MODEL AND APPLICATION OF THE DISPERSONAL ANALYSIS FOR A WEAR STUDY

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ABSTRACT

This paper shows a coherent calculation model of the unifactorial dispersion statistical analysis applied for the experimental data study obtained on samples of different volumes, drawn out from a researched statistical population, on statistical principles. Based on the calculation model it was conceived an algorithm, that was applied in the study of wear dependence upon the characteristics of the grease lubrication of the researched coupling. The model and the algorithm have been applied for the qualitative and quantitative determination of the influence of the antiwear characteristic of the lubricating grease on the wear level of the rolling tracks of the “tulip-shaped shaft” semi-coupling from the structure of the angular joint with tripod from the Dacia passenger cars transmission.

KEYWORDS: Model + application, dispersional analysis.

1. INTRODUCTION

1.2. Theoretical Notions

For the beginning, there are shown some theoretical notions that will be used for elaborating the calculation model suggested in this paper.

Each object subjected to the statistical research is considered a statistical unit. The statistical population is formed of the totality of the units that, due to a common characteristic, can be considered together.

The volume $N$ of the statistical population is represented by the number of the component units. Each statistical unit has some features called statistical characteristics.

The concrete manifestation forms of the characteristics are called variants. The sample designates a miniature population extracted randomly from the statistical population. The volume $n$ of the sample is given by the number of its components.

Often, technical and/or economical reasons require that the sample volume to be upper-limited and the credibility demand of the statistical analysis results requires an inferior limitation of the sample volume to the value $n \geq 3$. An essential condition to form the sample is that each unit extraction from the population to be randomly, in order to assure its representativity.

It is also admitted that the experimental, measured values of each characteristic are independent each other.

1.2. Explanation Concerning the Application Object

During running, a cinematic coupling with friction can be considered as a system with elements interconditioning each other, directly or indirectly.

From the point of view of the wear process, the coupling with friction can be considered as a tribosystem whose parameters can be grouped into:
- exterior parameters to the friction process;
- superficial interaction parameters.

The superficial interaction parameters reflect complex processes implied in modifying the initial condition of the coupling, the wear process, respectively. The action of the greasing medium is constituted as an interior parameter. The complexity of the phenomena produced in the real contact area and the simultaneous intervention of several parameters suggest the statistical nature of the friction-wear-lubrication phenomena.

In the case of the wear there are looking for answers to the following questions.

1. Which are the factors that have significant influence on the effect phenomena (qualitative aspect)?
2. Which is the influence dimension, if it exists (the quantitative aspect)?

The dispersion analysis on the experimental data on samples of the investigated populations can offer answers to these questions. The simplest case is the dispersion unifactorial analysis applied in this paper.
Table 1. Experimental data list.

<table>
<thead>
<tr>
<th>X - the values of the controlled factor</th>
<th>X₁</th>
<th>X₂</th>
<th>...</th>
<th>Xₖ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y - the values of the researched characteristic</td>
<td>y₁₁</td>
<td>y₁₂</td>
<td>...</td>
<td>y₁k</td>
</tr>
<tr>
<td></td>
<td>y₂₁</td>
<td>y₂₂</td>
<td>...</td>
<td>y₂k</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>yᵢ₁</td>
<td>yᵢ₂</td>
<td>...</td>
<td>yᵢₖ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>...</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| yᵢ, Sample average | y₁, y₂, ... | yₖ |

| y - general average |     |     |     |

2. THE MODELING OF THE UNIFACTORIAL DISPERSIONAL ANALYSIS

2.1 Initial Considerations

The dispersional analysis operates with sample components accidentally extracted from the studied statistical population. It is necessary that, depending on the population volume, the samples shall be formed on statistical principles. The volume of samples can be equal or different.

The model elaborated in this paper refers to the research on some different sample volumes, in order to directly assist the application shown in this paper.

2.2. The Mathematic Model

There are the following notations: X - the controlled factor, Y - the researched characteristic, Xᵢ, i=1, 2,..,k – the values of the controlled factor, yᵢj, i=1, 2,..,k; j=1, 2,..,nᵢ – the experimental values of the considered characteristic.

