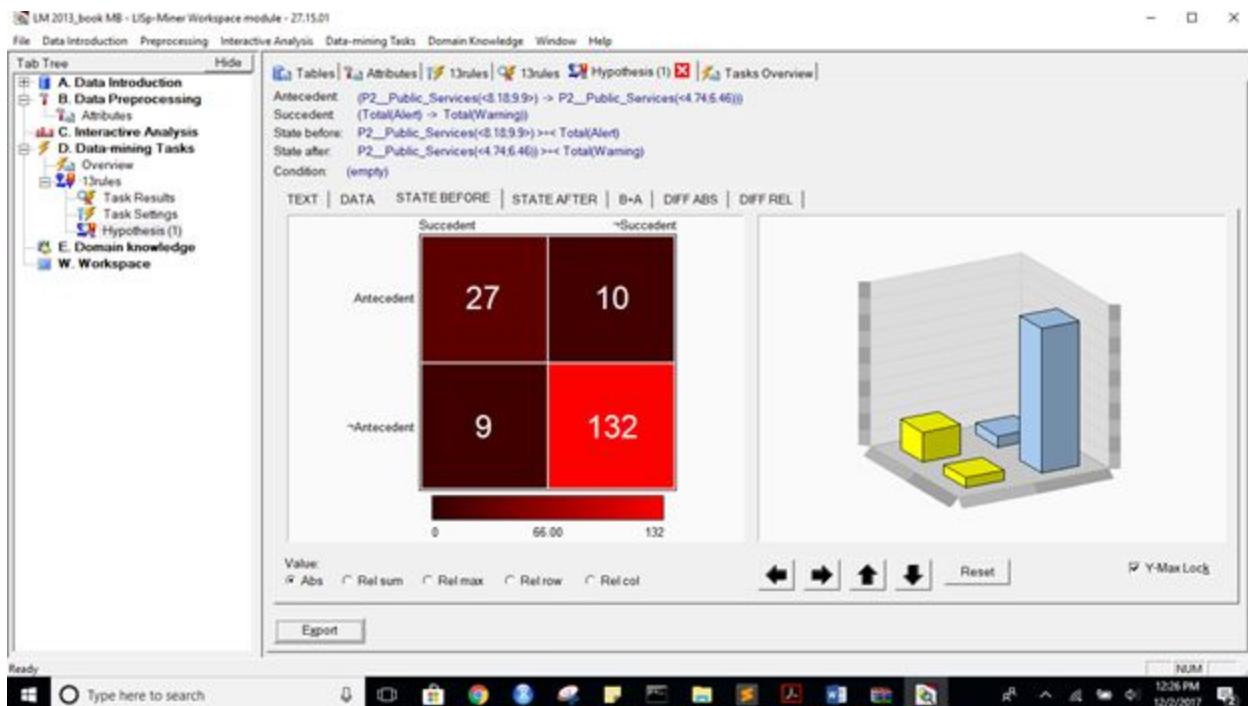
Maximal number of hypotheses: 1000

Params Sketch Validate Task Clone Run Bkgnd Run Grid Run Show Results

