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EXECUTION STRATEGY DEVELOPMENT USING DSM AND BAYESIAN BELIEF NETWORK-VALUE TRANSFORMATION APPROACH

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ABSTRACT

Equilibrium exists when value creation and consumption rates equal each other. Identifying the creation sequence in a sophisticated system will enable us to identify its equilibrium points.

Keywords: Equilibrium, principal circuit, strategy development, axis of symmetry

1 INTRODUCTION

Identifying execution variables dependencies is necessary in managing complex projects, but is it enough to support decision making in a dynamic environment? Understanding how the execution variables, elements, interact with the environment variables is a critical part of the answer. Such understanding will ensure the made decision balances different stakeholders' requirements, gains and results in a sustainable smooth execution.

If we have a DSM contains 100 elements, DSM size 100 x 100, representing the execution of a project. At which point in the DSM should we start the execution, and which direction should we take? Do DSM's elements behave the same way through the project execution? To be able to answer these questions we need to view the DSM as a system that transform value in two processes Benefit and Cost as time progress. DSM elements go throughout these processes assuming different states.

2 DSM AS A VALUE TRANSFORMATION SYSTEM

We need to define such a system with the goal of finding the value transformation maximum and minimum points. The following steps are taken:

1. Identifying Principal Loop/Circuit of dependency. This is the longest value transformation path, i.e. value transformation is proportional with time.
2. Logic quantification: DSM is defined as a value transformation system; two random sequences are introduced to represent how DSM elements go through the Benefit and Cost processes.
3. Build state matrix, 3N x N, where logic is replaced with the elements' state.
4. Analyze the result using Bayesian Belief Network, BBN.

2.1 Identifying principal loop of dependency

Principal loop/circuit of dependency, PC, represents the longest path of a sequential dependency, value transformation. Such path represents how the value is transformed with respect to time. The algorithm used to identify the PC is available in Psm32, http://www.problematics.com

2.2 Logic quantification

DSM could be viewed as a value transformation system where elements go through two processes Benefit and Cost. To be able to represent these two processes, the DSM needs to be split into two layers, B-layer where elements give benefit and C-layer where elements receive cost. In other words DSM is a superposition of two layers B & C placed above each other.

To quantify the DSM logic we need to introduce two random sequences representing the Benefit and Cost. Such sequences could be generated using expansion and contraction mechanisms. One of the reasons these mechanisms were selected is that they work in a similar way to how we build the dependency among the DSM elements, i.e. elements' benefits move vertically away from the DSM diagonal; while their costs move horizontally towards the DSM diagonal. B-layer expands while the C-layer contracts to execute the Benefit and Cost respectively.

Imagine an element at the DSM B-layer's diagonal which is moving perpendicular to and away from it, this is expansion. Contraction, at the C-layer, is the opposite: the element is moving towards the DSM's diagonal starting from the C-layer's corners. The system and the mechanisms are shown in Figure 1. In three dimensions a DSM cell is viewed as a tube that takes a benefit from an element, in the B-layer and conveys it to another element in the C-layer. In other words value moves perpendicular to both layers inside the tube.

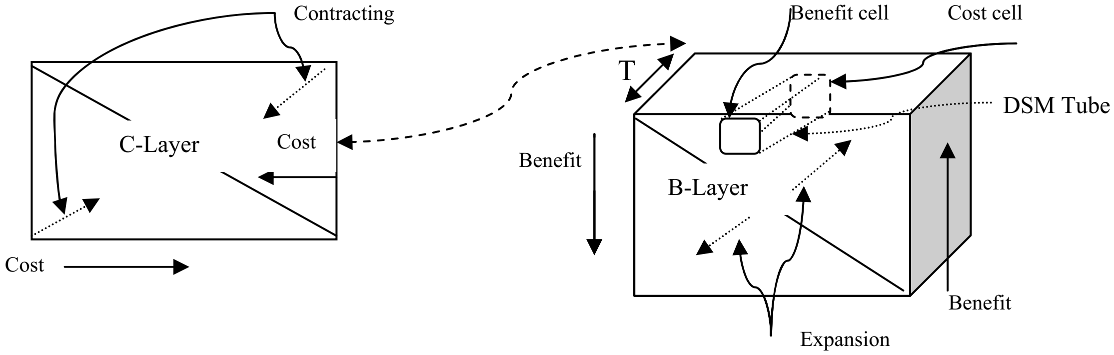

Figure 1. DSM B & C Layers with a distance T between them, Expansion and Collapsing mechanism depicted against the Cost and Benefit processes

CONp , Contraction, probability:

$CON_p = P(cf|ABCFG) = P(ABCFG|cf) * P(cf) / P(ABCFG) = 1/18$ (1)

-CON_p: Probability of a DSM tube's end at the C-layer being in Contraction.
-cf: C & F exchanging value with each other, there are always two possibilities i.e. C-F or F-C,
P (cf) value is 1/2
-P (ABCFG) : Probability of having variable A, B, C, F and G exchanging value without C exchanging value with F = 18/20
-P (ABCFG|cf): Probability of having variable A, B, C, F and G having C exchanging value directly with F = 1/10
These figures are easily obtained by counting the DSM cells satisfying the probability conditions.

Table 1. Contraction state probability

A	1/40	1/28	1/18	1/10	1/4	0
1/40	B	1/40	1/28	1/18	1/10	1/4
1/28	1/40	C	1/40	1/28	1/18	1/10
1/18	1/28	1/40	D	1/40	1/28	1/18
1/10	1/18	1/28	1/40	E	1/40	1/28
1/4	1/10	1/18	1/28	1/40	F	1/40
0	1/4	1/10	1/18	1/28	1/40	G

EX_p , Expansion, probability:

$EX_p = P(cf|CDEF) = P(CDEF|cf) * P(cf) / P(CDEF) = 1/10$ (2)

- EX_p: Probability of a DSM tube's end at the B-layer being in expansion.
-P (cf) value is 1/2 as mentioned previously
-P (CDEF): Probability of having variable C, D, E, and F exchanging value without C exchanging value directly with F = 10/12

-P (CDEF|cf): Probability of having variable A, B, C, F and G having C exchanging value directly with F = 1/6

Table 2. Expansion state probability

A	1/2	1/4	1/10	1/18	1/28	1/40
1/2	B	1/2	1/4	1/10	1/18	1/28
1/4	1/2	C	1/2	1/4	1/10	1/18
1/10	1/4	1/2	D	1/2	1/4	1/10
1/18	1/10	1/4	1/2	E	1/2	1/4
1/28	1/18	1/10	1/4	1/2	F	1/2
1/40	1/28	1/18	1/10	1/4	1/2	G

2.3 Elements state matrix

The introduced random sequences reflect two perpendicular axis of symmetry as shown in Tables 1 and 2. Geometrically they are represented as D and Z in Figure 2. Element X crosses axis D while switching from Cost to Benefit and vice versa. Axis Z was introduced to mark the end of fully forming X, i.e. creation as shown in Figure 2. Element crosses axis Z to switch from sending to receiving feedback, this process acts as a stabilizer to the entire system. For this reason Elements state will be calculated using quantum mechanics approach, i.e. represented in a complex form using the tubes' probability in Tables 1 and 2.

$Element\ State = E_s = EX_p + i\ CON_p$

-Element in Cost/Benefit: $E_s = (EX_p * CON_p)^{\wedge 2}$

-Element in C-layer and is not receiving value $E_s = CON_p^{\wedge 2}$

-Element in B-layer and is not giving value $E_s = EX_p^{\wedge 2}$

To balance the element state probability, i.e. Summation of all E_s equal one, a Creation state was added, CR. This state represents the period when the element is not in any place on the DSM. Geometrically it could be viewed as perpendicular axis to the DSM. Such axis appears when the element, at an equilibrium/starting point, trying to stabilize the system by adding or removing values, i.e. initial or intermediate conditions. Equation (3) shows the element state balance.

$$EX_p^{\wedge 2} + CON_p^{\wedge 2} + (EX_p * CON_p)^{\wedge 2} + CR = 1 \quad (3)$$

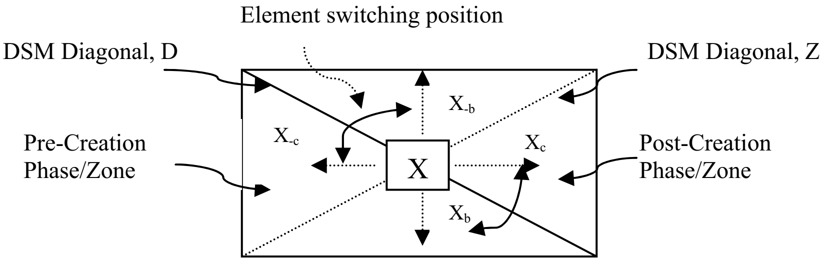

Figure 2. Element X Pre and Post Creation DSM Zones

Our interest is to study the elements before and after creation to identify their equilibrium point, at which the value created is equal to the value consumed. During our analysis we will deal with State as Value. The element state matrix, for a decision making problem is composed of 3N x N+4, while for situation analysis and strategy development is 2N x N+4. The additional 4 variables are added to represent the whole system state, the summation of the elements state matrix rows, and phase.

