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30. October 2009

Online at http://mpra.ub.uni-muenchen.de/18243/
MPRA Paper No. 18243, posted 30. October 2009 / 08:47

ECONOMIC DECISIONS IN CERTAINTY CONDITIONS

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Abstract. *Decisions' basic factors during decision making are interdependent, which reflects the features of the decision making they generate. Economic decisions in certainty conditions are characterized by maximum probability to accomplish pursued goals using the predicted ways. The elements involved in decision making are controllable variables, their features are known and their progress can be precisely anticipated.*

JEL classification: D80, D81

Keywords: Decision, certainty conditions, ELECTRE Method

Certainty conditions are neither merely theoretical, nor commonplace. There are several short-term situations [7] when decision makers have all the necessary information: current prices, ordered quantities, terms of reception/delivery of orders. The marginal analysis, the linear optimization – linear programming issues with one or several restrictions, the transport matter -, the non-linear optimization are just a few examples of decisional processes in certainty conditions.

Optimization issues refer either to source allocation such as: patterns for diets and mixtures, patterns for damage matters – related to workers operating their machines, equipment upon works, specialists in various complex tasks – either upon ordering factors (algorithms for limited restriction ordering, ordering patterns based on linear programming in integer numbers, flow ordering - flow shop), or to profit, or turnover maximization or to production cost minimization (patterns to set up production structure within a certain period of time). Most of these issues are descriptive and theoretical.

In the event of economic decisions in certainty conditions, managers surely know what conditions are to emerge later and to affect decisions' results. Since there is only one nature state whose future manifestation is surely known by decision makers, each potential action is to generate only one result (the accomplishment probability is 1). Such decisions regard the situations when after a managerial action only one consequence will occur. Therefore, decision makers surely know what result each alternative course of action will have. In such a circumstance, a sensible decision maker will choose from among the potential alternatives the one generating the best result.

Optimization methods and techniques of multidimensional decisions in certainty conditions are based on utility theory. Stated by Neuman and Morgenstern, utility theory though subject to controversy in some respects due to the subjective trait of the utility associated with each decisional consequence introduces the following essential features:

- if A and B are the consequences of some distinct ways of action, then A is preferred to B ($A > B$) provided that $u(A) > u(B)$, where u is the utility function;
- if C is the probabilistic mixture of two consequences A and B, $C = [pA, (1-p)B]$, where p is a probability, so $0 < p < 1$, and C_1 is a

consequence for which $C_1 \sim C$ (indifference between C_1 and C), then: $u(C_1) = pu(A) + (1-p)u(B)$;

- if u function has these traits, then it can be subject to a positive linear change: $u(A) = au(A) + b, a > 0, b \in \mathbf{R}$.

Consequently, if the utilities of two of the consequences are known, it will always be possible to set up the utility size of any other consequence. For example, if $u_{\max} = 1$ and $u_{\min} = 0$, the utility means subjective probability. As a rule, when setting decisional consequences' utilities, interval [0,1] is used, and grounding the size of utilities between the two extremes is done by means of the linear interpolation between 0 and 1.

In order to solve complex decisional issues in certainty conditions, the French School represented by Bernard Roy set up in 1967 the ELECTRE[1] Method (Elimination et Choix Traduisant la Realité). The method combines various theories: the theory of utility, graphs, linear interpolation, decisional variants' outranking, analyzing V_i variants by pairs according to several C_j criteria.

A decisional issue may occur under the following scheme:

C_j / V_i	C_1 … C_j … C_m
V_1 - V_i - V_n	R_{ij}

where: V_i – i decisional variant;

C_j – j decisional criterion;

R_{ij} – consequence of the decisional variant influenced by j decisional criterion.

In some circumstances, the results of decisional variants are not quantifiable (qualitative results emerge) and therefore it is necesarey they should be changed into utilities.

If utility scale from 0 to 1 is used, where 1 is given to the most favourable utility from the economic perspective, and 0 is given to the most unfavourable one, then R_{ij} consequences are turned into U_{ij} utilities as such:

$$aR_{ij} + b = U_{ij}.$$

If j criterion is optimized by maximization, then:

$$U_{ij} = \frac{R_{ij} - R_{\min}}{R_{\max} - R_{\min}}.$$

If j criterion is optimized by minimization, then:

$$U_{ij} = \frac{R_{\max} - R_{ij}}{R_{\max} - R_{\min}}.$$

[1] ELECTRE – "method to rank and select when multiple points of view are present"

The table of utilities is as follows:

C_j / V_i	C_1 … C_j … C_m
V_1 - V_i - V_n	U_{ij}

The following stage is introducing the importance coefficients of k_j and $j=\overline{1,m}$ criteria set up by decision makers according to various aspects:

- a company's economic and financial situation;
- the share of C_j criterion's importance in the set of issue's overall criteria;
- the goals pursued by the company.