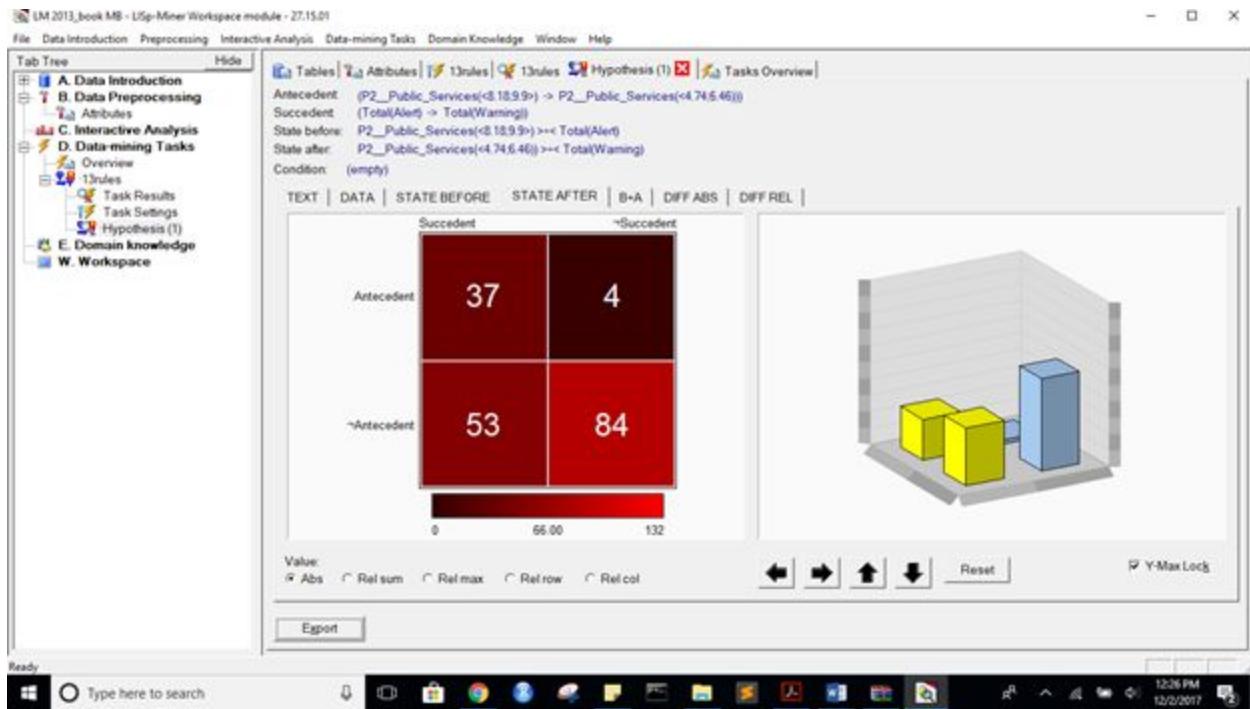
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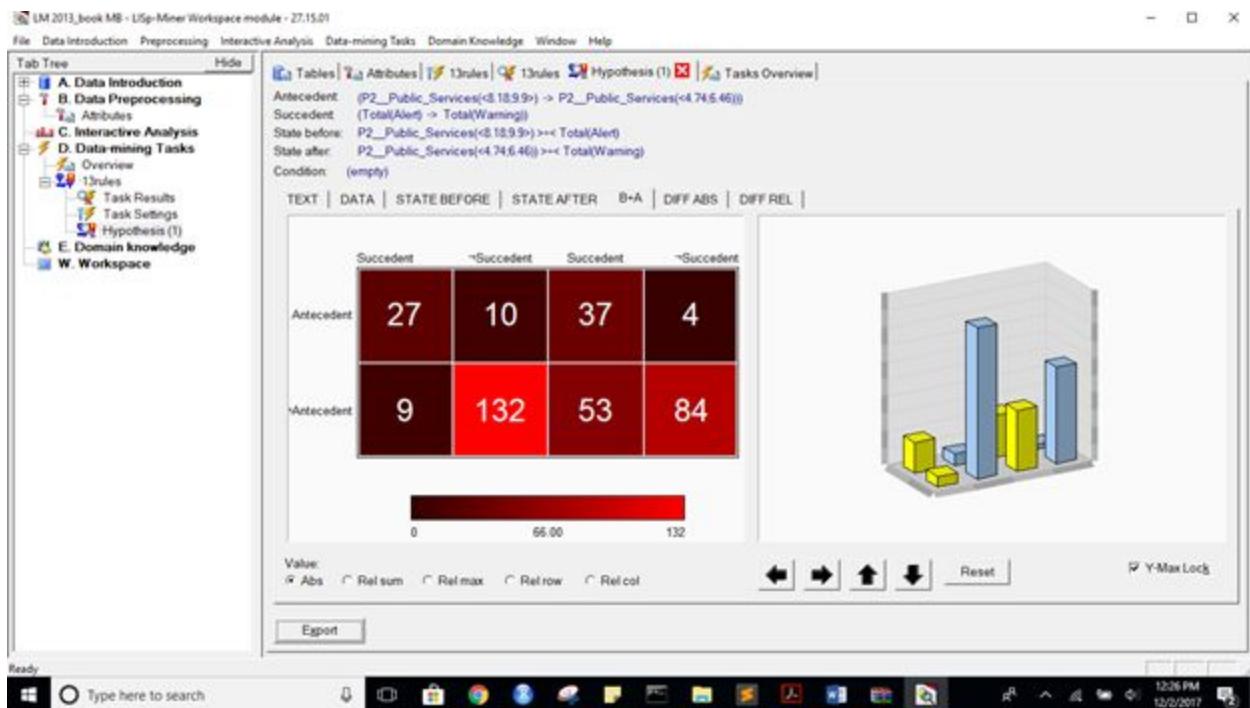
## STATE BEFORE :



