

SIMULATION OF PETROL STATION COMPETITIVE ENVIRONMENT

Abstract: The article deals with the decision making in the field of economy and management. The tool for decision making is represented by two dimensional partial differential equations of second order. The solution is focused on the judgmental forecasting of competitive environment in the branch of petrol stations. At first the theory is mentioned, then the way of building up a model and finally the case study of competitive environment of placement of a new petrol station is discussed.

Keywords: simulation, competitive environment, model, petrol stations

1 Introduction

The article deals with the build up of a model for judgmental forecasting in petrol station competitive environment. It presents the model, explains the used variables and their interpretation in the competitive environment. The case study presents the application of decision making – build up or not a new petrol station and where to place it. The two dimensional partial differential equation of second order is used for the simulation as a support of decision making process.

2 Theory

The meaning of used variables in competitive environment model in petrol station branch is as follows: The values of “cells” represents the utilization of petrol station $D_{t,i,j}$ with index of time t and coordinates i, j . The utilization is in the range from $+100\%$ to 0% , where $+100\%$ means the maximum petrol station utilization and 0% means the zero utilization of petrol station represented by profit. The value K is a simulation constant. The constants $Kx_{i,j}$ and $Ky_{i,j}$ present the rate of “influence” of competition environment in the direction of coordinates x, y of each cell. Each cell O_{ij} is coded in the following manner:

- a) any influence (except initial condition),
- b) solid obstacle,
- c) positive and constant influence,
- d) positive and variable influence,
- e) negative and constant influence,
- f) negative and variable influence.

The program was designed for the simulation of the competitive environment. The input values are constants K , $Kx_{i,j}$ ($n \times m$), $Ky_{i,j}$ ($n \times m$), matrix $D_{0,i,j}$ ($1 \times n \times m$) (initial conditions of petrol station utilization in time $T_0 = 0$), matrix O ($n \times m$) (code of each cell). The last item is the time T_{ends} , the end time of calculation of competitive environment. The differential equation was used for the simulation in the form

$$D_{t+1,i,j} = D_{t,i,j} + K \left[Kx_{ij} (D_{t,i,j-1} - 2D_{t,i,j} + D_{t,i,j+1}) + Ky_{ij} (D_{t,i+1,j} - 2D_{t,i,j} + D_{t,i-1,j}) \right]. \quad (1)$$

The parameters for simulation Kx_{ij} and Ky_{ij} are set up by means of fuzzy logic and K is a simulation constant.

The details of the program were described in Dostál [1,3] and applications in other branches in Dostál et al. [4,5,6,7].

3 Case study

The case study presents the situation of 12 existing petrol station in the territory of part of town Brno in Czech Republic and the simulation done for the support of decision making process to build up a new one or not and where to place it. The petrol stations for judgmental forecasting are marked by number from 1 to 12 and 13a, 13b at Figure 1. The initial state is represented graphically at Figure 2 and numerically at Figure 3.