Setting up these criteria is the result of collective decisions as specialists in various company departments get involved. Every specialist (S_i) has an equal number of points (P) that are distributed to the *n* criteria.

The sum of points granted to C_j criterion shall be:

$$P_j = \sum_{i=1}^{n} P_{ij} .$$

The importance coefficient of C_j criterion shall be:

$$k_j = \frac{P_j}{\sum_{j=1}^{m} P_j}, \ \sum_{j=1}^{m} k_j = 1 .$$

Then the variants' compliance indicators are set up as follows:

$$C(V_g, V_h) = \frac{\sum_{j \in J_c} k_j}{\sum_{j} k_j}, \ j = \overline{1,m},$$

where $\sum_{j \in J_c} k_j$ is the sum of criteria's importance coefficients for which the restriction $U(V_g) \geq U(V_h)$ is taken into account.

The table of compliance indicators is achieved:

V_j / V_i	V_1 …….. V_h ……. V_m
V_1 - V_g - V_n	$C(V_g, V_h)$

Outranking the two variants shall be higher as the compliance indicator is closer to 1 and total outranking corresponds to a compliance index that equals 1.

The next stage is the calculation of non-compliance indicators with the purpose to know the opposition intensity which can occur as related to a certain variant or the risk a decision maker assumes when choosing either variant.

$$D(V_g, V_h) = \begin{cases} \frac{1}{\alpha}\max(U(V_g) - U(V_h)), if \quad U(V_g) < U(V_h) \\ 0, if \quad U(V_g) \geq U(V_h) \end{cases}$$

where α is the maximum difference among utilities.
The result is the table of non-compliance indicators.

V_i \ V_j	V_1 ..... V_h ..... V_m
V_1 - V_g - V_n	$D(V_g, V_h)$

Choosing the best solution is done by means of graphs' theory and variants' outranking theory. A variant (V_g) outranks another variant (V_h), (this outranking is marked in the synthesis graph by a curve oriented from V_g to V_h) if:

$$C(V_g, V_h) \geq p \qquad (1)$$

$$D(V_g, V_h) \leq q \qquad (2)$$

where: *p, q* are values selected by a decision maker and go from 0 to 1;

$p \rightarrow$ acceptability threshold (it is recommended its value be close to 1);

$q \rightarrow$ risk threshold (it is recommended its value be as close to 0 as possible).

The variant which in certain *p* and *q* threshold values outranks all other variants is seen as the best.

The outranking relationship betwen a (V_g) variant and a (V_h) variant occurs to the extent to which restrictions (1) and (2) are taken into consideration, and it is even stronger as *p* and *q* have values that are close to 1, respectively 0.

The economic specialized literature in our country has brought about several improvement suggestions in the contents of the ELECTRE Method as it was originally conceived by the French School and such improvement is directed to the removal of its main defficiency – which is the incongruence of underlying criteria in compliance and non-compliance indicators – by setting some normalized compliance and non-compliance coefficients. The determining formula suggested there aims at both importance coefficients and the differences among comparing variants' utilities for both indices.

The main advantages lie in the fact that both in the original form and in the improved one the ELECTRE Method is characterized by great application simplicity and easiness which strongly recommend it in order to rationalize decision making processes in Romanian companies.

Numerical application:

S.C. Vitalia S.A. grows its production activities by purchasing high-performance equipment and modernizing certain departments. In order to achieve such investment, several variants are suggested which specify: the investment value, accomplishment term, total gross profit, profitability rate, labour productivity.

V_n	V_i (thousand monetary units)	T_r (months)	P_{bt} (thousand m.u.)	R_r (%)	W (m.u.)
V_1	2,356,780	32	230,000	0.20	1,800,000
V_2	2,100,000	36	265,000	0.40	1,850,000
V_3	2,526,000	48	244,000	0.25	1,900,000
V_4	2,620,000	42	285,000	0.30	2,000,000
V_5	2,780,000	46	320,000	0.35	1,700,000
V_6	2,340,000	40	315,000	0.15	1,770,000

where: V_n – decisional variant;
V_i - investment value;
T_r – accomplishment term;
P_{bt} - total gross profit;
R_r - profitability rate;
W- labour productivity.