Table 1 was formed with the experimental results.

2.2.1. Hypothesis

1. It is supposed that the experimental results on each column in table 1 (corresponding to each researched sample) are subjected to some independent normal laws.

2. It is considered that the normal laws have the same parameter. The verification of normal distribution hypothesis of the experimental results on each column can be done using a conformity test. In this paper the Sapiro-Wilk test was used.

If the normality is not verified, then there are compared the values of the average samples \( \bar{y}_i \) calculated by the relation (1), where the volume of the sample \( X_i \) was marked with \( n_i \).

\[
\bar{y}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} y_{ij}, \quad j = 1, 2, \ldots, k
\]  \hspace{1cm} (1)

The hypothesis has the significance that the controlled factor appears upon the average \( \mu \) and not upon the dispersion \( \sigma \) of the studied characteristic.

According to the experience plan and to the made hypotheses, in the end, it results the necessity to compare the averages of the samples to the general average \( \bar{y} \) calculated by the relation (2).

\[
\bar{y} = \frac{1}{k} \sum_{i=1}^{k} \bar{y}_i
\]  \hspace{1cm} (2)

2.2.2. Calculation Model for Different Volume Samples

I. The qualitative verification of the influence existence. Null hypothesis

a. The null hypothesis formulation.

Generally speaking, an randomly value of the researched characteristic \( Y \) is given by the relation (3), where the notations have the following significances: \( \mu \) – theoretical average of the normal distribution; \( \alpha_i \) – influence of the variation \( x_i \) of the controlled factor \( X_i \); \( \varepsilon_{ij} \) – randomly error with zero average and dispersion \( \sigma^2 \).

The influence of factor \( X \) upon \( Y \) is determined establishing the influence of the component \( \alpha_i \). If the influence is null, then \( \alpha_i = 0 \), and the relation (3) is written under the form (4), where \( \varepsilon_{ij} \) is the variation of the results around the average due to the uncontrolled factors assembly. In this case, the average of the samples, extracted from the same population, are equal each other, and are equal to the general average, that converges to the theoretical average \( \mu \) of the normal population \( N(\mu, \sigma^2) \), with a dispersion, \( \sigma^2 \) which is unknown.

\[
y_{ij} = \mu + \alpha_i + \varepsilon_{ij}
\]  \hspace{1cm} (3)

In order to verify the second hypothesis, the use of a dispersion homogeneity test is recommended.

\[
y_{ij} = \mu + \varepsilon_{ij}
\]  \hspace{1cm} (4)

b. Dispersion estimation.

It can be done based on the dispersion of the sample data or based on the dispersion of the sample averages.

b₁. Estimation based on the dispersion of the sample data.

Calculate the residual dispersion \( D_R \) with the relation (5) where \( N \) is determined with the relation (6) and it represents the total number of observations upon \( Y \).

\[
D_R = \frac{1}{N-k} \sum_{i=1}^{k} \sum_{j=1}^{n_i} \left( y_{ij} - \bar{y}_i \right)^2
\]  \hspace{1cm} (5)

\[
N = \sum_{i=1}^{k} n_i
\]  \hspace{1cm} (6)

b₂. Estimation based on dispersion of the sample averages \( D_s \).

For samples of different volumes \( n_i \), the estimation of the dispersion is calculated by the relation (7).
The ration $F$ is defined by the relation (14).

In order to quantify the influence of factor $X$ upon the characteristic $Y$ of the researched phenomenon, if it exists, it is necessary to find out a mathematical connection between $X$ and $Y$.

Then, there were determined the parameters of the distribution, supposed to be a normal one, of the characteristic $Y$.

The notations (16)...(19) have the following significances: \( \overline{y}_i \) - the error average \( \epsilon_{ij} \); \( \alpha_i \) - the influence average of \( \alpha_i \); \( \bar{y}_i \) - value average of \( y_{ij} \); \( \bar{\gamma} \) - general average of \( \overline{y}_i \).

\[
\bar{\gamma} = \frac{1}{n_i} \sum^n_{j=1} y_{ij}, \quad \alpha_i = \frac{1}{k} \sum^k_{i=1} \alpha_i, \quad \bar{y}_i = \frac{1}{n_i} \sum^n_{j=1} y_{ij}, \quad \bar{\gamma}_i = \frac{1}{k} \sum^k_{i=1} \overline{y}_i
\]

\[
\alpha_i = 0, \quad F = F_{calculated}
\]

Admit the hypotheses: \( \alpha_i = 0 \) and \( \overline{y}_i = 0 \).

