THE PREDICTION OF HOSPITAL COMPETITIVE ENVIRONMENT

Abstract: *The article deals with the possible build up of a model of hospital competitive environment. Two dimensional partial differential equations of second order are used. At first the theory is mentioned, than the way of build up of a model and finally the case study in health sector is mentioned. The two and three dimensional graph together with polar graph is used for evaluation. The method can be used in any field of competitive environment such as markets, banks, firms, supplier-customer relations, etc.*

1. INTRODUCTION

The two dimensional partial differential equations of second order can be used for the simulation of hospital competitive environment. The article presents the equation necessary for calculation, explains the used variables and their interpretation in the competitive environment. The case study presents the use in the field of hospital competitive environment. Some hospitals have positive influences because of these facts, they are new, they are big, they provide quality health care, they are specialized, they have very well educated doctors, top medical devices, quality management, good reputation and so on and vice versa.

2. THEORY

Two dimensional partial differential equations of second order will be used for simulation of competitive environment in the form

$$\frac{\partial D}{\partial t} = K_x \frac{\partial^2 D}{\partial x^2} + K_y \frac{\partial^2 D}{\partial y^2}.$$

The equation is in a differential form [Dostál 2008]

$$D_{t+1,i,j} = D_{t,i,j} + K\left[K_x\left(D_{t,i,j-1} - 2D_{t,i,j} + D_{t,i,j+1}\right) + K_y\left(D_{t,i+1,j} - 2D_{t,i,j} + D_{t,i-1,j}\right)\right]$$

where $K = \dfrac{\nabla t}{(\nabla x)^2}$.

3. BUILD OF THE MODEL

The meaning of used variables in the problems of build up of a model of competitive environment is as follows: The values of "cells" of competitive environment $D_{t,i,j}$ with index of time t and system of coordinates i, j are presented by the range from *+100%* to *-100%*, where *+100%* means maximum negative competitive environment and *-100%* means maximum positive competitive environments. The value *0%* means neutral competitive environment. The definition of variable of competitive environment D depends on a concrete application. In our case of hospitals it can be defined by the count of clients of hospitals and inhabitants of parts of towns and/or their attitude which hospital to visit. The various counts and their changes create the competitive environment. The variable for competitive environment D has the first derivative of competitive environment D' that presents the flow of the competitive environment and the second derivative D'' presents the acceleration of competitive environment.

The value K is a simulation constant. The constants K_x and K_y present the rate of spread of competition environment in direction of *x* and *y*. Each cell $O_{i,j}$ is coded in the following manner:

 a) any influence on competitive environment (except initial condition),

b) solid obstacle (obstacle for competitive environment),
c) positive and constant influence on competitive environment,
d) positive and variable influence on competitive environment,
e) negative and constant influence on competitive environment,
f) negative and variable influence on competitive environment.

The program was designed for the simulation of the competitive environment. The input values are constants K, K_x, K_y, matrix $D_{0,i,j}(n \: x \: m)$ (initial conditions D of competitive environment of each cell in time $T_0 = 0$), matrix $O(n \: x \: m)$ (code of each cell). The last item is the time T_{end}, the end time of calculation of competitive environment.

4. REAL CASE

The real case presents the situation of hospital competitive environment presented among hospitals placed in town. The name of town and name of hospitals are marked by number $1,2,3,4,5,6,7,8,9,10$ from the reasons of sensitive data and information. (See fig.1).

Fig.1 The places of hospitals

Fig.2 presents situation of hospital competitive environment from the point of public and transport availability that influences the decision making of patients. The spectrum of colours is used from red (*100%*), through yellow (*0%*) to green *(-100%)*. The scale of colours presenting the value of competitive environment D is displayed on the right part of the screen. Each cell has a colour, its value corresponds with the value of the competitive environment D after calculation 80 days, from green, via yellow to red. The situation in end time ($T_{80} = 80$) is as follows. Some cells have negative, some positive and some neutral influences on the competitive environment D. The simulation includes the changes of public and transport availabilities by construction of new