Solution:

1. The utilities' matrix is calculated according to the criterion's economic significance:

C_j / V_i	C_1	C_2	C_3	C_4	C_5
V_1	0.62	1.00	0.20	0.33	0.00
V_2	1.00	0.75	1.00	0.50	0.38
V_3	0.37	0.00	0.40	0.66	0.15
V_4	0.24	0.38	0.60	1.00	0.61
V_5	0.00	0.13	0.80	0.00	1.00
V_6	0.64	0.50	0.00	0.23	0.94

The calculation way – investment value:
The respective criterion optimizes by minimization according to formula:

$$U_{ij} = \frac{R_{\max} - R_{ij}}{R_{\max} - R_{\min}}$$

$$U_{11} = \frac{2,780,000 - 2,356,780}{2,780,000 - 2,100,000} = 0.62;$$

$$U_{21} = \frac{2,780,000 - 2,100,000}{2,780,000 - 2,100,000} = 1.00;$$

$$U_{31} = \frac{2,780,000 - 2,526,000}{2,780,000 - 2,100,000} = 0.37;$$

$$U_{41} = \frac{2,780,000 - 2,620,000}{2,780,000 - 2,100,000} = 0.24;$$

$$U_{5`} = \frac{2,780,000 - 2,780,000}{2,780,000 - 2,100,000} = 0.00;$$

$$U_{61} = \frac{2,780,000 - 2,340,000}{2,780,000 - 2,100,000} = 0.64$$

The calculation way – accomplishment term:

The respective criterion optimizes by minimization according to formula:

$$U_{ij} = \frac{R_{\max} - R_{ij}}{R_{\max} - R_{\min}}$$

$$U_{12} = \frac{48 - 32}{48 - 32} = 1.00;$$

$$U_{22} = \frac{48 - 36}{48 - 32} = 0.75;$$

$$U_{32} = \frac{48 - 48}{48 - 32} = 0.00;$$

$$U_{42} = \frac{48 - 42}{48 - 32} = 0.38;$$

$$U_{52} = \frac{48 - 46}{48 - 32} = 0.13;$$

$$U_{62} = \frac{48 - 40}{48 - 32} = 0.50.$$

The calculation way – gross profit:

The respective criterion optimizes by maximization according to formula:

$$U_{ij} = \frac{R_{ij} - R_{\min}}{R_{\max} - R_{\min}}$$

$$U_{13} = \frac{230,000 - 230,000}{320,000 - 230,000} = 0;$$

$$U_{23} = \frac{265,000 - 230,000}{320,000 - 230,000} = 0.39;$$

$$U_{33} = \frac{244,000 - 230,000}{320,000 - 230,000} = 0.15;$$

$$U_{43} = \frac{285,000 - 230,000}{320,000 - 230,000} = 0.61;$$

$$U_{53} = \frac{320,000 - 230,000}{320,000 - 230,000} = 1;$$

$$U_{63} = \frac{315,000 - 230,000}{320,000 - 230,000} = 0.94.$$

The calculation way – profitability rate:

The respective criterion optimizes by maximization according to formula:

$$U_{ij} = \frac{R_{ij} - R_{\min}}{R_{\max} - R_{\min}}$$

$$U_{14} = \frac{0.20 - 0.15}{0.40 - 0.15} = 0.20;$$

$$U_{24} = \frac{0.40 - 0.15}{0.40 - 0.15} = 1.00;$$

$$U_{34} = \frac{0.25 - 0.15}{0.40 - 0.15} = 0.40;$$

$$U_{44} = \frac{0.30 - 0.15}{0.40 - 0.15} = 0.60;$$
$$U_{54} = \frac{0.35 - 0.15}{0.40 - 0.15} = 0.80;$$
$$U_{64} = \frac{0.15 - 0.15}{0.40 - 0.15} = 0.00.$$

The calculation way – labour productivity:

The respective criterion optimizes by maximization according to formula:

$$U_{ij} = \frac{R_{ij} - R_{\min}}{R_{\max} - R_{\min}}$$
$$U_{15} = \frac{1{,}800{,}000 - 1{,}700{,}000}{2{,}000{,}000 - 1{,}700{,}000} = 0.33;$$
$$U_{25} = \frac{1{,}850{,}000 - 1{,}700{,}000}{2{,}000{,}000 - 1{,}700{,}000} = 0.50;$$
$$U_{35} = \frac{1{,}900{,}000 - 1{,}700{,}000}{2{,}000{,}000 - 1{,}700{,}000} = 0.66;$$
$$U_{45} = \frac{2{,}000{,}000 - 1{,}700{,}000}{2{,}000{,}000 - 1{,}700{,}000} = 1.00;$$
$$U_{55} = \frac{1{,}700{,}000 - 1{,}700{,}000}{2{,}000{,}000 - 1{,}700{,}000} = 0.00;$$
$$U_{65} = \frac{1{,}770{,}000 - 1{,}700{,}000}{2{,}000{,}000 - 1{,}700{,}000} = 0.23.$$

