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Informatics Economy

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1 Introduction

The subject deals with a synthesizing character, multi-disciplinary and application-oriented approach with information society, non-profit and for-profit (governmental, institutional and corporate) information technology projects and relationships, planning, evaluation, tendering, fundamental methodological issues of information systems (object-comparison, the role of artificial intelligence in knowledge exploration, knowledge transfer, and automation possibilities of modeling), role and relationships of IT processes and tasks of knowledge management assets (data, documents, algorithms).

The subject's logical curve is the following:

- optimized operation for sure events (operation and transport task – searching for highest revenue and profit, while in transport cases searching the minimal cost)
- knowledge exploration:
  - numerical interdependence – regression by Excel: trend function (linear- 6th level polynomial) fitting,
  - logical interdependence – Expert Systems:
    - rule based - intuitive
    - reality/case collection based: - inductive
    - one or multi/leveled
- Planning in future
  - Forecasting – assessment of forecasts!!
  - Decision theory - decision making in risky environment – mathematical model for "best result" – depending on the decision makers

2 Optimized operation for sure events

2.1 Operation optimization (basically linear based)

Operation optimization means usually a production process optimization which one part is based on micro economy (two inputs - one output – like: MRS, or the other side: one input and more outputs) and the other part is mathematics. Here usually an input or/and output combination is looked for to maximize Revenue or Profit. In the latter case the costs is taken into account.

This usual process is shown in the example below (source: (Csordásné Marton, 2010):

Example: *a Hungarian fashion company works for foreign orders. They are sewing denim jackets and denim pants. For the pants one while for the jackets two working hours are required. For the pants and for the jackets also two meter material is required, but for the pants 2 meter ribbon is also needed which is only acquirable from import. The plant can work/produce 10 hours per day. Daily from material 12 meters, and 8 meter ribbon can be used. On the pants 2.000 HUF/piece is the profit while on the jackets 3.000 HUF/piece. How many pants and jackets shall be produced to maximize profits?*

For A better overview include the data of the task into a table:

	A	B	C	D	E	F	G
1		Pants	Jackets	Capacity (limits)	Used		
2	Working hours	1	2	10	10		
3	Denim material	2	2	12	12		
4	Ribbon (import)	2		8	4		
5							
6	Price	2000	3000				
7					Max Profit:		
8	Solution	2	4		=SZORZATÖSSZEG(B6:C6;$B$8:$C$8)		

1. Table linear programming base table (own source)

With the help of the table the following **mathematical model** can be written:

Suppose that x1 piece pants and x 2 pieces of jacket are being produced/sewed. Since we are unable do not have a negative number of pants and jackets, so we assume that:

$x_1 \geq 0$ and $x_2 \geq 0$.

Just as much product can be produced in respect of the import ribbon, of the raw materials, and the working hours can not to exceed any limiting capacity, which is at our disposal. On the basis of the conditions, we can write and then use the following inequalities:

for working hours: $x_1 + 2x_2 \leq 10,$

for basic material (denim): $2x_1 + 2x_2 \leq 12,$

ribbon (import): $2x_1 <= 8$ -> $x_1 <= 4$.

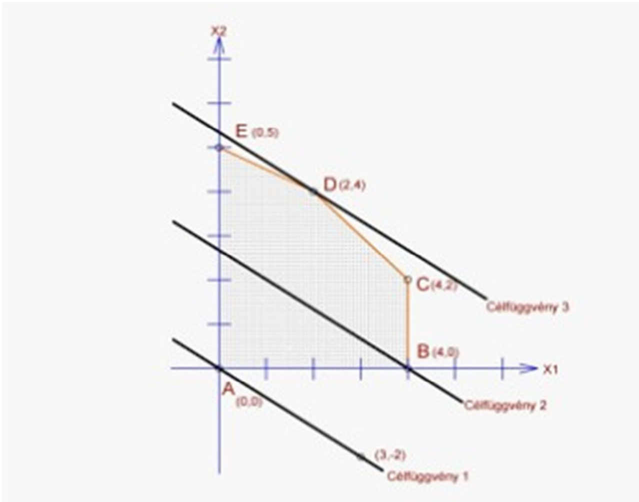
The goal/objective function is 2.000 x1 + 3.000 x2, which is signed as 2.000 x1 + 3.000 x2 -> max!

After simplification the 2x1+3x2-> max! can be used, it has the same solutions as the original goal function.

As in the case of integration, the "+ C" constant shall always be taken, namely the intersection of the y axis you can choose freely, the slope is fixed, the two coefficients (or rates) you can rearrange (assuming a homogeneous goal function, i.e. $2x_1 + 3x_2 = 0$):=> $x_2= -2/3\ x_1$, i.e. the -2/3 is the same or equal with-2000/3000.

2.1.1 The graphical solution

(see: the 1st Figure!):



1. Figure Graphical solution (http://www.tankonyvtar.hu/hu/tartalom/tamop425/0027_MAT7/images/MAT7497.png)

The conditions set out a polygon on the plain. The corner points of the polygon are called extremal points. These are A(0;0), B(4;0), C(4;2), D(2;4), E(0;5) in the specified task. Inside the boundaries of the polygon for every boundaries and point/internal solution, because it satisfies the conditions set in the task prescription. From these solutions we are looking for the optimal ones, that means maximal revenue for the company. These solutions can gotten by drawing the objective function also. The objective function's minimum, due to the $x_1>=0$ and $x_2>=0$ conditions is obviously zero. First plot the $2x_1+3x_2=0$ equation, straight objective function. For the conditions only that matches, which intersects the [0;0] point, which means that the company does not produce anything. Shifting the line parallel to the line straight in the positive plain-quarter, intersects the polygon itself, and in the end intersects/touches tangential the D [2;4] in the corner points. It can be accepted, that this is the optimal solution.

The graphic solution shows that the optimal solution, if the company sews two jeans and four jackets daily. The maximum gain of the company is then 16.000 HUF daily.

The graphical solution in this simple two-variable case is very favorable. In practice, of course, in the case of more variable (more than 2) and more conditions, the graphical solution is no longer applicable.

2.1.2 Solution under Excel with solver

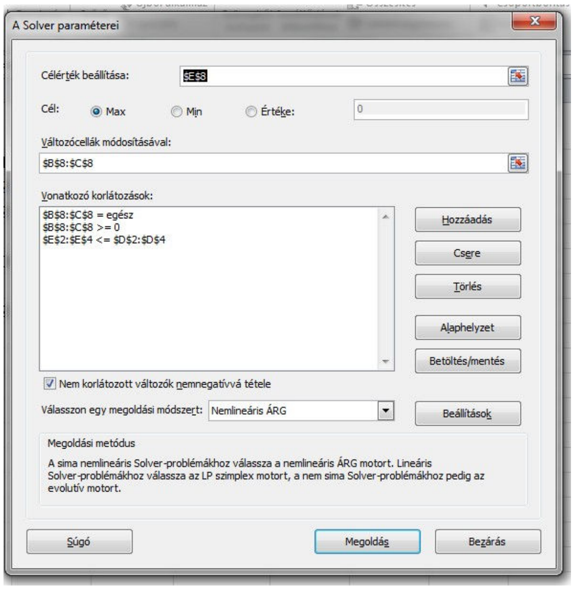
	A	B	C	D	E	F	G
1		**Pants**	**Jackets**	**Capacity (limits)**	**Used**		
2	Working hours	1	2	10	=SZORZATÖSSZEG(B2:C2;$B$8:$C$8)		
3	Denim material	2	2	12	0		
4	Ribbon (import)	2		8	0		
5							
6	Price	2000	3000				
7					**Max Profit:**		
8	Solution	0	0		0		

Note, that in English version Excels instead "Szorzatösszeg()" use the Sumproduct() function. Or for more sure, that E2 is shown is equal with: =B2*B8+C2*C8, which is suggested to write in this way: =B2*$B$8+C2*$C$8, and after it enough to copy it.

For other problems, tasks: The first task is to identify the technological matrix (here: B2:D4), then the limiting b vector (E2:E4), under it place the price/revenue factor, + 1 row where the solution values (how many pieces) will be placed. After it, the maximum profit or maximum revenue cell, plus one column where that has to be calculated how much is used from the limiting factors.

In case of other tasks, the moving cells/variables can be maximum 100, the constraints are also limited, but hopefully in our life that 100 variable will be enough.