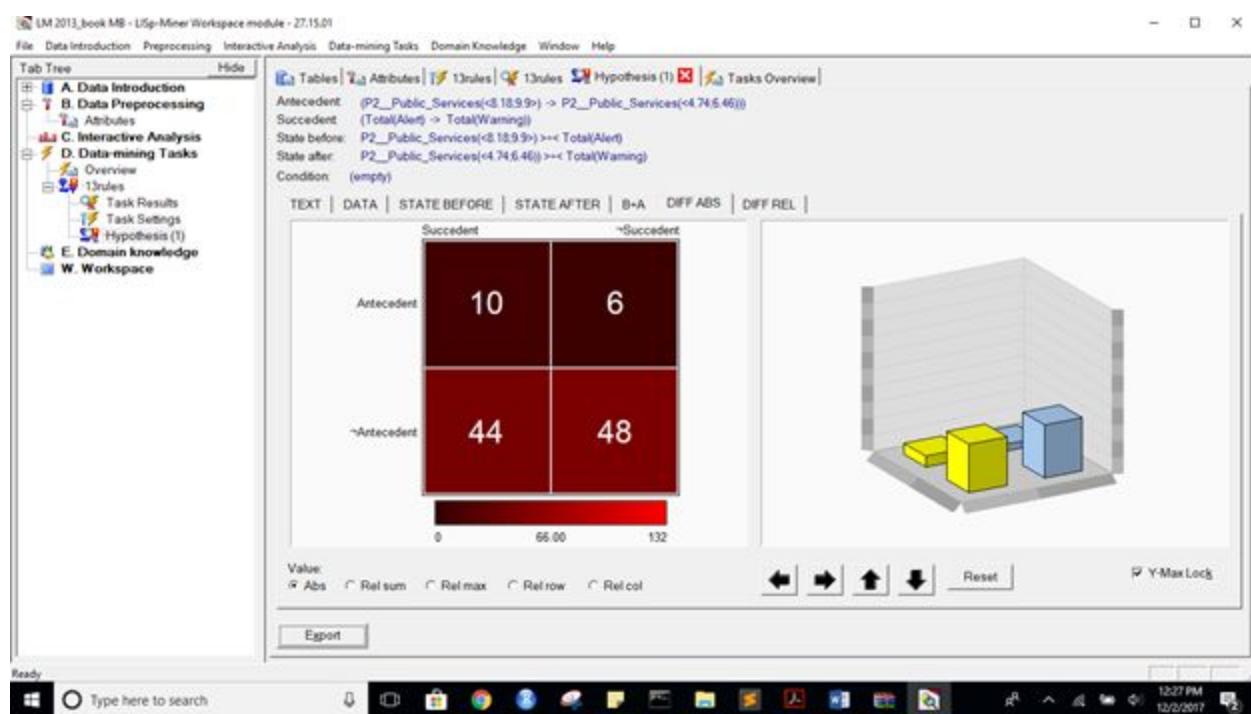
## STATE AFTER :