2. In order to set the significance coefficients, four specialists are asked for consultance and each has 20 points. The points granted to each criterion and the significance coefficients are to be seen in the following table:

C_j / S_i	C_1	C_2	C_3	C_4	C_5	p
S_1	2	3	6	5	4	20
S_2	3	5	4	6	2	20
S_3	4	3	4	3	6	20
S_4	3	4	5	2	6	20
p_i	12	15	19	16	18	80
k_i	0.16	0.18	0.24	0.20	0.22	-

3. The calculation of compliance indicators:

V_j / V_i	V_1	V_2	V_3	V_4	V_5	V_6
V_1	-	0.18	0.34	0.34	0.54	0.62
V_2	0.82	-	0.80	0.58	0.78	0.78
V_3	0.64	0.20	-	0.16	0.36	0.44
V_4	0.66	0.42	0.84	-	0.54	0.44
V_5	0.46	0.22	0.64	0.46	-	0.46
V_6	0.38	0.22	0.56	0.56	0.54	-

$C(V_1, V_2) = 0.18;$

$C(V_1, V_3) = 0.16 + 0.18 = 0.34;$
$C(V_1, V_4) = 0.16 + 0.18 = 0.34;$
$C(V_1, V_5) = 0.16 + 0.18 + 0.20 = 0.54;$
$C(V_1, V_6) = 0.18 + 0.24 + 0.20 = 0.62;$
$C(V_2, V_1) = 0.16 + 0.24 + 0.20 + 0.22 = 0.82;$
$C(V_2, V_3) = 0.16 + 0.18 + 0.24 + 0.22 = 0.80;$
$C(V_2, V_4) = 0.16 + 0.18 + 0.24 = 0.58;$
$C(V_2, V_5) = 0.16 + 0.18 + 0.24 + 0.20 = 0.78;$
$C(V_2, V_6) = 0.16 + 0.18 + 0.24 + 0.20 = 0.78;$
$C(V_3, V_1) = 0.24 + 0.20 + 0.20 = 0.64;$
$C(V_3, V_2) = 0.20;$
$C(V_3, V_4) = 0.16;$
$C(V_3, V_5) = 0.16 + 0.20 = 0.36;$
$C(V_3, V_6) = 0.24 + 0.20 = 0.44;$
$C(V_4, V_1) = 0.24 + 0.20 + 0.22 = 0.66;$
$C(V_4, V_2) = 0.20 + 0.22 = 0.42;$
$C(V_4, V_3) = 0.18 + 0.24 + 0.20 + 0.22 = 0.84;$
$C(V_4, V_5) = 0.16 + 0.18 + 0.20 = 0.54;$
$C(V_4, V_6) = 0.24 + 0.20 = 0.44;$
$C(V_5, V_1) = 0.24 + 0.22 = 0.46;$
$C(V_5, V_2) = 0.22;$
$C(V_5, V_3) = 0.18 + 0.24 + 0.22 = 0.64;$
$C(V_5, V_4) = 0.24 + 0.22 = 0.46;$
$C(V_5, V_6) = 0.24 + 0.22 = 0.46;$
$C(V_6, V_1) = 0.16 + 0.22 = 0.38;$
$C(V_6, V_2) = 0.22;$
$C(V_6, V_3) = 0.16 + 0.18 + 0.22 = 0.56;$
$C(V_6, V_4) = 0.16 + 0.18 + 0.22 = 0.56;$
$C(V_6, V_5) = 0.16 + 0.18 + 0.20 = 0.54.$

4. The calculation of non-compliance indicators:

V_i \ V_j	V_1	V_2	V_3	V_4	V_5	V_6
V_1	-	0.80	0.33	0.67	1.00	0.94
V_2	0.25	-	0.16	0.50	0.62	0.56
V_3	1.00	0.75	-	0.46	0.85	0.79
V_4	0.62	0.76	0.13	-	0.39	0.40
V_5	0.87	1.00	0.66	1.00	-	0.64
V_6	0.50	1.00	0.43	0.77	0.80	-

$D(V_1, V_2) = \max \{|0.62-1|, |0.20-1|, |0.33-0.50|, |0.00-0.38| \} = 0.80;$
$D(V_1, V_3) = \max \{|0.20-0.40|, |0.33-0.66|, |0.00-0.15|\} = 0.33;$

