THE ANALYSIS OF PROFESSIONAL IMPROVEMENT PROCESS BY ECONOMETRIC METHODS

TESELIOS DELIA
PhD Lecturer, “Constantin Brancoveanu” University of Pitesti, Romania
delia_teselios@yahoo.com

ALBICI MIHAELA
PhD Lecturer, “Constantin Brancoveanu” University of Pitesti, Romania
mturmacu@yahoo.com

ANTONESCU EUGENIA
PhD Reader, “Constantin Brancoveanu” University of Pitesti, Romania
eugenia_antonescu@yahoo.com

Abstract:
A problem of today organizations is to adapt to rapid changes taking place in society, and this can not be done without giving special attention to human capital and intangible goods (knowledge, information, creativity). As the human factor plays an essential role in the economic growth strategy, making an investment in training leads to long-term profitability growth. In order to strengthen the above, the paper presents an economic study related to professional development of the employees working within the National Forest Administration ROMSILVA, and the way in which selection was made in order to participate in these courses. In the analysis and interpretation of data was used the chi-square test.

Key words: human capital, investment, training, chi_square test, bivariate analysis

JEL classification: C02, M54

1. Introduction

Human resource, the most dynamic of all resources held by any organization, needs special attention from management in order to exploit the full capacity within professional activity [4].

Because human capital, as a type of resource, brings economic value to organizations, these should have a philosophy of investing in the training of all its workers [15], because, as Becker [2] said: “education and training are the most important investments in human capital”.

Although the economic activity, regardless of its nature, means the capitalization of labour so that this production factor becomes indispensable for economy [7], it is noticed that traditional factors of production (natural resources, labour and capital) have gradually diminished importance, being subject to the law of decreasing output, as the intangible goods (knowledge, information and creativity) have become more and more important because of the induced increasing output, the investment in all these being important factors of competitiveness [10].

General objectives of training and professional improvement activities refers to eliminate gaps between the actual and necessary level of staff knowledge and skills, creating learning opportunities for each employer, so learning to become a permanent activity of every man in the company [9].

The need for this activity within the organization derives from economic reasons related to increasing economic efficiency, costs occasioned by training and professional development activities being considered as investments for ensuring the progression of company [5].

Some organizations, especially large ones, may have extensive formal training programs, including classroom sessions and training programs online. Other organizations may prefer a simpler, more flexible approach of encouraging employees to participate in outside training and development programs as needs are identified [15].

Some of the benefits obtained by both organization and individual, following professional training, include [4]:
Organization benefits:
- developing and maintaining an adequate and sufficient level of knowledge, skills and abilities of the employees;
- capitalizing in a planned way the experience in professional work and of other forms of training and professional development at work;
- obtaining improved performance in activity;
- increase motivation of the employees.
Individual benefits:
- diversification of owned skills;
- increase job satisfaction;
- increase employee value on the labour market;
- increase chances of promotion.

2. Determining qualitative variables association

Chi-square test (written $\chi^2$) has a wide scope of applicability being frequently used as a test of association, to check the connection between two features, trying to answer the question: for a set of observed values of a feature, can we attribute the distribution of these values only to sampling variations?

The fundamental principle behind the test is to compare the frequency of cases of the samples members with frequencies expected for the population from which the samples were extracted [6].

The starting point is the formulation of the following hypotheses [11]:

$H_0$: Between the observed and expected values there are no significant differences, in other words, there is no relationship between the analyzed variables.

$H_1$: Between the observed and expected values are significant differences, there is a relationship between the analyzed variables.

The steps taken in using the $\chi^2$ test are:

Step 1: Considering the initial contingency table containing the observed distribution of values depending on the two variables under analysis, expected values are calculated using the formula:

$$a_{ij} = \frac{\text{the}_i\_\text{elements}'\_\text{sum}_\text{on}_i\_\text{line}*\text{the}_j\_\text{elements}'\_\text{sum}_\text{on}_j\_\text{column}}{\text{grand}_\text{total}}$$  \hspace{1cm} (1)

where $a_{ij}$ is the expected value located at the intersection of line $i$ with column $j$.

