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Article



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## APPLICATION OF STATISTICAL METHODS TO ASSESS THE EFFECTIVENESS OF THE SALES PROCESS OF CARS AND SPARE PARTS IN THE «AVTOEXPRESS-VLADIMIR» DEALERSHIP

**Abstract:** The analysis of Np-chart and U-chart based on statistical processing of the number of violations of technology and the quality level of supplied spare parts and components for pre-sale preparation of cars in the "Avtoexpress-Vladimir" dealership was performed in the article. The most rational version of the sales process of cars and spare parts in accordance with the normalized U-chart was proposed.

**Key words:** dealership, car, spare part.

**Language:** English

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### Introduction

The effectiveness of the sales process of cars and spare parts to them in the dealership is evaluated by a number of indicators. According to analytical formulas, the actual values of the effectiveness indicators of the sales process of products of automobile plants for a certain period of time are determined. However, it is possible to track the stability of the sales process by analyzing the statistical processing of the results of the experiment.

In this article, the analysis of the evaluation of the effectiveness of the sales process of cars and spare parts in the "Avtoexpress-Vladimir" dealership was carried out. The analysis of the activity and quality management system of the "Avtoexpress-Vladimir" dealership was presented by the authors in the works [1-2].

### The effectiveness indicators of the sales process of cars and spare parts

The following indicators and their normative (basic) values are used to assess the effectiveness of the sales process of cars and spare parts in the "Avtoexpress-Vladimir" dealership:

1. Implementation of planned indicators for net profit (1)

$$P = (P_a/P_p) \times 100\%, \quad (1)$$

where  $P_a$  is the actual indicator of net profit received for the analyzed period of time;  $P_p$  is the planned indicator of net profit for the analyzed period of time. The base value is more than 100%.

2. Implementation of the sales plan in pieces

$P_1$  is the indicator of implementation of the sales plans for the current period (2)

$$P_1 = (N/P_{cur}) \times 100\%, \quad (2)$$

where  $N$  is the total number of sales;  $P_{cur}$  is the sales plan for the current period. The base value is more than 100%.

3. Profitability of sales

It is calculated as the ratio of net income of the car dealership to the revenue of the car dealership multiplied by 100%. The base value is more than 4%.

4. Profitability of capital

It is calculated as the ratio of net income of the car dealership to the gross income of the car dealership multiplied by 100%. The base value is more than 50%.

5. The number of cars sold per seller

It is calculated as the ratio of the number of cars sold to the number of sellers. The base value is more than 12.

6. Net income per sales department employee

It is calculated as the ratio of the car dealership's net income to the number of sales department employees. The basic value is a set of statistical data.

7. The cost of additional equipment per car

It is calculated as the ratio of the cost of additional equipment to the number of cars sold. The basic value is a set of statistical data.

8. The number of consumer claims on official claims and in the book of complaints and suggestions. The base value is 0.

9. The number of consumer claims identified by calling. It is calculated by summing up the comments identified by calling customers. The base value is no more than 3%.

10. The level of compliance with the technology

It is calculated as the ratio of the number of inspections without comments to the total number of inspections. The base value is 1.

11. Satisfaction with the sales process (3)

$$\text{Satisfaction} = (N_{\text{fully satisfied}} + N_{\text{satisfied}}/2 - N_{\text{unsatisfied}} - N_{\text{very dissatisfied}})/N \times 100, \quad (3)$$

where  $N_{\text{fully satisfied}}$  is the number of fully satisfied customers;

$N_{\text{satisfied}}$  is the number of satisfied customers;

$N_{\text{unsatisfied}}$  is the number of unsatisfied customers;

$N_{\text{very dissatisfied}}$  is the number of very dissatisfied customers;

$N$  is the total number of responding customers.

12. Knowledge of products and services by the sales consultant.

13. Ability to answer questions and resolve complaints.

14. Explanation of the options and controls of the car during delivery to the customer.

15. A call from the dealer to the customer after issuing the new car.

The organization implements services and spare parts. Measurement in the implementation of the organization's activities are subject to:

1. Compliance of the "technology of presentation and sales of cars" with the requirements of customers.

2. Efficiency of the organization of the car dealerships.

3. The customer satisfaction.

4. The quality of pre-sale preparation.

5. Availability of the most demanded (by season) spare parts in warehouses.

6. Fulfillment of contractual obligations.

7. The quality of the repair performed and the performance of the car, compliance of its condition with the requirements of safety in road transport.