Write the relation (22) under the form (23), then after the form (24).

\[
\bar{y} - \mu = \alpha_i = \lambda_i \quad \alpha_i = \bar{y} - \mu
\]

The theoretical average $\mu$ of the population distribution characterised by the randomly variable $y_{ij}$ is estimated by the general average of the samples, according to the relation (25).

Their differences can be due to the sample fluctuations, so that they can be assigned to the influence of the controlled parameter $X$, upon the characteristic $Y$ of the researched phenomenon. It results that $X$ has a significant influence on $Y$.
Consider two estimations \( \hat{\alpha}_i \) and \( \hat{\alpha}_j \) of the influence of the variation \( x_i \) and \( x_j \) respectively, of \( X \) upon the general average \( \bar{y} \).

It is necessary to compare the two estimations. For a number \( k \) of values for \( X \) it is necessary to make a number \( N_c \) of comparisons, a number that is determined by the relation (27).

\[
N_c = C_k^1 = \frac{1.2\ldots k}{2!(k-2)!} \quad (27)
\]

In order to make this comparison it is defined the randomly variable \( t \), with the relation (28).

\[
t_{ij} = \left( \hat{\alpha}_i - \hat{\alpha}_j \right) \sqrt{\frac{\sigma_i^2}{n_i} + \frac{\sigma_j^2}{n_j}} \quad (28)
\]

Replace (26) in (28), which is written under the form (29) showing that the problem of the comparison of the estimations \( \hat{\alpha}_i \) and \( \hat{\alpha}_j \) is reduced to the comparison of the selection averages of the randomly variable, corresponding to the values of \( X_i, X_j \) and \( X \).

\[
\hat{\alpha}_i - \hat{\alpha}_j = \bar{y}_i - \bar{y}_j \quad (29)
\]

Admit that the sample averages have a normal distribution with the dispersion \( D(\bar{y}_i) \) and \( D(\bar{y}_j) \) respectively, calculated by the relation (30), where \( N \) is determined by the relation (6).

\[
D(\bar{y}_i) = D(\bar{y}_j) = \frac{\sigma^2}{N} \quad (30)
\]

The relation (30) is applied if the sample averages have a normal distribution, and their volume is \( n \leq 30 \).

If the theoretical dispersion \( \sigma^2 \) of the population is estimated by the residual dispersion \( D_R \) of the sample selection and taking into account the relations (29) and (30), then the relation (28) is written under the form (31).

\[
t_{ij} = \left( \bar{y}_i - \bar{y}_j \right) \sqrt{2D_R/N} \quad (31)
\]

\[
k^* = k(N - 1) \quad (32)
\]

The randomly variable \( t_{ij} \) has a Student distribution with the number of freedom degrees \( k^* \) given by the relation (32), where \( k \) and \( N \) have the previously mentioned significances.

a. The null hypothesis verification.

The null hypothesis of the averages equalities can be verified by the comparison of the calculated value of the variable \( t_{calculated} \) by the relation (31) with the value \( t_{tabled} \) extracted from the Student distribution table [3]. The value \( t_{tabled} \) is established depending on the number \( k^* \) and on the adopted significance level \( \alpha \) (which is kept constant for all comparisons).

The decision is taken as follows:
- the null hypothesis is rejected if \( t_{calculated} > t_{tabled} \).
- the null hypothesis is admitted if \( t_{calculated} < t_{tabled} \).

If the null hypothesis has been rejected, the estimation \( \hat{\alpha}_i \) is calculated for the \( k \) researched samples (relation 26) and determine its distribution parameters by the relations (33) – the average and (34) – the dispersion.

\[
\bar{\alpha}_i = \frac{1}{k} \sum_{i=1}^{k} \hat{\alpha}_i \quad (33)
\]

\[
S^2_{\alpha_i} = \frac{1}{k-1} \sum_{i=1}^{k} \left( \hat{\alpha}_i - \bar{\alpha}_i \right)^2 \quad (34)
\]

Figure 3 shows the algorithm calculation based on the described calculation model.