Part 1, N*N, Element total state across D axis of Symmetry:

$$Pre\text{-}Creation:\ E_{S\text{-}D} = X_{-b} + X_{-c} = -1*(EX_p^{\wedge 2} + CON_p^{\wedge 2}) \quad (4)$$

$$Post\text{-}Creation:\ E_{SD} = X_b + X_c = 1*(EX_p^{\wedge 2} + CON_p^{\wedge 2}) \quad (5)$$

Part 2, N*N, Element total state across Z axis of symmetry:

$$\text{Above Axis D: } E_{SZ}=X_{-b}+X_c=-1*(EX_p^{\wedge 2}+CON_p^{\wedge 2}) \quad (6)$$

$$\text{Below Axis D: } E_{S\text{-}Z}=X_b+X_{-c}=1*(EX_p^{\wedge 2}+CON_p^{\wedge 2}) \quad (7)$$

Part 3, N*N, Element CR state:

$$\text{DSM upper half (above D)} = 1*(1-(E_{SZ}+E_{S\text{-}D})) \quad (8)$$

$$\text{DSM lower half (below D)} = -1*(1-(E_{SD}+E_{S\text{-}Z})) \quad (9)$$

The above 3 matrices, for decision making problems, are stacked above each other and placed next to the system state matrix, 3N x 4. For situation analysis and strategy development problems, elements state matrix was built as a payoff matrix. Element's state was referenced to other elements' state.

2.4 Analyzing the results using Bayesian Belief Network, BBN

The tool used for the Bayesian Belief network analysis is Bayesialab 5.0.2, http://www.bayesia.com/en/products/bayesialab.php. The following is a summary of the steps performed to represent the DSM in BBN: (1) data is uploaded using the data-mining tool, (2) the discretization process performed is K-mean, (3) machine learning is applied using "Taboo" or "Sop-EQ" algorithm, and (4) clustering elements using K-means, elements are divided into classes each class is represented by a factor, e.g. F1, F2. The factor was given a title representing its effect on its class. Now we have a BBN with a minimum of 85% contingency table fit for situation analysis and strategy development applications and 80% for decision making.

3 ANALYSIS

The criterion for our analysis is to find equilibrium points, which are the keys to high value and stable execution. Equilibrium points could take one of the following shapes: minima, maxima or saddle point. Figure 3 shows the sign convention and its meaning, our reference is the point of creation which means the element starts to rotate its cost and benefit axis 180 degrees each.

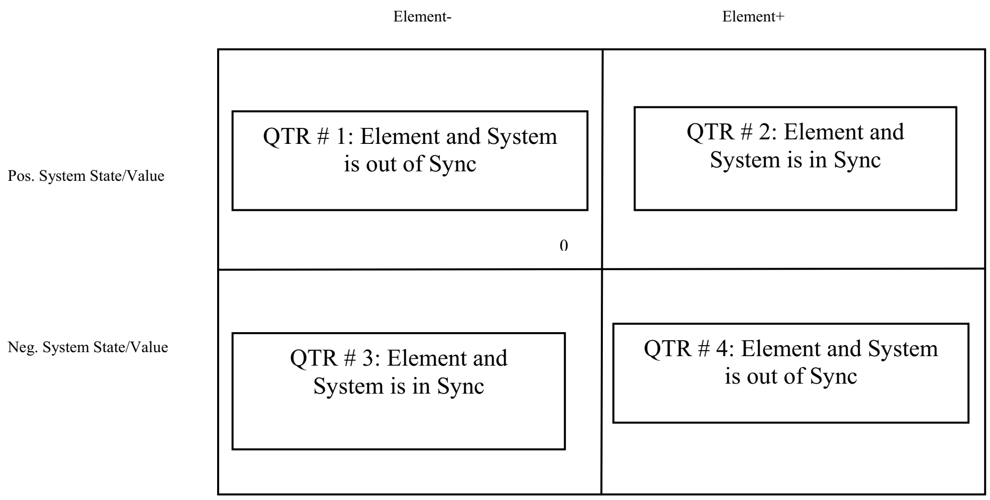

Figure 3. Element versus System State

In a Decision Making problem we need to identify the most stable alternative/s with respect to the total system state/value, which is calculated by adding the element state matrix rows. Figure 4 shows the Prisoner Dilemma as an example for decision making problem. The stable solution is F1, green curve, its slope is steeper on the left hand indicating that its minima, equilibrium, was approached from the negative side, uncertainty. This solution is perceived as a risk base alternative and to manage it, mitigate its uncertainty, a trust mechanism is required between the two prisoners in order for them not to tell on each other.

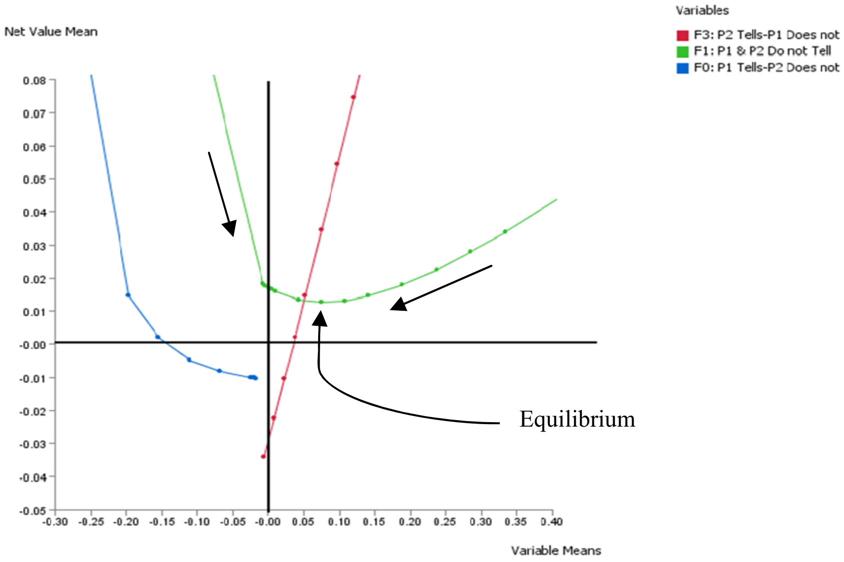

Figure 4. Dilemma decision making problem. Equilibrium solution is "F1: P1&P2 Do not Tell"

4 CONCLUSION AND RECOMMENDATION

A new approach was used to implement the DSM as a decision making tool using Bayesian Belief Network, BBN. To describe the DSM elements interaction:1-DSM was considered as a value transformation system, with two axis of symmetry and 2-two random sequences were introduced in the form of contraction and expansion mechanisms. Bayesian law was used to generate the sequences' probability. Due to DSM symmetry, elements were described in terms of a State using quantum mechanics approach. Elements state were arranged in a matrix and uploaded using data mining in BBN software, where elements were clustered in classes. Each class was represented by factor. Problems solutions were based on identifying equilibrium points in elements state versus the total system state.

DSM and BBN combined together using the proposed algorithm is a powerful tool, The DSM size used in this research was as high as 96 x 96. Using DSM alone is limited to sequencing and managing work iteration. Using BBN alone to model 96 x 96 is too costly, from computation perspective. While the results of the cases modeled in this work do not contradict reality, further research is required to verify the effect of the DSM feedback blocks, size and number, on the BBN accuracy.

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Execution Strategy Development Using DSM and Bayesian Belief Network-Value Transformation Approach

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The Needs

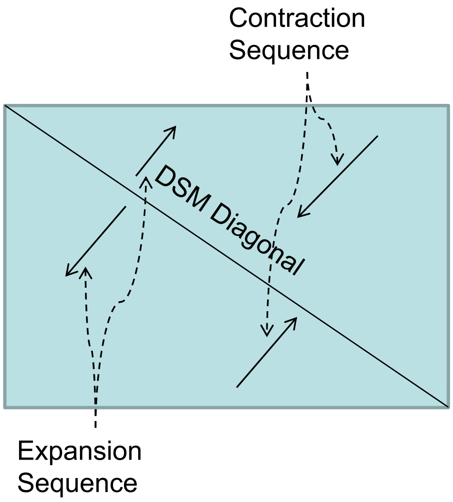
- What is our best strategy to execute projects? Do we have more than one?
- Is it possible to know risk/opportunities at early stage of the project?
- Can we trouble shoot execution problems, pinpoint the driver and make a decision to get the project back on the right track?
- **The above could be achieved if we can describe how DSM elements interact with each other.**

Our Goals and How to Achieve Them

- Logic dependency among elements is built into DSM.
- To achieve our goal we need to quantify this logic dependency.
- Then we can use artificial intelligence, AI, to identify the relation among the elements and how they interact.
- Given the way we build DSM logic, a Bayesian Belief Network, BBN, is a good base for such an AI. However we might have a problem trying to use BBN with feedback loops; i.e. changing direction W.R.T. Time.
- Now we have 2 problems to solve:
  - Feedback loop limitation in BBN.
  - Logic Quantification
- A partial solution to deal with the first problem is to arrange the elements in their longest time sequence. i.e. the principal loop of dependency, PC. The algorithm is available in Psm32, http://www.problematics.com

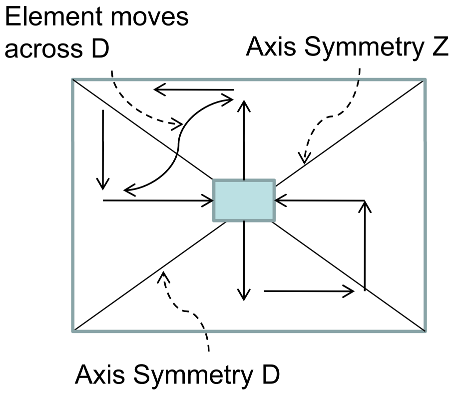
Logic Quantification

- To quantify the DSM logic two random sequences were introduced.
- These sequences need to preserve the DSM symmetry, and keep the information integrity.
- One way to think of these sequences is the probability of an element moving across the DSM in two opposite directions while the DSM is building itself, i.e. DSM size changes in the sequence probability calculation