The solver shall be set like this in harmony with the earlier:



2. Figure Linear programming task solver setting

2.2 Transport task –in transport tasks searching the minimal cost

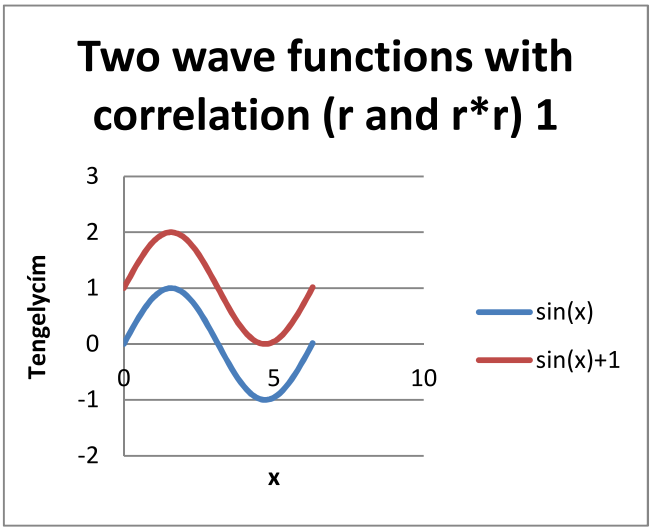
In a transport task we usually, the minimal cost has to be found with an adequate combination. See the transport_task_en.pptx!

3 Knowledge exploration

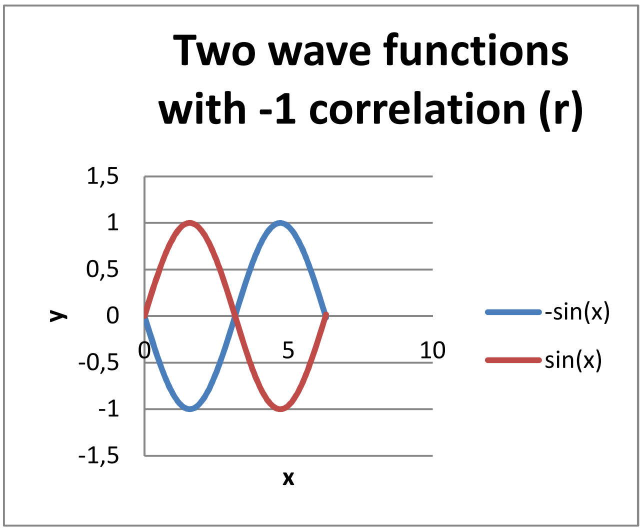
3.1 Numerical interdependence

In statistics it's called regression, which is usually the functional interconnection between two (said to be independent) phenomena. If they were absolute independent there would be no point in searching any connection between them.

The level (strength) of the interconnection is measured by correlation (sign r or R, out of dimension), which ranges [-1; …; 0; …; 1], and it measures the together moving of two pehnomena.1 is the absolute adequate connection (like sin(x) and sin(x)-1), zero is the absolute no/without connection or absolute independent, and -1 is the absolute opposite connection (mirrored moving, like sin(x) and –sin(x)). Above 0.85 said to be strong correlation (under -0.85 strong opposite), above 0.6 connection but by experience it can be stated, that 0.8 (or 0.85) is the level, where/when above or equal worth to talk about any real connection.



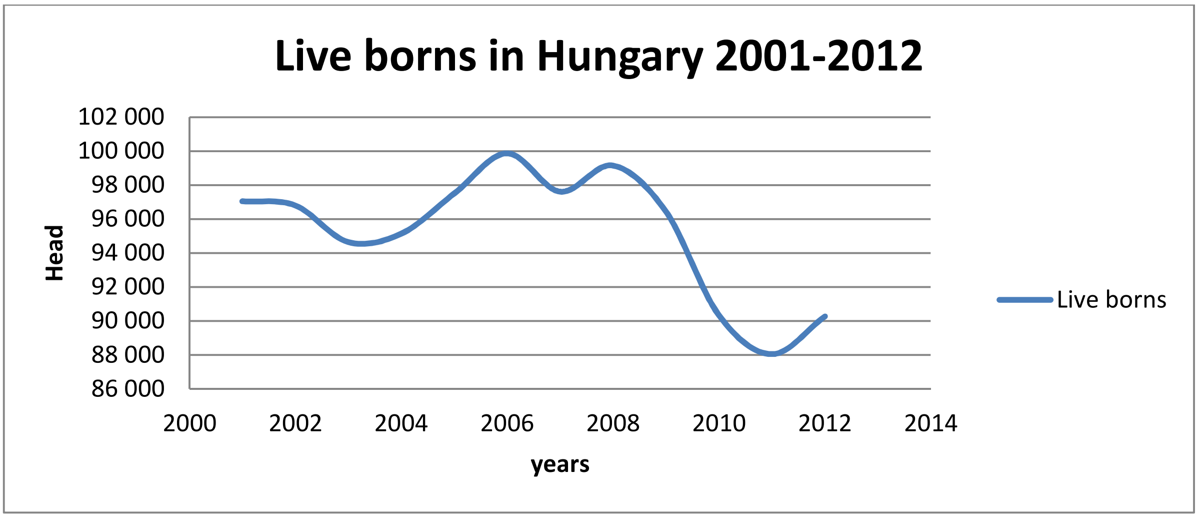
1. Diagram Two wave functions with correlations (r and r^2 also) +1



2. Diagram Two wave functions with -1 correlation

The regression (or better function creating – trend-line fit in Excel) is not else than specifying the functions shape in a mathematical equation. As the process is described and thought in Statistics – and by our viewpoint is quite unnecessary and complicated, only the practical usage is listed:

If a time-series is given as numerical functions are usually not supplied with stochastic phenomena, that shall be made by us, like the "live-born" time-series diagram in Hungary between 2001 and 2012. See 3rd Diagram on next page!



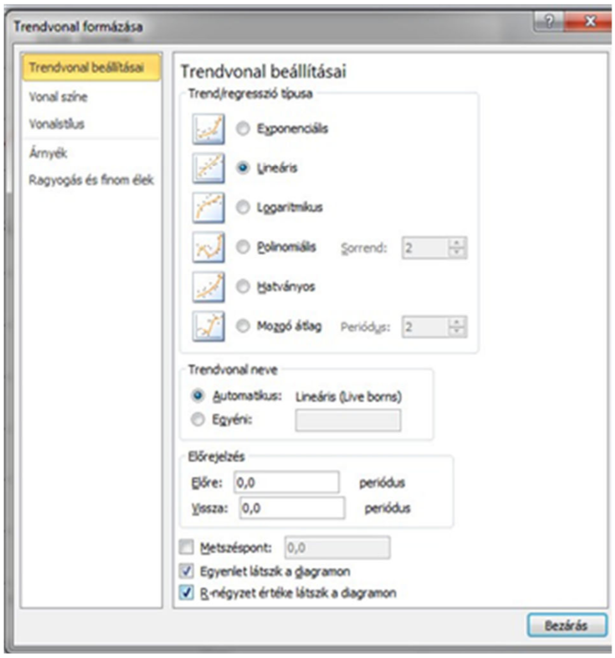
3. Diagram Live borns in Hungary 2001-2012

If anyone is curious about how it could be mathematized (regression) than only a right click on the curve is needed, than select “trend line fit” (or something similar).