routes, parking places, tram and bus lines, new building and housing estates etc that influence the attitude of patients which hospital visit in town. Other studies can be focused on the quality of health care, good reputation of hospitals, recommendation of doctors etc. or all attitudes can be searched together.
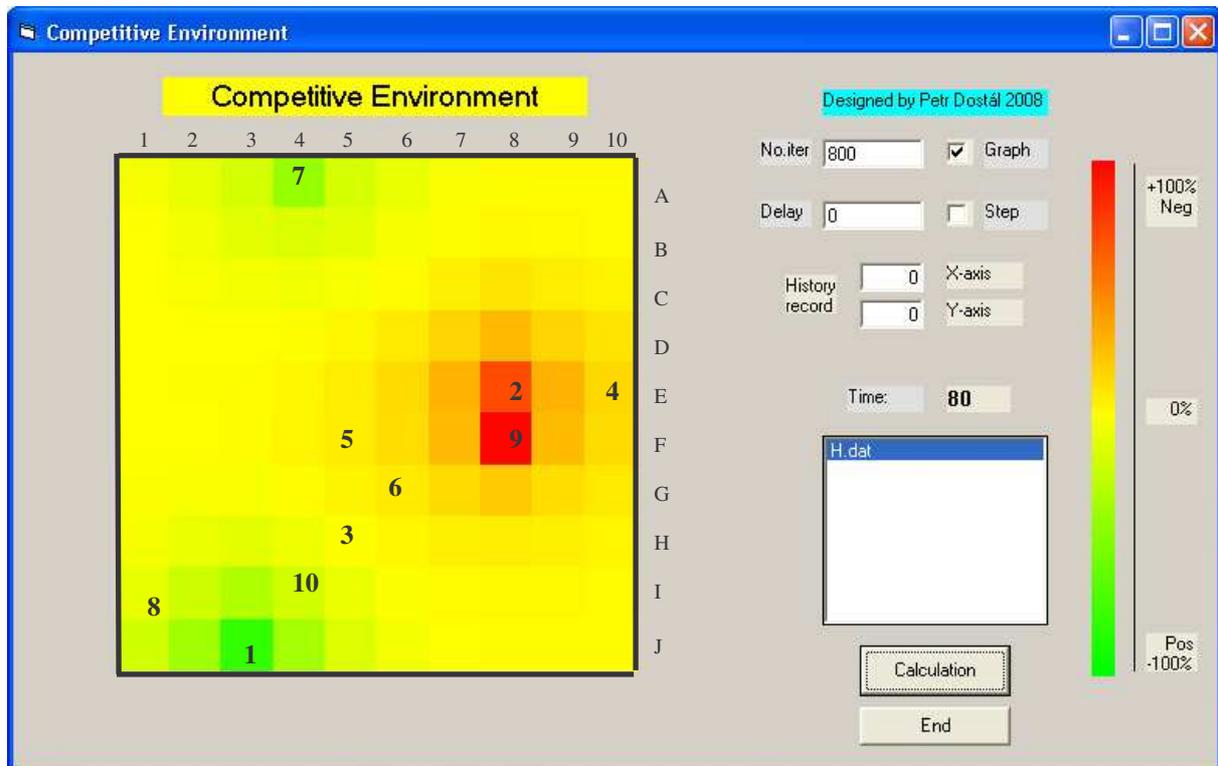

Fig.2 The situation after 80 days of simulation

Some hospitals have constant behaviour, others hospitals have behaviour changing in time. This dependence was generated by defined functions and partially by chaotic and pseudorandom generator. The hospitals influence each other. The calculation is programmed in MATLAB software and the results are exported into a text file *Dout.txt*. The fig.3 presented the results of fig.2 by a three-dimensional graph. The polar graph was used for the presentation and study of time dependence of hospital competitive environment of hospital no. *1,2,5,7,9* in time T_0 (dotted green line), T_{40} (dashed blue line) and T_{80} (red line). See fig.4.