Step 2: It is calculated the number of degree of freedom (the number of values that are free to vary after restriction has been placed on the data [12]):

$$\nu = (\text{number}_\text{of}_\text{lines}_\text{in}_\text{table} - 1) * (\text{number}_\text{of}_\text{columns}_\text{in}_\text{table} - 1)$$  \hspace{1cm} (2)

Step 3: From the chi-square table $\chi^2$ [13] it is read the theoretical value for the level of significance 0.05 and the number of degree freedom determined at Step 2.

Step 4: It is determined the value calculated for $\chi^2$ according to the formula:

$$\chi^2_{calc} = \sum_i \sum_j \frac{(b_{ij} - a_{ij})^2}{a_{ij}}$$  \hspace{1cm} (3)

where $b_{ij}$ is the observed value located at the intersection of line $i$ with column $j$.

Step 5: It is compared $\chi^2_{calc}$ with $\chi^2$ theoretic located at Step 3 and conclusions are drawn as:

- if $\chi^2_{calc} \geq \chi^2$ theoretic, then $H_0$ null hypothesis is rejected (in other words, the difference between the expected and the observed values is not due to chance)

- if $\chi^2_{calc} \leq \chi^2$ theoretic, then $H_0$ null hypothesis is accepted.

Further we use this test to answer the question: within organization is there an association between employees professional development, staff category and level of education?

3. Economic study

In order to answer the previous question, we consider the following study:

To increase labour productivity and economic competitiveness, the, through Organization Service, Human Resources, Programming and Scientific Research, provide annual professional development courses for staff in central and territorial structures. (Table 1) shows the situation of training the employees (for the current year) depending on the category of existing staff within the Administration, and the educational level associated with it.

It is intended to determine the following point: if professional development of the National Forest Administration employees was made taking into account the level of education and the staff category.

Observation: The data from (Table 1) are fictional and have an illustrative role.
Table 1. Contingency table of staff category in relation to the level of education

<table>
<thead>
<tr>
<th>Education level</th>
<th>Category of staff (observed values)</th>
<th>Secondary education</th>
<th>Short-term University studies (Forestry College)</th>
<th>Long-term University studies</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Office forester staff</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>Domain forester staff</td>
<td>180</td>
<td>100</td>
<td>120</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>Non forester staff</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>630</td>
<td>400</td>
<td>270</td>
<td>1300</td>
</tr>
</tbody>
</table>

Source: Created by the authors

The corresponding column percentages are the following:

Table 2. Table of percentages

<table>
<thead>
<tr>
<th>Education level</th>
<th>Category of staff (observed values)</th>
<th>Secondary education</th>
<th>Short-term University studies (Forestry College)</th>
<th>Long-term University studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Office forester staff</td>
<td>63</td>
<td>50</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Domain forester staff</td>
<td>29</td>
<td>25</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Non forester staff</td>
<td>8</td>
<td>25</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Created by the authors

The attached graphics data in (Table 2) are made by the authors and are presented below:

Graphic 1: Corresponding category of staff – secondary education level
We consider the following hypothesis:

$H_0$: Professional development has not been made considering the staff category and education level (there is no association between the analyzed variables)

$H_1$: Professional development has been made considering the staff category and education level

We use test $\chi^2$ covering the steps 1-5 outlined above:

Step 1: We calculate the expected values:

- for office forester staff with secondary education

$$a_{11} = \frac{700 \times 630}{1300} = 339.23$$  \hspace{1cm} (4)

- for office forester staff with short-term university studies

- for office forester staff with long-term university studies

Graphic 2: Corresponding category of staff – short-term university studies

Graphic 3: Corresponding category of staff – long-term university studies
\( a_{12} = \frac{700 \cdot 400}{1300} = 215.3 \)  
\( a_{13} = \frac{700 \cdot 270}{1300} = 145.38 \)  
- for office forester staff with long-term university studies