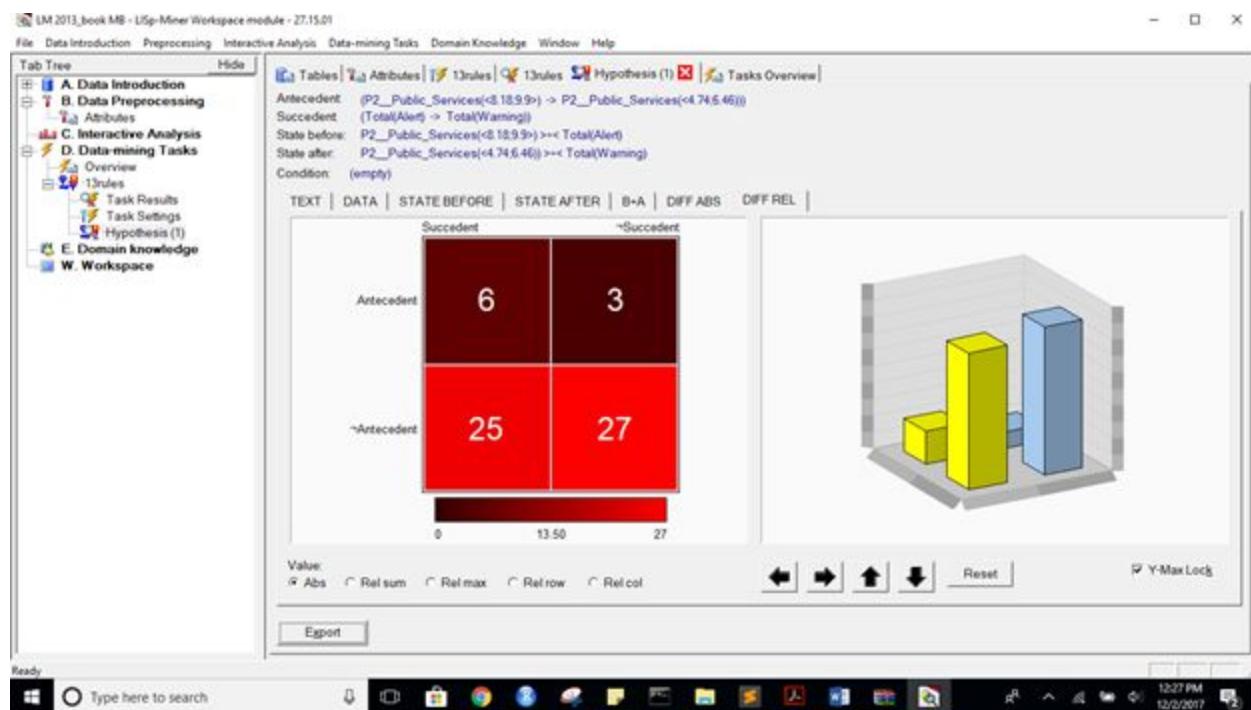
B + A :



DIFF ABS :



## DIFF REL :



## Alert to Stable with more Attributes:

$(S2\_Refugees\_and\_IDPs(<8.2;10>) \rightarrow S2\_Refugees\_and\_IDPs(<1;2.8))) \rightarrow \div \text{Total(Alert)} \rightarrow \text{Total(Stable)}$

Attribute	Used DBColumn	Categories	XCat	Sample categories
C1_Security_Apparatus	S	<1.2(0), <2.5(4), <4.6(4), <6.8(2), <8.2(10)		
C2_Factionalized_Elites	S	<1.2(0), <2.5(4), <4.6(4), <6.8(2), <8.2(10)		
C3_Group_Grievance	S	<1.2(0), <2.5(4), <4.6(4), <6.8(2), <8.2(10)		
P2_Public_Services	S	<1.3(0), <3.0(4,74), <4.7(4,46), <6.4(8,18), <8.18		
S1_Demographic_Pressures	S	<1.2(0), <2.5(4), <4.6(4), <6.8(2), <8.2(10)		
S2_Refugees_and_IDPs	S	<1.2(0), <2.5(4), <4.6(4), <6.8(2), <8.2(10)	Alert	
X1_External_Intervention	S	<1.3(0), <3.0(4,74), <4.7(4,46), <6.4(8,18), <8.18		

