Construction Skewness Correction the $\bar{X}$ And R Control Chart under Non –Normality

ID No.90

(PP 237 - 246)

https://doi.org/10.21271/zjhs.26.1.15

Kawa M. Jamal Rashid
Department Informatics Statistics, College Administration and Economics, University of Sulaimani
kawa.rashid@univsul.edu.iq

Received: 12/09/2021
Accepted: 02/12/2021
Published:25/02/2022

Abstract

Shewhart's charts are powerful tools in Statistical Process Control (SPC) and are widely used. Usually, Shewhart's charts are depending on the normality assumption. The control charts rely on normality assumptions, which is not always the case for industrial data. Skewness correction and an alternate technique of constructing non-normality control charts for persons The proposes of this paper is to use a skewness correction SC control chart to monitor or construct the $\bar{X}$ **and** R control chart for the skewness distribution. The SC chart or the new control chart compared with the Shewhart and weighted variance (WV) control.
The probability of exceeding out-of-control detections is also accomplished under a normal curve, the probability that a deviation from the means of the 3σ limit in both directions is 0.0027.
Change with the sample size leads to an increase in skewness distribution, leading to a relative increase in the type-I error.

Keywords: Control Chart, Skewness correction, R charts, Shewhart $\bar{X}$, and weighted variance control chart.

1. Intrduction:

Statistical Process Control is a powerful collection of tools to solve complex problems in quality control. It is useful in obtaining process stability and improving capability through the reduction of variability.
Control charts tools are the easy and very convenient method used in the process because it is based on experimentally proven statistical principles and the powerful tools in the statistical process control chart,Shewhart charts and weighted variance (WV) control charts were compared.
The Shewhart control chart includes the $\bar{X}$ and R control charts. The structure or the advance of the control chart depends on the assumption normality or approximately normal. In many cases, the normality assumption is not valid in case if that the distribution is skewed.
The conventional Shewhart $\bar{X}$ and R control charts of Type I error risks, i.e., the probabilities of a subgroup $\bar{X}$ **or** R falling outside the 3sigma control limits when the process is controlled.
Even when the process distribution is exponential with a known mean, the SC charts' control limits and Type I risk and their Type II risk are closer to those of the precise $\bar{X}$ **and** R charts than the WV and Shewhart charts. It comprises basically of three parts, namely the Upper Control Limit (UCL), the Central Line (CL), and the Lower Control Limit (LCL). The central line is the targeted goal of production, while the lower and upper control limits are the maximum boundaries for a process considered to be in control.
Let θ be a quality characteristic, and $\hat{\theta}$ be unbiased estimate, the expected mean is $E(\hat{\theta})$ and the standard deviation is $\sigma(\hat{\theta})$ be the estimator of $\hat{\theta}$. The central line, upper and lower class

limits of the quality in question can be derived as follows from the normal distribution and the Z transformation below. Lai and Cui, (2003), Mostapha, (2020), Osaman, (2018).

$$Z = \frac{E(\theta) - \hat{\theta}}{\sigma(\hat{\theta})}$$

The probability Z can be calculated within a given interval says L as follows

$$-L \leq \frac{E(\theta) - \hat{\theta}}{\sigma(\hat{\theta})} \leq L$$

$$CL = E(\hat{\theta})$$
$$UCL = E(\hat{\theta}) + L\sigma(\hat{\theta})$$
$$LCL = E(\hat{\theta}) - L\sigma(\hat{\theta})$$

L in the above Equations represents the number of standard deviations of the sample statistic that the control limits are placed from the central line. Osaman (2018).

2. Control charts for The Mean and Range

In statistical process control, control charts are simple to use but extremely effective. Shewhart control charts are the mother charts of all the existing variables control charts.
The traditional Shewhart $\overline{X}$ and R control charts are based on the premise that the quality characteristic's distribution is normal or nearly normal. These charts are mainly used for monitoring the process average and its variability. Shewhart control charts for the mean ($\overline{X}$) standard deviation(s) and Range (R) .Supposing that a quality characteristic under investigation say X is normally distributed with mean μ and standard deviation σ where both μ and σ are known and if a sample of size n say $X_1, X_2 \ldots X_n$ are taken, then the mean of this sample is given as follows.