Fig.1 The placements of petrol stations

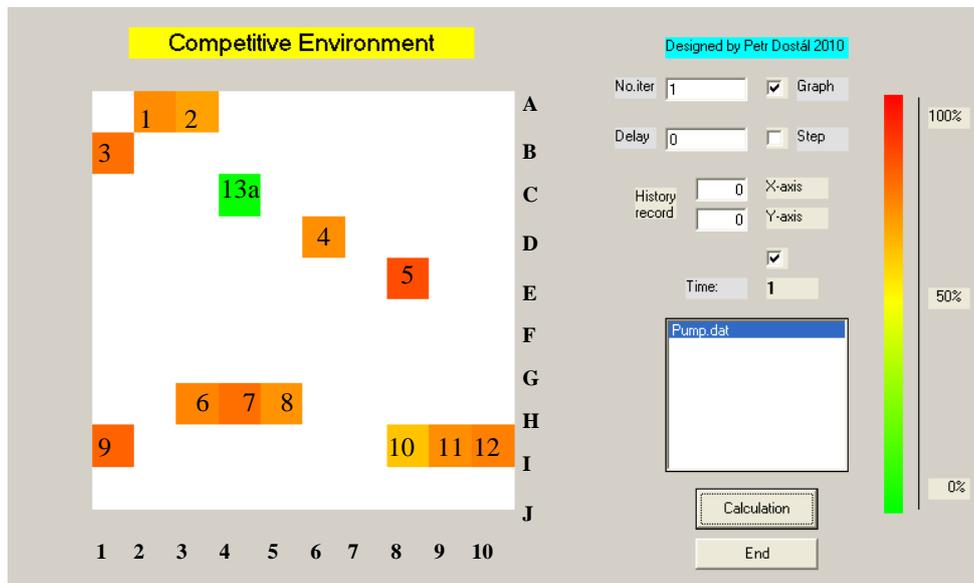


Fig.2 The initial situation of petrol stations

	1	2	3	4	5	6	7	8	9	10	
A	000	073	068	000	000	000	000	000	000	000	
B	078	000	000	000	000	000	000	000	000	000	
C	000	000	000	000	000	000	000	000	000	000	
D	000	000	000	000	000	072	000	000	000	000	
E	000	000	000	000	000	000	000	085	000	000	
F	000	000	000	000	000	000	000	000	000	000	
G	000	000	000	000	000	000	000	000	000	000	
H	000	000	074	078	071	000	000	000	000	000	
I	081	000	000	000	000	000	000	062	072	075	
J	000	000	000	000	000	000	000	000	000	000	

Fig.3 The initial situation of petrol stations

The decision making process uses simulation whether to build up (or not) a new petrol station No.13a in sector C4 or No.13b in sector J6. Therefore the value of utilization of petrol station is zero at the start of simulation. The simulation model includes the influence of surroundings, the availability, population density etc. The petrol stations are of various companies therefore there is a strong influence on competitive environment. The influx of new customers is the subject of solution by means of simulation. The most important fact of judgmental forecast is the future utilization of petrol pump No.13a in case of its build up. The process of simulation was done and the results are presented at Figure 4 and at Figure 5 for sector C4. The same simulation was done for petrol station No.13b in sector J6.

