Application Model Forecast in Production Management Process

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Abstract: *The success of business solutions is conditioned by the successful coordination and implementation of all phases of process management. Planning, as part of management, but also as a formalized procedure resulting integrated system of decisions in order to achieve the desired business plans in the future. In that sense, the plan must apply to all business functions of the system, down to the level of executive activity of all processes. Maintaining the level of volume production, its increasing trend and forecasting, assortment and quantity, is of great importance for the success of the business systems. This study presents the methodology related to the planning, forecasting the amount of finished products in the coming year based on data from past periods, in domain bakery industry.*

Keywords: *Model predictions, management, production process.*

1. INTRODUCTION

One of the main divisions of the process is: process management, the main (primary) processes and support processes. The main processes in the bakery industry are: production process, the process of procurement of raw materials, process sales. Management of the production process in this paper is viewed primarily through the planning stage of products to produce. In this regard it is necessary to first introduce the production process, products, bakery industry, the amounts of the produced in the previous period, which is the basis for understanding the proposed model forecasts the amount of finished product, ie, the value of products that would be the management of production plans.

2. THE PROCESS OF PRODUCTION IN THE BAKERY INDUSTRY

The production process in a wider context, consists of two subprocesses as follows: subprocesses preparation and subprocesses processing dough.

Knead the dough contains: flour, salt, yeast, additives and water in amounts prescribed by the recipe depending on the type of bread that is produced. Processing phase of the test are: sharing, round-forming, resting, fermentation and baking then, with some bread at the end of the final product. Mixing is done in special vessels for the purpose of using the mixer (SBM-200, with two speeds). After this vessel for lifting the dough using dough knead release that falls into the cage machines to share the test. Test pieces after the division of weight checks, and thus realizes that all testani pieces are the same weight. Production capacity delilice,

usually is 33 pieces per minute and is easy to calculate hourly capacity of a line for production of bread. The pieces of dough are transported in intermediate chamber resting test and then perform rolling testanih pieces (machines for rolling dough), after which they get the desired shape. With conveyor testani pieces reach the large fermentation chamber. In this chamber there is a fermentation test, which is defined by the following parameters: humidity, temperature and fermentation time. Depending on the type of bread that is produced depends on the time of fermentation. Transport bridge, where the marking is done bread, is used to connect a large fermentation chamber and tunnel oven in which baking is done. Proper functioning of tunnel kiln is very important to achieve uniform regime across the whole width of the baking oven. After leaving the furnace in the form of spraying water droplets on the surface but is formed baked bread crust bread-face. In order to get a quality product should be properly enforced in addition to technology and almost impeccable functioning machines and equipment, carry out proper packaging, transportation and storage of bread in the stores. Baking production test is taken every day before a customer has to withstand the competition.

Production performance is expressed through the level of the size of the yield of products.

The amount of bread in kilograms, which is obtained from 100kg of flour is called the yield or reproduction. Yield of bread is not uniquely defined by a simple relationship between the amount of bread produced and the quantity of raw materials. Losses occurring during the process: storage of materials, preparation of raw materials, making knead, dough processing, fermentation, baking, cooling, transportation and sales.

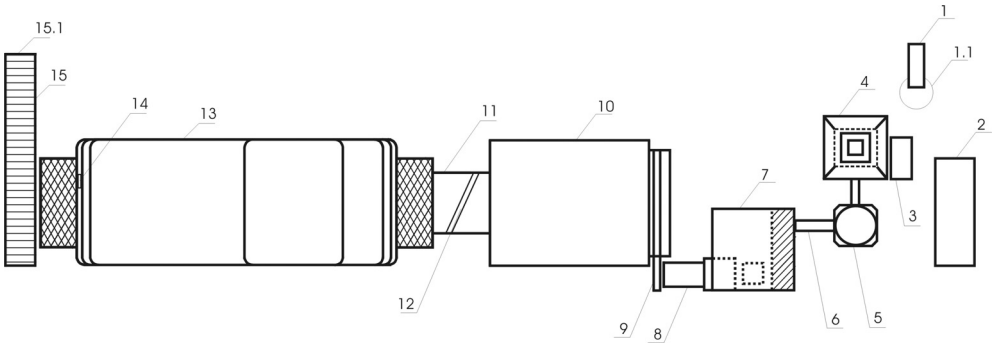

Figure 1- Lay out of the production equipment that is most fortunate in the industrial bakery plants

1. AUTOMATIC SCALES MIKSER
2. MIXER
3. LIFTER
4. DIVIDER DOUGH
5. ROUND SHAPER
6. DOUGH TRANSPORTER
7. INTERMEDIATE CHAMBER
8. ROL MACHINE
9. HORIZONTAL CONVEYOR
10. FERMENTATION CHAMBER
11. BRIDGE
12. SCREW CUTTER
13. AUTOMATIC TUNNEL OVEN
14. SPRAYER BREAD
15. CONVEYOR BREAD

1.1 TANKS FOR NOODLES

15.1. PLATO ZA PAKOVANJE HLEBA

Yield of bread can be calculated in two ways, namely:

- when the total mass of the test reject losses in production (calculated on 100 kg of flour) and
- consumption of resources multiply the coefficient of losses in manufacturing (calculated at 100 kg of flour).

