USE AND INTERPRETATION OF STATISTICAL QUALITY CONTROL CHARTS TO MONITOR THE QUALITY OF STUDENT EDUCATION AT THE UNDERGRADUATE LEVEL

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ABSTRACT

The application of the quality management approach in various production and service institutions in developed countries is a distinguished scientific management method, as the application of this system in higher education is one of the important pillars for developing universities and qualifying their graduates and educational cadres alike. The quality of education is a guarantee for the outputs of education to be qualified to lead the society and thus the need to apply the quality management approach in higher education to improve the level of university performance and employ advanced technology for the benefit of the educational process. The process of measuring quality in higher education is based on three main pillars (student, curriculum, and professor).

Therefore, the research aims to study this approach by taking the student's standard as the focus of the educational process through the results of his academic achievement. To achieve this, the researchers suggested using qualitative control maps by quantitative and descriptive methods, by taking samples from students of the Statistics Department, Faculty of Science, Asmara University, for the fall and spring semesters for the years (2013-2019). So that the student's product and production process are studied and that the defective is the student (who did not obtain the required average), with a proposal for other control panels that can measure the student's competence.

1. INTRODUCTION

The concept of quality appeared in the eighties of the last century in the United States of America with the rise in the pace of global economic competition and the conquest of the Japanese industry to global markets. Quality is basically an institutional concept related to productivity and profitability, and I moved to the field of education, considering that the

educational institution is an institution for the production of competencies and expertise capable of innovation and creativity, without which industrial institutions cannot develop their production and improve their products, [1].

This concept has moved to include education, as the quality of education has become the focus of attention for those interested in education at the regional and global levels, as many see that the challenges of the age are to raise the quality of education and improve the outputs, and to adopt a change towards the application of the quality system in university education to ensure its outputs, to be qualified to lead the community. Education quality is a set of standards, procedures, and decisions whose implementation aims to improve the educational environment. These standards include educational institutions with their various frameworks and forms, including the teaching and administrative staff, and the conditions of employees who have a direct or indirect relationship with the educational system, even if the quality standards differ from one institution to another, but they agree in many basic principles and foundations, all of which aim to bring out the final product, which is the student who holds all the skills that are based on thinking, research, criticism, analysis, strong personality and the ability to express an opinion, meeting the needs of the labor market and society as well, and to achieve this it is necessary to achieve quality standards in education, namely: the quality of the curricula, the quality of Educational and administrative frameworks, quality of infrastructure and public utilities, results of educational attainment, continuous improvement, and mechanisms for achieving quality education, [2].

Reforming the education system has become one of the most important issues that trouble officials all over the world, believing that the formation

of human capital is the mainstay of every economic and social renaissance and sustainable community development. Educational institutions are the ones that depend on building a person, developing his skills, increasing his capabilities, and developing his personality because education alone is capable of building a person who has the will to confront the features of this age and its repercussions in a way that preserves the role of science and education, which is becoming more and more in various areas of life. Therefore, higher education is the important pillar that prepares the human element and develops its capabilities, skills, and energies so that the student becomes a creative product, [4].

The higher education system in most developing countries, including Libya, suffers from many problems in education with regard to faculty members, curricula, and the administrative body, in addition to the community's dissatisfaction with the products due to the lack of students' specializations with the requirements of the labor market due to their focus on traditional education and indoctrination and thus the absence of Opportunities for their creativity and innovation and lack of development of their capabilities. These problems can be reduced or addressed if the administrative and educational system is reformed and developed within those institutions by establishing a high-quality educational system as an imperative in order to face these challenges and adapt to the changes taking place in the world today, [5].

2. RESEARCH IMPORTANCE

The study derives its importance from the nature of the era that was characterized by scientific progress, and the need to keep pace with the development of education for these changes in its outputs, through the

development of tools for measuring student achievement in accordance with comprehensive quality standards in order to be able to reduce educational waste represented by repetition, failure and inappropriateness of outputs to the labor market.

