ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume X (XX), 2011, NR2

USING DAUDIN'S METHODOLOGY FOR ATTRIBUTE CONTROL CHARTS.

Pérez-Bernabeu E.[1], Sellés M.A.[2], Carrión A.[3], Jabaloyes J.[4], Sánchez-Caballero S.[5]

[1] Dep. De Estadística e Investigación Operativa Aplicadas y Calidad, Universitat Politècnica de València, Spain, elenapb@eio.upv.es

[2] Instituto de Tecnología de Materiales, Universitat Politècnica de València, Spain, maselles@dimm.upv.es

[3] Dep. De Estadística e Investigación Operativa Aplicadas y Calidad, Universitat Politècnica de València, Spain, acarrion@eio.upv.es

[4] Dep. De Estadística e Investigación Operativa Aplicadas y Calidad, Universitat Politècnica de València, Spain, jabaloye@eio.upv.es

[5] Instituto de Diseño y Fabricación, Universitat Politècnica de València, Spain, sasanca@dimm.upv.es

Keywords: Statistical tool; control charts; attribute control charts.

Abstract: There are many methods that can be applied to each one of the control charts, for instance, Daudin´s methodology, which proposal is to set two stages of decision, and a rule to go on with the second stage. It is always taken two samples and, at first, it is only analyzed the first sample. Then, depending on the rule, it is analyzed the second sample or not, so that a good decision can be made. It is stated that in the existing bibliography there are several studies about variable control charts, concretely, average control charts. On the other hand there are fewer contributions for the attribute control chart.

1. INTRODUCTION

The control chart is a graph used to study how a process changes over time. Data are plotted in time order, and different types of control charts can be used, depending upon the type of data. The two broadest groupings are for variable data and attribute data.

We have different Attributes charts: p chart (proportion chart), np chart, c chart (count chart) and finally, **u chart**, the one we are going to modify and study its behavior.

Our main goal was to define a control chart with double sampling strategy that would accomplish improving the power of the classic u chart without increasing the average sample size.

2. PURPOSSE AND HYPOTHESIS

The main purpose is to make a comparison between the classic u-chart and a modified u-chart (by now DS-u chart), based on J.J.Daudin's methodology [1]. Daudin modifies the Shewhart chart applying a double sampling, so that way, he improves the behavior of the chart.

In this work, it is applied Daudin's philosophy to the attribute chart, concretely, to the u-chart.

As seen in figure 1, the modified u-chart has got a two stage scheme, with new control limits and sample size in each stage.

We have to calculate these new parameters, maintaining the most similar false alarm risk, α, and the sample size (or reducing the last one) of the classic u-chart.

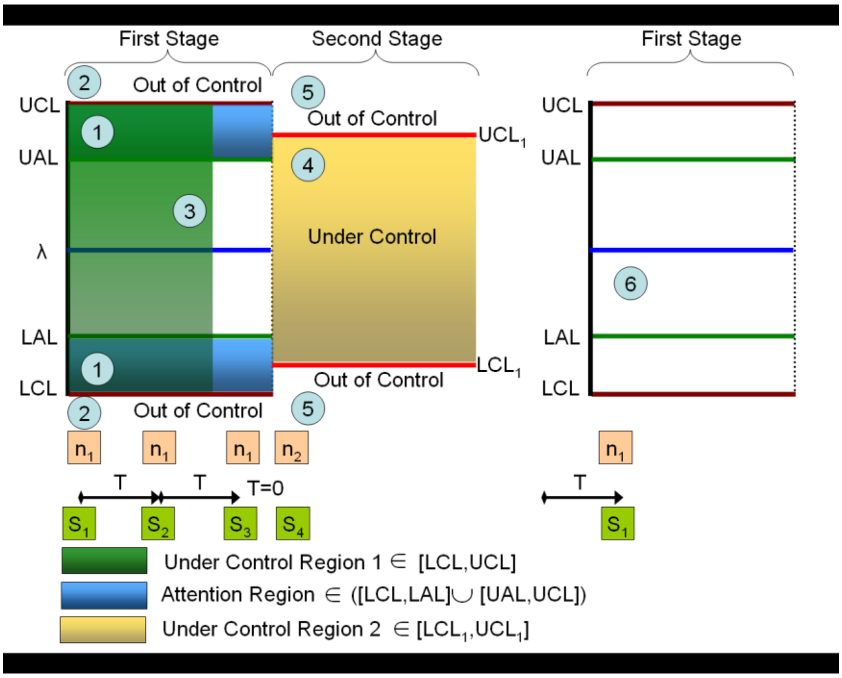

Figure 1. Scheme of the new DS-u chart;

3. METHODS

The method that has been chosen for calculating the new control limits of the two stages of the DS-u chart is software programming in C++.

It has been used Genetic Algorithms to get the better solutions. We used a library of free distribution, GAlib, that contains a set of C++ genetic algorithm objects. This library includes tools for using genetic algorithms to do optimization in any C++ program using any representation and genetic operators.

The parameters of the Genetic Algorithm have been selected following the rules showed in Martorell et al. [3].

As we want to know the behavior of the modified u-chart, we have selected some cases. One of them, showed in the figures below, is for the case that the defects per unit u_0 = 1, and three different false alarm risks: α= 0,027, α= 0,01, α= 0,05.

4. RESULTS

The main results we have obtained are the following:

- We obtain poor power improvements when u_1 is surrounding u_0=1, and the opposite occurs when improving the power at u_1, being much lower o much greater than u_0=1. (fig. 2). We also notice that the results are better at the time we reduce α.