DSM as a Value Transformation System and Its Axis of Symmetry

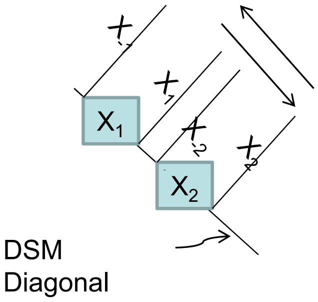
- •Our goal at this step is to apply the random sequences in a consistent way to preserve the DSM built logic.
- •To do that we need to view the DSM as a value transformation system
- •The value transformation is composed of two process Benefit and Cost, corresponds to the vertical and horizontal logic respectively.
- •Each element goes through these processes by crossing D-axis of symmetry.
- •At Z-axis of symmetry the element rotates its Benefit and Cost axis 180 degree, we call the period of this process creation.
- •The position of the element is described using a state in a complex form.
- •Our next step is to build a state matrix



Difference between Decision Making and Situation Analysis/Strategy Elements State Matrix

- In decision making our interest is finding the best solution and probably ignore the rest of the given alternatives.
- While in situation analysis/strategy our interest is finding how the elements interact with each other, i.e. the path elements take on the DSM.
- Element state matrix for decision making is composed of:
  - N x N Matrix for state across D-axis of symmetry
  - N X N Matrix for state across Z-axis of symmetry
  - N X N Matrix for CR state, it represents any other state not accounted for.
- For situation analysis we build the matrix to depict the path an element would take moving in two opposite direction:
  - N x N each column entry=X_{-i} +(X_1 + X_{-1})
  - N x N, each column entry=X_i +(X_1 + X_{-1})

Where $X_{+/-i}$ is the summation of the element post-/pre-creation state



Analysis Case # 1
Prisoner Dilemma

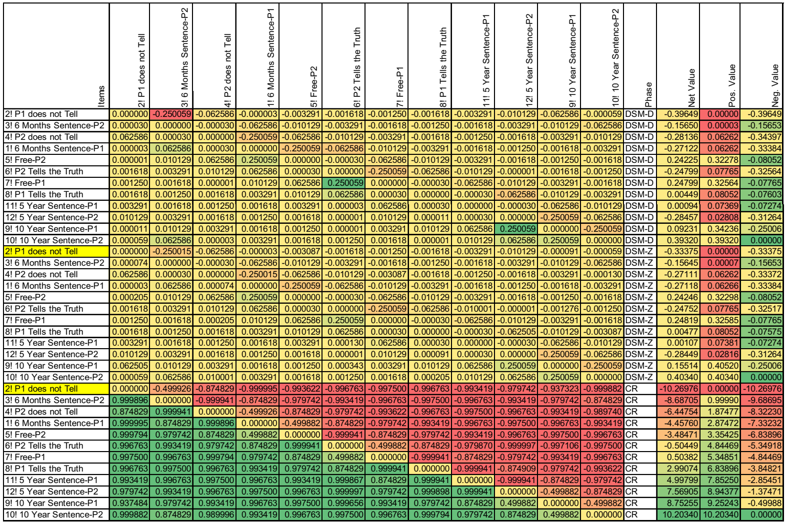
- **Elements:**
- P1 does not Tell
- 6 Months Sentence-P2
- P2 does not Tell
- 6 Months Sentence-P1
- Free-P2
- P2 Tells the Truth
- Free-P1
- P1 Tells the Truth
- 5 Year Sentence-P1
- 5 Year Sentence-P2
- 10 Year Sentence-P1
- 10 Year Sentence-P2

- Note: Zero's shown in the DSM mean logic one.

		Prisoner 2, P2	
		P2 does not tell	**P2 tells**
Prisoner 1, P1	**P1 does not tell**	Each serves 6 months	P2: goes free P1: 10 Yrs
	P1 tells	P1: goes free P2: 10 Yrs	Each serves 5 Yrs

Items	2! P1 does not Tell	3! 6 Months Sentence-P2	4! P2 does not Tell	1! 6 Months Sentence-P1	5! Free-P2	6! P2 Tells the Truth	7! Free-P1	8! P1 Tells the Truth	11! 5 Year Sentence-P1	12! 5 Year Sentence-P2	9! 10 Year Sentence-P1	10! 10 Year Sentence-P2
2! P1 does not Tell				0								
3! 6 Months Sentence-P2	0		0									
4! P2 does not Tell		0										
1! 6 Months Sentence-P1	0		0									
5! Free-P2	0					0						
6! P2 Tells the Truth					0					0		
7! Free-P1			0					0				
8! P1 Tells the Truth							0		0			
11! 5 Year Sentence-P1						0		0		0		
12! 5 Year Sentence-P2						0		0	0			
9! 10 Year Sentence-P1	0					0						
10! 10 Year Sentence-P2			0					0				