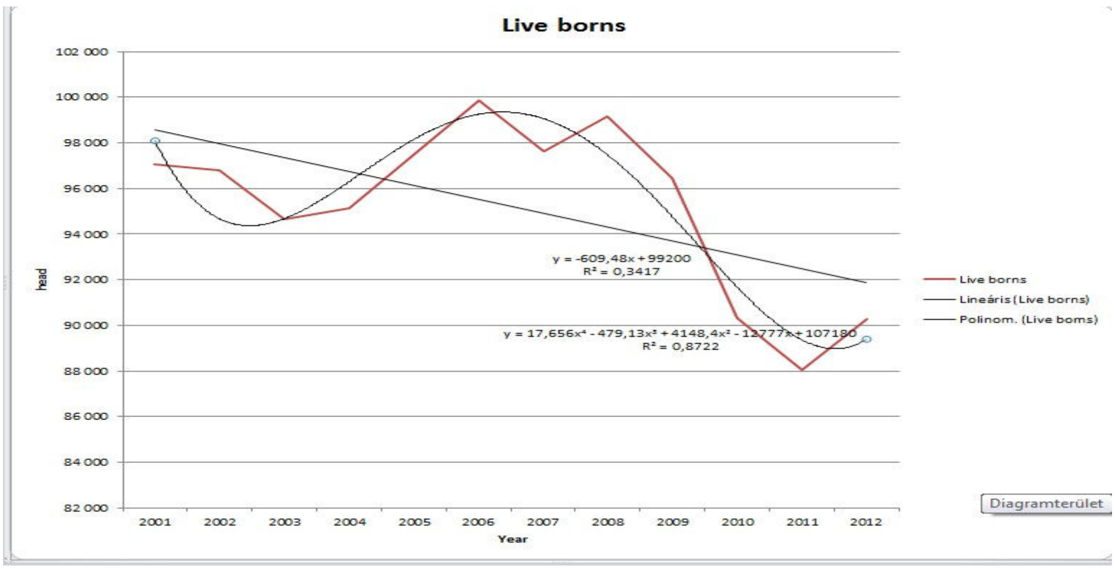
Out of these the linear and the polynomial which usually useable. The under (middle) positioned “moving-averages – Mozgó átlag” is always late with one step, the others, like exponential (too big increase), logarithmical (for quite big changes reducing, like sound strength - dB) is questionable where to use.

Suggested to click the bottom positioned “Equation shown” and “R^2 is shown on diagram” check-boxes also!

After setting a linear and a 4th ranked polynomial we get the following diagram:



3. Figure Trend-fitting setting



4. Diagram Regression or trend + polynomial-(4th degree) trend fitting

The shown equations can be tested by using the x – variables in this case from 1 till 12. Tested, and it gives back 0,341 r square.

As it can be seen, the linear trend has 0.3417 correlations square, which means a 0.5845 correlation (not too high), while the polynomial trend has 0.8722 r^2, which means quite high 0.9339 correlation. The only failure in the polynomial trend, that before and after the known period it usually keeps to the positive or to the negative infinite, so using it for forecasting is absolutely a “not suggested/forget it” category. For regression of the known period is ideal, for anything other is freaky.

Normally the linear trend is the basic (anywhere) for regression and forecasting, for the most important is, that without any trend turn, it can give “good enough” results. For longer terms without trend turn quite good results, but the real life is a bit different. In that case, when the phenomena (time-series) is better wavy the trend is good for nothing, or it shall be combined with a wave-function. Till trend-turn it will be much better.

The forecasting chapter is supplied in forecast_en.pptx file.

3.2 Logical interdependence – Expert Systems:

The source of the 2.2 chapter is (Pitlik, 1997)

The following points are relatively new and comprehensive in nature (crystallize looking) on the basis of the above, as well as literature (Kurbel, Wagner) theses at the Expert Systems (EXS), among the critical analysis that follows with the unconcealed intention to implement this method, and the mystique fog shall be dissolved, this technology is the simple reality of implicit interpreting. Expert systems are computer programs, which belongs to artificial intelligence (MI) research in science area. Similar to the concept of artificial intelligence, expert systems (EXS), there is no accepted definition. You can find a stopgap arrangement, such in the followings composed.

- in the context of a specific issue, in the case of special questions capable for conclusions to draw on the basis of knowledge,
- or by using an Expert System, the human problem-solving-ability is model able in relation to the specific focal points.

With the first "definition" that is wrong, that the substantive indicator (smart) cannot bounded well. No one can decide about the two concludes (the vendor's procedures), which may be regarded as (more) smart(er), or weather can either or both seen as intelligent/smart.

The second "definition" claims that the human problem-solving-ability, which we do not know, because the area's specialists neither able to define, but can be modeled as an amorphous, i.e. the same as another, similar system can be created design.

The central question in the problem-solving and data-information-knowledge to define concepts on the basis of ideas raised by following pragmatic definition of the concept of the expert system, the following is proposed:

The expert system is a procedure that allows handling to connections of arbitrary factors (state combinations) the consequences of the relationship system in a computerized form.

So an EXS is able to answer the "what is/will be, if" question, that is, or has the ability to model the reality through of relationships mappings. So an EXS is the objective knowledge's conscious form and can be transformed to algorithms.

With regard to the characteristics listed in the previous for EXS's is still no such a character in which it would differ from any function (mapping) returning process, which is a mathematical, a statistical procedure (discriminant analysis, regression analysis) etc.

In addition to defining the type of factors that, what kind of relationship can be handled in an EXS:

The Expert System (EXS) is so rule based, that is fundamentally based on logical operations and basically non-metric scales (options of factor, like colors, ranks) are being handled.

This complex definition might have been able to force the airy concepts onto the ground, and the deprive the definition of the EXS from any mysticism. The EXS logic is nothing so different from any other mathematical or statistical processes that are able to give assignments. The possible starting situations and the available function-creating (mapping) can be according to the specific procedures for the components. Every relationship is a matter of common search procedure, that is, "what is a kind of relationship, on the basis of certain criteria which gave the starting situation is best fit?"

3.2.1 Rule based –EXS intuitive

By the classical Wagner definition is able to handle logical interdependencies (rule based) between attributes connected with and/or. The Attributes has discrete options.

The following example is a close example for each student: Basic or **Main question**:"What will happen with the BA student in the end of the term?"

Depends on (**Attributes**):

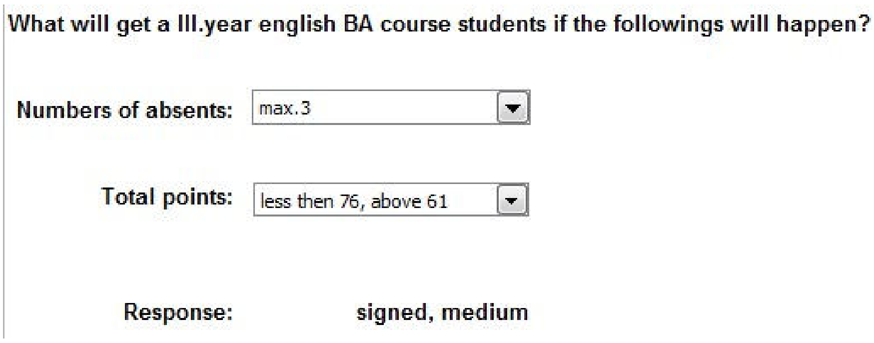
- How many absents (under 3, or equal or above 3 – 2 **options**)?
- How many points are obtained (5 **options**)?

On the base of it a Decision Matrix can be formed, where the number of columns are not else than multiplying the attribute's options, like 2*5=10. See in next table:

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	**attributes**	**options**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
3	Numbers of absents:	more than 3	1	1	1	1	1	0	0	0	0	0
4		max.3	0	0	0	0	0	1	1	1	1	1
5	Total points:	less then 51	1	0	0	0	0	1	0	0	0	0
6		less then 61, above 51	0	1	0	0	0	0	1	0	0	0
7		less then 76, above 61	0	0	1	0	0	0	0	1	0	0
8		less then 86, above 76	0	0	0	1	0	0	0	0	1	0
9		above or equal 86	0	0	0	0	1	0	0	0	0	1
10			**1010000**	**1001000**	**1000100**	**1000010**	**1000001**	**0110000**	**0101000**	**0100100**	**0100010**	**0100001**
11												
12		**result in the end of the term:**	no signature (see you next year)	no signature (see you next year)	no signature (see you next year)	no signature (see you next year)	no signature (see you next year)	signed, insufficient	signed, eligible	signed, medium	signed, good	signed, very goo

2. Table Decision Matrix for EXS (own source)

The Graphical user interface (GUI) is the following (3rd Table):