$$\overline{X} = \frac{\sum_{i=0}^{n} X_i}{n} \qquad \ldots 1$$

From the Normal distribution, the relationship between the range of a sample and the standard deviation of that distribution, and the W is the relative range of the with mean d_2 and whose parameters of the distribution of the sample size n are given below, d_2 is also a standard constant. Mostapha (2018).

$$W = \frac{R}{\sigma} \quad and \ \hat{\sigma} = \frac{\bar{R}}{d_2} \qquad \ldots 2$$

And the Upper and Lower control limit are given as. Montegomery, (2019), Osaman (2018).

$$UCL = \bar{\bar{X}} + \frac{3}{d_2\sqrt{n}}\bar{R} \quad , \quad LCL = \bar{\bar{X}} - \frac{3}{d_2\sqrt{n}}\bar{R} \quad and \quad Cl = \bar{\bar{X}} \qquad \ldots 3$$

$$A_2 = \frac{3}{d_2\sqrt{n}} \qquad \ldots 4$$

A_2 is a constant value from table .

Then the UCL and LUL are :

$$UCL = \bar{\bar{X}} + A_2\bar{R} \quad , \quad Cl = \bar{\bar{X}} \quad and \quad LCL = \bar{\bar{X}} - A_2\bar{R} \qquad \ldots 5$$

R-chart are given below:

$$\text{UCL} = \bar{R} + 3d_3\frac{\bar{R}}{d_2} \quad , \quad LCL = \bar{R} - 3d_3\frac{\bar{R}}{d_2} \quad and \quad Cl = \bar{R} \qquad ....6$$

If we let that:

$$\text{D}_3 = 1 - 3\frac{d_3}{d_2} \quad and \quad \text{D}_4 = 1 + 3\frac{d_3}{d_2} \qquad ...7$$

Then The UCL and LCL is given below

$$\text{UCL} = D_4\bar{R} \quad , \quad LCL = D_3\bar{R} \quad and \quad Cl = \bar{R} \qquad .... 8$$

3. Control Charts for Skewed Distributions

Let $X_{1i}, X_{2i} \ldots X_{ni}$, i=1, 2, . . . , r, be r subgroups (samples) of size n from a process distribution with mean μ, standard deviationσ, and skewness K_3 The conventional control charts or the classic Shewhart control are used when the distribution is normal for monitoring the process mean, and variability in the characteristics of a random quality variable of interest is based on the normality assumption, simply that the normality assumption of distribution data extracted from the characteristics of the quality variable show either a relatively normal distribution witch a value of the mean and standard deviation or can easily be made normal using the central limit theorem, where the distribution of the random quality variable under investigation is skewed.

Principe Of The SC Method. Abdu, et al, (2016), Abdu, et al, (2020), Montegomery, (2019).
The Skewness Correction SC $\bar{X}$ AND *R* Control Charts
Let X be a standardized random variable with μ=0 and σ =1 and if Skewness (k_3) is known then UCL , LCL and CL of Skewness Correction SC is :

$$UCL = 3 + \frac{\frac{4}{3}k_3}{1+0.2k_3^2} \quad , \quad LCL = -3 + \frac{\frac{4}{3}k_3}{1+0.2k_3^2} \quad and \quad CL = 0 \qquad .....9$$

There For The Control limit of Correction Of Skewness of average $\text{SC}_{\bar{X}}$ where Xi distributed with mean and standard deviation are known , then if :

$$C_4^* = \frac{\frac{4}{3}k_3(\bar{X})}{1+0.2k_3^2(\bar{X})} \quad , \quad d_4^* = \frac{\frac{4}{3}k_3(\bar{R})}{1+0.2k_3^2(\bar{R})} \qquad ....10$$

Then the $SC_{\bar{X}}$ are:

$$UCL_{\bar{x}} = \mu_{\bar{x}} + (3 + C_4^*)\sigma_x/\sqrt{n}$$
$$CL_{\bar{x}} = \mu_{\bar{x}} \qquad ....11$$
$$LCL_{\bar{x}} = \mu_{\bar{x}} + (-3 + C_4^*)\sigma_x/\sqrt{n}$$

$$UCL_{\bar{X}} = \bar{\bar{X}} + \left(3 + \frac{\frac{4k_3}{3\sqrt{n}}}{1+0.2k_3^2/n}\right)\frac{\bar{R}}{d_2^*\sqrt{n}} \quad \equiv \quad \bar{\bar{X}} + A_U^*\bar{R}$$
$$CL_{\bar{X}} = \bar{\bar{X}} \qquad ......12$$
$$LCL_{\bar{X}} = \bar{\bar{X}} + \left(-3 + \frac{\frac{4k_3}{3\sqrt{n}}}{1+0.2k_3^2/n}\right)\frac{\bar{R}}{d_2^*\sqrt{n}} \quad \equiv \quad \bar{\bar{X}} - A_L^*\bar{R}$$