3. THE RESULTS OF THE DISPERSION ANALYSIS IN THE WEAR STUDY

3.1. Explanations

The model and the calculation algorithm shown in the first section of the paper were used for the statistical research of the dependence of the rolling tracks practiced by a lubricating grease in the tulip-shaped shaft 1 (fig. 1).

The X [mm] controlled factor is the wear resistance of the grease in fresh state, represented by the diameter \( D \) of the wear blade determined on the four ball machine, under 40 daN, for 60 minutes, according to SR EN ISO 10293 method.

The characteristic \( Y [mm] \) of the effect phenomena is represented by the wear level resulted after the transmission test on the endurance stand, according to the method and program usually applied to the producer.

As part of the statistical experiment, the factor \( X \) took \( k=6 \) values, corresponding to the 6 grease types (Table 2 shows the commercial names of the 6
studied greases as well as the wear spot diameter \( D \) [mm] in the fresh state).

The grease resistance to wear is specific for each type of grease, so that the factor \( X \) has no randomly values.

The samples were constituted based on the principle of the unrepeatable simple selection. It was necessary to study some samples of different volumes, with a small number of components, so that there were used the statistics of the small numbers.

3.2. The results of the analysis

3.2.1. Qualitative Verification of the Existence of the \( X \) Influence on \( Y \)

Table 2 gives the explication on the decisions required by the calculated algorithm.

The factor \( F \) of the Fisher-Snedokor repartition was calculated and the calculated value was compared to the value in table, for an adopted confidence interval \( \alpha = 0.05 \) and for the calculated value of the freedom degrees, \( \vartheta_{D_1} = 5 \); \( \vartheta_{D_2} = 35 \).

As \( F_{\text{calculated}} > F_{\text{tabulated}} \) respectively, it was decided to reject the null hypothesis of the averages equality, that is \( X \) exercises a significant influence on \( Y \).

3.2.2. Quantitative Determination of the \( X \) Influence on \( Y \)

According to the calculation algorithm, the estimations \( \hat{\alpha}_i \), \( \hat{\alpha}_j \) of the influence of the variation \( x \) on \( X \) and their difference are calculated, for the number \( N_c = 15 \), comparisons required by the experiment.

For the comparison of the two estimations calculate the variable \( t_y \) calculated \( t_y \) calculated \( t_y \) calculated for \( N_c \) comparisons.

From the Student repartition [3] extract the value \( t_{\alpha} = 1.971 \), for the calculated number of the freedom degrees \( k = 240 \) and the adopted significance level \( \alpha = 0.05 \).

As the condition \( t_y \) calculated \( t_y \) calculated \( t_y \) calculated is satisfied for all the \( N_c = 15 \) comparisons, it was decided to reject the null hypothesis of the averages equality, resulting in a significant influence exerted by \( X \) on \( Y \).

Then, calculate the estimation \( \hat{\alpha} \) for the six researched samples and determine its distribution parameter: average \( \bar{\alpha} \) and dispersion \( S^2_\alpha \). The calculation results are given in table 4.

4. INTERPRETATION OF THE ANALYSIS RESULTS

4.1. Errors Determination

The theoretic average of the repartition is known. The error \( \xi \) of the calculated average \( \bar{\alpha} \) related to the theoretical average \( \mu_\alpha \) is determined by the relation (35).

For the researched experiment the following values were used in the relations (36)…(38)

\[
\xi = \mu_\alpha - \bar{\alpha} \quad (35)
\]

\[
\xi = \frac{S_\alpha}{\sqrt{n}} \quad (36)
\]

\[
S_\alpha = \sqrt{S^2_\alpha} \quad (37)
\]

\[
\vartheta = k - 1 \quad (38)
\]

From the Student repartition table the number \( t_{\text{tabulated}} = 2.71 \) was extracted. The calculated error by the relation (36) has the value \( \xi = 0.025 \).