Yield (reproduction) bread PH, in practice, is calculated using the formula:
PH = MHL · 100/Mb [%] (1)
where: PH-grain bread [%], MHL-made bread (bread mass) [kg], Mb-spent flour [kg]
Yield values for specific amounts of bakery products are: (average yield (%)): pastry (125 – 128), white wheat bread (136 – 138), black wheat bread (138 – 140), mixed rye bread (138 – 142), buns (142 – 145).

2.1 Bakery products industry

In terms of technology baked goods are defined by the rules on the quality of grain, milling and bakery products and quick frozen pasta dough (Gaz. SRJ, no. 52/95 and Gaz. SCG, no. 56/2003 - other rules and 4 / 2004 - other rulebook). Bakery products, in terms of these Rules, are: bread, pastry and other baked goods. Bakery products that are characteristic of the bakery industry in the current time are presented in table 1. Model presented in this paper included the products for which the greatest demand in the market, and accordingly are most profitable business system (regardless of unit price).

Table 1- Production of bakery products [6] ***- in tonnes (t) -***

Product Name	2004	2005	2006	2007	2008
Wheat bread	120. 042	121.161	127.399	129.336	127.837
Special bread	72. 356	76.521	65.257	58.516	56.872
Wheat pastry	4. 445	3.257	5.115	4.897	6.066
Special pastry	889	932	981	1.170	1.328
Special types of baked goods (pastries stuffed…)	3. 514	3.589	3.652	3.463	3.466
Unstuffed paste	19. 025	19.132	17.169	17.711	20.118

2.2 The Importance Of Planning For The Production Process In The Bakery Industry

Planning is one of the functions of process management, and scientific discipline that has its own methodology, concepts and categorical system.

Managers define what is needed to be done, when, how and who should do it. Manager of production planning method of use of capacities, marketing manager, is planning a way of introducing new products, distribution channels and price of product, financial manager of resources and allocation of resources. There is a need for planning at all levels of the organizational structure. Plans may vary in focus, form, level of detail included, the time horizon, functional area, approaches. Planning to get a desirable image of the future circumstances, taking into account currently available resources, past experience and various other factors. In the case of the bakery industry, special attention should be paid to the planning: raw materials needed for production (especially butter), distribution (exactly on time, frequent delays can lose consumers), the price of the product (price higher than its competitors refuse to consumers). The most important raw material for flour production process. Therefore, the planning order of flour, its quality, and financial importance for the price of the

product must give special attention. The methodology presented in this paper refers to the planning, that is, forecasting the amount of finished products in the coming year based on data from past periods.

Forecasting production of bakery products based on sales realized from the previous period is a continuous process in organizations, which can automate the design model.

Prediction of production of bakery products based on sales realized from the previous period is a continuous process in organizations, which can automate the design model.

3. ILLUSTRATIVE EXAMIN FORECAST MODELS

Input data are produced baked goods in tons per year in the bakery industry in Serbia (Table 1). In order to provide more accurate forecasts for the period 2009th year, it is necessary to determine the legality of the move by the previous value produced baked goods in the period 2004-2008. year. The method of forecasting (trend model) is a quantitative method. Most often the trend is considered the main direction of development for a long time. Examined the production of wheat bread per year can be a high correlation coefficient, based on input data, the present nonlinear model, the second degree polynomial, the expression [4]:

$$Y_t = a + bx_t + cx_t^2 \quad (2)$$

where: Yt - production in tons of bread wheat (endogenous variable),

Xt - t-th year - a period that is considered production wheat bread (Exogenous variable) and

a, b and c - model parameters which are calculated using the sum of least squares.