From here comes the importance of research through the low indicators of the effectiveness of the university from the perspective of educational quality, where estimates of academic achievement are among the indicators used in determining the efficiency and productivity of centers affiliated with higher education, and that the process of student assessment is subject to the traditional pattern of tests, which raises controversy about the role of the college in Education process. It also provides background information that helps faculty members develop tools to measure student achievement in higher education centers. This requires the Ministry of Higher Education and Scientific Research to hold several workshops, conferences, seminars and programs to develop education, and to ensure that educational outputs achieve the required quality, [3].

3. SEARCH OBJECTIVE

The research aims to shed light on the concept of educational quality and identify its objectives and the extent to which it can be applied in university education, study the reality of the application of quality education in university institutions through the standard of results for students' academic achievement, trying to contribute to achieving the desired educational quality through some results and recommendations for the practical side Search.

4. CONTROL CHART

Monitoring maps are a graphic form that represents the vertical coordinate of the studied trait, and the horizontal coordinate represents time, order of samples or production.

It includes the shape of the control map, upper bound of the control UCL, the center line (midline) CL, and the lower bound of the control LCL. The results of the examination of samples taken from production appear in the form of a fluctuating series within the limits of control, which indicates that the production process is within the limits of control and production well, but if it appears outside the limits of control, it is said that the production is out of control and the necessary solutions and treatments must be developed to correct this defect. The decision maker must define the concept of non-conformity of the production process with quality specifications, for example, in some cases the occurrence of some of its points outside the range (UCL, LCL) is evidence that the production process does not conform to quality specifications, and there are cases of points located at a level below the minimum level of control only while There are points at a level higher than the upper limit of observation, this is considered a normal thing that must be strengthened, [4,5].

There are two basic concepts in control panels and product control that can be clarified and in the light of these two concepts; the types of control maps can be identified:

1. Variables: It is the recording of the qualitative characteristics of the vocabulary of a particular sample after testing it with standard units. That is, the quality was expressed by the variable.

2. Attributes: They mean recording the results and selecting the sample items without units of measurement, as they are expressed as matching or non-conforming.

1. The arithmetic mean chart ($\overline{X}$ - Chart):

When preparing the arithmetic mean maps for a production process, K is taken from the samples so that each sample contains n units. The following should be noted:

(a)The first case: When the arithmetic mean of the population μ and the standard deviation of the population σ are known, the limits of control are as follows:

$$\begin{cases} UCL = \mu + 3\sigma/\sqrt{n} \\ \mu \\ LCL = \mu - 3\sigma/\sqrt{n} \end{cases} \quad (1)$$

(b)The second case: When the arithmetic mean of the population μ is unknown, and the population standard deviation σ is known, the limits of control are as follows:

$$\begin{cases} UCL = \overline{X} + 3\sigma/\sqrt{n} \\ \overline{X} \\ LCL = \overline{X} - 3\sigma/\sqrt{n} \end{cases} \quad (2)$$

(c)The third case: When the arithmetic mean of the population μ is known, and the population standard deviation σ is unknown, the limits of control are as follows:

$$\begin{cases} UCL = \mu + 3\bar{S}/\sqrt{n} \\ \mu \\ LCL = \mu - 3\bar{S}/\sqrt{n} \end{cases} \quad ; \ \bar{S} = \sum_{i=1}^{k} S_i \Big/ k \qquad (3)$$

Or

$$\begin{cases} UCL = \mu + 3\left(S_{pooled}\right)/\sqrt{n} \\ \mu \\ LCL = \mu - 3\left(S_{pooled}\right)/\sqrt{n} \end{cases} \quad ; \ S_{pooled} = \sqrt{\frac{(n-1)\sum_{i=1}^{k} S_i^2}{k(n-1)}} \qquad (4)$$

(d)Fourth case: When the arithmetic mean of the population μ, and the standard deviation of the population σ are unknown, the limits of control are as follows:

$$\begin{cases} UCL = \bar{\bar{X}} + 3\bar{S}/\sqrt{n} \\ \bar{\bar{X}} \\ LCL = \bar{\bar{X}} - 3\bar{S}/\sqrt{n} \end{cases} \quad ; \ \bar{S} = \sum_{i=1}^{k} S_i \Big/ k \qquad (5)$$

2.The Range chart (R - Chart):