4.2. The Confidence Interval

The theoretic average is in the confidence interval calculated by the relation (39) that has the expression (40).

\[
\alpha - \xi \leq \mu_\alpha \leq \alpha + \xi \quad (39)
\]

\[
\bar{\alpha} = 0.0533 \quad (40)
\]

0.0283 \leq \mu_\alpha \leq 0.0783

4.3. The Confidence Interval Interpretation

The calculation results show that the grease resistance to wear (factor \( X \)) influences the variation of the wear level \( Y \) on the average, with quantities situated in the interval [0.0283…0.0783] mm. As a percentage, in comparison to the general average determined by experimental results (table 2) the limits of this interval are [18.4…50.85]%. The influence sign is positive, with the significance that when the diameter of the grease wear spot increases the grease influence on the wear level increases too. Consequently, a grease with a weaker antiwear characteristic can influence the wear level increase more evidently.

4.4. Comparison of the Dispersion Analysis Results with the Results of the Regression and Correlation Analysis

Previously, it was achieved the regression and correlation study of the unifactorial model shown in this paper. It was also analysed the multifactorial models (with \( 2 \)... 5 controlled factors) and one of them was the grease resistance to wear [1].

The results have shown values of the determination coefficient \( dV \) included in the interval [18.4…50.85]% that was determined in this paper through dispersion analysis.
Table 2. The anti-wear characteristic of the greases.

<table>
<thead>
<tr>
<th>The commercial symbol of the grease</th>
<th>UM 185 Li2</th>
<th>Motul 423 B</th>
<th>UM 185 Li2+5%MoS2</th>
<th>UM 185 Li3+5%MoS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The wear spot diameter D[mm]</td>
<td>0.68</td>
<td>0.80</td>
<td>0.66</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Table 3. The qualitative verification of X influence on Y.

<table>
<thead>
<tr>
<th>X_i [mm]</th>
<th>0.68</th>
<th>0.80</th>
<th>0.66</th>
<th>0.90</th>
<th>0.50</th>
<th>0.70</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>D_y [mm]</td>
<td>0.27</td>
<td>0.10</td>
<td>0.12</td>
<td>0.32</td>
<td>0.22</td>
<td>0.80</td>
<td>The general average $\bar{y} = 0.154$; $N = 41; ; k = 6$; $S_x = 0.112327; ; S_T = 0.2283$; $D_R = 0.0033131; ; D_x = 0.0224654$; $\alpha_{adopted} = 0.05$; $F_{calculated} = 0.6.78; ; F_{tabulated} = 2.485$; $F_{calculated} &gt; F_{tabulated}$</td>
</tr>
<tr>
<td></td>
<td>0.18</td>
<td>0.06</td>
<td>0.30</td>
<td>0.28</td>
<td>0.08</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.22</td>
<td>0.11</td>
<td>0.16</td>
<td>0.25</td>
<td>0.18</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.20</td>
<td>0.14</td>
<td>0.22</td>
<td>0.20</td>
<td>0.09</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.21</td>
<td>0.08</td>
<td>0.14</td>
<td>0.23</td>
<td>0.11</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.17</td>
<td>0.16</td>
<td>0.12</td>
<td>0.28</td>
<td>0.07</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.09</td>
<td>0.18</td>
<td>0.11</td>
<td>0.16</td>
<td>0.12</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td>0.17</td>
<td>0.08</td>
<td>0.11</td>
<td>0.16</td>
<td>0.08</td>
<td></td>
</tr>
</tbody>
</table>

The sample average $\bar{y}_i$: 0.208, 0.097, 0.177, 0.239, 0.125, 0.077

Table 4. The results of the tests of null hypothesis of the averages equality.

