MATHEMATICAL OPTIMAL CHOICE MODELS SYSTEM OF SAUSAGES ASSORTMENT

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This article is devoted to mathematical models development for making an optimal choice of sausage products using different criteria. The modern stage of technological progress in meat industry is characterised by increasing complexity and by biological raw materials processing intensification, which cause the necessity of system analysis of all different relevant factors and connections between optimal choice criteria function of products' quality and hard limits on technological regime of production.

Problematical decision of given tasks while using usual methods, a big volume of information about supplies and finished products assortment which must be processed as well as sharply changeable demand and supply markets apply to necessity of use of up-to-date computer facilities. In this work the results of implementation of models of optimal choice of sausage products (using different criteria). The special programs' complex is developed, including sausage receipts database, library of optimal models, and working files with description of sausage stock.

In the first model the basic criteria is to maximise profit. This is a mostly common choice when the big amount of supplies and unlimited supply market exist, and when the wide assortment is not necessary. This task can be formulated as following mathematical model:

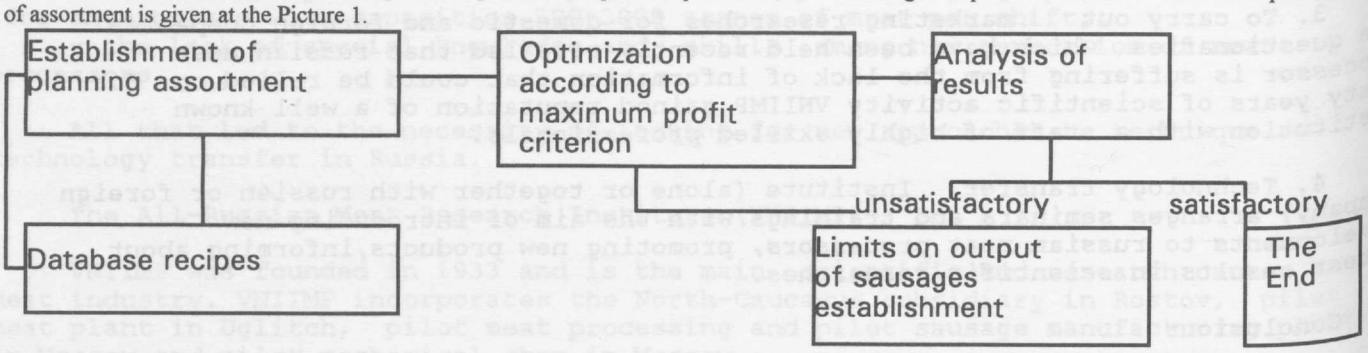
$$\sum_j (Pj -- Cj) Xj -- \text{ MAX}$$

$$\sum_J Yij\, Xj < Si, i = 1,...,I ,$$

$$Xj > 0, j = 1,...,J$$

where Xj -- amount of sausages of J-kind (in kg),
Yij -- amount of supplies of I-kind to produce J-kind sausages,
Pj -- price of 1 kg of J-kind sausages,
Cj -- price of supplies to produce 1 kg of J-kind sausages,
Si -- amount of supplies of I-kind in the stock (in kg)

This task belongs to linear programming problems and it is decided using simplex method. Unfortunately, the obtained decision must be discretely verified, because technological limits require that products output be equal of 10, 50 or 100 kg multiple. The structural scheme of optimal search of assortment is given at the Picture 1.