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File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
  - Overview
  - 13rules
  - Task Results
  - Task Settings
  - Hypothesis
  - E. Domain knowledge
  - F. Workspace

Tables Attributes 13rules 13rules Tasks Overview

Task: 13rules  
Comment: -  
Taskgroup: Default group of tasks  
Data matrix: x\_2013\_book  
Task type: Ac4B-Miner

Task run  
Start: 12.2.2017 12:30:19 Total time: 0h 0m 0s  
Number of verifications: 140 Mode: Standard  
Number of hypotheses: 2

Show all Show not in group Show hypotheses with from group Highlight

Add group Del group Edit group

Actual group of hypotheses: All hypotheses  
Hypotheses in group: 2 Shown hypotheses: 2 Highlighted: 0 Delete hypotheses

Nr.	Id	D-Conf	B-Conf	A-Conf	Hypothesis
1	2	0.341	0.920	0.579	(empty) : (S2_Refugees_and_IDPs(>=6.2)) >< (empty) : (Total[Alert] > Total[Stable])
2	1	-0.135	0.651	0.766	(empty) : (S1_Demographic_Pressures(>=6.2)) >< (empty) : (Total[Alert] > Total[Stable])

Detail Goto ID Copy Remove Filter Sorting Export

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BEFORE :

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File Data Introduction Preprocessing Interactive Analysis Data-mining Tasks Domain Knowledge Window Help

Tab Tree Hide

- A. Data Introduction
- B. Data Preprocessing
- C. Interactive Analysis
- D. Data-mining Tasks
  - Overview
  - 13rules
  - Task Results
  - Task Settings
  - Hypothesis (2)
  - E. Domain knowledge
  - F. Workspace

Tables Attributes 13rules 13rules Hypothesis (2) Tasks Overview

Antecedent: (S2\_Refugees\_and\_IDPs(<0.2.10)) > S2\_Refugees\_and\_IDPs(<1.2.8))  
Succedent: (Total[Alert] > Total[Stable])  
State before: S2\_Refugees\_and\_IDPs(<0.2.10)) >< Total[Alert]  
State after: S2\_Refugees\_and\_IDPs(<1.2.8)) >< Total[Stable]  
Condition: (empty)