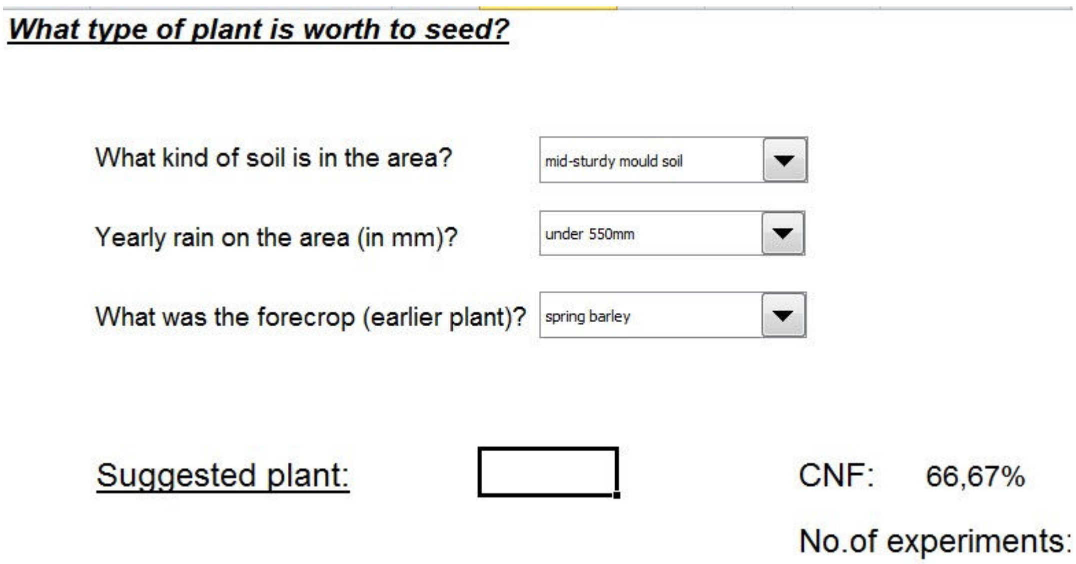


3. Table The GUI for the base EXS (own source)

3.2.2 Inductive – EXS

In an inductive EXS the rules are mapped down from the reality, usually on a frequency (probability) base. For mapping down the rules a database is needed.

In this example the Main question is: What type of plant is worth to seed?



4. Figure GUI for inductive EXS (own source)

The database looks like this (part):

Place of source	Date	felmérés alapja:	soil type on area?	Yearly rain (in mm)?	forecrop (earlier plant)?	Produced plant:	Experiment id.	Plant	
Hajdú-Bihar county	1999	hypothese	chernozem	under 550 mm	soft wheat	spring barley	K1	T	T: spring barley
Hajdú-Bihar county	1999	hypothese	brown forest soil	above 550 mm	corn/maize	soft wheat	K2	Ö	Ö: soft wheat
Hajdú-Bihar county	1999	hypothese	mid-sturdy mould soil	under 550 mm	sunflower	corn/maize	K3	K	K: corn/maize
Hajdú-Bihar county	1999	hypothese	other	above 550 mm	sugar beat	soft wheat	K4	Ö	C: sugar beat
Hajdú-Bihar county	1999	hypothese	chernozem	under 550 mm	potatoe	sugar beat	K5	C	N: sunflower
Hajdú-Bihar county	1999	hypothese	brown forest soil	above 550 mm	spring barley	soft wheat	K6	Ö	B: potatoe
Hajdú-Bihar county	1999	hypothese	mid-sturdy mould soil	under 550 mm	soft wheat	soft wheat	K7	Ö	
Hajdú-Bihar county	1999	hypothese	other	above 550 mm	corn/maize	soft wheat	K8	Ö	
Hajdú-Bihar county	1999	hypothese	chernozem	under 550 mm	sunflower	spring barley	K9	T	
Hajdú-Bihar county	1999	hypothese	brown forest soil	above 550 mm	sugar beat	potatoe	K10	B	
Hajdú-Bihar county	1999	hypothese	mid-sturdy mould soil	under 550 mm	potatoe	soft wheat	K11	Ö	
Hajdú-Bihar county	1999	hypothese	other	above 550 mm	spring barley	sunflower	K12	N	
Hajdú-Bihar county	1999	hypothese	chernozem	under 550 mm	soft wheat	sugar beat	K13	C	
Hajdú-Bihar county	1999	hypothese	brown forest soil	under 550 mm	corn/maize	soft wheat	K14	Ö	
Hajdú-Bihar county	1999	hypothese	mid-sturdy mould soil	under 550 mm	sunflower	spring barley	K15	T	
Hajdú-Bihar county	1999	hypothese	other	above 550 mm	sugar beat	spring barley	K16	T	
Hajdú-Bihar county	1999	hypothese	chernozem	under 550 mm	potatoe	sugar beat	K17	C	
Hajdú-Bihar county	1999	hypothese	brown forest soil	above 550 mm	spring barley	soft wheat	K18	Ö	
Hajdú-Bihar county	1999	hypothese	mid-sturdy mould soil	under 550 mm	soft wheat	soft wheat	K19	Ö	
Hajdú-Bihar county	1999	hypothese	other	above 550 mm	corn/maize	corn/maize	K20	K	
Hajdú-Bihar county	1999	hypothese	chernozem	under 550 mm	sunflower	soft wheat	K21	Ö	
Hajdú-Bihar county	1999	hypothese	brown forest soil	under 550 mm	sugar beat	soft wheat	K22	Ö	
Hajdú-Bihar county	1999	hypothese	mid-sturdy mould soil	under 550 mm	potatoe	soft wheat	K23	Ö	

4. Table Database table for and inductive EXS (own source)

The G column contains which was after the forecrop. As there are 3 attributes with 4, 2 and 6 options (48 columns will be the Decision Matrix) the database sheet contains 392 samples which means averagely 8,16 sample for one option combination (like chernozem, under 500mm and potatoe).

On the base of this database, a pivot can be created by Insert/Pivot which after some dimensioning and setting looks like this. In the end columns the CNF means Confidence factor, where e.g. 50% means 7 identical out of 14 samples, staying by the earlier example: chernozem, under 500 mm and potatoe, the sugar beet had the highest presence. If we have the distribution or presence %, than with a max() function we can get highest rate, and with the help of the vertical vlookup function the name of the mostly sowed plant can be found.

