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A CASE STUDY CONCERNING SALES PREDICTION USING SALES QUANTITATIVE PREDICTION METHODS

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Abstract: The sales condition the entire activity of a enterprise, its variation being considered the main risk factor on the performances and financial position of the enterprise. The importance of elaboration of such budget is given by: (a) on long term: the establishing of the investments and financing plans; (b) on medium term: the establishing of publicity and promotion expenses budget; and (c) on short term: the determination of the production level, of supply program, the optimization of labor force. In planning the sales volume, there exist several methods, from which we remind: causal method, non-causal method, direct method, indirect method, judgment and statistic methods. All these methods have advantages and disadvantages. *Quantitative methods* are the methods that in predictions' realization start from numbered statistic data. The linear adjustment, correlation may be applied for the general tendencies of sales evolution research, when the tendency is linear.

Keywords: sales prediction, linear adjustment, correlation

1. INTRODUCTION

Sales prediction is one of the most important phases of the budgetary process, because it is the basis of the other budgets preparation. In this phase, the enterprise's commercial policy is established. The sales budget is the "pivot" budget that allows the coordination of all the other budgets. (Anthony and Govindarajan, 2007)

This budget represents the numbered prediction of enterprise sales on products and services types and/or groups, in quantities and prices, on destinations and periods. (Dumitru and Ioanăş, 2005) These will be regrouped on clients, regions, countries. In estimations, the starting point is the sale activity. The sales prediction starts from the turnover's analysis on a long period of time, regularly the last 5-10 years.

Quantitative methods are the methods that in predictions' realization start from numbered statistic data. The *linear adjustment*, *correlation* may be applied for the general tendencies of sales evolution research, when the tendency is linear.

2. THE LINEAR ADJUSTEMENTS

On the basis of the sale made during the previous period, through *linear adjustment* the tendency of the future sale evolution is predicted. For this, the graphical representation of the quantitative volume of sale from an anterior period is necessary.

For exemplification, we consider that for S.C. „SIRCA" S.A. Piatra-Neamț enterprise, that has as activity domain the production of components for agrarian vehicles, establishes for the product *"semi-industrial bearings" type I*, for 2009, the following data referring to the sold units number, recouped for every month:

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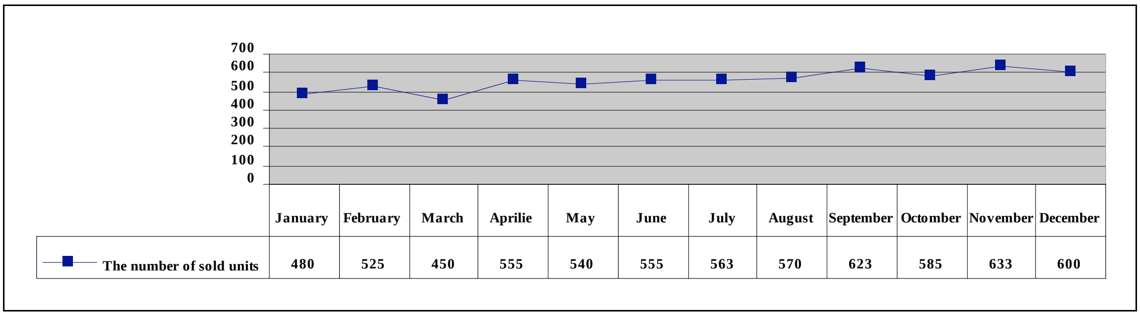

Fig.1. Graphical representation of sales in 2009

A linear tendency of sales progression is noticed. For linear adjusting and determination of the director quotient of the adjustment of the line, the lowest squares procedure is applied:

Table 1 The necessary values calculation for determination of the director quotient of the adjustments line

Months (xi)	The number of sold units (yi)	$\bar{x}$ - xi (Xi)	$\bar{y}$ - yi (Yi)	xi yi	xi^2
0	*1*	*2*	*3*	*4*	*5*
1	480.00	5.50	76.50	420.75	30.25
2	525.00	4.50	31.50	141.75	20.25
3	450.00	3.50	106.50	372.75	12.25
4	555.00	2.50	1.50	3.75	6.25
5	540.00	1.50	16.50	24.75	2.25
6	555.00	0.50	1.50	0.75	0.25
7	562.50	-0.50	-6.00	3.00	0.25
8	570.00	-1.50	-13.50	20.25	2.25
9	622.50	-2.50	-66.00	165.00	6.25
10	585.00	-3.50	-28.50	99.75	12.25
11	633.00	-4.50	-76.50	344.25	20.25
12	600.00	-5.50	-43.50	239.25	30.25
78	**6,678.00**	**0.00**	**0.00**	**1,836.00**	**143.00**
$\bar{x}$ = 6.50	$\bar{y}$ = 556.50				