TEXT | DATA STATE BEFORE STATE AFTER B-A DIFF ABS DIFF REL

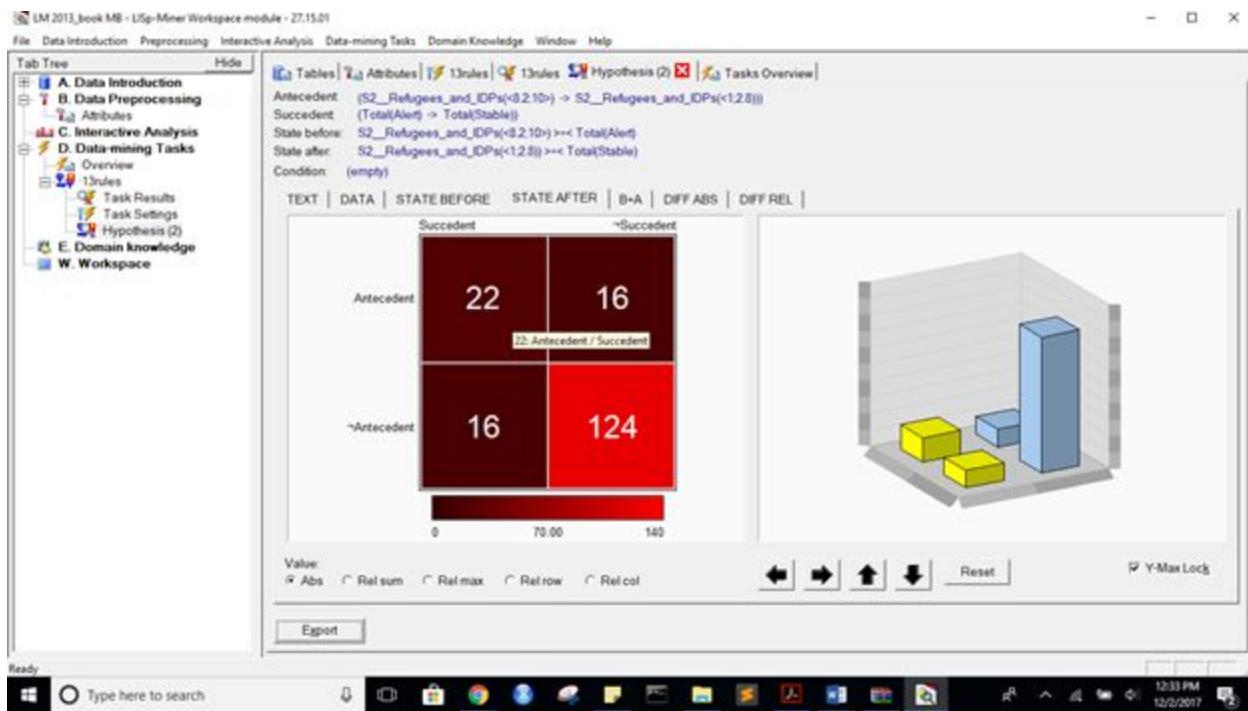
Succedent ~Succedent

	23	2	
Antecedent			
	13	140	
~Antecedent			

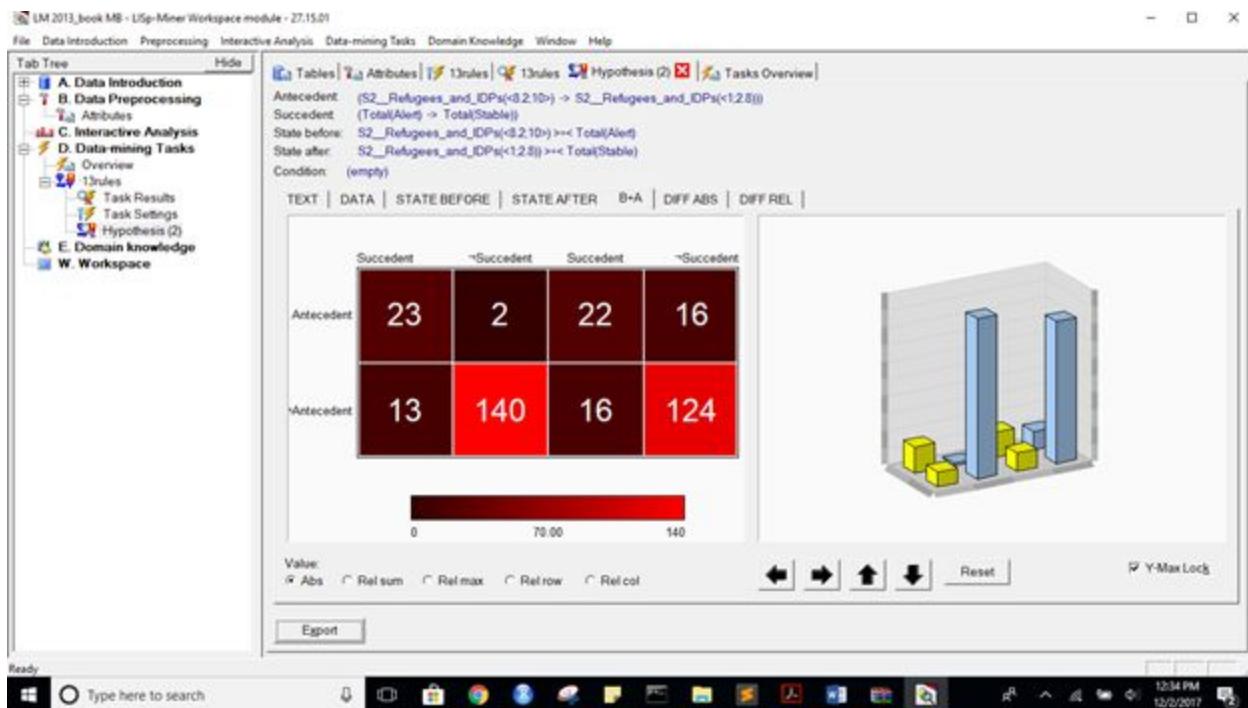
Value:  Abs  Rel sum  Rel max  Rel row  Rel col