Prisoner Dilemma
Element State Matrix

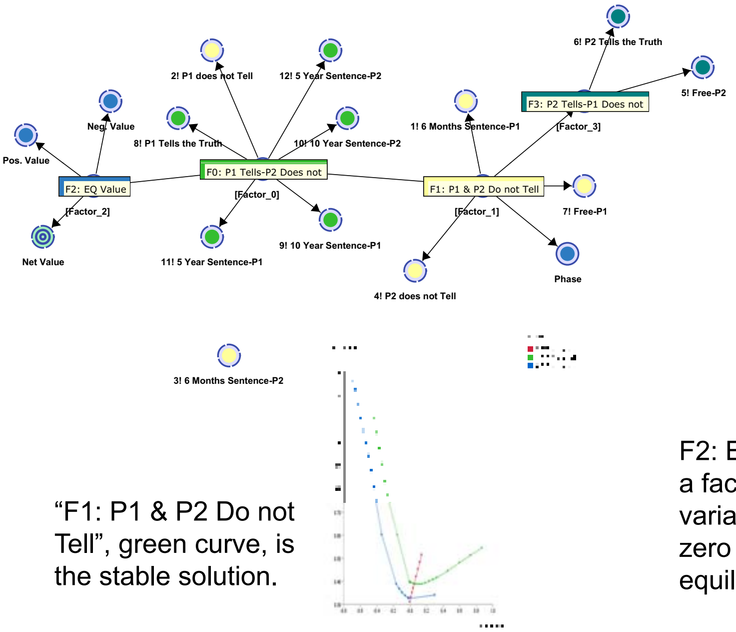


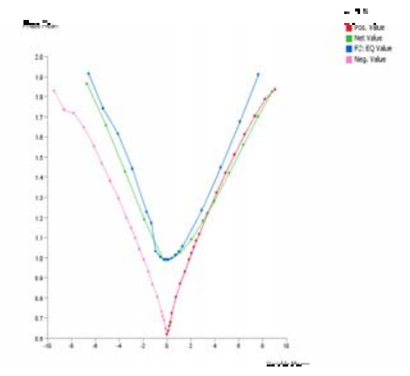
Items	2! P1 does not Tell	3! 6 Months Sentence-P2	4! P2 does not Tell	1! 6 Months Sentence-P1	5! Free-P2	6! P2 Tells the Truth	7! Free-P1	8! P1 Tells the Truth	11! 5 Year Sentence-P1	12! 5 Year Sentence-P2	9! 10 Year Sentence-P1	10! 10 Year Sentence-P2	Phase	Net Value	Pos. Value	Neg. Value
2! P1 does not Tell	0.000000	-0.250059	-0.062586	-0.000003	-0.003291	-0.001618	-0.001250	-0.001618	-0.003291	-0.010129	-0.062586	-0.000059	DSM-D	-0.39649	0.00000	-0.39649
3! 6 Months Sentence-P2	0.000030	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	-0.003291	-0.010129	-0.062586	DSM-D	-0.15650	0.00003	-0.15653
4! P2 does not Tell	0.062586	0.000030	0.000000	-0.250059	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	-0.003291	-0.010129	DSM-D	-0.28136	0.06262	-0.34397
1! 6 Months Sentence-P1	0.000003	0.062586	0.000030	0.000000	-0.250059	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	-0.003291	DSM-D	-0.27122	0.06262	-0.33384
5! Free-P2	0.000001	0.010129	0.062586	0.250059	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	DSM-D	0.24225	0.32278	-0.08052
6! P2 Tells the Truth	0.001618	0.003291	0.010129	0.062586	0.000030	0.000000	-0.250059	-0.062586	-0.010129	-0.000001	-0.001618	-0.001250	DSM-D	-0.24799	0.07765	-0.32564
7! Free-P1	0.001250	0.001618	0.000001	0.010129	0.062586	0.250059	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	-0.001618	DSM-D	0.24799	0.32564	-0.07765
8! P1 Tells the Truth	0.001618	0.001250	0.001618	0.003291	0.010129	0.062586	0.000030	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	DSM-D	0.00449	0.08052	-0.07603
11! 5 Year Sentence-P1	0.003291	0.001618	0.001250	0.001618	0.003291	0.000003	0.062586	0.000030	0.000000	-0.000030	-0.062586	-0.010129	DSM-D	0.00094	0.07369	-0.07274
12! 5 Year Sentence-P2	0.010129	0.003291	0.001618	0.001250	0.001618	0.000001	0.010129	0.000011	0.000030	0.000000	-0.250059	-0.062586	DSM-D	-0.28457	0.02808	-0.31264
9! 10 Year Sentence-P1	0.000011	0.010129	0.003291	0.001618	0.001250	0.000001	0.003291	0.010129	0.062586	0.250059	0.000000	-0.250059	DSM-D	0.09231	0.34236	-0.25006
10! 10 Year Sentence-P2	0.000059	0.062586	0.000003	0.003291	0.001618	0.001250	0.001618	0.000001	0.010129	0.062586	0.250059	0.000000	DSM-D	0.39320	0.39320	0.00000
2! P1 does not Tell	0.000000	-0.250015	-0.062586	-0.000003	-0.003087	-0.001618	-0.001250	-0.001618	-0.003291	-0.010129	-0.000091	-0.000059	DSM-Z	-0.33375	0.00000	-0.33375
3! 6 Months Sentence-P2	0.000074	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	-0.003291	-0.010129	-0.062586	DSM-Z	-0.15645	0.00007	-0.15653
4! P2 does not Tell	0.062586	0.000030	0.000000	-0.250015	-0.062586	-0.010129	-0.003087	-0.001618	-0.001250	-0.001618	-0.003291	-0.000130	DSM-Z	-0.27111	0.06262	-0.33372
1! 6 Months Sentence-P1	0.000003	0.062586	0.000074	0.000000	-0.250059	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	-0.003291	DSM-Z	-0.27118	0.06266	-0.33384
5! Free-P2	0.000205	0.010129	0.062586	0.250059	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	-0.001618	-0.001250	-0.001618	DSM-Z	0.24246	0.32298	-0.08052
6! P2 Tells the Truth	0.001618	0.003291	0.010129	0.062586	0.000030	0.000000	-0.250059	-0.062586	-0.010001	-0.000001	-0.001276	-0.001250	DSM-Z	-0.24752	0.07765	-0.32517
7! Free-P1	0.001250	0.001618	0.000205	0.010129	0.062586	0.250059	0.000000	-0.000030	-0.062586	-0.010129	-0.003291	-0.001618	DSM-Z	0.24819	0.32585	-0.07765
8! P1 Tells the Truth	0.001618	0.001250	0.001618	0.003291	0.010129	0.062586	0.000030	0.000000	-0.000030	-0.062505	-0.010129	-0.003087	DSM-Z	0.00477	0.08052	-0.07575
11! 5 Year Sentence-P1	0.003291	0.001618	0.001250	0.001618	0.003291	0.000130	0.062586	0.000030	0.000000	-0.000030	-0.062586	-0.010129	DSM-Z	0.00107	0.07381	-0.07274
12! 5 Year Sentence-P2	0.010129	0.003291	0.001618	0.001250	0.001618	0.000001	0.010129	0.000091	0.000030	0.000000	-0.250059	-0.062586	DSM-Z	-0.28449	0.02816	-0.31264
9! 10 Year Sentence-P1	0.062505	0.010129	0.003291	0.001618	0.001250	0.000343	0.003291	0.010129	0.062586	0.250059	0.000000	-0.250059	DSM-Z	0.15514	0.40520	-0.25006
10! 10 Year Sentence-P2	0.000059	0.062586	0.010001	0.003291	0.001618	0.001250	0.001618	0.000205	0.010129	0.062586	0.250059	0.000000	DSM-Z	0.40340	0.40340	0.00000
2! P1 does not Tell	0.000000	-0.499926	-0.874829	-0.999995	-0.993622	-0.996763	-0.997500	-0.996763	-0.993419	-0.979742	-0.937323	-0.999882	CR	-10.26976	0.00000	-10.26976
3! 6 Months Sentence-P2	0.999896	0.000000	-0.999941	-0.874829	-0.979742	-0.993419	-0.996763	-0.997500	-0.996763	-0.993419	-0.979742	-0.874829	CR	-8.68705	0.99990	-9.68695
4! P2 does not Tell	0.874829	0.999941	0.000000	-0.499926	-0.874829	-0.979742	-0.993622	-0.996763	-0.997500	-0.996763	-0.993419	-0.989740	CR	-6.44754	1.87477	-8.32230
1! 6 Months Sentence-P1	0.999995	0.874829	0.999896	0.000000	-0.499882	-0.874829	-0.979742	-0.993419	-0.996763	-0.997500	-0.996763	-0.993419	CR	-4.45760	2.87472	-7.33232
5! Free-P2	0.999794	0.979742	0.874829	0.499882	0.000000	-0.999941	-0.874829	-0.979742	-0.993419	-0.996763	-0.997500	-0.996763	CR	-3.48471	3.35425	-6.83896
6! P2 Tells the Truth	0.996763	0.993419	0.979742	0.874829	0.999941	0.000000	-0.499882	-0.874829	-0.979870	-0.999997	-0.997106	-0.997500	CR	-0.50449	4.84469	-5.34918
7! Free-P1	0.997500	0.996763	0.999794	0.979742	0.874829	0.499882	0.000000	-0.999941	-0.874829	-0.979742	-0.993419	-0.996763	CR	0.50382	5.34851	-4.84469
8! P1 Tells the Truth	0.996763	0.997500	0.996763	0.993419	0.979742	0.874829	0.999941	0.000000	-0.999941	-0.874909	-0.979742	-0.993622	CR	2.99074	6.83896	-3.84821
11! 5 Year Sentence-P1	0.993419	0.996763	0.997500	0.996763	0.993419	0.999867	0.874829	0.999941	0.000000	-0.999941	-0.874829	-0.979742	CR	4.99799	7.85250	-2.85451
12! 5 Year Sentence-P2	0.979742	0.993419	0.996763	0.997500	0.996763	0.999997	0.979742	0.999898	0.999941	0.000000	-0.499882	-0.874829	CR	7.56905	8.94377	-1.37471
9! 10 Year Sentence-P1	0.937484	0.979742	0.993419	0.996763	0.997500	0.999656	0.993419	0.979742	0.874829	0.499882	0.000000	-0.499882	CR	8.75255	9.25243	-0.49988
10! 10 Year Sentence-P2	0.999882	0.874829	0.989996	0.993419	0.996763	0.997500	0.996763	0.999794	0.979742	0.874829	0.499882	0.000000	CR	10.20340	10.20340	0.00000

Added variables to represent the system:

- Phase
- Net Value: summation of the elements state.
- Pos. Value: the positive component of the net value.
- Neg. Value: the Negative component of the net value.

Prisoner Dilemma
Bayesian Belief Network, BBN





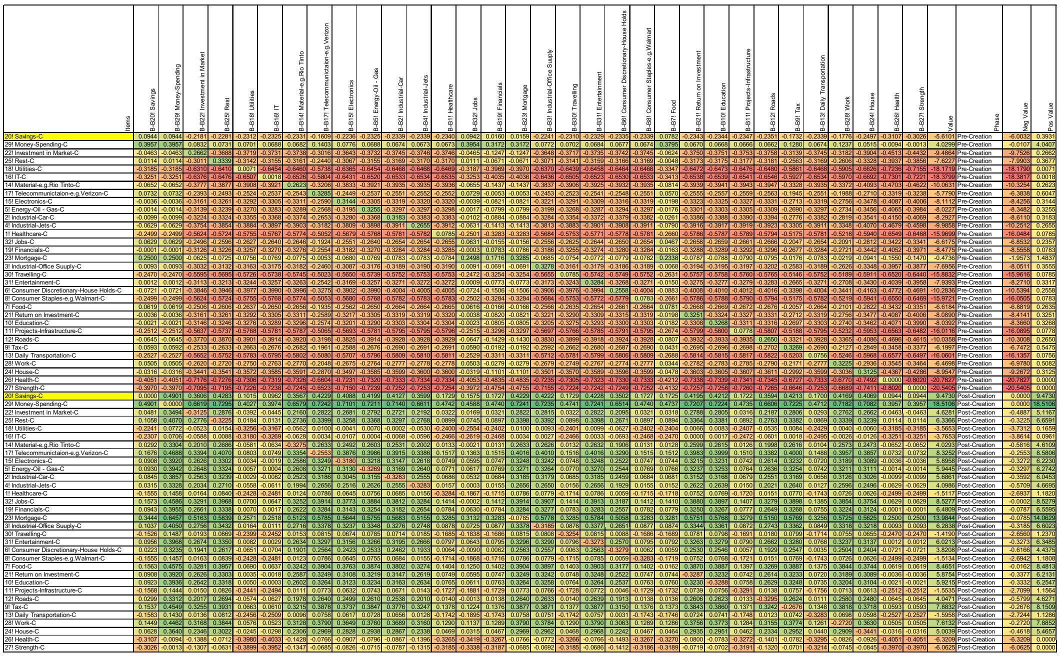
“F1: P1 & P2 Do not Tell”, green curve, is the stable solution.

F2: EQ Value, blue curve above, is a factor representing the system variables Class. When it equals zero it sets the system to equilibrium.

Analysis Case # 2
500 S&P

Items	20! Savings	29! Money-Spending	22! Investment in Market	25! Rest	18! Utilities	16! IT	14! Material-e.g.Rio Tinto	17! Telecommunictaion-e.g.Verizon	15! Electronics	5! Energy-Oil - Gas	2! Industrial-Car	4! Industrial-Jets	1! Healthcare	32! Jobs	19! Financials	23! Mortgage	3! Industrial-Office Suuply	30! Travelling	31! Entertainment	6! Consumer Discretionary-House Holds	8! Consumer Staples-e.g.Walmart	7! Food	21! Return on Investment	10! Education	11! Projects-Infrastructure	12! Roads	9! Tax	13! Daily Transportation	28! Work	24! House	26! Health	27! Strength
20! Savings		0																					0									
29! Money-Spending	0																												0			
22! Investment in Market	0																															
25! Rest																														0		
18! Utilities		0	0					0		0				0																		
16! IT			0		0			0	0					0																		
14! Material-e.g.Rio Tinto			0		0	0								0																		
17! Telecommunictaion-e.g.Verizon			0		0	0								0																		
15! Electronics			0			0	0							0																		
5! Energy-Oil - Gas			0		0	0								0																		
2! Industrial-Car			0			0	0							0																		
4! Industrial-Jets			0			0	0		0					0																		
1! Healthcare					0	0			0					0																		
32! Jobs					0	0	0	0	0	0	0	0	0		0		0	0	0	0	0				0							
19! Financials			0		0	0								0		0																
23! Mortgage		0													0																	
3! Industrial-Office Suuply			0		0	0								0																		
30! Travelling		0				0				0	0	0		0																		
31! Entertainment		0			0				0					0				0														
6! Consumer Discretionary-House Holds			0		0	0			0					0								0										
8! Consumer Staples-e.g.Walmart			0		0	0								0								0										
7! Food		0																		0	0											
21! Return on Investment					0	0	0	0	0	0	0	0	0		0		0			0		0										
10! Education		0				0																						0				
11! Projects-Infrastructure						0								0													0					
12! Roads																									0							
9! Tax																							0						0			
13! Daily Transportation										0	0															0						
28! Work														0			0							0				0				0
24! House					0											0				0												
26! Health				0	0								0									0										
27! Strength																						0									0	