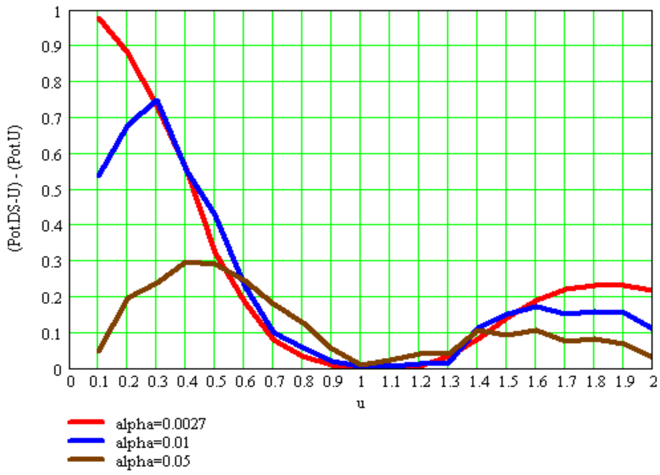

Figure 2. Difference of power;

- Even we improve the power curve in $u_0=1$, the sample size mean is not reduced of the classic u-chart sample size. (fig. 3).

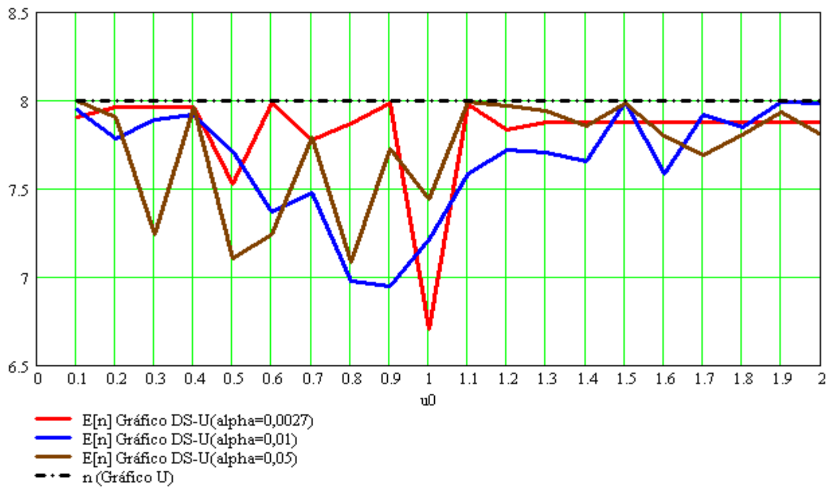

Figure 3. Sample size mean of the DS-u chart;

- We can distinguish between two patterns of behavior: for values of $u_1 < u_0$, and for values of $u_1 > u_0$. (figs.4 and 5)
- In the cases that $u_1 < u_0$, the differences between the power are greater than the other case ($u_1 > u_0$), but while we improve the power difference in one value u1, the power curve is worst than the classic u-chart for values of $u_1 > 1$. As we can see in fig.5, this doesn't happen in the other case. We have lower improvements of power, but we improve the entire power curve, not only in a specific value of u_1.

Now, the work is in progress, analyzing other cases, and so determine in which cases should be used this modified u-chart, DS-u chart.

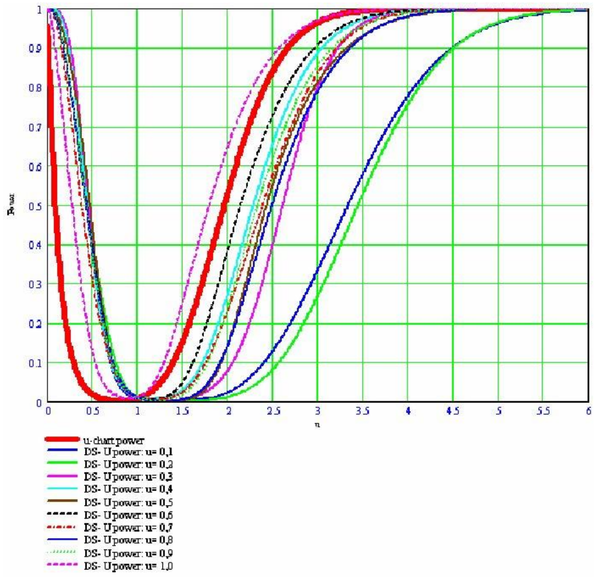

Figure 4. Power for values of u_1<1;

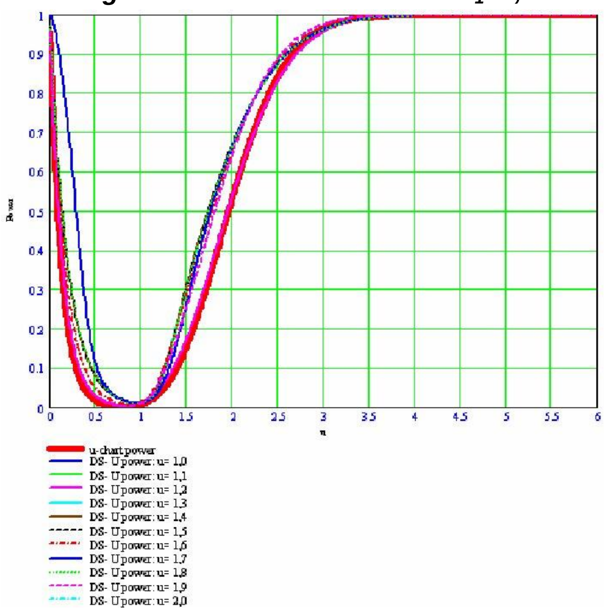

Figure 5. Power for values of u_1>1

AKNOWLEDGEMENT

The software for this work used the GAlib genetic algorithm package, written by Matthew Wall at the Massachusetts Institute of Technology.

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