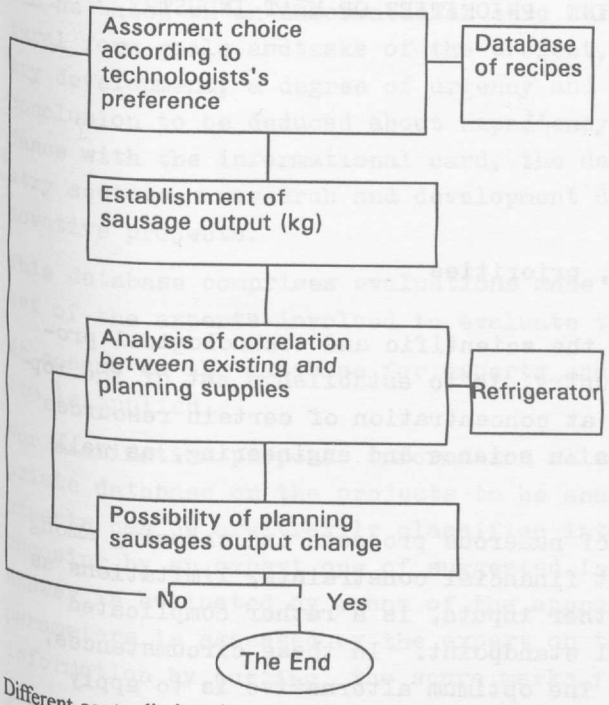


Picture 1

But from the practical point of view this task does not have a solution in the most cases in Russia, because a preference function and current supplies (raw materials) available often contradict each other, and use of the algorithm described above makes impossible to solve the problem. The special flexible stage-by-stage model is developed when technologist chooses an assortment variant according to his own preference (the preference function is not formulated in this model).

Assortment is chosen according to customers' demands and sausage market satisfactory level. It is essential to emphasise that highly-demanded products must have a good or an excellent quality. Use of this approach creates a game-situation when a computer only generates different variants, but man must make an optimal choice. In case if the chosen variant does not satisfy the capacity of enterprise's refrigerators, the amount of sausage output according to chosen assortment might be adjusted, or the given assortment can be changed to more suitable one.

The structural scheme of optimal choice of sausage assortment using technologist's preference function is given at the Picture 2.



Picture 2

Different contradictions between schedule and volumes of supplies and their current demand may occur in the process of obtaining necessary raw materials according to Industrial Program in the meat processing enterprises. Thus creates the situation problem of inventories management. This problem is decided in the conditions of raw materials supplies' fluctuations in amount and in assortment. In this case a change in assortment components is unwise, because of technological limitations.

If the shortfall of beef and pork supplies occurs which can consists of 20, 50 or even 80 % to plan volume of supplies, the enterprise can not implement the planning tasks and real output can consists of 60-70% to plan output, which influence the total business activities of the enterprise. Algorithm of previous task can be used to solve this problem. At the beginning the assortment must be chosen taken into consideration the existing shortfall of certain kind raw materials. If the chosen assortment does not correspond with the refrigerators capacity, the sausage recipe can be changed, but without changing in correlation between kinds of sausages produced. In this case the capacity of plant's division serves as a limitation.

Assortment choice may be done with the help of an algorithm of proportional products output with considering possible priorities and supplies existence. According to this method all raw materials in refrigerators are divided proportionally between chosen kinds of sausages which have equal and high priority. There are two possibilities: there are enough raw materials to produce all planning volume of chosen sausages, so, the whole volume of plan output will be produced; or supplies to produce certain kind of high-priority sausage is not enough, so, the volume produced will be as high as it possible using the limited amount of supplies. When the high-priority sausages were produced, remaining raw materials would be used to produce next-priority sausages, and so on.

Such a distribution of supplies allows to have a maximal-wide assortment of sausages considering stock capacity, but it does not give an opportunity to keep the given distribution proportions. From the other side, this algorithm allows to adjust assortment following the demand market changes very quickly.

$$\sum_{j} Gj\,(Bj - Xj) \rightarrow MIN$$

$$\sum_{J} Yij\,Xj < Si, \quad i = 1,...,I,$$

$$Xj > 0,\ j = 1,...,J$$

where Xj -- amount of sausages of J-kind (in kg), Yij -- amount of supplies of I-kind to produce J-kind sausages, Bj --planning amount of J-kind sausages (in kg), Gj -- rate of priority of production of J-kind sausages, Si -- amount of supplies of I-kind in the stock (in kg)

The complex of mathematical models explained above gives to technologist and enterprise's executives the opportunity to make better and quicker decisions in different market's and enterprise's situations. Programs' complex is a technologist's working place. It is applied to IBM PC facilities with use of TURBO PASCAL programming language.