Export 12:33 PM 12/2/2017

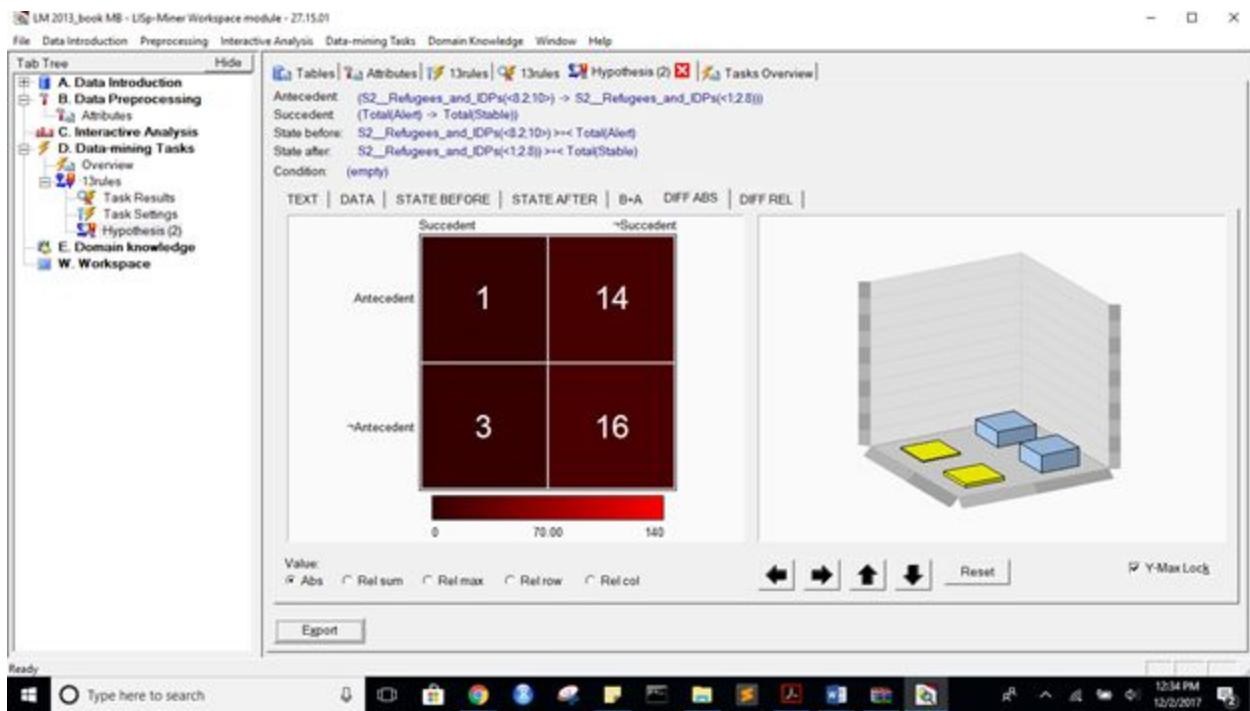
AFTER :