The calculation relation for the director quotient of the adjustment line is:

$$(1)\quad a=\frac{\sum xi\cdot yi}{\sum x^2}=\frac{1{,}836.00}{143.00}=12.84$$

from where the equation

$$(2)\qquad y-\bar{y}=a\,(x-\bar{x})$$

becomes:

y – 556.50= 69.60 (x – 6.50)

➔ y = 12.84 x + 556.50.

If the linear tendency of the sale progression is maintained, then for the next months the following sold quantities can be predicted: 723.52; 736.36…

3. CORRELATION

It can be used when is noticed that a single factor „*x*” determines the „*y*” sale, the connection between these being noted through relation: *y = f(x)*, aspect that mathematically speaking, means, that for a variation of „*x*” factor, a variation of „*y*” factor corresponds, and economically speaking, means that the sales are influenced by „*x*” factor.

The linear relation between the two factors may be expressed either graphically, or by means of „*r*” linear correlation quotient. There exist linear correlations between „*x*” and „*y*” when graphically, the cloud points are prolonged around a line, or when „*r*” quotient is near „1” or “-1”.

For exemplification, we consider that for S.C. „SIRCA” S.A. Piatra-Neamţ enterprise, during the first semester of 2009, the following data were registered, data referring to the number of units sold for one of the fabricated products and its aferent revenue share from the total of the sale:

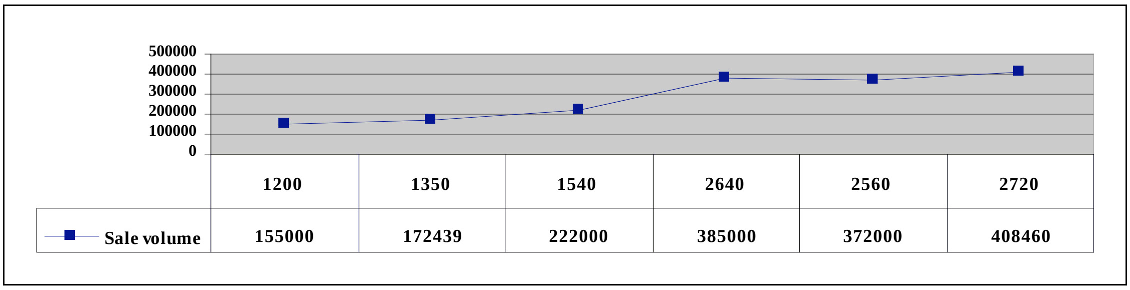

Fig.2. Graphical representation of sale evolution for the first semester of 2009

For („*r*") correlation quotient calculation, the following relations (Iacob and Ionescu,, 1999; Sgârdea, 2007) can be used:

$$r = \frac{\sum xi \cdot yi}{\sqrt{\sum xi^2 \cdot \sum yi^2}} \qquad (3)$$

or

$$r = \frac{\sum xi \cdot yi - n \cdot \bar{x} \cdot \bar{y}}{\sqrt{\left(\sum xi^2 - n \cdot \bar{x}^2\right)\left(\sum yi^2 - n \cdot \overline{yi}^2\right)}} \qquad (4)$$

On the basis of the data above presented, through the lowest squares procedure, *the correlation quotient* is established, as follows:

Table 2 The necessary values for determination of "r" correlation quotient, according to the first relation

xi	yi	$\bar{x}$ - xi	$\bar{y}$ - yi	xi yi	xi^2	yi^2
1,200.00	155,000.00	870.00	130,816.58	113,810,428.68	756,900.00	17,112,978,830.03
1,350.00	172,439.27	720.00	113,377.31	81,631,665.67	518,400.00	12,854,415,201.79
1,950.00	222,000.00	120.00	63,816.58	7,657,990.16	14,400.00	4,072,556,481.53
2,640.00	385,000.00	-570.00	-99,183.42	56,534,546.73	324,900.00	9,837,349,872.50
2,560.00	372,000.00	-490.00	-86,183.42	42,229,873.50	240,100.00	7,427,581,074.45
2,720.00	408,460.24	-650.00	-122,643.65	79,718,373.93	422,500.00	15,041,465,424.06
12,420.00	**1714,899.51**	**0.00**	**0.00**	**381,582,878.67**	**2,277,200.00**	**66,346,346,884.36**
$\bar{x}$ =*2,070.00*		$\bar{y}$ =285,816.58				