$D(V_1, V_4)$ = max {|0.20-0.60|, |0.33-1.00|, |0.00-0.61|} = 0.67;
$D(V_1, V_5)$ = max {|0.20-0.80|, |0.00-1.00|} = 1.00;
$D(V_1, V_6)$ = max {|0.00-0.94|, |0.62-0.64|} = 0.94;
$D(V_2, V_1)$ = max {|0.75-1.00|} = 0.25;
$D(V_2, V_3)$ = max {|0.50-0.66|} = 0.16;
$D(V_2, V_4)$ = max {|0.50-1.00|, |0.38-0.61|} = 0.50;
$D(V_2, V_5)$ = max {|0.38-1.00|} = 0.62;
$D(V_2, V_6)$ = max {|0.38-0.94|} = 0.56;
$D(V_3, V_1)$ = max {|0.37-0.62|, |0.00-1.00|} = 1.00;
$D(V_3, V_2)$ = max {|0.37-1.00|, |0.00-0.75|, |0.40-1.00|, |0.15-0.38|} = 0.75;
$D(V_3, V_4)$ = max {|0.00-0.38|, |0.40-0.60|, |0.66-1.00|, |0.15-0.61|} = 0.46;
$D(V_3, V_5)$ = max {|0.00-0.13|, |0.40-0.80|, |0.15-1.00|} = 0.85;
$D(V_3, V_6)$ = max {|0.37-0.64|, |0.00-0.50|, |0.15-0.94|} = 0.79;
$D(V_4, V_1)$ = max {|0.24-0.62|, |0.38-1.00|} = 0.62;
$D(V_4, V_2)$ = max {|0.24-1.00|, |0.38-0.75|, |0.60-1.00|} = 0.76;
$D(V_4, V_3)$ = max {|0.24-0.37|} = 0.13;
$D(V_4, V_5)$ = max {|0.60-0.80|, |0.61-1.00|} = 0.39;
$D(V_4, V_6)$ = max {|0.24-0.64|, |0.38-0.50|, |0.61-0.94|} = 0.40;
$D(V_5, V_1)$ = max {|0.00-0.62|, |0.13-1.00|, |0.00-0.33|} = 0.87;
$D(V_5, V_2)$ = max {|0.00-1.00|, |0.13-0.75|, |0.80-1.00|, |0.00-0.50|} = 1.00;
$D(V_5, V_3)$ = max {|0.00-0.37|, |0.00-0.66|} = 0.66;
$D(V_5, V_4)$ = max {|0.00-0.24|, |0.13-0.38|, |0.00-1.00|} = 1.00;
$D(V_5, V_6)$ = max {|0.00-0.64|, |0.13-0.50|, |0.00-0.23|} = 0.64;
$D(V_6, V_1)$ = max {|0.50-1.00|, |0.00-0.20|, |0.23-0.33|} = 0.50;
$D(V_6, V_2)$ = max {|0.64-1.00|, |0.50-0.75|, |0.00-1.00|, |0.23-0.50|} = 1.00;
$D(V_6, V_3)$ = max {|0.00-0.40|, |0.23-0.66|} = 0.43;
$D(V_6, V_4)$ = max {|0.00-0.60|, |0.23-1.00|} = 0.77;
$D(V_6, V_5)$ = max {|0.00-0.80|, |0.94-1.00|} = 0.80;

The graph construction:

Iteration 1:

$p = 1$

$q = 1 - p = 0$

The two matrices are checked (they correspond to tables $C(V_g, V_h)$ and $D(V_g, V_h)$) and the aim is to identify relationships: $C(V_g, V_h) \geq 1$; $D(V_g, V_h) \leq 0$.

There are no such relationships.

Iteration 2:

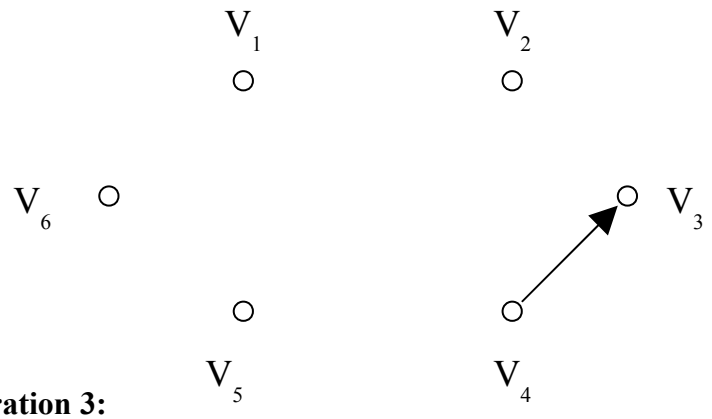
$p = 0.84$

$q = 1 - p = 0.16$

$C(V_4, V_3) = 0.84 \geq p$

$D(V_4, V_3) = 0.13 \leq q$

The result is $V_4 PV_3$ and curve $V_4 \rightarrow V_3$ is drawn according to what graph $G[V(0.84;0.13)]$ shows.



