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NEW POSSIBILITIES OF STRATEGIC PLANNING

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Abstract. The report is dedicated to the strategic planning (SP) tasks solutions and forecasting in the wide area of «research and development», namely economic and other goals of target forecasting. Application of popular (probabilistic) statistical methods (analysis of variance (ANOVA) and regression) for SP is discussed. It is necessary to apply distribution free rank criteria, especially expert methods (paired and multiple comparisons) and their generalization (more complicated methods) at least to the extent of GOST 23554.0-79, GOST 23554.1-79, GOST 23554.2-81.

According to the authors' opinion and it is proposed to draw public attention to the acute deficiency of real scientific and practical SP activity. This deficit caused innumerable works (articles and books) about strategic planning (SP) This report is an attempt to resist the above-mentioned non-productive process

Keywords: strategic planning (SP), statistical methods and SP, expert judgement and SP, deficiency of fundamental theory and significant applications, distribution-free rank methods, soft measurements.

> *«I feel that in the last few days we have been exchanging anecdotes and stories with the intention that they will be remembered, at least for a while. I think there is a long Jewish tradition that history and wisdom are being transmitted from one generation to another not through lectures and history books, but through anecdotes, funny stories, and appropriate jokes».*
>
> Amos Tversky (1937–1996) [15]

Since the 60s there have been some well-known models in strategic planning by Saaty AHP/ANP [13]. These multilevel models make it possible to solve direct and reverse problems – forecasting and planning respectively. Yet, from the point of view of carrying out "soft calculations" (for the information about soft measurements and calculations, look up journal "Soft Measurements and Calculations" as well as article by S.V.Prokopchina "Modern Theory of Measurements: Types of Measurements" [10]) these models are disadvantageous. We are here to eliminate these drawbacks.

AHP/ANP models are worked out in such a way that it is possible to estimate how lower levels impact higher levels (for all levels). These impacts are looked upon as non-random variables. Probabilistic approach can be regarded as the fulfillment of "soft" calculations. Such an approach requires a shift from one variable to the confidential interval (that is, random variable) and continuous distribution.

This report is an attempt to build the original model by Saaty with random variables, which meet certain assumptions – impacts are independent, the type of distribution through all the levels is known and all parameters can be estimated.

Let us draw an example which illustrates that high-accuracy measurements do not hold any meaning as estimation in shift location $\mu 1$ is equal to = 38,1°C (a child body temperature). Another value of this parameter estimation is, for instance, equal to = 37,9°C. Their difference is not huge and is equal to 0,2°C and it shouldn't be thought that $\mu 1 > \mu 2$.

The matter is that (Let us assume!):

a) the accuracy of body temperature measurement by a usual thermometer is 0,1 °C,

b) inherent variation of child body temperature centigrade depending on circumstances of measurement (measured in the morning or in the evening, etc)

Accuracy of variations may lead to the amount 0,2-0,3°C, or even more.

Soft measurements can be called body temperature measurements in 10-points scale, in which 3 points (equal to app 36,9°C) and 9 points (equal to app 38,9°C) may signal to the doctor, examining the child, that there is an inflammatory process (on condition that the doctor does not know when the temperature was measured, either in the morning or in the evening). In the meantime, when considered 10-points scale, the difference in 6 points turns quite essential. Under field conditions 10-points scale would be suitable for the "tactile" contact, for example, by putting your palm on the child's forehead.

Difference in 5 or more points is essential.

Let us come back to example 1. Assume

$$Y = \sigma X + \mu, \sigma \neq 0, \quad \text{(G1)}$$

where σ – scale parameter, μ –shift in location parameter. Let us denote all such transformations by

g (X) = g(t) = $\sigma T + \mu, \sigma \neq 0$.

Let us denote via

Pg(x(t)) = P [g(X)ϵB] = P (X ϵ g^{-1} (B)), that is, probability distribution function g(X) is fully defined by probability distribution of vector-argument X. See [3, p. 214-216], [7, p. 146-149].

For linear function:

$$p_{g(x)}(t) = \frac{1}{|\sigma|} p_x\left(\frac{t-\mu}{\sigma}\right) \frac{1}{|\sigma|} p_x\left(\frac{t-\mu}{\sigma}\right) \quad \text{(G2)}$$

If X – discrete vector-argument with function of frequency Px, then g(X) is discrete and has frequency function:

$$p_{g(x)}(t) = \sum_{\{x:g(x)=t\}} p_x(x) \quad \text{(G3)}$$

Assume X is a continuous random variable with density Px, function g is real-valued and one-to-one on open sets S, in which P [$X \epsilon S$] = 1. Assume that derivative $g'g'$ function is g and turn into 0 on S. Then, transformation g(X) is continuous with density:

$$p_{g(x)}(t) = \frac{p_x(g^{-1}(t))\ p_x(g^{-1}(t))}{|g'(g^{-1}(t))||g'(g^{-1}(t))|}, \quad (1)$$

where $t \epsilon g(S)$ and equal to 0 when $t \bar{\epsilon} S$.

