Graphs, Trees and Forests as Models of Psychosocial Factors

Anita Galuszka[1] **and Adam Galuszka**[2]

[1] Institute of Psychology, Silesian University Grazynskiego 53, 40-126 Katowice, Poland

[2] Institute of Automatic Control, Silesian University of Technology Akademicka 16, 44-100 Gliwice, Poland

Two so-called diseases of civilization were taken into account in this paper: arterial hypertension and neoplasm with bad prognosis (Koszarowski 1985, Sheridan and Radmacher 1992). These diseases were explored under psychological point of view, i.e. such psychological properties like: hope, anxiety, meaning of life, coping with stress, different tests of self-esteem and other health cognitive-emotional processes were explored. Most of these factors describe emotional sphere of human life. Such kind of data are usually analyzed using different statistical tests that verify assumed hypothesis (Brzezinski 1997, Ferguson and Takane 1989). In the case explored in this paper data are special since they are unique in country-scale: over 70 psychosocial factors were determined for almost 200 patients suffering from serious diseases. Moreover the dynamic of these disease were taken into account: the data collection has been divided into 3 stages.

Contribution of this paper is a proposition of graph representation for correlation exploration between all available data and forest representation causality relations between factors. As it is shown such model can describe differences and similarities of cognitive-affective processes between diseases and leads to graphical model of dependences between measured factors.

The data were collected in Upper Silesia hospitals, including the Oncology Center - the M. Skodowska-Curie Institute in Gliwice, and the Central Clinical Hospital of the Silesian Medical Academy in Katowice. We studied 181 patients: 108 with hypertension and 73 with neoplasm. The dynamics of the disease was taken into account in the research. The patients were examined thrice: stage I, 0-10 days from the time of diagnosis, was regarded as the period of shock due to the patients learning about his/her severe chronic illness. Negative emotions (mostly anxiety) were expected at that stage, as well as an unfavorable self-rating of subjective health and a low sense of meaning in life. Stage II was carried out about five weeks after the first examination. In that period the patients could be expected to have adapted to their new life situation. They had enough time to undertake health-promoting activities that would improve not only their physical health, but also emotional state. The patients improved affective condition and involvement in their own treatment should lead to their more favorable self-appraisal of health. Moreover, their perceived meaning in life should be higher than that in stage I. In stage III, about five months from the second examination, the patients could be expected to have markedly adapted to life with their chronic illness.

Finally, the factors are represented by 2 matrices: first collects data for hypertension, second collects data for neoplasm. Both consist of 75 column that correspond to factors. The number of rows corresponds to a number of patients: 108 for hypertension and 73 for neoplasm.

It is assumed that a set V is the set that consists of all factors, i.e. graph for each disease consists of 75 vertices. Nodes from 3 to 19 are for stage I, 20 to 47 for stage II and 48 to 73 for stage III. First and last two describes population properties. It is also assumed that the edge exists when absolute value of Pearsons correlation coefficient between two vertices is greater than 0,5 and significance level is lower than 0,05. The border value of r is chosen arbitrary but is convenient for graph illustration (for lower values of r firstly low correlations are also considered as edges, secondly the number of edges fast increases and the graphs become difficult for presentation). Despite the data are of different kind (used scales are: interval and rating) only the correlation is calculated. This is justified since the correlation coefficients will be treated as weights of graphs edges. Summarizing it can be stated that correlation between factors in different stages are modeled by undirected weighted graph.

Graphs were analyzed in the following way: a) Graph matching problem has been solved to show similarities between two diseases; b) A hypothetical graph model has been introduced to show differences between two diseases.

Directed correlations indicates causality relations. In case of presented graphs the only directed correlations representing cause-effect relations are correlations between vertices (factors) measured in different stages. Basing on this assumption it is possible to construct directed forests for hypertension and neoplasm data.

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