Iteration 3:

$p = 0.82$

$q = 1 - p = 0.18$

$C(V_2, V_1) = 0.82 \geq p$

$D(V_2, V_1) = 0.25 > q$

There are no such relationships.

Iteration 4:

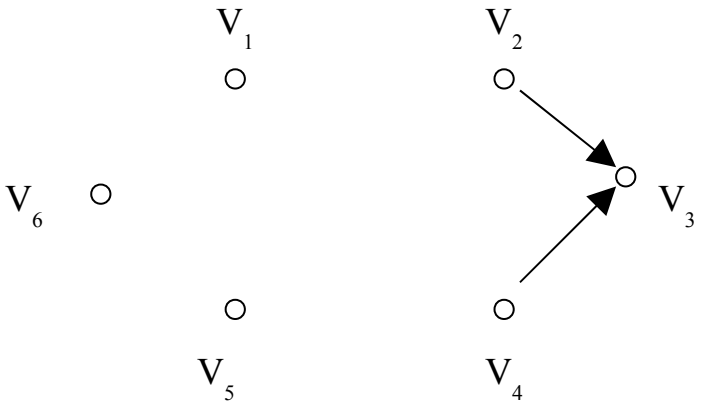
$p = 0.80$

$q = 1 - p = 0.20$

$C(V_2, V_3) = 0.80 \geq p$

$D(V_2, V_3) = 0.16 < q$

The result is $V_2 PV_3$ and curve $V_2 \rightarrow V_3$ is drawn according to what graph $G[V(0.80;0.16)]$ shows.



Iteration 5:

$p = 0.78$

$q = 1 - p = 0.22$

$C(V_2, V_5) = 0.78$

$D(V_2, V_5) = 0.62$ There are no such relationships.

$C(V_2, V_6) = 0.78$

$D(V_2, V_6) = 0.56$ There are no such relationships.

Iteration 6:

$p = 0.66$

$q = 1 - p = 0.34$
$C(V_3, V_1) = 0.66$
$D(V_3, V_1) = 1.00$ There are no such relationships.
$C(V_4, V_1) = 0.66$
$D(V_4, V_1) = 0.62$ There are no such relationships.

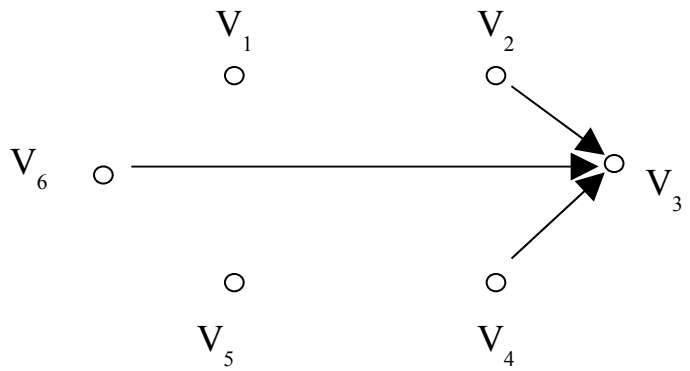
Iteration 7:
$p = 0.64$
$q = 1 - p = 0.36$
$C(V_5, V_3) = 0.64$
$D(V_5, V_3) = 0.66$ There are no such relationships.

Iteration 8:
$p = 0.62$
$q = 1 - p = 0.38$
$C(V_1, V_6) = 0.62$
$D(V_1, V_6) = 0.94$ There are no such relationships.

Iteration 9:
$p = 0.58$
$q = 1 - p = 0.42$
$C(V_2, V_4) = 0.58$
$D(V_2, V_4) = 0.50$ There are no such relationships.

Iteration 10:
$p = 0.56$
$q = 1 - p = 0.44$
$C(V_6, V_3) = 0.56 \geq p$
$D(V_6, V_3) = 0.43 < q$

The result is $V_6 P V_3$ and curve $V_6 \rightarrow V_3$ is drawn according to what graph $G[V(0.56;0.45)]$ shows.



$C(V_6, V_4) = 0.56$

$D(V_6, V_4) = 0.77$ There are no such relationships.