Formula (1) is called change of variables formula.

Therefore, we can observe that this structure enables us to model "probabilistic" target trees and target net with the help of variables substitution formula.

This data points out the path to soft measurements and calculations.

Let us consider example 2. Assume that a university management plans to increase performance of majority of students in mathematical statistics (MS).

Let us regard S(x) as performance in MS. It is possible to frame S(x) in the following way:

$$S(x) = A(x) + B(x) + C(x), \quad (2)$$

Where $A_1(x)$ – input to the performance from the increase of academic lecture,

$A_2(x)$ – input to the performance from the увеличения количества семинарских занятий,

$B_1(x)$ – input to the performance from the increase of tutorials,

$B_2(x)$ – input to the performance from the students' motivation rise,

$C_1(x)$ – input to the performance from the teachers' motivation rise,

$C_2(x)$ – input to the performance from the enhancement of the lecture course contents,

$C_3(x)$ – input to the performance from the improvement of study process arrangement

Let us simply assume that variables A_i, B_j, C_k, i = 1,2, j = 1,2, k = 1,2,3 are measured in the same units, for instance, in % (₽) «expenses» for so-called actions (see Figure №1).

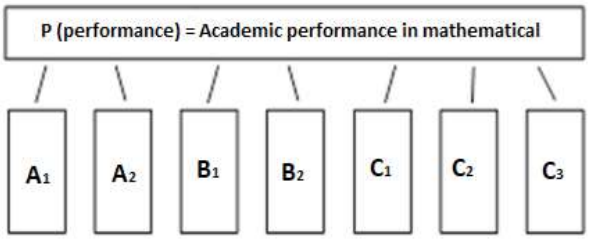

Fig. 1 A model scheme, increasing students' performance level

Here A_i, B_j, C_k, i = 1,2, j = 1,2, k = 1,2,3. Then:

$$\sum_i A_i + \sum_j B_j + \sum_k C_k = 100$$
$$\sum_i A_i + \sum_j B_j + \sum_k C_k = 100 \quad (3)$$

It is possible to use 100-points scale, etc.

In order to get all $A_i(x)$, $B_j(x)$, $C_k(x)$ we can apply statistical methods (like regression analysis), either jointly or seperately from the methods of expert estimation. See [14,9] about regression analysis, GOST 23554.1-79, GOST 23554.1-79, GOST 23554.2-81. GOST 23554.3-81), [16, 17] about expert judgment.

Let us denote F = {i, j, k, i = 1,2, j = 1,2, k = 1,2,3}. To ensure expert estimation of input to the performance (higher target level) of lower targets level it is possible to apply as numerical variables (that is, a_i*, b_i*, c_i*, which correspond to A_i, B_j, C_k $\forall i, j, k \in F \forall i, j, k \in F$), as points, ranks, paired comparison. See [13, 17].

Here we are looking into forecasting performance with known A_i, B_j, C_k. This is, so to call, a direct problem. The problem of performance planning, shown on picture 1, is interpreted as a diverse problem. The performance level is set to reach, for instance, 90 points out of 100-points scale. It is necessary to find A_i, B_j, C_k for all i, j, k.

For example, A_1 is equal to 2 hours per week (additional hours devoted to increase of lecturing).

There is a linear function

$$A_1(x) = a_1 x + \tilde{c_1} A_1(x) = a_1 x + \tilde{c_1} \quad (4)$$

We should estimate $a_1 a_1$and we should apply different methods for it (for instance, least square method, maximum likelihood method, etc.) Let us suppose that the increase of lectures by 2 hours per week will lead to the increase of performance by 10 points by the end of the term. Analysis of variance serves for estimating the hypothesis about the influence of factors on variables. See [12].

In the current climate the Russian and foreign community are taking a much closer look at SP. The evidence of this is received from the Federal Law dated 28.06.2014 N 172-ФЗ [1] and Edict of the Russian Federation President dated 07.05.2018 № 204 [2]. As well as some other works are very illustrative of this issue [4, 5, 6, 8, 12].

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