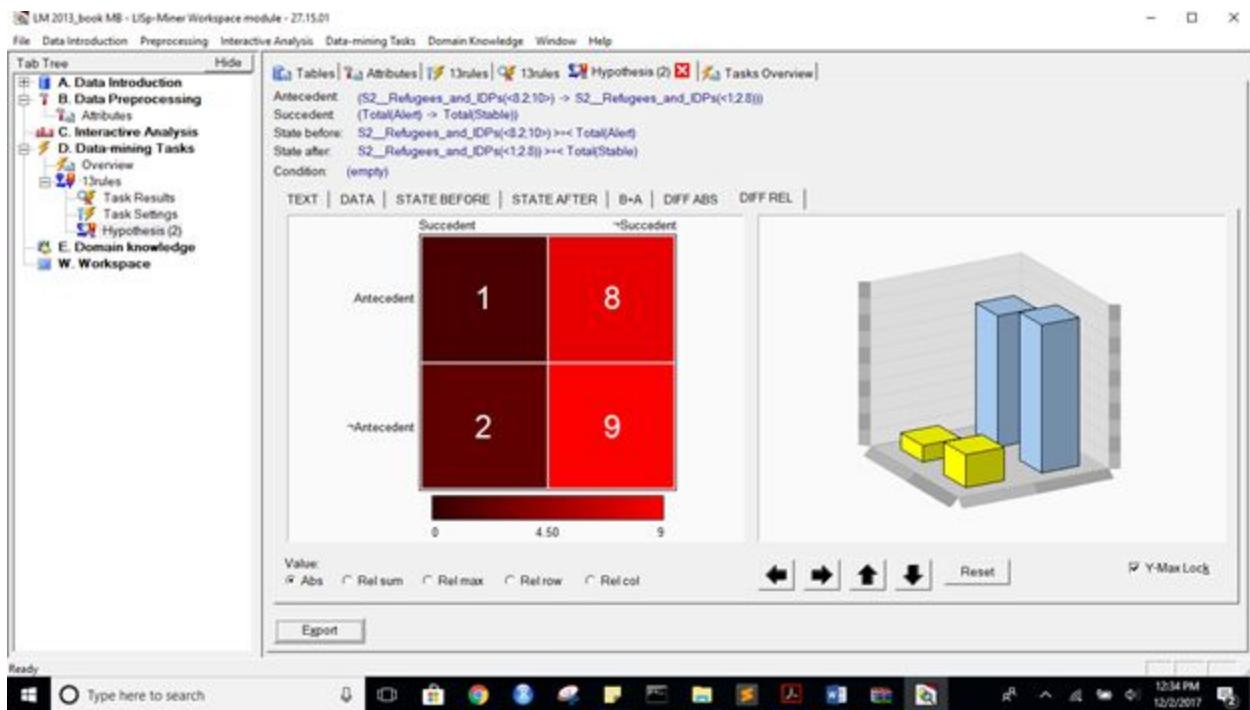
B + A :



DIFF ABS :



## DIFF REL :



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## **CONCLUSION:**

Data was collected from various sources across the web and data has been pre-processed, discretized and classification was done with the assistance of WEKA. Action Rules have been generated and analyzed using LispMiner. So, Action rules can be used as a measure to determine the condition of a country and adopting necessary preventive steps in order to improve the condition of a country.

## **References:**

- <http://weka.sourceforge.net/doc.dev/weka/classifiers/rules/JRip.html>
- <http://weka.sourceforge.net/doc.dev/weka/classifiers/bayes/BayesNet.html>
- <http://weka.sourceforge.net/doc.dev/weka/classifiers/bayes/NaiveBayes.html>
- <http://fsi.fundforpeace.org/>
- <http://fundforpeace.org/fsi/2017/05/13/fragile-states-index-and-cast-framework-methodology/>
- <http://hdr.undp.org/en>
- <https://data.worldbank.org>
- <http://databank.worldbank.org/data/home.aspx>
- <http://hdr.undp.org/en/data>