The range chart is an alternative to the standard deviation chart. The boundaries of this chart are calculated as follows:

$$\begin{cases} UCL = D_4 \bar{R} \\ \bar{R} \\ LCL = D_3 \bar{R} \\ Wherr \ D_3, D_4 \ is \ tabular \ values \end{cases} \quad ; \ \bar{R} = \sum_{i=1}^{k} R_i \Big/ k \qquad (6)$$

5. QUALITY CONTROL OF THE RESULTS OF THE STUDENTS OF THE STATISTICS DEPARTMENT OF ASMARIYA UNIVERSITY

A sample of the semester averages of students of the Statistics Department at the Faculty of Science, Asmariya University for the academic years (2013-2019) was taken from the results charts. Using the statistical program SSPS, the arithmetic mean and standard deviation of the samples were found, and they were as they are in the table (1):

TABLE 1: THE SAMPLES OF THE STUDY

Academic year		the size	Semester average	Semester standard deviation	Academic year average
2013/2014	Spring	36	47.63	25.56	41.58
	Autumn	37	35.52	18.33	
2014/2015	Spring	30	57.57	16.99	51.91
	Autumn	42	46.25	21.72	
2015/2016	Spring	61	43.11	21.89	42.10
	Autumn	55	41.05	25.39	
2016/2017	Spring	43	60.56	19.62	57.79
	Autumn	60	55.01	20.73	
2017/2018	Spring	51	58.66	17.48	56.84
	Autumn	58	60.87	22.96	
2018/2019	Spring	50	60.43	18.44	60.65
	Autumn	48	65.50	22.25	
2019/2020	Spring	38	63.45	21.25	64.59
	Autumn	39	65.73	18.55	

By substituting the statistical data shown in the table (1), in the SSPS statistical program, a control chart can be found about the arithmetic mean and range, as shown in the figures (1, 2):