Iteration 11:

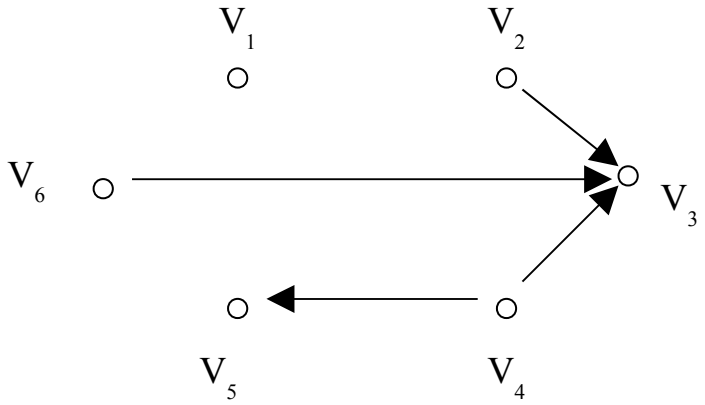
$p = 0.56$

$q = 1 - p = 0.46$

$C(V_4, V_5) = 0.54$

$D(V_4, V_5) = 0.39$

The result is $V_4 P V_5$ and curve $V_4 \rightarrow V_5$ is drawn according to what graph $G[V(0.54; 0.39)]$ shows.



$C(V_6, V_5) = 0.54$

$D(V_6, V_5) = 0.80$ There are no such relationships.

$C(V_1, V_5) = 0.54$

$D(V_1, V_5) = 1.00$ There are no such relationships.

Iteration 12:

$p = 0.46$

$q = 1 - p = 0.54$

$C(V_5, V_1) = 0.46$

$D(V_5, V_1) = 0.87$ There are no such relationships.

$C(V_5, V_4) = 0.46$

$D(V_5, V_4) = 1.00$ There are no such relationships.

$C(V_5, V_6) = 0.46$

$D(V_5, V_6) = 0.64$ There are no such relationships.

Iteration 13:

$p = 0.44$

$q = 1 - p = 0.56$

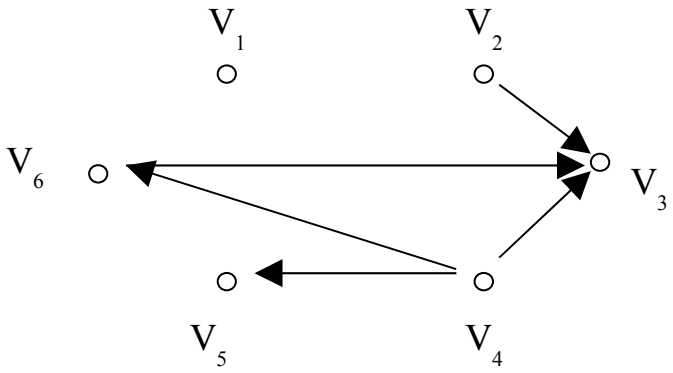
$C(V_3, V_6) = 0.44$

$D(V_3, V_6) = 0.79$ There are no such relationships.

$C(V_4, V_6) = 0.44$

$D(V_4, V_6) = 0.40$

The result is $V_4 P V_6$ and curve $V_4 \longrightarrow V_6$ is drawn according to what graph $G[V(0.44;0.40)]$ shows.



Iteration 14:

$p = 0.42$

$q = 1 - p = 0.58$

$C(V_4, V_2) = 0.42$

$D(V_4, V_2) = 0.76$ There are no such relationships.

Iteration 15:

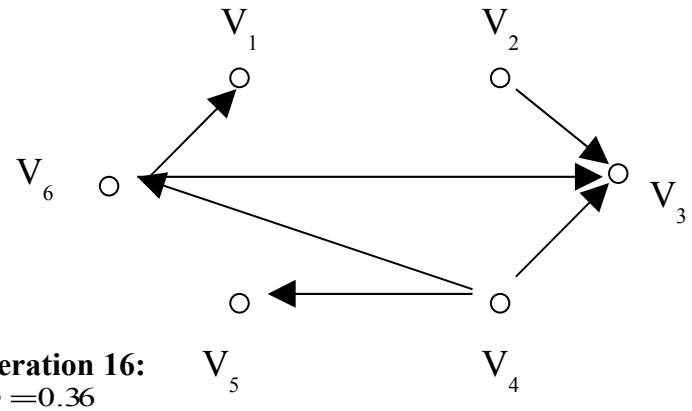
$p = 0.38$

$q = 1 - p = 0.62$

$C(V_6, V_1) = 0.38$

$D(V_6, V_1) = 0.50$

The result is $V_6 P V_1$ and curve $V_6 \longrightarrow V_1$ is drawn according to what graph $G[V(0.38;0.50)]$ shows.



Iteration 16:

$p = 0.36$

$q = 1 - p = 0.64$

$C(V_3, V_5) = 0.36$

$D(V_3, V_5) = 0.85$ There are no such relationships.