Results $r = \dfrac{381{,}582{,}878.67}{\sqrt{151{,}083{,}901{,}125{,}057{,}000.00}} = 0.982$

Or, using the second relation, the necessary data are calculated in the following table:

Table 3 The necessary values for determination of "r" correlation quotient, according to the second relation

xi	yi	xi yi	xi ^{2}	yi ^{2}
1,200.00	155,000.00	186,000,000.00	1,440,000.00	24,025,000,000.00
1,350.00	172,439.27	232,793,016.19	1,822,500.00	29,735,302,270.98
1,950.00	222,000.00	432,900,000.00	3,802,500.00	49,284,000,000.00
2,640.00	385,000.00	1,016,400,000.00	6,969,600.00	148,225,000,000.00
2,560.00	372,000.00	952,320,000.00	6,553,600.00	138,384,000,000.00
2,720.00	408,460.24	1,111,011,844.33	7,398,400.00	166,839,765,117.48
12,420.00	**1,714,899.51**	**3,931,424,860.53**	**27,986,600.00**	**556,493,067,388.46**
$\bar{x}$ =*2,070.00*	$\bar{y}$ =285,816.58			

Results $r = \dfrac{3{,}931{,}424{,}860.53 - 6.00 \cdot 2{,}070.00 \cdot 285{,}816.58}{\sqrt{\left(27{,}986{,}600.00 - 6.00 \cdot 2{,}070.00^2\right) \cdot \left(556{,}493{,}067{,}388.46 - 285{,}816.58^2\right)}} = 0.982$

The correlation index's value is very close to 1, which means that between the two factors there exists a very tight correlation.

The equation of the „y" regression line, in rapport to „x" helps for the knowledge of the phase of the revenue in unit as basis for estimation the sales volume. The line's equation is established according to the relation:

$$(5)\quad y - \bar{y} = a(x - \bar{x}),$$

where $a = 167.57$, results $y = 167.57\,x - 61{,}053.32$.

The tendency is not always linear, when the prediction of the sales volume for the following period is desired. There can be *exponential* or *under the form of power*. Certain nonlinear functions may be transformed in functions rehandled by a variable change as follows:

➲ the adjusting through *a power function:*

$$(6)\quad y = b \cdot x^{a}$$

using logarithms, it results:

$$(7)\quad \log y = \log b + a \cdot \log x$$

and noting

$$(8)\quad Y = \log y;\ \ X = \log x \text{ and } B = \log b$$

, it results:

$$(9)\quad Y = B + a\,X$$

➲ the adjusting through a*n exponential function:*

$$(10)\quad y = b \cdot a^{x},$$

using logarithms, it results:

$$(11)\quad \log y = \log b + x \cdot \log a$$

and noting

$$(12)\quad Y = \log y;\ \ A = \log a \text{ and } B = \log b$$

it results:

$$(13)\quad Y = B + A\,x$$

In both situations, instead of presenting graphically the couple (x, y), the points corresponding to couple (log x, log y), will be represented, respective (x, log y), resulting a linear tendency; instead, by means of the lowest squares, the resulted equations can be analyzed for determination of „a" and „b" values.

For exemplification, we consider that for S.C. „SIRCA" S.A. Piatra-Neamț enterprise the production of a new type of *"semi-industrial bearings" type II* was started, for which the sale statistics on 4 years period is presented as follows:

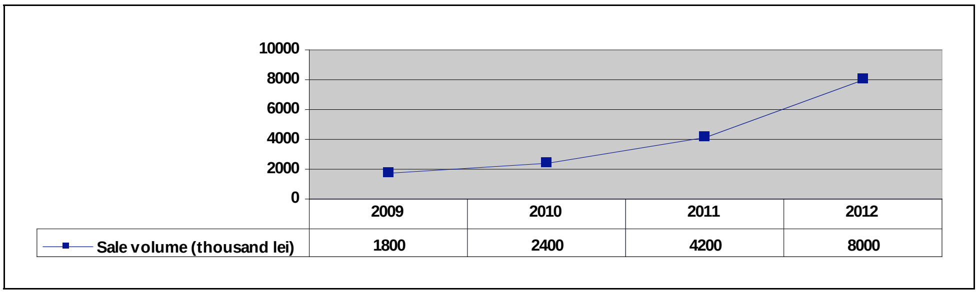

Fig.3. The sales and revenues' evolution

According to graphic, an exponential growth of sale volume is noticed. As consequence, the equation is presented as $y = b \cdot a^{x}$ type, where *xi* represents the years taken under consideration, and *yi* the sales volume expressed in thousand lei.