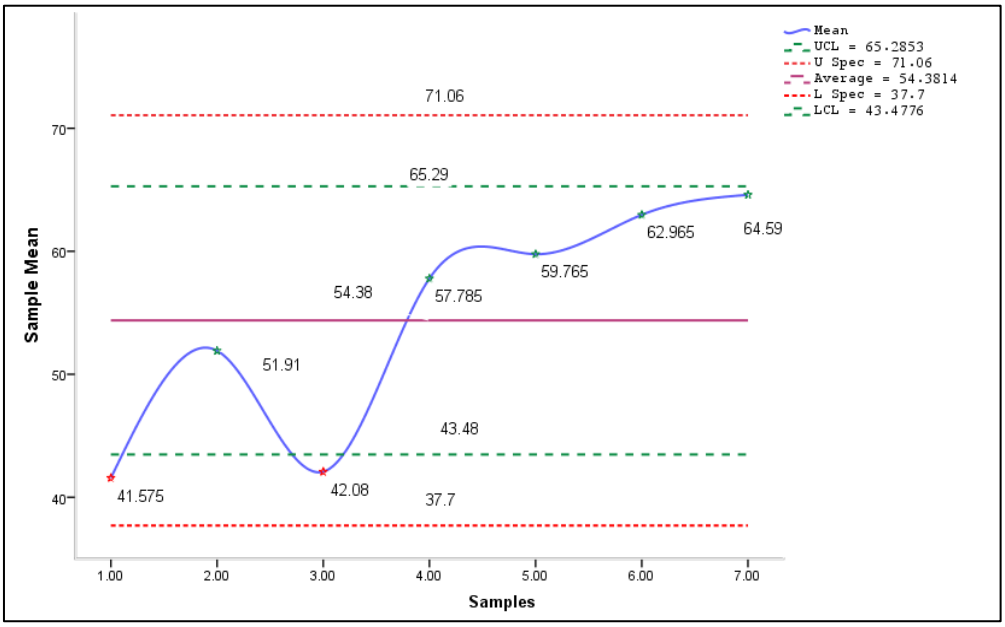

Figure 1: the chart of arithmetic mean

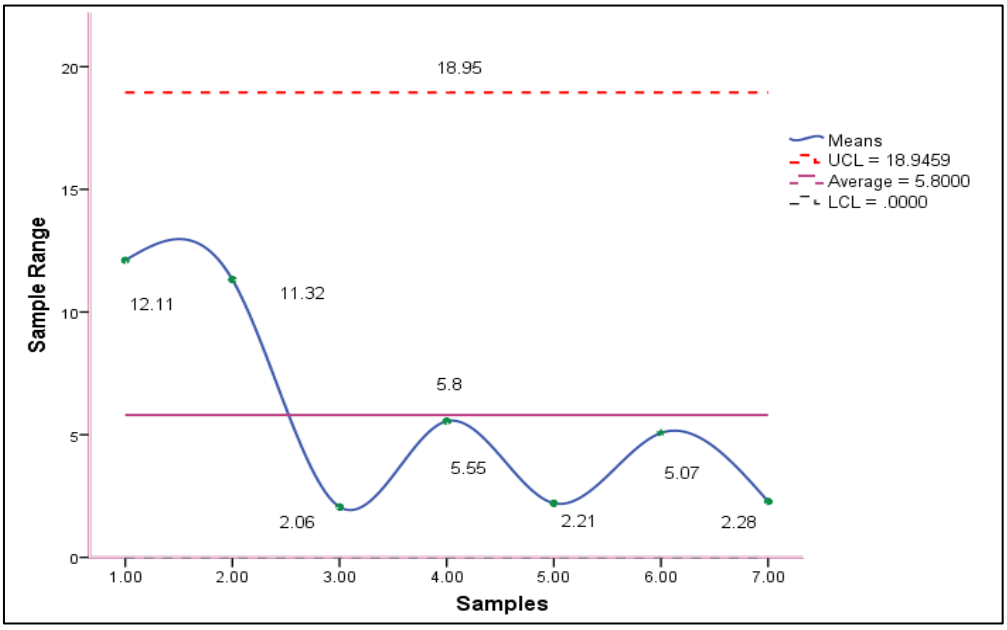

Figure 2: the chart of range

Figures (1, 2) shows that the average of sample no.1 and sample no.3 is outside the upper limit of the control chart of the arithmetic mean. As for the R chart, all points lie between the control limits. We are creating a control chart for both X and R of the study data, and then removing samples beyond the control limits and recalculating the control chart limits based on the remaining 5 samples, see table 2:

Table 2: the samples of the study modified

Academic year		the size	Semester average	Semester standard deviation	Academic year average
2014/2015	Spring	30	57.57	16.99	51.91
	Autumn	42	46.25	21.72	
2016/2017	Spring	43	60.56	19.62	57.79
	Autumn	60	55.01	20.73	
2017/2018	Spring	51	58.66	17.48	56.84
	Autumn	58	60.87	22.96	
2018/2019	Spring	50	60.43	18.44	60.65
	Autumn	48	65.50	22.25	
2019/2020	Spring	38	63.45	21.25	64.59
	Autumn	39	65.73	18.55	

By substituting the statistical data shown in the table (2), in the SSPS statistical program, a control chart can be found about the arithmetic mean and range, as shown in the figures (3,4):