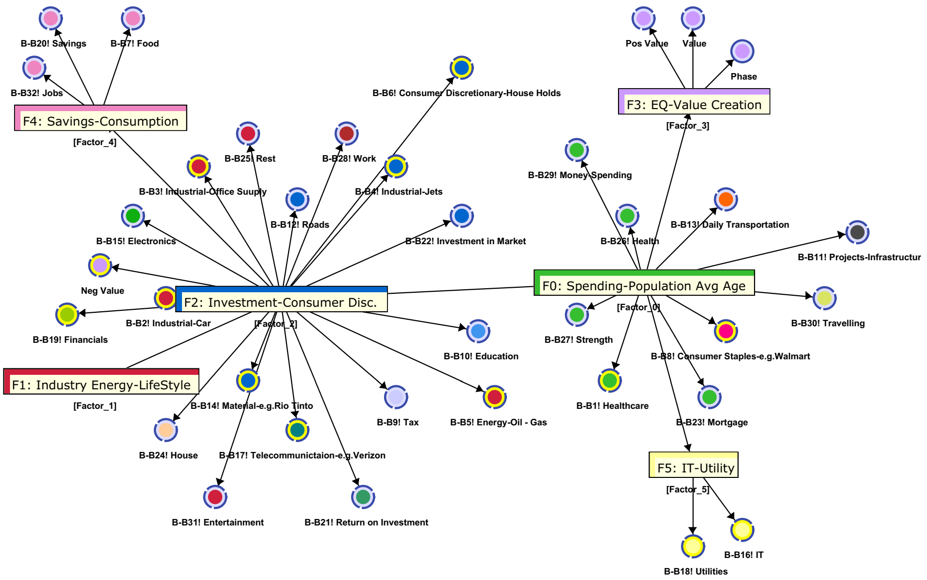
500 S&P
Element State Matrix



Items	B-B20! Savings	B-B29! Money-Spending	B-B22! Investment in Market	B-B25! Rest	B-B18! Utilities	B-B16! IT	B-B14! Material-e.g.Rio Tinto	B-B17! Telecommunictaion-e.g.Verizon	B-B15! Electronics	B-B5! Energy-Oil - Gas	B-B2! Industrial-Car	B-B4! Industrial-Jets	B-B1! Healthcare	B-B32! Jobs	B-B19! Financials	B-B23! Mortgage	B-B3! Industrial-Office Suuply	B-B30! Travelling	B-B31! Entertainment	B-B6! Consumer Discretionary-House Holds	B-B8! Consumer Staples-e.g.Walmart	B-B7! Food	B-B21! Return on Investment	B-B10! Education	B-B11! Projects-Infrastructure	B-B12! Roads	B-B9! Tax	B-B13! Daily Transportation	B-B28! Work	B-B24! House	B-B26! Health	B-B27! Strength	Value	Phase	Neg Value	Pos Value
20! Savings-C	0.0944	0.0944	-0.2181	-0.2281	-0.2312	-0.2325	-0.2331	-0.1609	-0.2236	-0.2325	-0.2339	-0.2339	-0.2340	0.0942	0.0160	0.0159	-0.2241	-0.2310	-0.2329	-0.2335	-0.2339	0.0782	-0.2343	-0.2344	-0.2347	-0.2351	-0.1732	-0.2339	-0.1776	-0.2497	-0.3107	-0.3026	-5.6101	Pre-Creation	-6.0032	0.3931
29! Money-Spending-C	0.3957	0.3957	0.0832	0.0731	0.0701	0.0688	0.0682	0.1403	0.0776	0.0688	0.0674	0.0673	0.0673	0.3954	0.3172	0.3172	0.0772	0.0702	0.0684	0.0677	0.0674	0.3795	0.0670	0.0668	0.0666	0.0662	0.1280	0.0674	0.1237	0.0515	-0.0094	-0.0013	4.0299	Pre-Creation	-0.0107	4.0407
22! Investment in Market-C	-0.0463	-0.0463	0.2662	-0.3688	-0.3719	-0.3731	-0.3738	-0.3016	-0.3643	-0.3732	-0.3745	-0.3746	-0.3746	-0.0465	-0.1247	-0.1247	-0.3648	-0.3717	-0.3735	-0.3742	-0.3745	-0.0624	-0.3750	-0.3751	-0.3753	-0.3758	-0.3139	-0.3745	-0.3182	-0.3904	-0.4513	-0.4432	-9.4864	Pre-Creation	-9.7526	0.2662
25! Rest-C	0.0114	0.0114	-0.3011	0.3339	-0.3142	-0.3155	-0.3161	-0.2440	-0.3067	-0.3155	-0.3169	-0.3170	-0.3170	0.0111	-0.0671	-0.0671	-0.3071	-0.3141	-0.3159	-0.3166	-0.3169	-0.0048	-0.3173	-0.3175	-0.3177	-0.3181	-0.2563	-0.3169	-0.2606	-0.3328	-0.3937	-0.3856	-7.6227	Pre-Creation	-7.9903	0.3677
18! Utilities-C	-0.3185	-0.3185	-0.6310	-0.6410	0.0071	-0.6454	-0.6460	-0.5738	-0.6365	-0.6454	-0.6468	-0.6468	-0.6469	-0.3187	-0.3969	-0.3970	-0.6370	-0.6439	-0.6458	-0.6464	-0.6468	-0.3347	-0.6472	-0.6473	-0.6476	-0.6480	-0.5861	-0.6468	-0.5905	-0.6626	-0.7236	-0.7155	-18.1719	Pre-Creation	-18.1790	0.0071
16! IT-C	-0.3251	-0.3251	-0.6376	-0.6476	-0.6507	0.0018	-0.6526	-0.5804	-0.6431	-0.6520	-0.6533	-0.6534	-0.6535	-0.3253	-0.4035	-0.4036	-0.6436	-0.6505	-0.6523	-0.6530	-0.6533	-0.3413	-0.6538	-0.6539	-0.6541	-0.6546	-0.5927	-0.6534	-0.5970	-0.6692	-0.7301	-0.7221	-18.3799	Pre-Creation	-18.3817	0.0018
14! Material-e.g.Rio Tinto-C	-0.0652	-0.0652	-0.3777	-0.3877	-0.3908	-0.3921	0.2623	-0.3206	-0.3833	-0.3921	-0.3935	-0.3935	-0.3936	-0.0655	-0.1437	-0.1437	-0.3837	-0.3906	-0.3925	-0.3932	-0.3935	-0.0814	-0.3939	-0.3941	-0.3943	-0.3947	-0.3328	-0.3935	-0.3372	-0.4093	-0.4703	-0.4622	-10.0631	Pre-Creation	-10.3254	0.2623
17! Telecommunictaion-e.g.Verizon-C	0.0732	0.0732	-0.2393	-0.2493	-0.2524	-0.2537	-0.2543	0.3285	-0.2449	-0.2537	-0.2551	-0.2552	-0.2552	0.0729	-0.0053	-0.0053	-0.2453	-0.2523	-0.2541	-0.2548	-0.2551	0.0570	-0.2555	-0.2557	-0.2559	-0.2563	-0.1945	-0.2551	-0.1988	-0.2710	-0.3319	-0.3238	-5.7790	Pre-Creation	-6.3838	0.6047
15! Electronics-C	-0.0036	-0.0036	-0.3161	-0.3261	-0.3292	-0.3305	-0.3311	-0.2590	0.3144	-0.3305	-0.3319	-0.3320	-0.3320	-0.0039	-0.0821	-0.0821	-0.3221	-0.3291	-0.3309	-0.3316	-0.3319	-0.0198	-0.3323	-0.3325	-0.3327	-0.3331	-0.2713	-0.3319	-0.2756	-0.3478	-0.4087	-0.4006	-8.1112	Pre-Creation	-8.4256	0.3144
5! Energy-Oil - Gas-C	-0.0014	-0.0014	-0.3139	-0.3239	-0.3270	-0.3283	-0.3289	-0.2568	-0.3195	0.3255	-0.3297	-0.3297	-0.3298	-0.0017	-0.0799	-0.0799	-0.3199	-0.3268	-0.3287	-0.3294	-0.3297	-0.0176	-0.3301	-0.3303	-0.3305	-0.3309	-0.2690	-0.3297	-0.2734	-0.3456	-0.4065	-0.3984	-8.0227	Pre-Creation	-8.3482	0.3255
2! Industrial-Car-C	-0.0099	-0.0099	-0.3224	-0.3324	-0.3355	-0.3368	-0.3374	-0.2653	-0.3280	-0.3368	0.3183	-0.3383	-0.3383	-0.0102	-0.0884	-0.0884	-0.3284	-0.3354	-0.3372	-0.3379	-0.3382	-0.0261	-0.3386	-0.3388	-0.3390	-0.3394	-0.2776	-0.3382	-0.2819	-0.3541	-0.4150	-0.4069	-8.2927	Pre-Creation	-8.6110	0.3183
4! Industrial-Jets-C	-0.0629	-0.0629	-0.3754	-0.3854	-0.3884	-0.3897	-0.3903	-0.3182	-0.3809	-0.3898	-0.3911	0.2655	-0.3912	-0.0631	-0.1413	-0.1413	-0.3813	-0.3883	-0.3901	-0.3908	-0.3911	-0.0790	-0.3916	-0.3917	-0.3919	-0.3923	-0.3305	-0.3911	-0.3348	-0.4070	-0.4679	-0.4598	-9.9858	Pre-Creation	-10.2512	0.2655
1! Healthcare-C	-0.2499	-0.2499	-0.5624	-0.5724	-0.5755	-0.5767	-0.5774	-0.5052	-0.5679	-0.5768	-0.5781	-0.5782	0.0785	-0.2501	-0.3283	-0.3283	-0.5684	-0.5753	-0.5771	-0.5778	-0.5781	-0.2660	-0.5786	-0.5787	-0.5789	-0.5794	-0.5175	-0.5781	-0.5218	-0.5940	-0.6549	-0.6468	-15.9699	Pre-Creation	-16.0484	0.0785
32! Jobs-C	0.0629	0.0629	-0.2496	-0.2596	-0.2627	-0.2640	-0.2646	-0.1924	-0.2551	-0.2640	-0.2654	-0.2654	-0.2655	0.0631	-0.0155	-0.0156	-0.2556	-0.2625	-0.2644	-0.2650	-0.2654	0.0467	-0.2658	-0.2659	-0.2661	-0.2666	-0.2047	-0.2654	-0.2091	-0.2812	-0.3422	-0.3341	-6.6175	Pre-Creation	-6.8532	0.2357
19! Financials-C	-0.0001	-0.0001	-0.3126	-0.3226	-0.3257	-0.3270	-0.3276	-0.2554	-0.3182	-0.3270	-0.3284	-0.3284	-0.3285	-0.0003	0.0783	-0.0786	-0.3186	-0.3255	-0.3274	-0.3280	-0.3284	-0.0163	-0.3288	-0.3289	-0.3292	-0.3296	-0.2677	-0.3284	-0.2721	-0.3442	-0.4052	-0.3971	-8.4775	Pre-Creation	-8.5558	0.0783
23! Mortgage-C	0.2500	0.2500	-0.0625	-0.0725	-0.0756	-0.0769	-0.0775	-0.0053	-0.0680	-0.0769	-0.0783	-0.0783	-0.0784	0.2498	0.1716	0.3285	-0.0685	-0.0754	-0.0772	-0.0779	-0.0782	0.2338	-0.0787	-0.0788	-0.0790	-0.0795	-0.0176	-0.0783	-0.0219	-0.0941	-0.1550	-0.1470	-0.4736	Pre-Creation	-1.9573	1.4837
3! Industrial-Office Suuply-C	0.0093	0.0093	-0.3032	-0.3132	-0.3163	-0.3175	-0.3182	-0.2460	-0.3087	-0.3176	-0.3189	-0.3190	-0.3190	0.0091	-0.0691	-0.0691	0.3278	-0.3161	-0.3179	-0.3186	-0.3189	-0.0068	-0.3194	-0.3195	-0.3197	-0.3202	-0.2583	-0.3189	-0.2626	-0.3348	-0.3957	-0.3877	-7.6956	Pre-Creation	-8.0511	0.3555
30! Travelling-C	-0.2470	-0.2470	-0.5595	-0.5695	-0.5726	-0.5738	-0.5745	-0.5023	-0.5650	-0.5739	-0.5752	-0.5753	-0.5753	-0.2472	-0.3254	-0.3254	-0.5655	0.0785	-0.5742	-0.5749	-0.5752	-0.2631	-0.5757	-0.5758	-0.5760	-0.5765	-0.5146	-0.5752	-0.5189	-0.5911	-0.6520	-0.6440	-15.8832	Pre-Creation	-15.9616	0.0785
31! Entertainment-C	0.0012	0.0012	-0.3113	-0.3213	-0.3244	-0.3257	-0.3263	-0.2542	-0.3169	-0.3257	-0.3271	-0.3272	-0.3272	0.0009	-0.0773	-0.0773	-0.3173	-0.3243	0.3284	-0.3268	-0.3271	-0.0150	-0.3275	-0.3277	-0.3279	-0.3283	-0.2665	-0.3271	-0.2708	-0.3430	-0.4039	-0.3958	-7.9393	Pre-Creation	-8.2710	0.3317