Method of least squares the values for certain parameters, a, b and c. These parameters are determined on the basis of equations and computation was done on the basis of expression [4]:

$$aN + b\sum_{t=1}^{N} X_t + c\sum_{t=1}^{N} X_t^2 - \sum_{t=1}^{N} Y_t = 0$$

$$a\sum_{t=1}^{N} X_t + b\sum_{t=1}^{N} X_t^2 + c\sum_{t=1}^{N} X_t^3 - \sum_{t=1}^{N} X_t Y_t = 0$$

$$a\sum_{t=1}^{N} X_t^2 + b\sum_{t=1}^{N} X_t^3 + c\sum_{t=1}^{N} X_t^4 - \sum_{t=1}^{n} X_t^2 Y_t = 0$$

$$\Rightarrow \quad \begin{aligned} 5a + 15b + 55c &= 625.775 \\ 15a + 55b + 225c &= 1.901.090 \\ 55a + 225b + 979c &= 7.016.578 \end{aligned} \quad (3)$$

Solution of equations (3) replacement method, based on the calculated values in the model, we obtain values for the parameters a, b, c. The estimated values of model parameters

$$\hat{c} = 681{,}214, \quad \hat{b} = 6.463{,}786 \quad \hat{a} = 113.257$$

Correlation equations describing the production of wheat bread per year is estimated mathematical model is presented

$$\hat{Y}_t = 113.257 + 6.463{,}786X_t - 681{,}214X_t^2.$$

The standard error of the model (standard deviation $\hat{\sigma}_{\hat{y}}$) is an absolute indicator of representativeness of models and variations of the average level of actual value of the dependent variables in relation to the expected trend value, and given expression [4]

$$\hat{\sigma}_{\hat{y}} = \sqrt{\frac{\varepsilon_t}{N}} \quad (4)$$

where: ε_t - rating rezidalnih sum of squares deviation, N - considered the period time series.

Analysis of the results was conducted based on the prognostic model checking.

3.1. Analysis Results

With the perceived model can be estimated production of wheat bread for the period 2009th year, assuming that it will continue to further growth on the basis of mathematical models. Bread wheat production estimate from the model forecasts for the period 2004-2008. The standard deviation of the values on which to perform analysis of the results (Table 2 and 3).

Table 2- Implemented the model forecasts for the period 2004-2008.

Year	X_t	$\hat{Y}_t=a+bx_t+cx_t^2$ (t)	Y_t (t)	$Y_t-\hat{Y}_t$	$(Y_t-\hat{Y}_t)^2$
2004	1	119.039,57	120.042	1.002,43	1.004.865,90
2005	2	123.459,71	121.161	- 2.298,71	5.284.067,66
2006	3	126.517,43	127.399	881,57	777.165,66
2007	4	128.212,71	129.336	1.123,29	1.261.780,42
2008	5	128.545,57	127.837	-708,57	502.071,44

$\varepsilon_t = 8.830.751,09$

Table 3- Implemented the model forecasts for the period 2009. g.

Year	Xt	$\hat{Y}_t=a+bx_t+cx_t^2$	Y_t (t)	$Y_t-\hat{Y}_t$	$(Y_t-\hat{Y}_t)^2$
2009	6	127.516			

Scattering diagram is shown for the $\hat{Y}_t$ estimated values (Figure 2). Scattering points in the diagram represent deviations from the perceived trend direction. The estimated trend direction is drawn through two points for the values of variables Xt and lines drawn through them direction (Figure 2). In the example they point the direction of assessed value of production of bread wheat in 2004. year, $\hat{Y}_{2004}=113257+6.463,78601-68\,1,21431^2=119039,57$, which is taken as the initial and final value in 2008. year term: $\hat{Y}_{2008}=113257+6.463,78605-68\,1,21435^2=128545,57$ Check prognostic models for 2009. year was analyzed based on the comparison of the estimated production of wheat bread perceived model achieved production of bread wheat in 2009. year. Production of wheat bread for 2009. year on the basis of the model is perceived $\hat{Y}_{2009}=113257+6.463,78606-68\,1,21436^2=127516\ t$

$$\hat{\sigma}_{\hat{y}} = \sqrt{\frac{8.830751,09}{5}} = 1.328,97$$

The standard error of the model is t. The optimal trend line is one that has a small standard error. The average deviation of bread wheat production is 1.329 tons of real value, expressed in original units of measure the dependent variable Y. The problem of units to be eliminated by calculating the relative indicators - coefficient of variation trend, which is the percentage standard error of arithmetic mean trend of the time series Y [5],

$$\hat{V}_{\hat{y}} = \frac{\hat{\sigma}_{\hat{y}}}{\bar{Y}} \cdot 100 \quad (5)$$

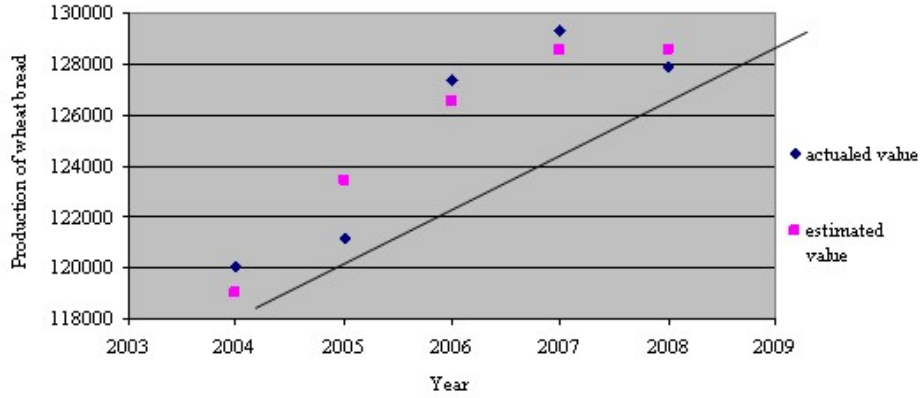

Figure 2 - Scattering diagram the actual value of the estimated values of model with trend line