Mennyiség : Kísérlet — Produced plant

soil type on area?	Yearly rain (in mm)?	What was the forecrop (earlier plant)?	corn/maize	potatoe	soft wheat	spring barley	sugar beat	sunflower	CNF:	
chernozem	under 550 mm	soft wheat	0,00%	0,00%	13,33%	46,67%	40,00%	0,00%	46,67%	spring barley
		corn/maize	50,00%	0,00%	33,33%	16,67%	0,00%	0,00%	50,00%	corn/maize
		sunflower	0,00%	0,00%	35,71%	64,29%	0,00%	0,00%	64,29%	spring barley
		sugar beat	33,33%	0,00%	0,00%	66,67%	0,00%	0,00%	66,67%	spring barley
		potatoe	35,71%	0,00%	7,14%	7,14%	50,00%	0,00%	50,00%	sugar beat
		spring barley	16,67%	0,00%	16,67%	16,67%	50,00%	0,00%	50,00%	sugar beat
	above 550 mm	soft wheat	0,00%	0,00%	33,33%	16,67%	50,00%	0,00%	50,00%	sugar beat
		corn/maize	50,00%	0,00%	33,33%	16,67%	0,00%	0,00%	50,00%	corn/maize
		sunflower	16,67%	0,00%	16,67%	66,67%	0,00%	0,00%	66,67%	spring barley
		sugar beat	33,33%	0,00%	0,00%	66,67%	0,00%	0,00%	66,67%	spring barley
		potatoe	60,00%	0,00%	0,00%	40,00%	0,00%	0,00%	60,00%	corn/maize
		spring barley	16,67%	0,00%	16,67%	16,67%	50,00%	0,00%	50,00%	sugar beat
brown forest soil	under 550 mm	soft wheat	14,29%	0,00%	14,29%	71,43%	0,00%	0,00%	71,43%	spring barley
		corn/maize	46,67%	0,00%	20,00%	26,67%	6,67%	0,00%	46,67%	corn/maize
		sunflower	14,29%	0,00%	28,57%	57,14%	0,00%	0,00%	57,14%	spring barley
		sugar beat	0,00%	0,00%	37,50%	62,50%	0,00%	0,00%	62,50%	spring barley
		potatoe	0,00%	33,33%	16,67%	50,00%	0,00%	0,00%	50,00%	spring barley
		spring barley	20,00%	0,00%	60,00%	20,00%	0,00%	0,00%	60,00%	soft wheat
	above 550 mm	soft wheat	0,00%	0,00%	57,14%	28,57%	14,29%	0,00%	57,14%	soft wheat
		corn/maize	54,55%	9,09%	9,09%	18,18%	0,00%	9,09%	54,55%	corn/maize
		sunflower	0,00%	0,00%	14,29%	57,14%	0,00%	28,57%	57,14%	spring barley
		sugar beat	10,00%	10,00%	10,00%	60,00%	10,00%	0,00%	60,00%	spring barley
		potatoe	28,57%	0,00%	0,00%	42,86%	14,29%	14,29%	42,86%	spring barley
		spring barley	6,25%	0,00%	18,75%	6,25%	37,50%	31,25%	37,50%	sugar beat
mid-sturdy mould soi	under 550 mm	soft wheat	26,67%	0,00%	26,67%	40,00%	6,67%	0,00%	40,00%	spring barley
		corn/maize	37,50%	0,00%	25,00%	25,00%	12,50%	0,00%	37,50%	corn/maize
		sunflower	13,33%	13,33%	13,33%	60,00%	0,00%	0,00%	60,00%	spring barley
		sugar beat	33,33%	0,00%	0,00%	66,67%	0,00%	0,00%	66,67%	spring barley
		potatoe	46,67%	0,00%	20,00%	20,00%	13,33%	0,00%	46,67%	corn/maize
		spring barley	28,57%	14,29%	42,86%	14,29%	0,00%	0,00%	42,86%	soft wheat
	above 550 mm	soft wheat	0,00%	0,00%	12,50%	50,00%	37,50%	0,00%	50,00%	spring barley
		corn/maize	20,00%	20,00%	0,00%	60,00%	0,00%	0,00%	60,00%	spring barley
		sunflower	0,00%	14,29%	0,00%	85,71%	0,00%	0,00%	85,71%	spring barley
		sugar beat	20,00%	0,00%	20,00%	40,00%	20,00%	0,00%	40,00%	spring barley
		potatoe	60,00%	0,00%	0,00%	40,00%	0,00%	0,00%	60,00%	corn/maize
		spring barley	0,00%	0,00%	0,00%	33,33%	66,67%	0,00%	66,67%	sugar beat
other	under 550 mm	soft wheat	16,67%	0,00%	16,67%	50,00%	0,00%	16,67%	50,00%	spring barley
		corn/maize	60,00%	0,00%	0,00%	40,00%	0,00%	0,00%	60,00%	corn/maize
		sunflower	20,00%	0,00%	20,00%	60,00%	0,00%	0,00%	60,00%	spring barley
		sugar beat	20,00%	0,00%	20,00%	60,00%	0,00%	0,00%	60,00%	spring barley
		potatoe	25,00%	50,00%	25,00%	0,00%	0,00%	0,00%	50,00%	potatoe

5. Table Knowledge mapping down table for inductive EXS (own source)

Note that in case of 4 possible answers, the equal 25%:25%:25%:25% means, that noone can say anything as none of them has majority above the others. Whether one had majority with 2%, than a classical statistical would examine with t-probe/ f-probe and so on, that whether that 2% is significant deviation or no significant or perhaps only error of the measure…. This is something about we don't deal, 10% sometimes is not a great difference sometimes a great, of course 20% looks more impressive.

3.2.3 One or multi/leveled

It means, that e.g.: in case of TPLL (Third Party Liability -) insurance for cars - which is said to be 5 minutes to make a contract, that was about 30 for me, as identity card, driving-license, vehicle-s traffic permission and anything other was needed – imagine the Expert System, which was about 4-5 screens, from α to Ω or from A till Z. And after it imagine that anything which is in one layer is doubled or tripled by gender, by the address or anything else.

The first example (what will happen with English BA students) that had/has 2 attributes (absence and points) with 2 and 5 options (by each), 10 columns (multiplication of options) by dividing for genders (male/female) we get 2 layers (2*10 separate table) for males and females, and if we insert one other point of view like address (in Hungary there are about 3.200 settlements – villages, towns, and the capital Budapest with 23 districts) it has to be made by 2*3.200 which is 4.600 independent tables, each with 10 columns. Those could be integrated into one, which has 46.000 columns or by transposed into rows. The newer Excels has 16.384 (A-XFD) columns, so only in transposed to rows could contain it.

The earlier mentioned TPLL for cars, other insurance (travel, life, housing etc.) comparing sites (without any commercial nature: netrisk.hu, clb.hu, biztositas.hu etc. don't know how many more) are using the EXS on a relational database base, there are no (theoretical – in practical exists) limitations in number of rows or columns.

4 Planning, and planning in the future

Financial planning should be anytime in the foreground, without respect that in case of a family, a firm, a town, a country etc. The problem, that usually in this order is more and more the ratio of those people (in charge), who is responsible for money spending with more and more money, and with the ratio of more and more wasted money! The source for the next chapters is: (Székely, és mtsai., 1996)

4.1 Decision theory

Decision making in risky environment – mathematical model for "best result" – depending on the decision makers risk attitude.

4.1.1 Application of the Bayes-Laplace theory - the value of the exact information

At the prompt time of a decision, a decision-maker does not have complete information on the expected environmental conditions, factors affecting the future values of the decision. So his decision can only be adjusted that alternative – examining a longer period of time – where the smallest is the risk of fallacy/error. Therefore the risk neutral decision-maker chooses that alternative, for which the results are expected to be the highest. This decision, however, it also means that in the long run the achieved profit will be less averagely, than the decision maker could get if he could tell in advance the changes of environmental conditions at all times. In this case, would choose that alternative, which due to the sure changes of the environment the most outcomes can be achieved.

In the 1st table a sample example can be found to learn the underlying problem, and a solution with the a-posteriori probabilities. The table contains an imaginary decision situation, of course, in a simplified form, in order to raise more the relevant important parts. In this example, a corn grower farmer (owner) must decide whether how long growing-period corn to sow – a1, a2, a3 action alternatives, depending on what kind of the weather can be looked forward along the growing of maize.

For easier understanding the model we assume, that the corn price that is not dependent on the weather which usually effects the market price, the price now is set to 22.00 HUF/kg price, and applied during the result calculation (see in table, 1st block). Then, just off the a1, a2, a3 alternatives of actions shall be examined, to which the estimated yields are given on the base of (depending on) the yearly rainfall (dry, normal, rainy) discrete values, in the 2nd block. The 3rd block's result matrix is created from the 1st and 2nd blocks. The odds of occurrence of different environmental conditions are signed by u1, u2 and u3, which are based on the experience of the last 50 years, and the values are 0.16, 0.64 and 0.20. The last line of the 3rd block, the a1, a2, a3 as action alternatives are the expected values calculated on the LAPLACE–BAYES theorem. That decision- maker, who is indifferent for the risk, would choose the a3 alternative, because this version with the 76.76 thousand HUF/hectare gives the highest expected value. Averaged over a longer time interval, this gross-margin/coverage would get the decision maker as expected value, as in the state of the environment the frequency of occurrence appears, which conforms to the probability values. We assume, therefore, that the owner by the a-priori environmental conditions of occurrence of probabilities estimates took into account of course, a sufficiently long period of time – the a-posteriori odds of occurrence of environmental conditions.

Out of the specified alternatives of actions, the a_3 signed "results" the highest expected values, so the a_3's average gross margin values are placed in the table's 4th block signed as "initial INFO" column.

In contrast, if the owner could forecast the changes in environmental conditions at all times exactly, even before the corn sowing, more or less often could change the action alternatives. From the 3rd block in case of a drier year (u1) the farmer would choose the a1 alternative, since this with the 66.5 thousand HUF/hectare value, is the highest gross margin. In an average year (u2) would change the a2 or a3 marked alternative, nonetheless in a rainy year (u3) the a3 alternative were chosen. The best results of the environmental conditions are located in the table's 4th "INFO" column.

If the environmental conditions during a longer time span occur with 0.16, 0.64 and 0.20 frequency, then the available gross margin 78.28 thousand HUF/ha value can be calculated with weighted average (which formally conforms to the expected value). The value of 1.520 HUF/ha is the available value beside the not full scale information. Therefore, in this case, the owner could pay 1.520 Ft/hectare for a full one year forecasting before he goes on beside the not full scale information. For example, a farmer who grows maize on 100 ha, accordingly yearly could provide close to 152.000 HUF yearly for such a weather-forecast. The value of full scale information increases by the volume of the production.