Where
And the control chart for Rang of SC_R are as show:

$$UCL_R = \mu_R + (3 + d_4^*)\sigma_R$$
$$CL_R = \mu_R \quad \text{....13}$$
$$LCL_R = \mu_R + (3 + d_4^*)\sigma_R$$

And the based on the control charts for the range (*R*-chart) obtained by the SC method when the process
distribution and parameters are unknown are given as follows. Abdu, *et al*, (2020), Derya and Anan, (2012), Mans, (2008), Subba Latha, (2016).

$$UCL_{SCR} = \left[1 + \left(3 + d_4^* \frac{d_3^*}{d_2^*}\right)\bar{R}\right]$$
$$CL_R = \bar{R} \quad \text{....14}$$
$$LCL_{SCR} = \left[1 + \left(-3 + d_4^* \frac{d_3^*}{d_2^*}\right)\bar{R}\right]$$

Where

$$D_3^* = \left[1 + \left(-3 + d_4^* \frac{d_3^*}{d_2^*}\right)\bar{R}\right] \quad \textbf{... 15}$$

And

$$D_4^* = \left[1 + \left(3 + d_4^* \frac{d_3^*}{d_2^*}\right)\bar{R}\right] \quad \textbf{.... 16}$$

Where

SC_R limit as following :

$$UCL_{SCR} = D_4^*\bar{R}$$
$$CL_{SCR} = \bar{R} \quad \textbf{...17}$$
$$LCL_{SCR} = D_3^*\bar{R}$$

Weighted Variance method Chani and Heng, (2003), Michael and Zhang, (2008), Osaman, (2018), Subba and Latha, (2016) .

During the population changes, non-symmetric control limits need to be used (Bai & Choi, 1995). Methods such as the Weighted Variance (WV), Weighted Standard Deviation (WSD), and Skewness Correction (SC) are generally more reliable. Using these methods helps the experimenter misinterpret results and hence produce a better output.
This method works basically by dividing the area under a probability density function of a random variable under investigation into two portions concerning the mean of the distribution.
Each portion has the same mean but different standard deviations and are separate symmetric distributions (curves). These new portions can be identified if the mother curve is symmetric.
In cases where the mother distribution is Skewed, one curve is longer than the other depending on the side of the skins. The control limits for the mean and the range are then obtained using these new distributions.
In other words, one of the two distributions is used for the upper control limit while the other one is used for the lower control limit. (Choobineh & Ballard, 1987).

4. $\bar{X}$ **and *R* Control Limits for the Weighted Variance Method** Abdu, et al, (2020), Chung and Cheng, (2014), Mans, (2008), Mostapha, (2020), Subba and Latha, (2016)

Just like Shewhart's approach, the WV method uses the standard deviation to establish the control limits for the mean and range charts. The only difference between the two methods lies at the level of the two multiplication factors added to the WV method (Karagöz & Hamurkaroğlu), Control Charts For Skewed Distribution: Weibull, Gamma,

Lognormal,2012). Therefore, the control limits obtained from the WV method are also considered to be the Shewhart type charts.
The two multiplication factors used in the establishment of the control limits for the mean ($\bar{X}$) And the range (R) charts are as follows (Bai & Choi, 1995).

$$UCL: \sqrt{2P_X} \quad , \quad LCL: \sqrt{2(1-P_X)} \qquad \text{....18}$$

If the parameters of the quality process under investigation are known, the control limits of the $\bar{X}$ chart obtained using the WV method are as follows.

$$UCL_{WV_{\bar{X}}} = \mu_x + 3\frac{\sigma_x}{\sqrt{n}}\sqrt{2P_x}$$
$$CL_{WV} = \mu_x \qquad \text{....19}$$
$$LCL_{WV_{\bar{X}}} = \mu_x - 3\frac{\sigma_x}{\sqrt{n}}\sqrt{2(1-P_x)}$$