8. The condition and performance of the car before and after maintenance.

The measurement results are recorded in the process indicators in electronic form. Internal audits evaluate the quality management system and its compliance with the established requirements and parameters. The audit results, together with other input data, are analyzed by the top management in order to find areas for the development of the quality management system and improve its effectiveness.

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### Selection of indicators and statistical methods of the object of control

There is a wide variety of quality management methods, the most used of them are statistical methods of the quality management [3-10]. To solve problems related to the quality of products and services, 7 traditional methods ("tools" of the quality) are widely used: control charts, Pareto charts, checklists, scatter charts, histogram, stratification, and Ishikawa charts.

To evaluate the sales process of cars and spare parts in the "Avtoexpress-Vladimir" dealership it is proposed to use the following parameters:

1. The number of detected violations of the technology of pre-sale preparation of the car for a certain period of time.

2. The quality level of supplied spare parts and components for pre-sale preparation of cars.

Pre-sale preparation of the car consists in carrying out a complex of works to bring the car into proper condition and give it such a marketable appearance. Pre-sale preparation includes:

1. The complex of works on the restoration of the paintwork.

2. The complex of works to bring the interior and luggage compartment in the perfect condition.

3. Works on the engine compartment.

4. Concealment of defects in the bottom, wheel arches, wing rims, etc.

5. Elimination of defects on glasses, headlights, front lights, etc.

6. Updating bumpers, rims, tires.

The car pre-sale service is characterized by the rather laborious and technologically complex process. Logically, the process of providing services for pre-sale preparation of cars can be divided into three parts: technical training, control and diagnostic works and cosmetic training.

Cars supplied by the manufacturer arrive at the dealer in transport condition and several standard factory configurations. As a rule, the car delivery is carried out "on its own", as a result of which, in addition to significant contamination of the exterior and dusting of internal spaces, cars on the way acquire

some minor damage to the paintwork in the form of scratches and chips. In view of the above, it is possible to specify the list of works performed during pre-sale preparation of cars in order to compile a detailed description of them and further analysis. The work on technical preparation should include the transfer of cars from the transport condition to the operational one, that is, the installation of mirrors, wiper blades, additional equipment, as well as the completion of cars with the necessary accessories. The list of control and diagnostic works includes checking the tightening torques of the joints of suspension elements, bodywork and power units, computer diagnostics of control systems, checking the functioning and efficiency of components, assemblies and equipment of cars, as well as checking the tightness of hydraulic and pneumatic systems, refilling to the maximum level of working fluids, tension of drive mechanisms and other works on bringing cars in operational condition.

It should be noted here that the list of control and diagnostic works alone significantly exceeds the volume of control studies during the annual state technical inspection of motor vehicles, which clearly indicates the technical complexity of service provided.

### Application of statistical methods

The analysis of pre-sale preparation of the Lada cars is proposed to be conducted on the basis of statistical regulation of the following indicators:

1. The number of detected violations of the technology of pre-sale preparation of cars.

2. The quality level of supplied spare parts and components for pre-sale preparation of cars.

It is proposed to analyze the number of violations of the technology of pre-sale preparation of cars on the basis of periodic control of the indicator, taking into account the total number of inspections.

The number of violations was counted weekly. The results of the analysis for 20 weeks are presented in the Table 1.

**Table 1. The analysis of the number of violations of the technology of pre-sale preparation of cars.**

No. of the subgroup (week)	The number of violations of the technology of pre-sale preparation of cars	The total number of operations checked	The proportion of inconsistencies
1	2	15	0.1333
2	0	15	0
3	0	15	0
4	1	15	0.0667
5	0	15	0
6	0	15	0
7	2	15	0.1333
8	0	15	0
9	0	15	0
10	1	15	0.0667