By the use of logarithms, the equation becomes $Y = B + A\,x$, for which the graphic will appear as a *linear tendency*, as follows:

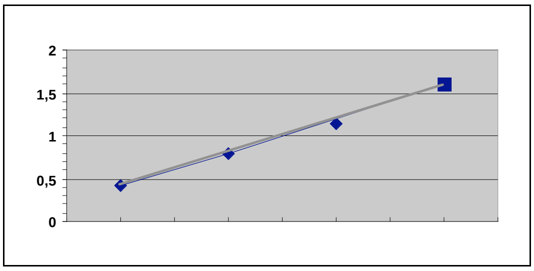

Fig.4. Graphical representation of sale evolution

For determining the values corresponding to „a" and „b" the following calculations are necessary:

Table 1 Calculation necessary for "a" and "b" determination

xi	yi	Y = log y	$\overline{x}$ - xi
0	*1*	*2*	*3*
1	1,800.00	3.255	1.50
2	2,400.00	3.380	0.50
3	4,200.00	3.623	-0.50
4	8,000.00	3.903	-1.50
10	**16,400.00**	**14.162**	**0.00**
$\overline{x}$ = 2.50			$\overline{Y}$ = 3.540

$\overline{Y}$ - Yi	xi• Yi	xi^2
4	*5*	*6*
0.285	0.428	2.25
0.160	0.080	0.25
-0.083	0.041	0.25
-0.363	0.544	2.25
0.000	**1.093**	**5.00**

By noting with n – the number of years, the calculation relations for "A" are:

$$A = \frac{\sum xi \cdot Yi}{\sum xi^2} \quad (14)$$

or

$$A = \frac{\sum xi \cdot Yi - n \cdot \overline{x} \cdot \overline{Y}}{\sum xi^2 - n \cdot \overline{x}^2} \quad (15)$$

$$A = \frac{\sum xi \cdot Yi}{\sum xi^2} = \frac{1.093}{5.00} = 0.2186$$

but $A = \log a$ results $a = 10^{0.2186} = 1.654$.

$B = \overline{Y} - a \bullet \overline{x} = 3.540 - 1.654 \bullet 2.50 = -0.595$

but $B = \log b$ results $b = 10^{-0,595} = 0.254$.

As consequence, determining the „*a*" and „*b*" values, the equation of exponential function $y = b \bullet a^x$ becomes $y = 0.254 \bullet 1.654^x$

In what the application of this method for sales prediction and the interpretation of the obtained results is concerned, there exists a series of limits. Firstly, the correlation does not signifies causality, therefore, the real cause of the connection between the economic variables there may be a variable not taken into consideration yet. Secondly, the identification of the determinant factor in sales estimation is not easy to be realized.

There should also be mentioned that, in reality, the sales are placed under the influence of many factors, and in this case the relation becomes: $y = f(x_1, x_2, \ldots, x_n)$.

Also, it may lead to interpretation errors as a consequence of the relation between the variables not correlated from a logically point of view. Some correlations between variables may just be due to hazard and not to economic logic.

4. CONCLUSIONS

In planning the sales volume, there exist, as above presented, multiple methods, each enterprise being able to chose for one or several. Specific literature (Rachlin, 2007) suggests several methods, from which we remind: causal method, non-causal method, direct method, indirect method, judgment methods, statistic methods (trend's analysis, correlation analysis, the precise purpose method, the industry analysis method, the line production analysis method, the final user's method).

Al these methods have advantages and disadvantages. Practice proves that most of the big enterprises use the combination of these methods. Alvin Toffler mentioned in his paper "Adaptable Corporation": "Usually, the planners have the tendency of relying on quantified data and of avoiding the other information types. But the omitting of qualitative information can no longer be allowed, and the wrapping of the entire information will be more difficult."

A correct prediction of sales is vital for enterprise's success on long term. The marketing studies take into consideration the products already existing on the market, as well as new products. The research will also be realized on the external environment, respective the general economic conjuncture, position in rapport to concurrence, prices' level, clients' behavior etc., as well as on the internal environment, respective the normal production capacity, commercial policy, prices policy etc.

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