The control limits obtained with respect to the WV method for the R chart when the process parameters are known are given as : (Abdu. M.2016, Abdu. M.2012)

$$UCL_{WVR} = \mu_R + 3\sigma_R\sqrt{2P_x}$$
$$CL_{WVR} = \mu_R \qquad \text{.... 20}$$
$$LCL_{WVR} = \mu_R - 3\sigma_R\sqrt{2(1-P_x)}$$

The $\bar{X}$ control limits obtained with respect to the WV method when the process parameters are unknown are given below.

$$UCL_{WVR} = \bar{\bar{X}} + 3\frac{\bar{R}}{d_2'\sqrt{n}}\sqrt{2P_x}$$
$$CL_{WV\bar{x}} = \bar{\bar{X}} \qquad \text{..... 21}$$
$$UCL_{WVR} = \bar{\bar{X}} - 3\frac{\bar{R}}{d_2'\sqrt{n}}\sqrt{2(1-P_x)}$$

Where

$$W_U = \frac{3\sqrt{2P_x}}{d_2'\sqrt{n}} \quad and \quad W_L = \frac{3\sqrt{2(1-P_x)}}{d_2'\sqrt{n}} \qquad \text{.....22}$$

$$UCL_{WV\bar{x}} = \bar{\bar{X}} + W_U\bar{R}$$
$$CL_{WV\bar{x}} = \bar{\bar{X}} \qquad \text{.... 23}$$
$$UCL_{WV\bar{x}} = \bar{\bar{X}} - W_U\bar{R}$$

The value of constants W_U and W_L were calculated for various values of n by (Bai &Choi 1995).
The R control obtained with respect to the WV method when the process parameters are unknown are given as: Abdu, et al, (2020), Derya and anan, (2012), Mans, (2008), Mostapha, (2020), Subba and Latha, (2016)

$$UCL_{WVR} = \bar{R}\left[1 + 3\frac{d_3'}{d_2'}\sqrt{2P_X}\right]$$
$$CL_{WV\bar{R}} = \bar{R} \qquad \text{....24}$$
$$UCL_{WVR} = \bar{R}\left[1 - 3\frac{d_3'}{d_2'}\sqrt{2(1-P_X)}\right]$$

$$D_4^* = \left[1 + 3\frac{d_3'}{d_2'}\sqrt{2(P_X)}\right] \quad and \quad D_3^* = \left[1 - 3\frac{d_3'}{d_2'}\sqrt{2(1-P_X)}\right] \qquad \text{...25}$$

$$UCL_{WVR} = D_{4WV}\,\bar{R}$$
$$CL_{WVR} = \bar{R} \qquad \text{....26}$$
$$UCL_{WVR} = D_{3WV}\,\bar{R}$$

5. A numerical illustrates Example:

In the practical section , we use data obtained from a cement factory (Mass) in Sulaymaniyah, which consists of data from one of the basic chemical elements of the cement compound is SO3 , we have a sample size n=4 for 30 days of SO3 is One of the cement compounds, as shown in Table 1.

Table (1) contains the Data of the value of SO3 of Cement.

#	X1	X2	X3	X4	Average	Range
1	3.01	3.14	2.81	2.43	2.49	2.14
2	2.83	2.69	2.68	2.53	2.55	0.83
3	2.83	2.43	2.84	3.01	2.78	0.57
4	2.58	2.53	2.84	2.83	2.99	1.47
5	2.77	3.01	2.89	2.25	3.42	2.23
….	….	….	….	….	….	….
….	….	….	….	….	….	….
….	….	….	….	….	….	….
25	2.54	2.61	2.96	2.56	8.28	22.46
26	2.9	2.83	2.58	3.04	8.58	23.42
27	3.04	2.79	3.79	2.79	9.16	24.21
28	2.7	2.64	2.63	2.68	8.99	25.37
29	2.15	2.43	2.55	2.7	9.03	26.85
30	2.86	2.69	2.55	2.85	9.53	27.45

Calculating Steps:

1- Calculating the UCL, And LCL Shewhart by using the Eq.(3 or 5)and data as in table (1) with sample size (4), where the value of UCL and LCL Control chart Are(3.13 and 2.38) with central limit is 2.75, as shown in table 2 Then the UCL and LCL of Rang by Shewhart are (1.17,0) with a CL of rang is (0.513).