4.1.2 The value of the more precise information calculated on the base of the Bayesian theorem

It's hardly likely that we would ever have a safe weather forecast system. However, there may be a certain process of forecast projections which is likely to occur.

To explain the situation of the decision look and inspect the 1st table's 5th block. In this case it is assumed that the owner/decision maker, having once looked at 50 years of weather records determined that April's weather behaves like as they were classified into three categories: "dry" (z_1), "normal" (z_2) and "wet" (z_3), in relation to the annual average of the 50 years period, as indicated in the matrix.

1	DATA: Corn price (Price) [HUF/kg]:	22,00
	Cost depending on yield Cost(Yield) [HUF/kg]:	12,50

2 DATA MATRIX the various corn's - early (a1), medium (a2), and late (a3)- yields in different weather conditions/years (uj) [t/ha]

		Action alternatives (a_i)		
environmental conditin	**(u_j)**	a_1	a_2	a_3
cold year	u_1	7,0	6,8	6,0
normal year	u_2	7,6	8,0	8,0
warm year	u_3	8,2	9,3	10,0

3 The RESULT MATRIX of the Gross-margins (GM), in different growing phases of the corn (a_i) in different weather years (u_j); GM=(Price-Variable_Cost(Yield))*Q; [1000 HUF/ha]

		Action alternatives (a_i)		
environmental conditin	**(u_j)**	a_1	a_2	a_3
dry year	u_1	66,50	64,60	57,00
normal year	u_2	72,20	76,00	76,00
rainy year	u_3	77,90	88,35	95,00
Expectable value	q	72,43	76,65	76,76

4 RESULT MATRIX

:

		initial INFO	**sure INFO**	**better INFO**
Average GM-s expected on long term beside any kind of informston	u_1	***	66,50	71,25
	u_2	***	76,00	76,83
	u_3	***	95,00	83,60
Average Gross Margins	>>	76,76	78,28	77,52
Distance from the 2nd coloumn	>>	-1,52		-0,76

5 DATA MATRIX for calculating the (u_j) and (z_k) evironmental conditions probabilities

	Environmental conditions (z_k) (April weathers)				
	dry	normal	rainy		
(u_j)	z_1	z_2	z_3	Σu_j	$p(u_j)$
u_1	**5**	**3**	**0**	8	0,1600
u_2	**7**	**16**	**9**	32	0,6400
u_3	**0**	**4**	**6**	10	0,2000
Σz_k	**12**	**23**	**15**	50	Σ(E)
$p(z_k)$	0,2400	0,4600	0,3000	S(p)	1,0000

6 RESULT MATRIX

for the (conditional) a-posteriori probabilities $p(u_j/z_k)=[p(u_j \ldots z_k)]/p(z_k)$

	(z_k)		
(u_j)	z_1	z_2	z_3
u_1	0,4167	0,1304	0,0000
u_2	0,5833	0,6957	0,6000
u_3	0,0000	0,1739	0,4000

7 RESULT MATRIX

: The expectable values of the action alternatives (a_i) in different environmental conditions (z_k) [1.000 HUF/ha]

	(a_i)		
(z_k)	a_1	a_2	a_3
z_1	69,83	71,25	68,08
z_2	72,45	76,66	76,83
z_3	74,48	80,94	83,60

6. Table The a-posteriori probabilities, taking into account the environmental conditions in order to better forecast for BAYES theorem source: KUHLMANN, f. (2003)

For example, looking at the first row of the matrix it turns out that concerning 8 dry years (u_1), the April was dry for 5 years, for 3 years normal, and was rainy in none of any year. Viewing 32 years April was 16 times normal (u_2), 7 years dry and 9 years rainy. Finally in 10 rainy years (u_3) April was dry in 6 years, in 4 years normal and there was not a single year when April was rainy.

These data are immediately visible to the April and the successive years the relationship between certain weather, anyone can discover the relationship, which could be used to forecast the weather, since the April weather coincides the corn sowing so you can use this information to economic gains. Obviously, the owner/decision maker would like to be even closer/stronger links between weather, but in any event, better than if April's weather were divided evenly (equally) over each year of the three categories (z_k). Of course, it would be desirable if all the dry/normal/rainy weather years like April had been also dry/normal/rainy. In this case, the owner, assuming that the connection concerns the next year also, it would be the perfect weather forecast device in his hand. In the light of April's weather, he could forecast surely in advance the annual weather and therefore choose the right action as the best alternative.

However, the values in the matrix are also to contribute to increase the accuracy of the forecast. In particular, the development of such a forecast, the conditional probabilities has to be calculated for that case(s), when after a certain environmental condition (z_k) occurs as a result a different environment condition (u_j). These probabilities, which are also known as a-posteriori probabilities, to clearly distinguish from the u_j a-priori probabilities of the occurrence of the new environmental state. Their values are calculated on the basis of the Bayes theorem ([2] LIPSCHUTZ, s. 1976). The conditional probability generally expresses that the u_j condition occurs, if the z_k condition already occurred.

$$p(u_j|z_k) = \frac{p(u_j \cap z_k)}{p(z_k)} \tag{1}$$

The $p(u_j \cap z_k)$ is the joint probability that the u_j and z_k conditions occur together and $p(z_k)$ is the probability that a z_k condition occurs.

For determination of the sampling sites, as in the case of the economic problems in every rule can be found, and as that in the matrix's 5th block for 50 years ago has been given, the joint probability, and (2) the equation can be determined very simply.

$$p(u_j \cap z_k) = \frac{|u_j \cap z_k|}{|\Sigma E|} \tag{2}$$

The sum of $|\Sigma E|$ sample, which in our example spans 50 years, the $|u_j \cap z_k|$ is the number of cases for when the u_j and z_k happen jointly. For example, from in the matrix it can be seen that eg.:, $|u_1 \cap z_1|=5$ or $|u_2 \cap z_2| = 16$ etc.

The probability p (z_k) can be defined in the (1) equation's denominator (divider) as follows:

$$p(z_k) = \frac{|\Sigma z_k|}{|\Sigma E|} \tag{3}$$

By inserting the (2) and (3) equation into the (1) equation we get to the final sampling site, to determine the conditional probability:

$$p(u_j|z_k) = \frac{|u_j \cap z_k|}{|\Sigma z_k|} \tag{4}$$

The table's 6th block contains the conditional probability values. For example, the p ($u1 | z1$) value is calculated as follows:

$$p(u_1 | z_1)=(5/50)/(12/50)=5/12=0.4167.$$

With the help of conditional probabilities p ($u | z_k$) the expected value of the a_i action alternatives can be calculated. The expected value of an action alternative can be gotten in that way, that in the case of various a_i action alternatives, the u_j environmental conditions (annual forecast) determined results are weighted with the $p(u_j | z_k)$ conditional probability (being multiplied), to ensure that the already occurred z_k environmental status (April weather) effect on different u_j environmental conditions occurrence, shall appear in the expected value.

$\mu(a_1,z_1)=e_{11} \cdot p(u_1 | z_1)+e_{21} \cdot p(u_2 | z_1)+e_{31} \cdot p(u_3 | z_1)$

$\mu(a_1,z_1)=66{,}5 \cdot 0{,}4167+72{,}2 \cdot 0{,}5833+77{,}9 \cdot 0{,}0000=69{,}83$

To calculate the expected values, so in general the following is applicable:

$$\mu(a_i, z_k) = \sum_{i=1}^{m} e_{ji} \cdot p(u_j | z_k) \qquad j=1,\ldots,n;\ k=1,\ldots,q \qquad (5)$$

The expected values are calculated according to this method are consisted in the table's 7th block. This uses the decision-making matrix that identifies current best action alternatives. In this example, if z_1 condition occurs, you should choose the a_2 alternative, since this alternative's 71.25 thousand HUF value is the highest expected value. By z_2 and z_3 states the a3 should be chosen. The maximum expected value of 3 rows of 4 block "with better INFO" column.

The expected values are calculated according to this method, consisted in the table's 7th block. This matrix is used by the decision-maker to identify the current best action alternative. In this example, if z_1 condition occurs, he should choose the a_2 alternative, since with 71.25 thousand HUF/ha value, this is the highest expected value. For the z_2 and z_3 state the a_3 should be chosen. The maximum expected value of the 3 rows the 4th blocks "better INFO" column contains.

