POSSIBILITIES TO EVALUATE THE QUALITY OF EDUCATION BY VERIFYING THE DISTRIBUTION OF MARKS

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Abstract:*In the higher education, for the evaluation of education process it is of high interest to use some numeric indicators obtained from the database with the final results realized by the students on exams session. For this purpose could be used the following numeric indicators: proportion of students absent on final evaluation, proportion of non-promoted students, normality degree of passing marks distribution.*

In order to do this we realized an Excel calculation program that could be applied to each discipline. The inputs are concrete (students total, students present to final evaluation, marks absolute frequency) and the outputs for the three indicators are binary (competent or non-competent, in the last situation the verdict being: "Give explanations. Propose an action plan, with actions, responsible and terms").

To verify the imposed normality degree we elaborate a calculation program based on Kolmogorov-Smirnov concordance test. So, it was realized the increase of analyze objectivity and it was created the opportunity to apply corrective measures in order to improve the education process.

Keywords: education, quality, normality, distribution , concordance test.

1. INTRODUCTION

The Romanian higher education institutions are preoccupied to develop a quality management system in conformity with ISO 9000 standards [2]. Some universities are ISO 9001:2008 certified, among them being University of Pitesti.

The model of quality system management described in ISO 9000 standards provides a vertical integration, in accordance with Deming circle (Plan – Do – Check – Act), for a continuous improvement of quality [4]. The four steps of Deming circle correspond to four important chapters of ISO 9001:2008 standard: 5 – Management responsibility, 6 – Resource management, 7 – Product realization and 8 – Measure, analyze and improvement.

In Chapter 5 – Management responsibility it is emphasizes that: Top management must provide proof of commitment for development and implementation of quality management system and for continuous improvement of its efficiency by running management analyses. For this purpose, "at planned intervals must be done analyzes of organization's quality management system, in order to be sure that it is corresponding, adequate and effective."

Among the input elements of the analize there are the product performance and the product conformity, and one of the output elements is the improvement of quality management system efficiency and of its processes.

In this context, the Department for Quality of Education within University of Pitesti do twice a year a global analyze of the data gathered and processed from all the functional components of university, in concordance with the system procedure "Analyze done by management"

2. EVALUATION OF DIDACTIC ACTIVITIES

Considering that the management analyze of didactic activity is very ample, in our faculty we proposed to use objective indicators, of quantitative type, obtained on the basis of numeric data or by conversion of attributive data of binary type in quantitative data.

The last activity with this objective took place after exams session, and the primary data of numeric type were represented by the marks obtained by the students. For reducing the activity volume, we decided the activity to be selective, as follows: the analyze was done in each of 11 faculties, for each exam.

Based on the former experience, the department team decided to use the following three indicators:

1). percent of students present at exam, P_{prez};
2). percent of students which pass the exam, P_{prom};
3). normality degree of passing marks distribution.

The limits for these indicators were considered to be as follows:

1) P_{prez} = (amount of students present / students total) $\cdot 100 < 20\%$;

2) P_{prom} = (amount of promoted students / amount of students present)$\cdot 100 < 20\%$;

3) normality degree of passing marks distribution $\geq 5\%$ (corresponding to an admissible risk of maxim 95%).

For processing the data it was created a special program in Excel using as inputs the verbal identification data and the numeric data in bold characters. It was also set down a control key in order to signalize the presence of wrong data.

The outputs are:

- for the control key: OK / Count again;

- for the three numeric parameters: OK / Give explanations. Set up an Action plan (action / responsible /term).

In the form presented in Table 1, there is an application for a hypothetic situation, with correct input data (control key is "OK" and not "Count again"), but there are inadequate results for the last two indicators.

For the analyze done at university level, each faculty provided the following documents:

A. For each discipline analyzed:

1 – the copy of curricula for the formation study of specialization;

2 – the copy of discipline syllabus;

3 – the Excel form with the data processed and the values obtained;

4 – the Action plan proposed.

B. For the whole action deployed within faculty:

1 – the centralizing with disciplines, study years and specialization analyzed;

2 – the synthesis of deployed activity;

3 – observations, proposals and suggestions for improving this work instrument and the way of realizing this activity.

The final analyze was done in the presence of the Vice-Dean responsible with quality of education and of the Rector, so it is a real analyze of the education process done by the top management [5].