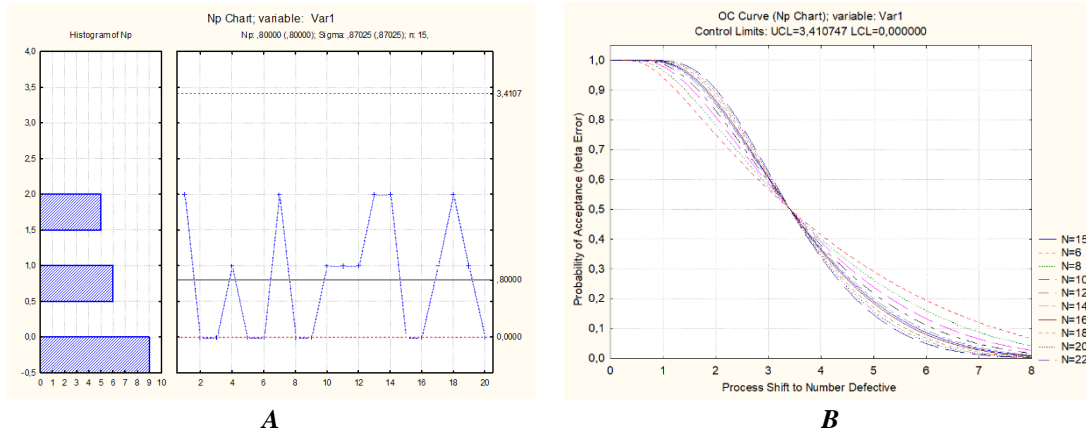
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11	1	15	0.0667
12	1	15	0.0667
13	2	15	0.1333
14	2	15	0.1333
15	0	15	0
16	0	15	0
17	1	15	0.0667
18	2	15	0.1333
19	1	15	0.0667
20	0	15	0
	Average 0.8	Average 15	Average 0.0556

To analyze the number of violations of the technology of pre-sale preparation of cars, it is proposed to use the Np-chart of the number of

inconsistencies (the rejection rate is higher than 5%, the calculation of control boundaries based on the binomial distribution) (Figure 1).



**Figure 1. A – The Np-chart of the number of violations of the technology of pre-sale preparation of cars; B – Operational characteristics of the Np-chart.**

The analysis of the control chart shows that the process is in the statistically controlled state.

It is proposed to evaluate the quality of supplied spare parts and components for pre-sale preparation of cars on the basis of periodic control of supplied spare

parts and components. The number of delivered batches of spare parts and components was counted weekly and the number of batches of the inappropriate quality was counted. The results of the analysis of the indicator for 20 weeks are presented in the Table 2.

**Table 2. The analysis of the quality level of supplied spare parts and components for pre-sale preparation of cars.**

No. of the subgroup (week)	The number of spare parts and components of the inadequate quality in the batch	The total number of spare parts and components in the batch	The proportion of spare parts and components of the inadequate quality
1	1	25	0.04
2	2	27	0.07407
3	0	30	0
4	1	23	0.04347
5	0	20	0
6	0	20	0
7	0	21	0
8	0	25	0
9	1	26	0.03846
10	0	30	0
11	0	24	0

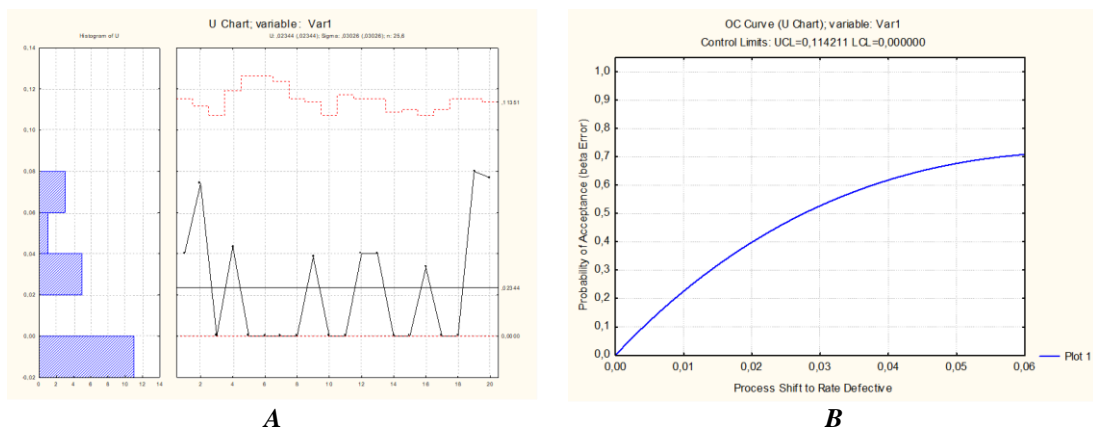
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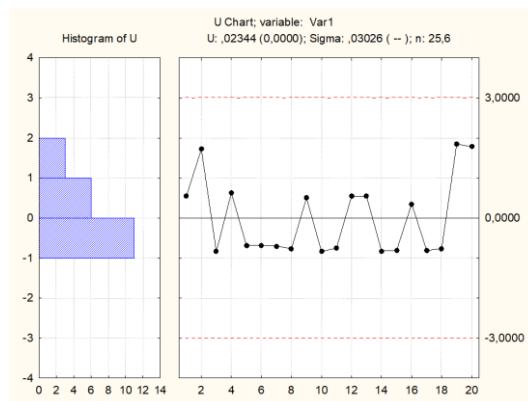
12	1	25	0.04
13	1	25	0.04
14	0	29	0
15	0	28	0
16	1	30	0.03333
17	0	28	0
18	0	25	0
19	2	25	0.08
20	2	26	0.07692
	Average 0.6	Average 25.6	Average 0.0233