If we take into account the z_1, z_2 and z_3 states, where z_1 = 0.2400, z_2 = 0.4600 and z_3=0.3000 happens with the listed probabilities, then the row's maximal expected values can be weighted with the probabilities in the 4th block, and from the sum of the results, the long-term average gross-margins can be calculated which is the consequent use of April's weather information. The average gross margin of 77.52 thousand HUF/hectare, although that's under with 760 HUF/hectare of the value of u_j environmental condition's sure forecast's, but again with 760 Ft/hectare higher than the value of what could be achieved, if only the a-priori probabilities $p(u_j)$ could be used. In the case when between April's and the annual weather's suspected connection is really appropriate, the owner would pay 720 HUF per hectare in order to determine the temperature in April. This is the value of a better forecast. Of course, this value is in proportion with the volume of production increase. Larger companies can use the information to gain an economic advantage.

The example also even sought to better forecast the more valuable, the closer the relationship between the formerly known as the z_k states, and in newly out formed u_i conditions retrospectively

4.1.3 The attitudes of the risky decisions (on the side of the risk-holder) - decision theory

- **Laplace criterion** - basic assumption that the different fact states occurrence is not known, so anyone may act, if each probability were equal**Maximax criteria** – it's main idea is, that in case of any possible strategy we have to examine/expect/evaluate the best results, so that alternative has to be chosen which gives ("promises") the best result out of the good ones.**Maximin criterion** – also Wald's decision rule, must consider the strategies, the consequences in terms of action versions, and then to choose the best among the worst outcome.The **maximin** and **maximax** criteria should be applied in naturally reverse effect, if it's about cost- or loss-minimization.
- **Minimax criterion** - the possible strategies, that must be chosen which has the least worst outcome. Goal is to minimize the lost profit/benefits.**Hurwicz criteria** forms a transition between the maximin and maximax principle. In case of its application, the so-called optimism coefficient (α), from 0 to 1 scale is the measured optimism of the decision maker. You need to choose a strategy, where this sum (expected value$_i$*coefficient$_i$) amount is maximal.
- **Minimum regret criterion, the smallest regret principle,** namely that, where we need to choose the version of that action for where the minimum amount is needed to miss (compared to the maximum possible), if the events turns to unfavorable.

A hasty signature can be a quite risky decision too – so it's better to think/calculate before any kind of signature/action.

The events are generally unfavorable, if we don't have/don't own some necessary background information. Nothing happened/happen/will happen occasionally (without any reason), and there are only generally quite small, or rather vague, and sometimes false information is what the majority knows.

In Hungary if something turns/happens into unfavorable, at first "you do not need to rush," "not to make a hasty decision", "you should get informed," hey, we have time for that yet," etc. and at last the "the time will solve it."

> „*Otherwise* this is the typical habit of the time anyway*, it will* really *have a kind of* solution*, but* are usually well below the *(expectable)* optimum, so it's not worthy to entrust the matter*, but* many people do not even know *it* exactly when the coffin is nailed down above them.*"* (Antallfy, 2009)

4.1.4 Critics on the Bayes-Laplace theorem

The first thing in the case of the corn grower farmer, that the price was supposed to be 22 HUF/kg. As the weather influences the yield, which influences the Supply (independently from the Demand – no one needs more and more food yearly), the equilibrium price (and any other price also) will be influenced/changed!

The essence in this Bayes-Laplace story is, that the past is clear, and anyone may learn from the past (like inductive Expert-Systems –or in previous schools, the History subject started sometimes with that, to write on the first page, that "The past is a mirror for the future"), so only the "a-posteriori" probabilities are those probabilities that can be used, for planning in the future (on the base of 10-20-30-40-50 years perhaps) – statistically! That part is TRUE, the Yield and Price can be weighted with probabilities – with another one.

Switching to soft-wheat: out of 10 years, there are only 2-3 years, when the yield is above 4.5 ton/hectare (in Hungary, without watering - irrigation). Other 4-5 is normal: from 3-4.5 t/ha, and there are 1-2 years when it's under 3 ton/hectare. So the best result has about 0.25 chances, the normal about 0.55, and the not favorable (less) has about 0.2. These are only frequencies.

That kind of probability can be used for weighting which (see in the forecasting) calculates the direction hit of forecasts. Out of 100 forecasts if we manage to forecast the direction (increase and decrease) in 85 cases, we may plan with quite confidence, but some of the students wouldn't be enough sure/satisfied with 0.95 probabilities even – so it depends on.

The task in yearly planning to calculate/forecast exact yield and price values, to which the area (on how many hectares to sow) shall be optimized. This would be, but now in Hungary everything works in other way.

With the SAPS subsidies (for wheat, corn, sunflower + rape and protein plants like alfalfa) which is about 60.000 HUF/hectare (about 200 EUR- with national top-up), the subsidy is more than the reachable gross-margin/profit. That's why if this can be gotten without production (yes, can get, without national top-up (national extra subsidy)) than we get to that point, that it's not worth to produce. Though it may happen, but most of the areas are still used, though in rented form too, but now the question is better to own area and rent it out as the "guaranteed" revenue (average rental fee e.g.: 50.000 HUF/ha) as profit is more if the capital (money) were in bank. Out of 1 Million HUF as capital (like the price of one hectare land) 50.000 HUF (5%) is more than the 4% interest minus za.20% taxes (about 3.2% is the rest). Those who produce (with rented area also) would have finished anything, if there were no such profit or only losses. So nowadays that strategy is made, that our 6 million hectare is mostly used, as with one machine-line (+ some adapters) anything can be produced which is under the effect of the SAPS subsidy (wheat, corn, sunflower + rape and protein plants like alfalfa).

If anything is produced in a large quantity (like wheat, corn / maize, oily seeds etc.), it will be sellable, but the question always remain - on which price. Usually most of the producers don`t have any contract at fixed price for fixed quantity for next year – as usually anyone better awaits, what will happen, and usually the same happens: if the yield is high than the price is low, or when the yield is less/little than the price is high but as Yield*Price is always the Revenue, than the question still remains – is it higher than the costs (?)– if it were in long-term under, than crop and other agricultural production wouldn’t exist now in Hungary.

The other please read in the forecasts_en.pptx!

4.2 Forecasting – evaluation of forecasts!!

See in in forecast_en.pptx!

5 COCO analysis

On the base of the introduction.pptx, “On the earlier basis, in the Informatics Economy, as anything is almost solved, we only have to compare objects in an objective way…”

So the self_task itself is comparing object (anything which is comparable), any examples can be used, which is out in the course, but a minivan.xlsx is out also in the course as a useable example

The steps of the COCO are the following:

1. Starting data matrix table (rows: objects, columns attributes + values)

Base data								
Modell	Urban fuel consumption (liter\100km)	CO2 emission (g\km)	Guarantee (years)	Usefull load (kg)	Volume of cargo (m2)	Width of cargo (mm)	Lenght of cargo (mm)	Price with 27%VAT (HUF)
Citroen Berlingo 1.6 HDi District L1	6,0	138	2	675	3,70	1 380	1 800	4 186 885
Fiat Doblo 1.6 Multijet Maxi SX	5,5	139	2	750	3,40	1 470	2 060	4 265 900
Ford Transit Connect L1 1.8 TDCi	7,2	143	5	577	2,70	1 538	1 558	4 940 300
Mercedes Citan 109 CDI A2	5,3	112	3	775	3,10	1 219	1 753	4 428 000
Nissan NV200 1.5dCI Acenta	5,8	138	3	814	4,20	1 500	2 040	5 133 594
Peugeot Partner 1.6 HDi Access L1	6,0	198	2	655	3,00	1 230	1 800	4 406 000
VW Caddy 1.6 CR TDi First	6,6	149	2	741	3,20	1 550	1 780	4 384 040

7. Table Starting data table (own source)

2. Ranking order, for each attribute we have to define what is good e.g.: fuel consumption is better when it’s low (1 – in rank function), place for luggage is better when is big enough (0 – in rank function)