Table 1

Identification data		
Faculty		
Dean		
Quality Responsible		
Specialization		
ECTS Responsible		
Study year		
Tutor of the formation		
Discipline		
Holder of discipline		
Department		
Head of department		
Input data		
Students	**115**	
Absents	**18**	
Non-promoted students	**22**	
S1. Promoted students	75	
Marks of 5	**12**	
Marks of 6	**10**	
Marks of 7	**15**	
Marks of 8	**20**	
Marks of 9	**11**	
Marks of 10	**7**	
S2. Passing marks	75	
Control key: $S_1 = S_2$?	Yes	OK
Output data		
Absents percent	P_{prez} = 16 (< 20?)	OK

Non-promoted percent	P_{prom} = 23 (< 20?)	Give explanations. Propose an action plan (actions, responsible and terms)
The shape of distribution is quasi-normal (Gauss bell)? Tick 1 (for OK) or 0 (for KO).	F = **0** (= 1?)	Give explanations. Propose an action plan (actions, responsible and terms)
Note: It will be fill in with verbal data in the header and with numeric data (only) in the cells in bold characters.		

3. DETERMINATION OF NORMALITY DEGREE OF PASSING MARKS DISTRIBUTION USING THE KOLMOGOROV-SMIRNOV TEST

It is obvious that, if the process of evaluating student's preparation is good, then the passing marks distribution must correspond to the normal law.

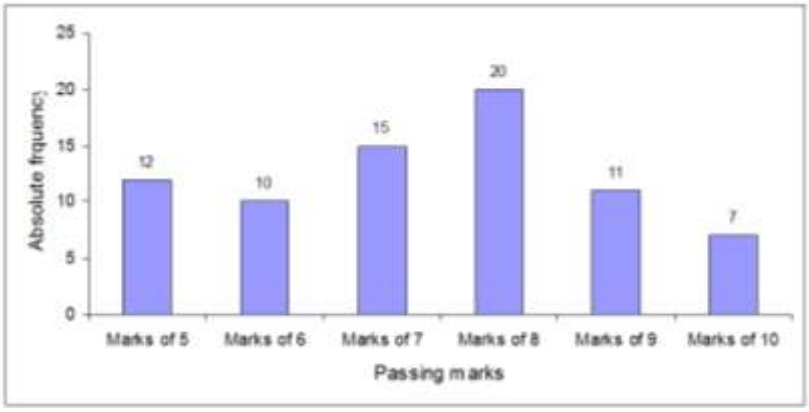

Fig.1. Graph of absolute frequencies corresponding to the case presented in Table 1.

In order to verify this, it is necessary a modeling of the passing marks statistic distribution (absolute or relative) using a normal law and then to determine the concordance degree between the normal model and the empiric distribution. It could be realized a subjective evaluation of the distribution, by visual check, if the frequency histogram has a bell shape [3], as for the normal law, but could not be specified the concordance degree with the normal model.

In order to do an objective evaluation of the distribution normality it is necessary to use a concordance test. For the case studied, considering that there are enough data, it will be used the Kolmogorov-Smirnov test [1].

We realized a special calculation program in Microsoft Excel, with the following stages:

• Calculation of statistic parameters of distribution, useful for defining the normal law:

$$m = \frac{\sum_{i=5}^{10} n_i \cdot i}{\sum_{i=5}^{10} n_i} = \frac{12 \cdot 5 + 10 \cdot 6 + 15 \cdot 7 + 20 \cdot 8 + 11 \cdot 9 + 7 \cdot 10}{75} = 7.4 \quad (1)$$

$$\sigma = \sqrt{\frac{\sum_{i=5}^{10} n_i \cdot (x_i - m)^2}{\sum_{i=5}^{10} n_i - 1}} = \sqrt{\frac{\sum_{1}^{7} n_i \cdot (x_{med,i} - m)^2}{75-1}} = 1.2 \quad (2)$$

• Define the analytic relation for the normal model, with the values calculated for those two parameters:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\frac{(t-m)^2}{2\sigma}} = \frac{1}{1.2\sqrt{2\pi}} \cdot e^{-\frac{(t-7.4)^2}{2\cdot 1.2}} \quad (3)$$

