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EXPERT DATABASES AND EXPERT ESTIMATIONS IN BUILDING MATHEMATICAL INTERPRETATIONS AND MODELS FOR DEVELOPMENT OF ENTREPRENEURSHIP SUBJECTS

Building mathematical interpretations and models for decision making in economics heavily relies on estimating the current and preceding states of a system. The analytical estimation can be done using known mathematical models only in specific cases. Mostly interrelationships, trends, and influence strengths within a new economic system are very hard to fit in an existing model. The reason is the lack of observational data to build a consistent model. The solution is to use expertise and knowledge of managerial staff or external personnel which experienced development of similar systems. Such an usage is commonly referred to as expert estimations.

To conduct and apply an expert estimation, two fundamental conditions are to be held: the expert group should consist of members having the expertise in the field or closely relating to the subject of economical activity (e. g., an enterprise), and estimations of the experts should be consistent. If estimations of an expert come too often inconsistent or of low consistency, the weight of this expert must be respectively decreased. It is done to maintain the quality of estimations. To control the expert weights, a database of the expert group is used. The consistency is controlled by studying basic statistical properties of estimations.

Expert knowledge and estimations are commonly considered as a local study, and so they are not widely highlighted in academic literature, except for some very specific publications in scientific journals. Therefore, the existing theoretical aspects of expert knowledge and estimations are hardly applicable to development of entrepreneurship subjects in small business. Meanwhile, in most countries the small business significantly influences the growth of the gross domestic product. In this way, the goal is to recapitulate the knowledge about using expert estimations in building mathematical interpretations and models for development of entrepreneurship subjects.

The typical database for expert estimations includes a list of expert groups, an enumeration of all experts in those groups, and a list of estimation procedures (Figure 1). The table of experts contains information about every expert: full name, expertise, the group identifier, weight. The table of expert groups contains a description of every group's field and associated fields. This table is connected to the table of experts by the unique number of the group to which the expert is assigned. The table of estimation procedures refers every procedure to the number of the group which participated in it. The successfulness of the participation is registered by an attribute of the logical type. Peculiarities of every procedure are recorded also.

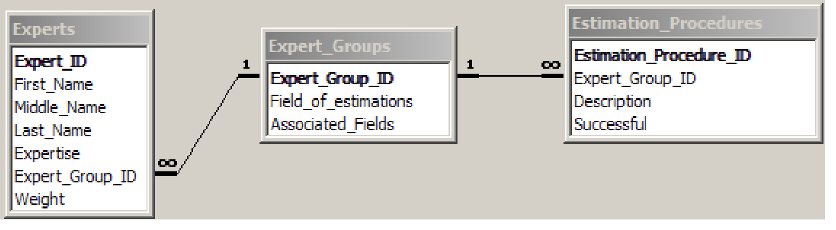

Figure 1. An example of the typical database for expert estimations

Such expert databases are also used to trace estimation procedures of other related expert groups. This is intentionally done to compare performances. The best group may eventually be promoted to participate in new procedures or to have increased salaries, awards, discounts, etc.

Suppose that some parameter a is to be estimated by using a continuous or discrete scale. This parameter somehow relates to the economic activity of an entrepreneurship subject. It may describe the entrepreneurship subject profitability, investment attractiveness, economic security, cooperation potential, etc.

Let there be G expert groups, by L_g experts in group g, $g = \overline{1, G}$. Expert l in group g has its weight w_{gl}, where

$$\sum_{l=1}^{L_g} w_{gl} = 1 \text{ by } w_{gl} > 0 .$$

Expert l in group g gives one's estimate a_{gl} of the parameter. Then the average

$$\tilde{a}_g = \sum_{l=1}^{L_g} w_{gl} a_{gl} \qquad (1)$$

is calculated. The consistency of the estimation procedure is studied by using standard deviation

$$\sigma_g^{(a)} = \sqrt{\sum_{l=1}^{L_g} w_{gl} \left(a_{gl} - \tilde{a}_g \right)^2} \qquad (2)$$

for (1) within group g. Besides, absolute deviation

$$\delta_{gl}^{(a)} = \left| a_{gl} - \tilde{a}_g \right| \text{ by } l = \overline{1, L_g} \qquad (3)$$

for expert l in group g and maximal absolute deviation

$$\hat{\delta}_g^{(a)} = \max_{l=\overline{1, L_g}} \left| a_{gl} - \tilde{a}_g \right| \qquad (4)$$

within this group are calculated. Given the respective tolerable values $\sigma_{\max}^{(a)}$ and $\delta_{\max}^{(a)}$ for (2) and (4), the procedure is counted inconsistent while

$$\sigma_g^{(a)} > \sigma_{\max}^{(a)} \qquad (5)$$

or

$$\hat{\delta}_g^{(a)} > \delta_{\max}^{(a)} . \qquad (6)$$

If (6) holds then those experts for which inequality

$$\delta_{gl}^{(a)} > \delta_{\max}^{(a)} \qquad (7)$$

holds are registered with a purpose to lower their weights (which are tied to reliability of estimates from those experts). Otherwise, if both inequalities (5) and (6) are false, the procedure is counted consistent.

One of the ways to update weights of the experts is to use their competences based on their accuracies in the last estimation procedure, whether it has been successful (consistent) or not. Thus, if $r_{gl}^{(a)}$ is an estimate accuracy of for expert *l* in group *g* with respect to parameter *a*, the weight of this expert for the next procedure is updated as [1]

$$w_{gl} = \frac{r_{gl}^{(a)}}{\sum_{k=1}^{L_g} r_{gk}^{(a)}} \text{ by } l = \overline{1, L_g} . \tag{8}$$

The accuracy, reflecting the quality and proficiency of the expert, can be evaluated in multiple ways using absolute deviations (3). For instance,

$$r_{gl}^{(a)} = \frac{1}{\lambda + \delta_{gl}^{(a)}} \text{ by some } \lambda > 0 \tag{9}$$

to exclude possible division by zero. Constant λ for (9) is selected based on the range of absolute deviations (3) and an intention of the weight updating. Obviously, as λ becomes smaller, the difference among experts' weights grows. This can be used for steeper updatings.

Another group or a few groups may estimate the same parameter. Then a sort of competition among such groups is followed by finally selecting the best group whose accuracies (9) are the greatest. In fact, the expert group may have its weight as well.

Binary estimations are the easiest to conduct and analyze due to the scale for the estimate consists of only two values and the estimation result has plain statistics and interpretation. Besides, this type is the easiest to be implemented in social networks [2] not requiring proficient experts. Furthermore, the number of formal experts (users or guests of a network related somehow to an entrepreneurship subject) is then dramatically increased that makes estimation results more reliable and consistent.

Whenever building mathematical models is intractable, expert estimations are the only approach to interpret a parameter or feature of an entrepreneurship subject in order to improve its productivity and development in general. Estimation procedures and their consistency are used as to evaluate unobservable (non-measurable) parameters, as well as to correct experts' proficiencies evolving as the procedures go on. All the related information is to be stored and updated in expert databases.

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