2- From table (4), the value A*UCL and A*LCL are (1.1, 0.51) with sample Size(4) and

k =2 were calculated by Eq(12) with d*2 is (1.86) [6] then the UCL and LCL of X_{SC} are (3.32,2.5), and UCL_{SC} and LCL_{SC} of Rang Is (1.9, 0.0154) with D*4 and D*3 is (3.71, 0.03) where D4 and D3 are calculated by Eq (15 and 16) where d*2, d*3, d*4 [6] table(4))

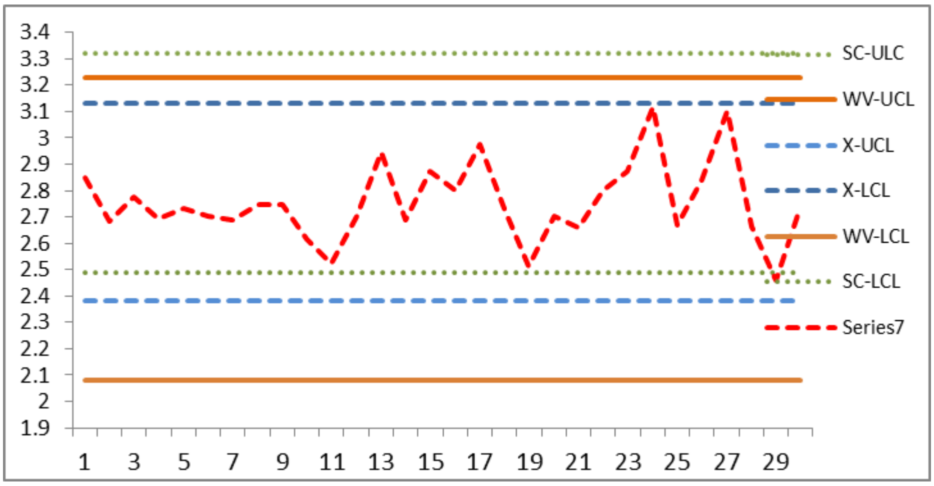
3- So, to calculate the value of UCL X_{WV} and LCL X_{WV} by Eq(23)

The value of P=0.65 and d*2=1.86, then the value of UCL and LCL is (3.23,2.08) as shown in Fig.(1). It is seen that the UCL SC and LCLSC are better at controlling the limit.

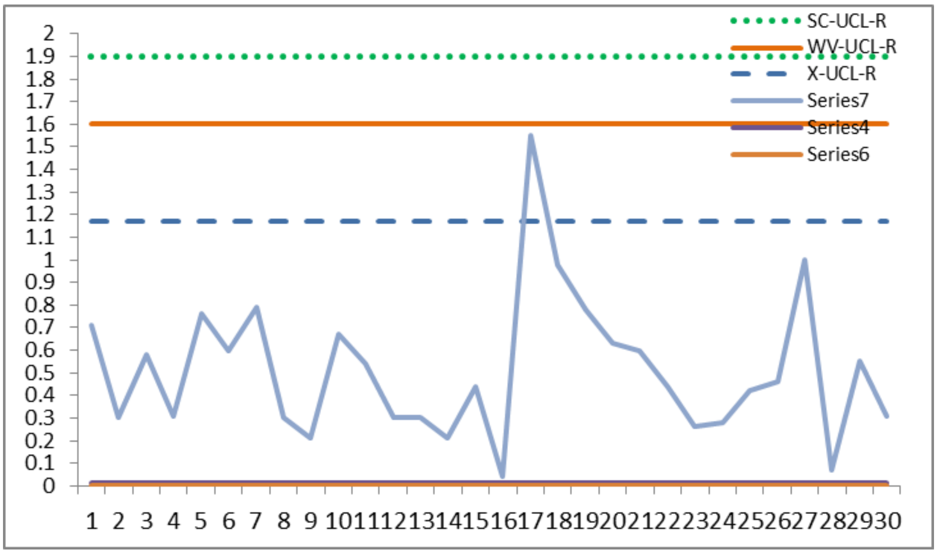
For The Rang Control Limit For $R_{Shewhart}$ is (1.17,0), for R_{SC} is (1.90, 0.0154), and For R_{WV} is (1.59,0), as shown in table (2) and Fig(2). From the value of UCL, and LCL and control charts, depending on the UCL, and LCL limit it is seen that the SC control chart is better.