6! Consumer Discretionary-House Holds-C	-0.0721	-0.0721	-0.3846	-0.3946	-0.3977	-0.3990	-0.3996	-0.3275	-0.3902	-0.3990	-0.4004	-0.4005	-0.4005	-0.0724	-0.1506	-0.1506	-0.3906	-0.3976	-0.3994	0.2558	-0.4004	-0.0883	-0.4008	-0.4010	-0.4012	-0.4016	-0.3398	-0.4004	-0.3441	-0.4163	-0.4772	-0.4691	-10.2836	Pre-Creation	-10.5394	0.2558
8! Consumer Staples-e.g.Walmart-C	-0.2499	-0.2499	-0.5624	-0.5724	-0.5755	-0.5768	-0.5774	-0.5053	-0.5680	-0.5768	-0.5782	-0.5783	-0.5783	-0.2502	-0.3284	-0.3284	-0.5684	-0.5753	-0.5772	-0.5779	0.0783	-0.2661	-0.5786	-0.5788	-0.5790	-0.5794	-0.5175	-0.5782	-0.5219	-0.5941	-0.6550	-0.6469	-15.9721	Pre-Creation	-16.0505	0.0783
7! Food-C	0.0619	0.0619	-0.2506	-0.2606	-0.2637	-0.2650	-0.2656	-0.1935	-0.2562	-0.2650	-0.2664	-0.2664	-0.2665	0.0616	-0.0166	-0.0166	-0.2566	-0.2635	-0.2654	-0.2661	-0.2664	0.0781	-0.2668	-0.2669	-0.2672	-0.2676	-0.2057	-0.2664	-0.2101	-0.2822	-0.3432	-0.3351	-6.6184	Pre-Creation	-6.8819	0.2635
21! Return on Investment-C	-0.0036	-0.0036	-0.3161	-0.3261	-0.3292	-0.3305	-0.3311	-0.2589	-0.3217	-0.3305	-0.3319	-0.3319	-0.3320	-0.0038	-0.0820	-0.0821	-0.3221	-0.3290	-0.3309	-0.3315	-0.3319	-0.0198	0.3251	-0.3324	-0.3327	-0.3331	-0.2712	-0.3319	-0.2756	-0.3477	-0.4087	-0.4006	-8.0890	Pre-Creation	-8.4141	0.3251
10! Education-C	-0.0021	-0.0021	-0.3146	-0.3246	-0.3276	-0.3289	-0.3296	-0.2574	-0.3201	-0.3290	-0.3303	-0.3304	-0.3304	-0.0023	-0.0805	-0.0805	-0.3205	-0.3275	-0.3293	-0.3300	-0.3303	-0.0182	-0.3308	0.3268	-0.3311	-0.3316	-0.2697	-0.3303	-0.2740	-0.3462	-0.4071	-0.3990	-8.0392	Pre-Creation	-8.3660	0.3268
11! Projects-Infrastructure-C	-0.2512	-0.2512	-0.5637	-0.5737	-0.5768	-0.5781	-0.5787	-0.5065	-0.5693	-0.5781	-0.5795	-0.5795	-0.5796	-0.2515	-0.3296	-0.3297	-0.5697	-0.5766	-0.5785	-0.5791	-0.5795	-0.2674	-0.5799	-0.5800	0.0778	-0.5807	-0.5188	-0.5795	-0.5232	-0.5953	-0.6563	-0.6482	-16.0116	Pre-Creation	-16.0895	0.0778
12! Roads-C	-0.0645	-0.0645	-0.3770	-0.3870	-0.3901	-0.3914	-0.3920	-0.3198	-0.3825	-0.3914	-0.3928	-0.3928	-0.3929	-0.0647	-0.1429	-0.1430	-0.3830	-0.3899	-0.3918	-0.3924	-0.3928	-0.0807	-0.3932	-0.3933	-0.3935	0.2650	-0.3321	-0.3928	-0.3365	-0.4086	-0.4696	-0.4615	-10.0358	Pre-Creation	-10.3008	0.2650
9! Tax-C	0.0593	0.0592	-0.2533	-0.2633	-0.2663	-0.2676	-0.2682	-0.1961	-0.2588	-0.2676	-0.2690	-0.2691	-0.2691	0.0590	-0.0192	-0.0192	-0.2592	-0.2662	-0.2680	-0.2687	-0.2690	0.0431	-0.2695	-0.2696	-0.2698	-0.2702	0.3269	-0.2690	-0.2127	-0.2849	-0.3458	-0.3377	-6.1997	Pre-Creation	-6.7472	0.5475
13! Daily Transportation-C	-0.2527	-0.2527	-0.5652	-0.5752	-0.5783	-0.5795	-0.5802	-0.5080	-0.5707	-0.5796	-0.5809	-0.5810	-0.5811	-0.2529	-0.3311	-0.3311	-0.5712	-0.5781	-0.5799	-0.5806	-0.5809	-0.2688	-0.5814	-0.5815	-0.5817	-0.5822	-0.5203	0.0756	-0.5246	-0.5968	-0.6577	-0.6497	-16.0601	Pre-Creation	-16.1357	0.0756
28! Work-C	0.0505	0.0505	-0.2620	-0.2720	-0.2750	-0.2763	-0.2770	-0.2048	-0.2675	-0.2764	-0.2777	-0.2778	-0.2778	0.0503	-0.0279	-0.0279	-0.2679	-0.2749	-0.2767	-0.2774	-0.2777	0.0344	-0.2782	-0.2783	-0.2785	-0.2790	-0.2171	-0.2777	0.3225	-0.2936	-0.3545	-0.3464	-6.4698	Pre-Creation	-6.9780	0.5082
24! House-C	-0.0316	-0.0316	-0.3441	-0.3541	-0.3572	-0.3585	-0.3591	-0.2870	-0.3497	-0.3585	-0.3599	-0.3600	-0.3600	-0.0319	-0.1101	-0.1101	-0.3501	-0.3570	-0.3589	-0.3596	-0.3599	-0.0478	-0.3603	-0.3605	-0.3607	-0.3611	-0.2992	-0.3599	-0.3036	0.3125	-0.4367	-0.4286	-8.9547	Pre-Creation	-9.2672	0.3125
26! Health-C	-0.4051	-0.4051	-0.7176	-0.7276	-0.7306	-0.7319	-0.7326	-0.6604	-0.7231	-0.7320	-0.7333	-0.7334	-0.7334	-0.4053	-0.4835	-0.4835	-0.7235	-0.7305	-0.7323	-0.7330	-0.7333	-0.4212	-0.7338	-0.7339	-0.7341	-0.7345	-0.6727	-0.7333	-0.6770	-0.7492	0.0000	-0.8020	-20.7827	Pre-Creation	-20.7827	0.0000
27! Strength-C	-0.3970	-0.3970	-0.7095	-0.7195	-0.7226	-0.7238	-0.7245	-0.6523	-0.7150	-0.7239	-0.7252	-0.7253	-0.7254	-0.3972	-0.4754	-0.4755	-0.7155	-0.7224	-0.7242	-0.7249	-0.7252	-0.4132	-0.7257	-0.7258	-0.7260	-0.7265	-0.6646	-0.7253	-0.6689	-0.7411	-0.8020	0.0000	-20.5405	Pre-Creation	-20.5405	0.0000
20! Savings-C	0.0000	0.4901	0.3606	0.4283	0.1015	0.0962	0.3567	0.4229	0.4088	0.4199	0.4127	0.3599	0.1729	0.1575	0.1727	0.4229	0.4222	0.1729	0.4228	0.3502	0.1727	0.1725	0.4195	0.4212	0.1722	0.3594	0.4213	0.1700	0.4169	0.4069	0.0944	0.0944	9.4730	Post-Creation	0.0000	9.4730
29! Money-Spending-C	0.4901	0.0000	0.6619	0.7295	0.4027	0.3974	0.6579	0.7242	0.7101	0.7211	0.7140	0.6611	0.4742	0.4588	0.4740	0.7241	0.7235	0.4741	0.7241	0.6514	0.4740	0.4737	0.7207	0.7224	0.4735	0.6606	0.7225	0.4712	0.7182	0.7082	0.3957	0.3957	18.5106	Post-Creation	0.0000	18.5106
22! Investment in Market-C	0.0481	0.3494	-0.3125	0.2876	-0.0392	-0.0445	0.2160	0.2822	0.2681	0.2792	0.2721	0.2192	0.0322	0.0169	0.0321	0.2822	0.2815	0.0322	0.2822	0.2095	0.0321	0.0318	0.2788	0.2805	0.0316	0.2187	0.2806	0.0293	0.2762	0.2662	-0.0463	-0.0463	4.6281	Post-Creation	-0.4887	5.1167
25! Rest-C	0.1058	0.4070	0.2776	-0.3225	0.0184	0.0131	0.2736	0.3399	0.3258	0.3368	0.3297	0.2768	0.0899	0.0745	0.0897	0.3398	0.3392	0.0898	0.3398	0.2671	0.0897	0.0894	0.3364	0.3381	0.0892	0.2763	0.3382	0.0869	0.3339	0.3239	0.0114	0.0114	6.3366	Post-Creation	-0.3225	6.6591
18! Utilities-C	-0.2241	0.0772	-0.0523	0.0154	-0.3256	-0.3167	-0.0562	0.0100	-0.0041	0.0070	-0.0002	-0.0530	-0.2400	-0.2554	-0.2402	0.0100	0.0093	-0.2401	0.0099	-0.0627	-0.2402	-0.2404	0.0066	0.0083	-0.2407	-0.0535	0.0084	-0.2429	0.0040	-0.0060	-0.3185	-0.3185	-3.5653	Post-Creation	-3.7312	0.1659
16! IT-C	-0.2307	0.0706	-0.0588	0.0088	-0.3180	-0.3269	-0.0628	0.0034	-0.0107	0.0004	-0.0068	-0.0596	-0.2466	-0.2619	-0.2468	0.0034	0.0027	-0.2466	0.0033	-0.0693	-0.2468	-0.2470	0.0000	0.0017	-0.2472	-0.0601	0.0018	-0.2495	-0.0026	-0.0126	-0.3251	-0.3251	-3.7653	Post-Creation	-3.8614	0.0961
14! Material-e.g.Rio Tinto-C	0.0292	0.3304	0.2010	0.2686	-0.0581	-0.0634	-0.3275	0.2633	0.2492	0.2603	0.2531	0.2002	0.0133	-0.0021	0.0131	0.2633	0.2626	0.0132	0.2632	0.1906	0.0131	0.0128	0.2599	0.2615	0.0126	0.1998	0.2616	0.0104	0.2573	0.2473	-0.0652	-0.0652	4.0293	Post-Creation	-0.5816	4.6109
17! Telecommunictaion-e.g.Verizon-C	0.1676	0.4688	0.3394	0.4070	0.0803	0.0749	0.3354	-0.2553	0.3876	0.3986	0.3915	0.3386	0.1517	0.1363	0.1515	0.4016	0.4010	0.1516	0.4016	0.3290	0.1515	0.1512	0.3983	0.3999	0.1510	0.3382	0.4000	0.1488	0.3957	0.3857	0.0732	0.0732	8.3252	Post-Creation	-0.2553	8.5806
15! Electronics-C	0.0908	0.3920	0.2626	0.3302	0.0034	-0.0019	0.2586	0.3249	-0.3180	0.3218	0.3147	0.2618	0.0749	0.0595	0.0747	0.3248	0.3242	0.0748	0.3248	0.2522	0.0747	0.0744	0.3215	0.3231	0.0742	0.2614	0.3232	0.0720	0.3189	0.3089	-0.0036	-0.0036	5.8958	Post-Creation	-0.3272	6.2230