5. CONCLUSION

The mentioned designed model is focused on the field of hospital competition environment. This method of the build up of a model and its realization by suggested program enables the search for hospital competitive environment that could be very important and its results can be used for decision making processes. The calculation can prevent losses. The designed method can be used not only for hospital competitive environment by also for example for the field of markets, banks, firms, supplier-customer relations etc.
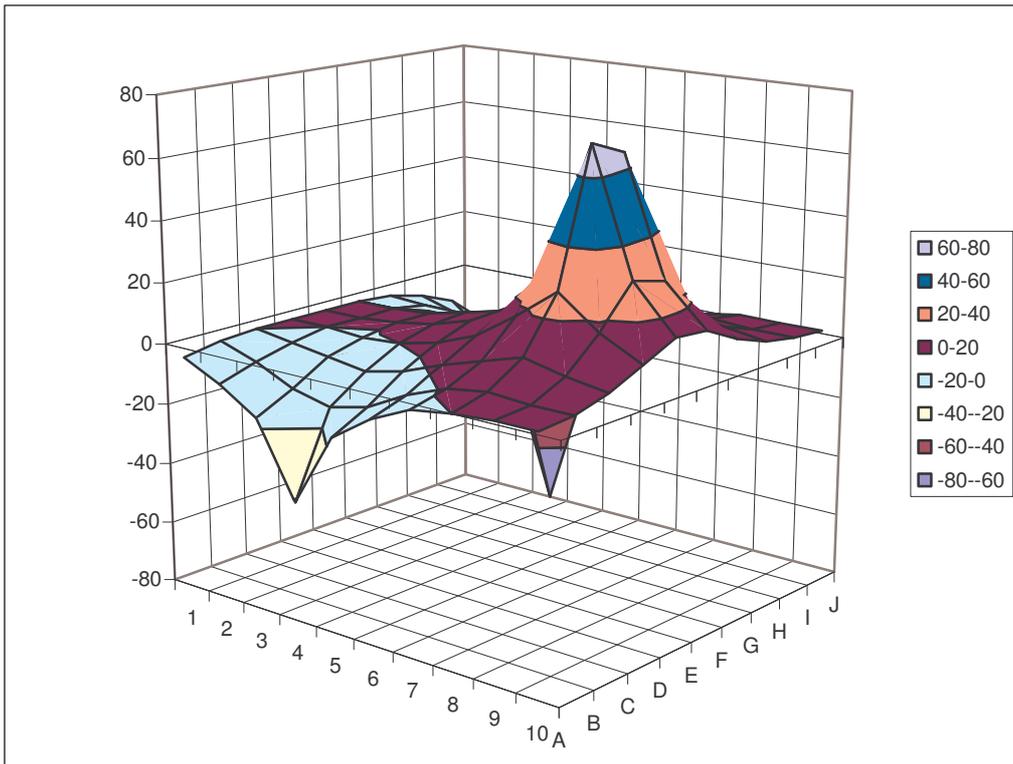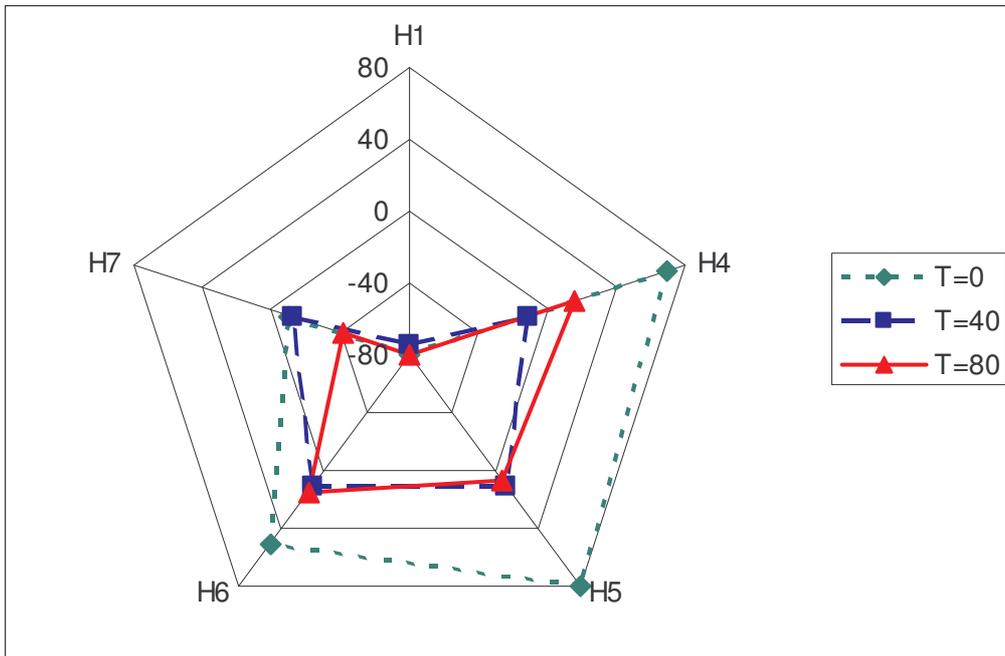
Fig.3 The three-dimensional graph of hospital competitive environment

Fig.4 The polar graph of hospital competitive environment