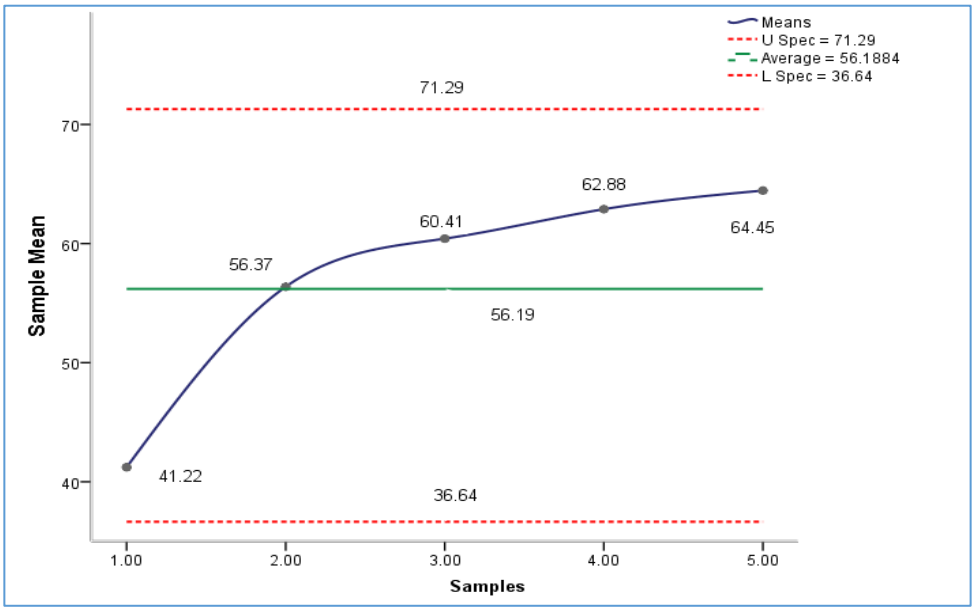

Figure 3: the chart of arithmetic mean

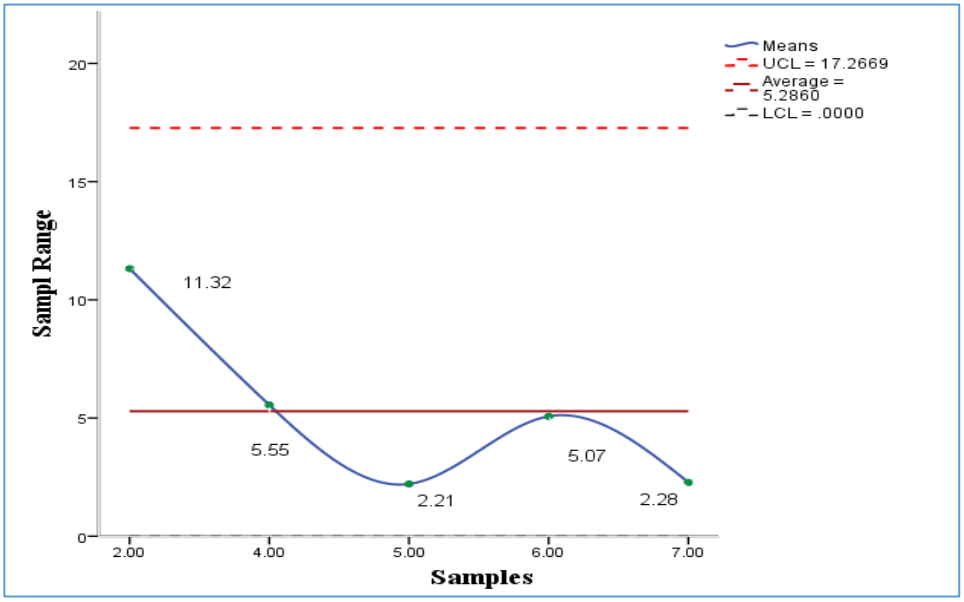

Figure 4: the chart of range

From table (2), and Figures (3,4), in the light of the modified information, it is clear that all the samples fall within the control limits whether for the arithmetic mean chart or the R range chart.

6. CONCLUSION AND RECOMMENDATION:

By applying control maps to the results of students of the Statistics Department for the academic years (2013/2014 - 2019/2020), one obtained the following:

1. Control charts can be used to analyze the quality of higher education on the part of students.
2. The results of the range maps showed that there were no spaces between the samples taken from the seven stages.
3. It is clear from the control maps of the arithmetic average that the Statistics Department is not within the control limits of student rates for the two academic years (2013/2014, 2015/2016), which indicates the weak homogeneity of the department's students in terms of the student's scientific level.
4. The two pillars of educational quality represented by the curricula and faculty members for the academic years (2014/2015, 2016/2017-2019/2020) effectively contributed to achieving the department's educational outcomes.

Through the findings of the researchers recommended the following:

1. Work on applying the concepts of quality from the students' side as an important criterion for measuring the productivity of the educational process and their interaction with the curriculum and

faculty members alike, to reach high quality in terms of educational outcomes represented by qualified graduates for the labor market.

2. Employ qualitative control methods with control maps in calculating quality in terms of the efficiency of the university professor and the curriculum.

3. Benefiting from the non-parametric method in quality applications, especially for metadata, and in the event that data distribution is not specified.

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