5! Energy-Oil - Gas-C	0.0930	0.3942	0.2648	0.3324	0.0057	0.0004	0.2608	0.3271	0.3130	-0.3269	0.3169	0.2640	0.0771	0.0617	0.0769	0.3271	0.3264	0.0770	0.3270	0.2544	0.0769	0.0766	0.3237	0.3253	0.0764	0.2636	0.3254	0.0742	0.3211	0.3111	-0.0014	-0.0014	5.9445	Post-Creation	-0.3297	6.2742
2! Industrial-Car-C	0.0845	0.3857	0.2563	0.3239	-0.0029	-0.0082	0.2523	0.3186	0.3045	0.3155	-0.3283	0.2555	0.0686	0.0532	0.0684	0.3185	0.3179	0.0685	0.3185	0.2459	0.0684	0.0681	0.3152	0.3168	0.0679	0.2551	0.3169	0.0656	0.3126	0.3026	-0.0099	-0.0099	5.6861	Post-Creation	-0.3592	6.0453
4! Industrial-Jets-C	0.0315	0.3328	0.2034	0.2710	-0.0558	-0.0611	0.1994	0.2656	0.2516	0.2626	0.2555	-0.3283	0.0157	0.0003	0.0155	0.2656	0.2650	0.0156	0.2656	0.1929	0.0155	0.0152	0.2622	0.2639	0.0150	0.2021	0.2640	0.0127	0.2596	0.2496	-0.0629	-0.0629	4.0986	Post-Creation	-0.5709	4.6695
1! Healthcare-C	-0.1555	0.1458	0.0164	0.0840	-0.2428	-0.2481	0.0124	0.0786	0.0645	0.0756	0.0685	0.0156	-0.3284	-0.1867	-0.1715	0.0786	0.0779	-0.1714	0.0786	0.0059	-0.1715	-0.1718	0.0752	0.0769	-0.1720	0.0151	0.0770	-0.1743	0.0726	0.0626	-0.2499	-0.2499	-1.5117	Post-Creation	-2.6937	1.1820
32! Jobs-C	0.1573	0.4586	0.3291	0.3968	0.0700	0.0647	0.3252	0.3914	0.3773	0.3884	0.3812	0.3284	0.1414	-0.0002	0.1412	0.3914	0.3907	0.1414	0.3913	0.3187	0.1412	0.1410	0.3880	0.3897	0.1407	0.3279	0.3898	0.1385	0.3854	0.3754	0.0629	0.0629	8.5277	Post-Creation	-0.0002	8.5279
19! Financials-C	0.0943	0.3955	0.2661	0.3338	0.0070	0.0017	0.2622	0.3284	0.3143	0.3254	0.3182	0.2654	0.0784	0.0630	-0.0784	0.3284	0.3277	0.0783	0.3283	0.2557	0.0782	0.0779	0.3250	0.3267	0.0777	0.2649	0.3268	0.0755	0.3224	0.3124	-0.0001	-0.0001	6.4809	Post-Creation	-0.0787	6.5595
23! Mortgage-C	0.3444	0.6457	0.5163	0.5839	0.2571	0.2518	0.5123	0.5785	0.5644	0.5755	0.5683	0.5155	0.3285	0.3132	0.3283	-0.0785	0.5778	0.3285	0.5784	0.5058	0.3283	0.3281	0.5751	0.5768	0.3279	0.5150	0.5769	0.3256	0.5725	0.5625	0.2500	0.2500	13.9844	Post-Creation	-0.0785	14.0629
3! Industrial-Office Suuply-C	0.1037	0.4050	0.2756	0.3432	0.0164	0.0111	0.2716	0.3378	0.3237	0.3348	0.3276	0.2748	0.0878	0.0725	0.0877	0.3378	-0.3185	0.0878	0.3377	0.2651	0.0877	0.0874	0.3344	0.3361	0.0872	0.2743	0.3362	0.0849	0.3318	0.3218	0.0093	0.0093	6.2838	Post-Creation	-0.3185	6.6023
30! Travelling-C	-0.1526	0.1487	0.0193	0.0869	-0.2399	-0.2452	0.0153	0.0815	0.0674	0.0785	0.0714	0.0185	-0.1685	-0.1838	-0.1686	0.0815	0.0808	-0.3254	0.0815	0.0088	-0.1686	-0.1689	0.0781	0.0798	-0.1691	0.0180	0.0799	-0.1714	0.0755	0.0655	-0.2470	-0.2470	-1.4190	Post-Creation	-2.6560	1.2370
31! Entertainment-C	0.0956	0.3968	0.2674	0.3350	0.0082	0.0029	0.2634	0.3297	0.3156	0.3266	0.3195	0.2666	0.0797	0.0643	0.0795	0.3296	0.3290	0.0796	-0.3273	0.2570	0.0795	0.0792	0.3263	0.3279	0.0790	0.2662	0.3280	0.0768	0.3237	0.3137	0.0012	0.0012	6.0213	Post-Creation	-0.3273	6.3485
6! Consumer Discretionary-House Holds-C	0.0223	0.3235	0.1941	0.2617	-0.0651	-0.0704	0.1901	0.2564	0.2423	0.2533	0.2462	0.1933	0.0064	-0.0090	0.0062	0.2563	0.2557	0.0063	0.2563	-0.3279	0.0062	0.0059	0.2530	0.2546	0.0057	0.1929	0.2547	0.0035	0.2504	0.2404	-0.0721	-0.0721	3.8208	Post-Creation	-0.6166	4.4375
8! Consumer Staples-e.g.Walmart-C	-0.1555	0.1457	0.0163	0.0839	-0.2428	-0.2481	0.0123	0.0786	0.0645	0.0755	0.0684	0.0155	-0.1714	-0.1868	-0.1716	0.0786	0.0779	-0.1715	0.0785	0.0059	-0.3283	-0.1719	0.0752	0.0768	-0.1721	0.0151	0.0769	-0.1743	0.0726	0.0626	-0.2499	-0.2499	-1.5134	Post-Creation	-2.6942	1.1808
7! Food-C	0.1563	0.4575	0.3281	0.3957	0.0690	0.0637	0.3242	0.3904	0.3763	0.3874	0.3802	0.3274	0.1404	0.1250	0.1402	0.3904	0.3897	0.1403	0.3903	0.3177	0.1402	-0.0162	0.3870	0.3887	0.1397	0.3269	0.3887	0.1375	0.3844	0.3744	0.0619	0.0619	8.4651	Post-Creation	-0.0162	8.4813
21! Return on Investment-C	0.0908	0.3920	0.2626	0.3303	0.0035	-0.0018	0.2587	0.3249	0.3108	0.3219	0.3147	0.2619	0.0749	0.0595	0.0747	0.3249	0.3242	0.0748	0.3248	0.2522	0.0747	0.0744	-0.3287	0.3232	0.0742	0.2614	0.3233	0.0720	0.3189	0.3089	-0.0036	-0.0036	5.8754	Post-Creation	-0.3377	6.2131
10! Education-C	0.0923	0.3936	0.2642	0.3318	0.0050	-0.0003	0.2602	0.3264	0.3123	0.3234	0.3163	0.2634	0.0765	0.0611	0.0763	0.3264	0.3258	0.0764	0.3264	0.2537	0.0763	0.0760	0.3230	-0.3288	0.0758	0.2629	0.3248	0.0735	0.3204	0.3104	-0.0021	-0.0021	5.9215	Post-Creation	-0.3332	6.2547
11! Projects-Infrastructure-C	-0.1568	0.1444	0.0150	0.0826	-0.2441	-0.2494	0.0111	0.0773	0.0632	0.0743	0.0671	0.0143	-0.1727	-0.1881	-0.1729	0.0773	0.0766	-0.1728	0.0772	0.0046	-0.1729	-0.1732	0.0739	0.0756	-0.3291	0.0138	0.0757	-0.1756	0.0713	0.0613	-0.2512	-0.2512	-1.5535	Post-Creation	-2.7099	1.1564
12! Roads-C	0.0299	0.3312	0.2017	0.2694	-0.0574	-0.0627	0.1978	0.2640	0.2499	0.2610	0.2538	0.2010	0.0140	-0.0013	0.0138	0.2640	0.2633	0.0140	0.2639	0.1913	0.0138	0.0136	0.2606	0.2623	0.0133	-0.3295	0.2624	0.0111	0.2580	0.2480	-0.0645	-0.0645	4.0471	Post-Creation	-0.5799	4.6271
9! Tax-C	0.1537	0.4549	0.3255	0.3931	0.0663	0.0610	0.3215	0.3878	0.3737	0.3847	0.3776	0.3247	0.1378	0.1224	0.1376	0.3877	0.3871	0.1377	0.3877	0.3150	0.1376	0.1373	0.3843	0.3860	0.1371	0.3242	-0.2676	0.1348	0.3818	0.3718	0.0593	0.0593	7.8832	Post-Creation	-0.2676	8.1509
13! Daily Transportation-C	-0.1583	0.1430	0.0136	0.0812	-0.2456	-0.2509	0.0096	0.0758	0.0617	0.0728	0.0656	0.0128	-0.1742	-0.1895	-0.1743	0.0758	0.0751	-0.1742	0.0757	0.0031	-0.1743	-0.1746	0.0724	0.0741	-0.1748	0.0123	0.0742	-0.3283	0.0698	0.0598	-0.2527	-0.2527	-1.5958	Post-Creation	-2.7244	1.1286
28! Work-C	0.1449	0.4462	0.3168	0.3844	0.0576	0.0523	0.3128	0.3790	0.3649	0.3760	0.3689	0.3160	0.1290	0.1137	0.1289	0.3790	0.3784	0.1290	0.3790	0.3063	0.1289	0.1286	0.3756	0.3773	0.1284	0.3155	0.3774	0.1261	-0.2720	0.3630	0.0505	0.0505	7.6132	Post-Creation	-0.2720	7.8852
24! House-C	0.0628	0.3640	0.2346	0.3022	-0.0245	-0.0298	0.2306	0.2969	0.2828	0.2938	0.2867	0.2338	0.0469	0.0315	0.0467	0.2969	0.2962	0.0468	0.2968	0.2242	0.0467	0.0464	0.2935	0.2951	0.0462	0.2334	0.2952	0.0440	0.2909	-0.3441	-0.0316	-0.0316	5.0039	Post-Creation	-0.4618	5.4657
26! Health-C	-0.3107	-0.0094	-0.1388	-0.0712	-0.3980	-0.4033	-0.1428	-0.0766	-0.0907	-0.0796	-0.0867	-0.1396	-0.3265	-0.3419	-0.3267	-0.0766	-0.0772	-0.3266	-0.0766	-0.1493	-0.3267	-0.3270	-0.0800	-0.0783	-0.3272	-0.1401	-0.0782	-0.3295	-0.0826	-0.0926	-0.4051	-0.4051	-6.3209	Post-Creation	-6.3209	0.0000
27! Strength-C	-0.3026	-0.0013	-0.1307	-0.0631	-0.3899	-0.3952	-0.1347	-0.0685	-0.0826	-0.0715	-0.0787	-0.1315	-0.3185	-0.3338	-0.3187	-0.0685	-0.0692	-0.3185	-0.0686	-0.1412	-0.3186	-0.3189	-0.0719	-0.0702	-0.3191	-0.1320	-0.0701	-0.3214	-0.0745	-0.0845	-0.3970	-0.3970	-6.0625	Post-Creation	-6.0625	0.0000