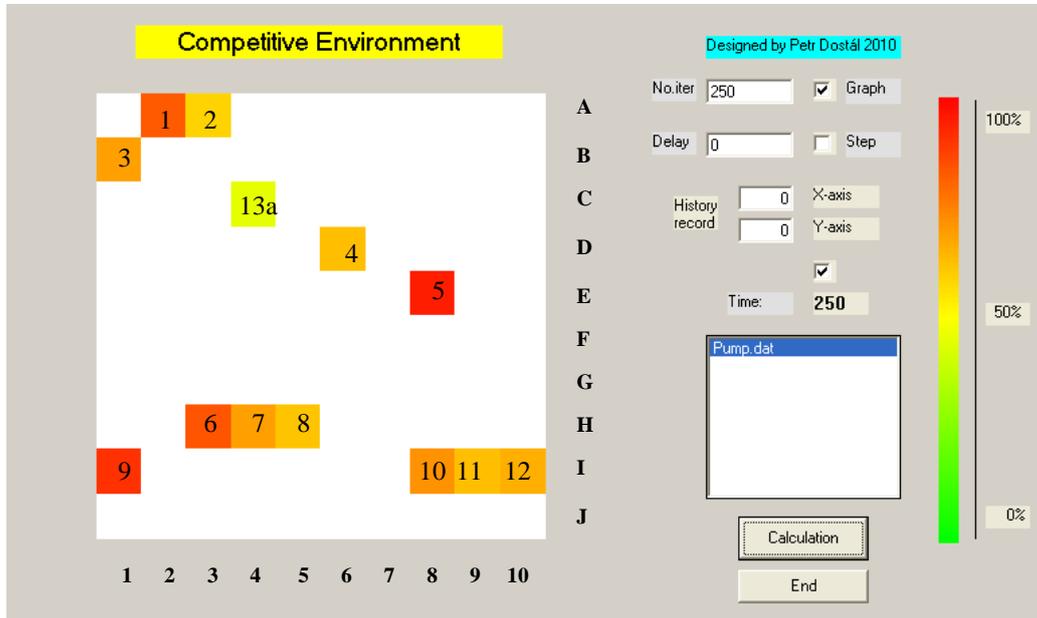


Fig.4 The situation of petrol stations after 250 days

	1	2	3	4	5	6	7	8	9	10	
A	000	082	059	000	000	000	000	000	000	000	000
B	069	000	000	000	000	000	000	000	000	000	000
C	000	000	000	045	000	000	000	000	000	000	000
D	000	000	000	000	000	063	000	000	000	000	000
E	000	000	000	000	000	000	000	094	000	000	000
F	000	000	000	000	000	000	000	000	000	000	000
G	000	000	000	000	000	000	000	000	000	000	000
H	000	000	083	069	062	000	000	000	000	000	000
I	090	000	000	000	000	000	000	071	063	066	000
J	000	000	000	000	000	000	000	000	000	000	000

Fig.5 The situation after 250 days of simulation

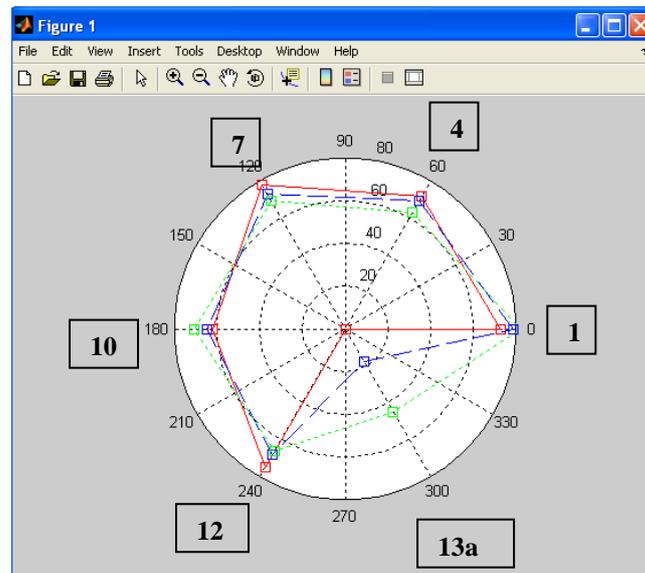


Fig.6 The utilization of some petrol stations

The results of calculations is possible to present by a spider graph presented at Figure 6, where the petrol stations No. 1, 4, 7, 10, 12 and 13a were drawn in time T_0 (full line), T_{125} (dashed line) and T_{250} (dotted line). The graph enables the search of dynamic changes of utilization of petrol stations given by influx of new customers. The low increase of utilization of petrol stations No.13a supports the solution not to build up a new one in sector C4.

4 Discussion

The simulation after 250 days gives the following results. The utilization of warehouse No.13a in sector C4 increased only from 0% to 45% and it gives the support for decision makers – not to build there a new one. The build up of a new petrol station decreased the utilization of petrol stations in neighbouring areas, not in further area. The change of place can lead to better utilization. The utilization of petrol station No.13b reached 75% in sector J6 and it gives the support for decision makers – to build there a new one, especially when the aggressive advertising campaign will be done.

5 Conclusion

The result of simulation and decision making process is clear. The low increase of utilization of petrol station No.13a supports the solution not to build up a new one in sector D4. The aggressive advertising and placement of a new petrol station No.13b in the sector J6 supports solution to build up a new one.

The mentioned designed model is focused on the field of environment among petrol stations. The described method of the build up of a model and its realization by suggested program enabled the search for strategy of placement of petrol stations that are very important for the decision makers. The calculation can leads to right decision with the aim to decrease costs and save money of companies and firms. The designed method can be used not only for petrol station environment by also for example for hospitals, banks, companies, firms, warehouses, suppliers or customer relations etc.