To analyze the quality level of supplied spare parts and components for pre-sale preparation of cars, it is proposed to use the U-chart (the rejection rate is

less than 5%, the calculation of control boundaries based on the Poisson distribution) (Figures 2 and 3).



**Figure 2. A – The U-chart of the proportion of spare parts and components of the inadequate quality; B – Operational characteristics of the U-chart.**



**Figure 3. The normalized U-chart.**

The analysis of the control chart shows that the process is in the statistically controlled state.

The use of the statistical control system will allow timely detection of misalignment of indicators of the car sales process in the car dealership, reduce the number of inconsistencies and increase the overall efficiency of the organization.

**Discussion of the results**

The indicators and their normative (basic) values for evaluating the effectiveness of the sales process of cars and spare parts in the "Avtoexpress-Vladimir" dealership were determined.

The analysis of pre-sale preparation of the Lada cars is proposed to be conducted on the basis of statistical regulation of the following indicators:

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1. The number of detected violations of the technology of pre-sale preparation of cars.

2. The quality level of supplied spare parts and components for pre-sale preparation of cars.

Pre-sale preparation of the car consists in carrying out the complex of works to bring the car into proper condition and give it such the marketable appearance. The car pre-sale service is characterized

by the rather labor-intensive and technologically complex process.

To analyze the number of violations of the technology of pre-sale preparation of cars, it is proposed to use the Np-chart of the number of inconsistencies. To analyze the quality level of supplied spare parts and components for pre-sale preparation of cars, it is proposed to use the U-chart.

## References:

1. Chemezov, D., et al. (2022). Analysis of the features of the car sales process in the «Avtoexpress-Vladimir» dealership. *ISJ Theoretical & Applied Science*, 09 (113), 101-104.
2. Chemezov, D., et al. (2022). Analysis of the quality management system of the «Avtoexpress-Vladimir» dealership. *ISJ Theoretical & Applied Science*, 10 (114), 47-52.
3. (n.d.). ISO 16269-4. *Statistical interpretation of data – Part 4: Detection and treatment of outliers*.
4. (n.d.). ISO 5479. *Statistical interpretation of data – Tests for departure from the normal distribution*.
5. (2014). ISO 22514-1:2014. *Statistical methods in process management – Capability and performance – Part 1: General principles and concepts*.
6. (2013). ISO 22514-2:2013. *Statistical methods in process management – Capability and performance – Part 2: Process capability and performance of time-dependent process models*.
7. (2007). ISO/TR 22514-4:2007. *Statistical methods in process management – Capability and performance – Part 4: Process capability estimates and performance measures*.
8. (2013). ISO 22514-6:2013. *Statistical methods in process management – Capability and performance – Part 6: Process capability statistics for characteristics following a multivariate normal distribution*.
9. (2012). ISO 22514-7:2012. *Statistical methods in process management – Capability and performance – Part 7: Capability of measurement processes*.
10. (2013). ISO 7870-2:2013. *"Control charts – Part 2: Shewhart control charts", IDT*.

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