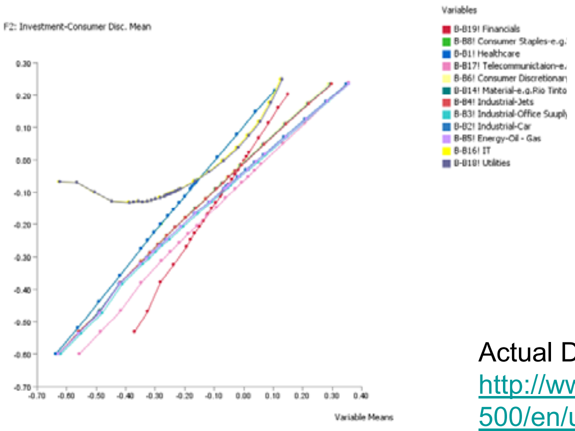
INVEST ON VISUALIZATION

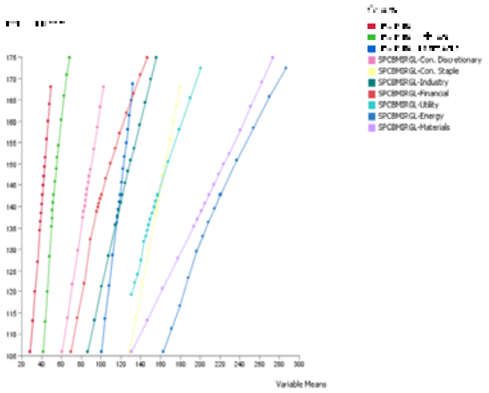
Analysis Case # 2
500 S&P BBN



INVEST ON VISUALIZATION

500 S&P
Investment Mean Versus Economic Sectors





Model results close
to equilibrium state

Actual Data: Global indices, http://www.standardandpoors.com/indices/sp-500/en/us/?indexId=spusa-500-usduf--p-us-l--, The data span the period from Dec 2007 to Jan 2011.

Conclusion & Further Development

- DSM logic was quantified using two random sequences, and elements state matrix was built.
- The matrix was uploaded into Bayesialab 5.0.2, http://www.bayesia.com/en/products/bayesialab.php. using data mining
- There is high potential of using this approach especially when there is no available data, or in a complex situation.
- The way the state matrix is built is being optimized to suit different type of problems, e.g. decision making, situation analysis..
- Part of the current work is to fine tune the modeling parameters in BBN.