MODEL FORECAST

Supplier: Bakery industry Product: Wheat bread

Address and place the supplier: Belgrade

Model prognoze

Isporučilac: Proizvodnja pekarskih proizvoda Proizvod: Pšenični hleb

Adresa i mesto isporučioca: Trenutni status:

God.	Xt	Xt0	Xt^2	Xt^3	Xt^4	Yt	Xt * Yt	Xt^2 * Yt
1	1	1.0000	1.0000	1.0000	1.0000	120.042	120.0420	120.0420
2	2	2.0000	4.0000	8.0000	16.0000	121.161	242.3220	484.6440
3	3	3.0000	9.0000	27.0000	81.0000	127.399	382.1970	1,146.5910
4	4	4.0000	16.0000	64.0000	256.0000	129.336	517.3440	2,069.3760
5	5	5.0000	25.0000	125.0000	625.0000	127.837	639.1850	3,195.9249
Σ	15.0000	15.0000	55.0000	225.0000	979.0000	625.7750	1,901.0900	7,016.5780

Jednačina modela: **Yt = 113.2573 + 6.4636 * Xt -0.6812 * Xt^2**

Provera modela

God.	Xt	Yt	Yt0	Yt - Yt0	(Yt-Yt0)^2
1	1.0000	119.0397	120.0420	-1.0023	1.0046
2	2.0000	123.4597	121.1610	2.2987	5.2840
3	3.0000	126.5174	127.3990	-0.8816	0.7773
4	4.0000	128.2127	129.3360	-1.1233	1.2618
5	5.0000	128.5456	127.8370	0.7086	0.5022
Σ	15.0000	625.7751	625.7750	0.0001	8.8300

Grafik modela prognoze

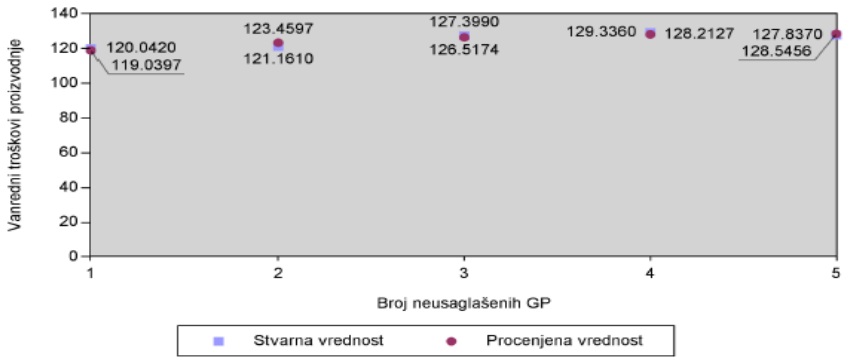

Figure 3: Model forecasts production of bakery products

If the coefficient of variations of the model closer to zero it is a model more representative. The upper limit is not defined, but usually takes the agreed limits of representation of 10% [5].

$$\bar{Y} = \frac{625.775}{5} = 125.155 \quad i \quad \hat{V}_{\hat{Y}} = \frac{1.328{,}97}{125.155} \cdot 100 = 1{,}06$$

The report (figure 3) contains the following elements: the actual value, estimated value, production of wheat hleba.Adresa and place the supplier, the supplier, wheat bread products, bakery industry, the equation model, implemented the model, scattering diagram svarnih value of the estimated values of model.

4. CONCLUSION

Analysis of the results, based on the prognostic model checking in the period 2004-2009. can be seen in the following conclusions:

the expected growth in production of wheat bread $(\hat{Y}_t)$ is 113.257 t,

average growth in production of wheat bread to the level of the Republic of Serbia is 6.464 tons,

average expected decline in production was 681t of wheat bread,

standard model of pea (standard deviation) is the average deviation from the empirical data rated value is 1.329 t.

Representative model was tested standard forecasting error trend. Shows the average deviation of actual value dependent variables in relation to the expected trend value.

Values of the variations of the model is 1.06 is closer to zero and less than 10%, which confirms the perceived reprezantativnost model predictions.

Report on the analysis results are submitted to management for appropriate decision-making and a document control decisions.

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