Iteration 17:

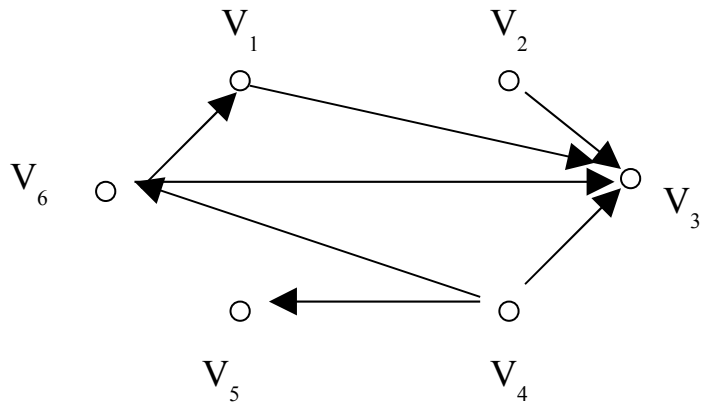
$p = 0.34$

$q = 1 - p = 0.66$

$C(V_1, V_3) = 0.34$

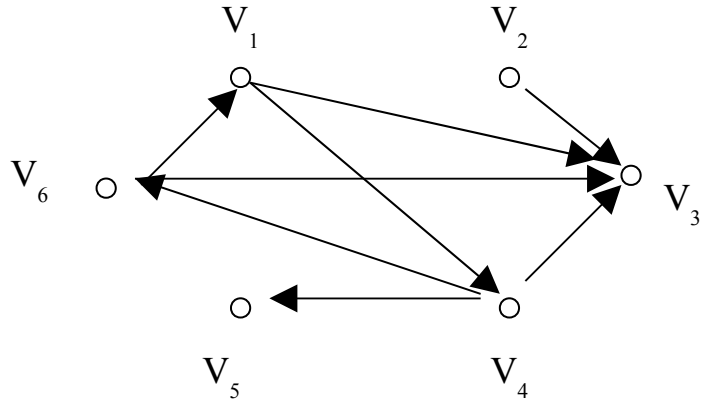
$D(V_1, V_3) = 0.33$

The result is $V_1 PV_3$ and curve $V_1 \longrightarrow V_3$ is drawn according to what graph $G[V(0.34;0.33)]$ shows.



$C(V_1, V_4) = 0.34$
$D(V_1, V_4) = 0.67$

The result is $V_1 PV_4$ and curve $V_1 \longrightarrow V_4$ is drawn according to what graph $G[V(0.34;0.67)]$ shows.



Iteration 18:

$p = 0.22$
$q = 1 - p = 0.78$
$C(V_5, V_2) = 0.22$
$D(V_5, V_2) = 1.00$ There are no such relationships.
$C(V_6, V_2) = 0.22$
$D(V_6, V_2) = 1.00$ There are no such relationships.

Iteration 19:

$p = 0.20$
$q = 1 - p = 0.80$
$C(V_3, V_2) = 0.20$
$D(V_3, V_2) = 0.75$

The result is $V_3 PV_2$ and curve $V_3 \longrightarrow V_2$ is drawn in contradiction with iteration 4.

Iteration 20:

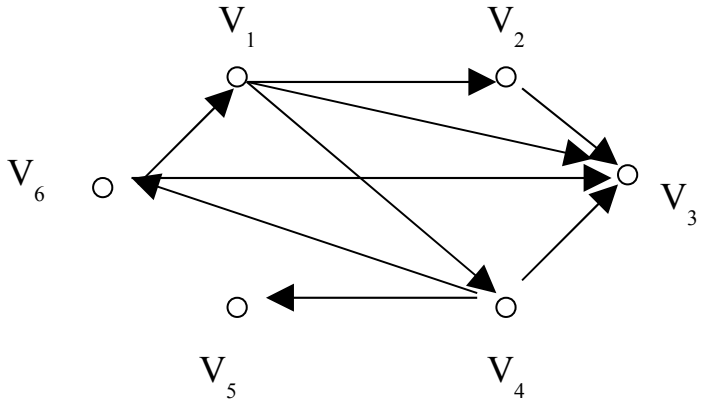
$p = 0.18$

$q = 1 - p = 0.82$

$C(V_1, V_2) = 0.18$

$D(V_1, V_2) = 0.80$

The result is $V_1 P V_2$ and curve $V_1 \rightarrow V_2$ is drawn according to what graph $G[V(0.18;0.80)]$ shows.



Iteration 21:

$p = 0.15$

$q = 1 - p = 0.85$

$C(V_3, V_4) = 0.15$

$D(V_3, V_4) = 0.46$

The result is $V_3 P V_4$ and curve $V_3 \rightarrow V_4$ is drawn in contradiction with iteration 2.

Conclusion: The result is optimal variant V_1, but the contradiction level is high ($q = 0,85$).

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