• Determine the values of the difference between the cumulated frequency experimentally determined F_{ex} and the theoretic cumulated frequency F_{teor} (Table 2)

Table 2

Passing marks	Experimental cumulated frequency, F_{ex}	Theoretic cumulated frequency, F_{teor}	D_{max}
5	0.16	0.03	0.13
6	0.29	0.13	**0.16**
7	0.49	0.38	0.12
8	0.76	0.69	0.07
9	0.91	0.90	0.00
10	1.00	0.98	0.02

• Identify the maximum difference between those two distributions (figure 2):

$$D_{\max} = \max\left|F_{ex} - F_{teor}\right| = 0.16 \text{ (for mark 6)} \quad (4)$$

• Calculate the size:

$$\lambda_{\alpha} = D_{\max} \cdot \sqrt{n} = 0.16 \cdot \sqrt{75} = 1.40 \quad (5)$$

• Comparison between the determined value λ_α and the value $\lambda_{0,005} = 1.33$, corresponding to $\alpha = 5\%$ (from the tables of Kolmogorov-Smirnov test [1]):

$$\lambda_\alpha < \lambda_{0.05} = 1.33 \qquad (6)$$

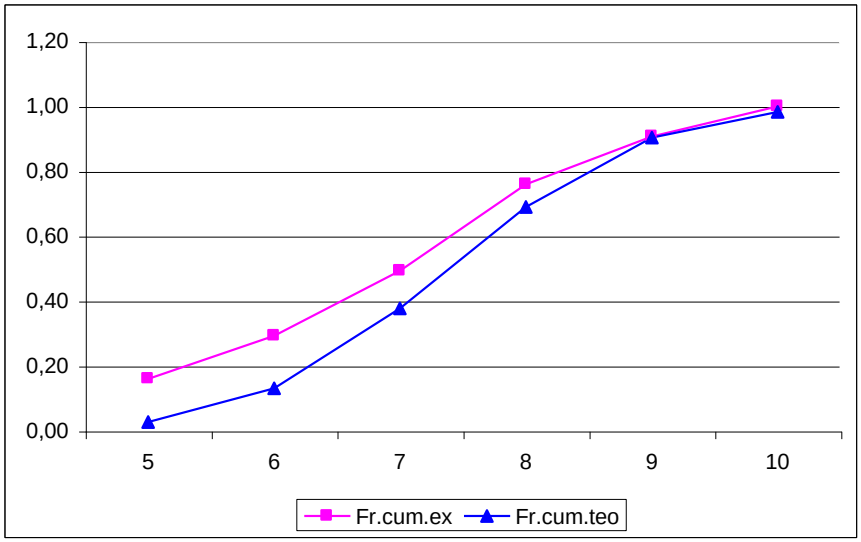

Fig. 2. F_{ex} and F_{teor} graphs.

Checking the inequality (6), it is considered that the normality degree is good (the risk is under 5%), and the value 1 is put in Excel table; in a contrary situation we use value 0.
For the example above the inequality is not confirmed, so the verdict is: "Give explanations. Propose an action plan (actions, responsible and terms)".
The non-conforming degree of distribution normality prove the existence of special causes that must be identified and eliminated, in order to normalize the process (to be subjected only to common causes, that will be accepted) [2].

4.CONCLUSIONS

The special Excel program realized for analyzing the education process on the basis of the marks obtained by students in the exam session, together will the whole activity developed, offer some opportunities:

1 – the information from «Identification data» could reveal essential problems in faculty management, as: there is not nominated an ECTS responsible for specialization or a tutor for the study formation; in this situation, the quality responsible will solve rapidly the problem together with the faculty leadership.

2 – in the disciplines curricula could be find non-conformities, such as the most frequent one: use of another form for discipline curricula than the one issued by the Department of Education Quality ;

3 – an abnormal distribution of passing marks must imply a reconsideration of all the activities counted at final evaluation, so an analyze on multiple directions;

4 – if the indicators are not fulfilled, the faculty staff must do a serious analyze and propose an Action plan; this will improve the education process in the faculty.

The final analyze, performed by the top management, will provide a global vision of the education process on the basis of centralized data, and there are conditions for taking the most appropriate decisions for improving these indicators and the education process, by removing the root causes.

More, during this large reunion, there are analyzed the observations concerning the tool used on the proposed method, so this will be improved in the future.

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