<table>
<thead>
<tr>
<th>C.n</th>
<th>$\bar{y}_i - \bar{y}_j$</th>
<th>$t_{ij} = \bar{y}_i - \bar{y}_j$</th>
<th>$t_{y}$</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.097-0.208</td>
<td>$\gamma_{12} = 0.111$</td>
<td>8.73156</td>
<td>$t_{calculated} &gt; t_{tabulated}$</td>
</tr>
<tr>
<td>2</td>
<td>0.097-0.177</td>
<td>$\gamma_{13} = 0.080$</td>
<td>6.29300</td>
<td>“</td>
</tr>
<tr>
<td>3</td>
<td>0.097-0.239</td>
<td>$\gamma_{14} = 0.142$</td>
<td>11.1700</td>
<td>“</td>
</tr>
<tr>
<td>4</td>
<td>0.097-0.125</td>
<td>$\gamma_{15} = 0.028$</td>
<td>2.20250</td>
<td>“</td>
</tr>
<tr>
<td>5</td>
<td>0.097-0.077</td>
<td>$\gamma_{16} = 0.020$</td>
<td>2.37320</td>
<td>“</td>
</tr>
<tr>
<td>6</td>
<td>0.208-0.177</td>
<td>$\gamma_{23} = 0.031$</td>
<td>2.43800</td>
<td>“</td>
</tr>
<tr>
<td>7</td>
<td>0.208-0.239</td>
<td>$\gamma_{24} = 0.031$</td>
<td>2.43800</td>
<td>“</td>
</tr>
<tr>
<td>8</td>
<td>0.208-0.125</td>
<td>$\gamma_{25} = 0.083$</td>
<td>6.52900</td>
<td>“</td>
</tr>
<tr>
<td>9</td>
<td>0.208-0.077</td>
<td>$\gamma_{26} = 0.131$</td>
<td>10.30500</td>
<td>“</td>
</tr>
<tr>
<td>10</td>
<td>0.177-0.239</td>
<td>$\gamma_{34} = 0.062$</td>
<td>4.87700</td>
<td>“</td>
</tr>
<tr>
<td>11</td>
<td>0.177-0.125</td>
<td>$\gamma_{35} = 0.052$</td>
<td>4.09000</td>
<td>“</td>
</tr>
<tr>
<td>12</td>
<td>0.177-0.077</td>
<td>$\gamma_{36} = 0.100$</td>
<td>7.86600</td>
<td>“</td>
</tr>
<tr>
<td>13</td>
<td>0.239-0.125</td>
<td>$\gamma_{45} = 0.114$</td>
<td>11.32700</td>
<td>“</td>
</tr>
<tr>
<td>14</td>
<td>0.239-0.077</td>
<td>$\gamma_{46} = 0.162$</td>
<td>12.74300</td>
<td>“</td>
</tr>
<tr>
<td>15</td>
<td>0.125-0.077</td>
<td>$\gamma_{56} = 0.048$</td>
<td>3.77600</td>
<td>“</td>
</tr>
</tbody>
</table>

Conclusions: $k = 6; \; N = 41; \; D_R = 0.0033131; \; N_c = 15; \; k^* = n^* = 240; \; t_{tabulated} = 1.971; \; \alpha_{adopted} = 0.05$

Estimations: $\hat{\alpha}_1 = 0.057; \hat{\alpha}_2 = 0.054; \hat{\alpha}_3 = 0.023; \hat{\alpha}_4 = 0.080; \hat{\alpha}_5 = 0.29; \hat{\alpha}_6 = 0.077$

Distribution parameters: $S_\alpha^2 = 0.00055948; \; \bar{\alpha} = 0.0503$
5. CONCLUSION

This paper shows a coherent unifactorial model, being an operative optimization method of the statistical experiments research with different volumes samples, extracted from the studied population on statistical principles.

The model has been synthesized in an calculation algorithm applied in this paper. It has been appreciated that the unifactorial dispersionsal analysis...
is useful for the selection of the factors that have a significant influence upon the multifactorial phenomena, being an operative optimization method of the statistical experiments research.

The dispersional statistical analysis is also useful to the quantitative determination of the influence of the selected factor having a significant influence within the statistical experiment.

The model of unifactorial dispersion analysis shown in this paper can be used for the qualitative and quantitative analysis of the dependence of any controlled factor and the researched phenomenon, based on the experimental results.

In the tribosystems research field, the model is useful to distinguish the factors with significant influence on the multifactorial phenomena and it can be used to promote some optimized solutions of the friction couplings.

REFERENCES