\( a_{21} = \frac{400 \cdot 630}{1300} = 193.84 \)  
- for domain forester staff with secondary education

\( a_{22} = \frac{400 \cdot 400}{1300} = 123.07 \)  
- for domain forester staff with short-term university studies

\( a_{23} = \frac{400 \cdot 270}{1300} = 83.07 \)  
- for domain forester staff with long-term university studies

\( a_{31} = \frac{200 \cdot 630}{1300} = 96.92 \)  
- for non forester staff with secondary education

\( a_{32} = \frac{200 \cdot 400}{1300} = 61.53 \)  
- for non forester staff with short-term university studies

\( a_{33} = \frac{200 \cdot 270}{1300} = 41.53 \)  
- for non forester staff with long-term university studies

Step 2: We calculate the number of degree of freedom to be equal to the number of columns in the table minus one multiplied by the number of rows in the table minus one. In our case there were three rows and three columns. Therefore:
\[ v = (3 - 1)(3 - 1) = 4 \]  

We choose the level of significance (namely the probability of rejecting the null hypothesis) as 0.05 and we organize the expected values, obtained in step 1, in the following table:

**Table 3. Contingency table of expected values**

<table>
<thead>
<tr>
<th>Education level</th>
<th>Secondary education</th>
<th>Short-term University studies (Forestry College)</th>
<th>Long-term University studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office forester staff</td>
<td>339.23</td>
<td>215.3</td>
<td>145.38</td>
</tr>
<tr>
<td>Domain forester staff</td>
<td>193.84</td>
<td>123.07</td>
<td>83.07</td>
</tr>
<tr>
<td>Non forester staff</td>
<td>96.62</td>
<td>61.53</td>
<td>41.53</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>629.69</strong></td>
<td><strong>399.90</strong></td>
<td><strong>269.98</strong></td>
</tr>
</tbody>
</table>

Source: Created by the authors

Step 3: Theoretical value for the level of significance 0.05 and 4 degrees of freedom is: \( \chi^2_{0.05,4} = 9.49 \)

Step 4: To determine if we reject the null hypothesis \( H_0 \), the obtained value for chi-square must be greater than the theoretical value, for the level of significance of 0.05.

Therefore we calculate the value for chi-square:
We note that the empirical value of the random variable is greater than the theoretical value, therefore we can say that the two observed variables, Education level and Category of staff are statistically dependent, or in other words, the distribution of persons sent to training courses takes into account the category of staff and the level of education.

It is found that the differences between observed values and those expected are statistically significant to guarantee with a probability of 95% that there is a link between variables.

Therefore, $H_0$ null hypothesis is rejected with a probability of 5%, in other words, in the process of professional development, the category of staff and the educational level were taken into account.

4. Conclusions

Modern management involves a wide range of skills and guidelines, many of which involve statistics related skills, information technology use, accounting and mathematics. Management focuses on rational problem solving and logical thinking.

Labor force is undoubtedly the most important resource in a company. Efficient use of labour and the employee assessment opportunities, achievement of optimal recruitment process, conducting training programs for staff are just some of the responsibilities of the human resources department. Human resource management is very important for increasing profitability of the company, and the use of scientific methods about human resources, especially in conditions of economic crisis, is a mandatory requirement [18].

Contemporary economic changes have led managers „to carefully examine the knowledge that supports the work of organization they lead and how they are run” [8], the focus being moved from the traditional factors of production to intangible assets. The experience achieved shows that, regardless of the evolution of the economic cycle, there is no substitute for investments in human capital [14], and this is achieved by the desire to increase future income by increasing labour productivity.

The economic study proposed in the paper leads to the idea that there is clearly a link between the professional development process, staff category and the level of education, the beneficiaries of the human capital development being the individual, companies and therefore, the society.

5. Bibliography

[6]. Howitt, D., Cramer, D., Introducere în SPSS pentru psihologie, Editura Polirom, Iaşi, 2010
[13]. *** http://www.docstoc.com/docs/46593916/Chi-Square-Table-III