3. **RANKING** table: use of the rank() function

	A	B	C	D	E	F	G	H	I
2	Base data								
3	Modell	Urban fuel consumption (liter\100km)	CO2 emission (g\km)	Guarantee (years)	Usefull load (kg)	Volume of cargo (m2)	Width of cargo (mm)	Lenght of cargo (mm)	Price with 27%VAT (HUF)
4	Citroen Berlingo 1.6 HDi District L1	6,0	138	2	675	3,70	1 380	1 800	4 186 885
5	Fiat Doblo 1.6 Multijet Maxi SX	5,5	139	2	750	3,40	1 470	2 060	4 265 900
6	Ford Transit Connect L1 1.8 TDCi	7,2	143	5	577	2,70	1 538	1 558	4 940 300
7	Mercedes Citan 109 CDI A2	5,3	112	3	775	3,10	1 219	1 753	4 428 000
8	Nissan NV200 1.5dCI Acenta	5,8	138	3	814	4,20	1 500	2 040	5 133 594
9	Peugeot Partner 1.6 HDi Access L1	6,0	198	2	655	3,00	1 230	1 800	4 406 000
10	VW Caddy 1.6 CR TDi First	6,6	149	2	741	3,20	1 550	1 780	4 384 040
11									
12									
13	RANKING	1	1	0	0	0	0	0	
14	Modell	Urban fuel consumption (liter\100km)	CO2 emission (g\km)	Guarantee (years)	Usefull load (kg)	Volume of cargo (m2)	Width of cargo (mm)	Lenght of cargo (mm)	
15	Citroen Berlingo	=SORSZÁM(B4;B$4:B$10;B$13)		4	5	2	5	3	
16	Fiat Doblo 1.6 Multijet Maxi SX	2	4	4	3	3	4	1	
17	Ford Transit Connect L1 1.8 TDCi	7	5	1	7	7	2	7	
18	Mercedes Citan 109 CDI A2	1	1	2	2	5	7	6	
19	Nissan NV200 1.5dCI Acenta	3	2	2	1	1	3	2	
20	Peugeot Partner 1.6 HDi Access L1	4	7	4	6	6	6	3	
21	VW Caddy 1.6 CR TDi First	6	6	4	4	4	1	5	

8. Table Ranking table (own source)

4. **COCO_ STAIRS** table, where the values will be given by the solver, it represents, that if one value in one column (the same attribute) is better, than it shall be paid/it’s worth for more (value, money etc.)

5. **STAIRS_ DIFFERENCE** table: Contains the differences between the steps (by attributes), like 1st attribute's 1st step's value - 1st attribute's 2nd step's value, like: S_{11}-S_{12}, S_{12}-S_{13},..., S_{nm}-S_{nm+1}, it's important as with this table, can easily set in solver and ensure later the stairs to be stairs, and not flatland + gap or flatland + mountain.

Lenght of cargo (mm)		STAIRS DIFFERENCE						
787 647	1-2	50000	50000	50000	50000	50000	50000	50000
737 647	2-3	50000	50000	50000	50000	50000	50000	50000
687 647	3-4	50000	50000	50000	50000	50000	50000	50000
637 647	4-5	50000	50000	50000	50000	50000	50000	50000
587 647	5-6	50000	50000	50000	50000	50000	50000	50000
537 647	6-7	50000	50000	50000	50000	50000		=H30-H31
487 647								

9. Table Stairs difference table (own source)

6. **RECOLLECT** table, where the values are being recollect by objects (with vlookup() function), then summed in the end, and can be compared to the real price/value etc. Then in +1st column, the difference is calculated, under the column summed with Sumtotal() function (2 times the vector itself – not to have problem with the negative/positive values – they neutralize each).

COCO STAIRS Modell	Urban fuel consumption (liter\100km)	CO2 emission (g\km)	Guarantee (years)	Usefull load (kg)	Volume of cargo (m2)	Width of cargo (mm)	Lenght of cargo (mm)
1	787 647	787 647	787 647	787 647	787 647	787 647	787 647
2	737 647	737 647	737 647	737 647	737 647	737 647	737 647
3	687 647	687 647	687 647	687 647	687 647	687 647	687 647
4	637 647	637 647	637 647	637 647	637 647	637 647	637 647
5	587 647	587 647	587 647	587 647	587 647	587 647	587 647
6	537 647	537 647	537 647	537 647	537 647	537 647	537 647
7	487 647	487 647	487 647	487 647	487 647	487 647	487 647

RECOLLECT	2	3	4	5	6	7	8	
Modell	Urban fuel consumption (liter\100km)	CO2 emission (g\km)	Guarantee (years)	Usefull load (kg)	Volume of cargo (m2)	Width of cargo (mm)	Lenght of cargo (mm)	Price with 27%VAT (HUF)
Citroen Berlingo	=FKERES(B15;$A$25:$H$31;B$33;0)		637 647	587 647	737 647	587 647	687 647	4 186 885
Fiat Doblo 1.6 Multijet Maxi SX	737 647	637 647	637 647	687 647	687 647	637 647	787 647	4 265 900
Ford Transit Connect L1 1.8 TDCi	487 647	587 647	787 647	487 647	487 647	737 647	487 647	4 940 300
Mercedes Citan 109 CDI A2	787 647	787 647	737 647	737 647	587 647	487 647	537 647	4 428 000
Nissan NV200 1.5dCI Acenta	687 647	737 647	737 647	787 647	787 647	687 647	737 647	5 133 594
Peugeot Partner 1.6 HDi Access L1	637 647	487 647	637 647	537 647	537 647	537 647	687 647	4 406 000
VW Caddy 1.6 CR TDi First	537 647	537 647	637 647	637 647	637 647	787 647	587 647	4 384 040

10. Table COCO stairs and Recolect table (own source)

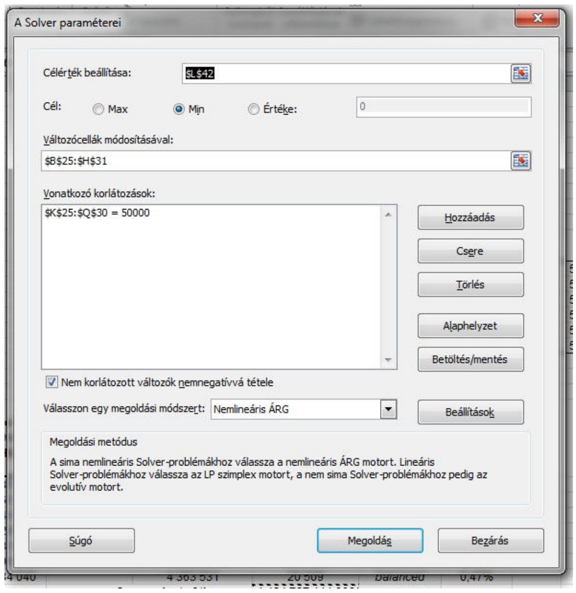
This value has to be minimized, by changing the COCO_STAIRS table's values, + two constraints, the COCO_STAIRS table's values shall be positive, and the Stairs difference table's values shall be equal exactly with 50, 100, 200, 500 etc. (depends on).

Price with 27%VAT (HUF)		How much should it be?	Difference	Verdict	%
4 186 885		4 613 531	-426 646	*balanced*	-9,25%
4 265 900		4 813 531	-547 631	*Cheap*	-11,38%
4 940 300		4 063 531	876 769	*Expensive*	21,58%
4 428 000		4 663 531	-235 531	*balanced*	-5,05%
5 133 594		5 163 531	-29 937	*balanced*	-0,58%
4 406 000		4 063 531	342 469	*balanced*	8,43%
4 384 040		4 363 531	20 509	*balanced*	0,47%
		Sumproduct of the error:	1 424 727 111 809		

11. Table Result Table with verdicts (own source)

7. **SETTING the Solver (see the 5th Figure!)**
    a. the sumproduct of the error shall be minimized or set to zero
    b. by changing the COCO stairs table
    c. constraints:
        i. the values of the COCO stairs shall be positive or zero (here the check box signing is the same: non limited variables are set to positive)
        ii. the stairs difference shall be set to fix value, like 100, 500 etc. depends on

Then the solver shall be run minimal twice, and after it the results may be interpret. Next to it a COCO_INVERSE run is needed too, which is not else than changing the ranking orders direction. For easier, right click on the worksheet and copy to, than enough to change the 0 to 1, and the 0 to 1 (0: the higher is the better, 1: the smaller is the better). The result should be the same, but the differences shall be under the COCO_DIRECT result values by 2%.



5. Figure Solver settings (own source)

+1 COCO Y(0), where the Y value (price) is taken into the X-s, and complete with a new Y which has a standardized value like 1.000 or 10.000 or 1.000.000 – depends on the original values.

6 References

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