Table (2) Value Of D4, D3, D*4, D*3 and UCL, LCL

	d2=2.059	A2=0.729		d*2 =1.86			
	D4=2.282			D*4= 3.71	A^*_U =1.1	D^*4_{wv} =3.965	
	D3=0			D*3 =0.03	A^*_L =0.51	D^*3_{wv}==0.54	
	$X_{\_shehwart}$			$X_{\_Sc}$		$X_{\_WV}$	
	UCL	LCL	CL	UCL	LCL	UCL	LCL
X Control	3.13	2.38	2.75	3.32	2.5	3.23	2.08
Rang-Control	1.17	0	0.513	1.90	0.0154	1.59	0



Fig(1) control Limit for $X_{Shewhart}$, X_{SC} and X_{WV}



Fig(2) control Limit for $R_{Shewhart}$, R_{SC} and R_{WV}

By using Eq (15,16), Determined the value of the D*4 and D*3 of X _SC ,which value are depending on the value of Sample size (n) and shift (k) as shown in table(3)

Table(3) The constant value D*4 and D*3 of SC control chart

	n=2		n=3		n=4		n=5	
k	D*4	D*3	D*4	D*3	D*4	D*3	D*4	D*3
0	4.14	0	2.96	0	2.53	0	2.30	0.10

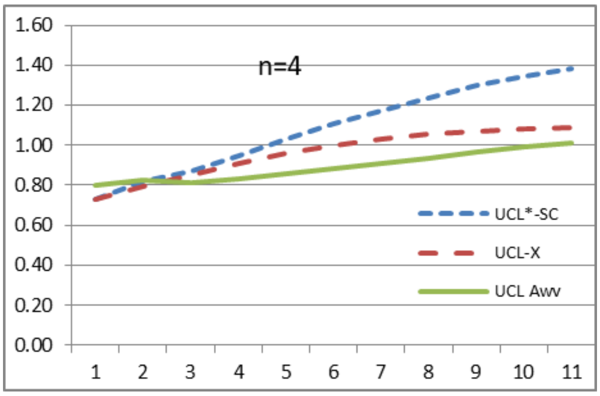
0.4	4.20	0	3.07	0	2.69	0.01	2.40	0.14
0.8	4.39	0	3.28	0	2.86	0.06	2.62	0.17
1.2	4.70	0	3.57	0	3.12	0.09	2.88	0.18
1.6	5.04	0	3.90	0	3.44	0.07	3.16	0.16
2	5.31	0	4.22	0	3.71	0.03	3.43	0.12
2.4	5.62	0	4.45	0	3.96	0.00	3.68	0.07
2.8	5.88	0	4.71	0	4.21	0.00	3.93	0.00
3.2	6.10	0	4.93	0	4.43	0.00	4.12	0.00
3.6	6.27	0	5.13	0	4.61	0.00	4.30	0.00
4	6.44	0	5.29	0	4.80	0.00	4.48	0.00

Table (4) shows that the value of A* (UCL and LCL) constant of X, SC and WV Control chart

By Eq(12,21) and constant of control chart (d2* ,d3*,d4*), for different k ,sample size (n) and probability value (p=0.65) calculating the value of A* of (UCL,LCL) for X, SC and WV as shows in table(4) , and it clears from four charts are comparative for A*UCL

Table(4) A*UCL(A*C) and AL* constant of X, SC and WV Control chart

	n=2						n=3						n=4						n=5					
K	AU* X	AU*-SC	AU* wv	AL* X	AL*-SC	AL* wv	AU* X	AU*-SC	AU* wv	AL* X	AL*-SC	AL* wv	AU* X	AU*-SC	AU* wv	AL* X	AL*-SC	AL* wv	AU* X	AU*-SC	AU* wv	AL* X	AL*-SC	AL* wv
0	1.88	1.89	2.07	1.88	1.89	1.69	1.02	1.03	1.13	1.02	1.03	0.92	0.73	0.73	0.80	0.73	0.73	0.65	0.58	0.58	0.63	0.58	0.58	0.52
0.4	2.11	2.13	2.07	1.65	1.66	1.69	1.13	1.14	1.13	0.92	0.93	0.92	0.79	0.82	0.83	0.66	0.69	0.67	0.62	0.63	0.64	0.53	0.53	0.52
0.8	2.32	2.36	2.09	1.44	1.46	1.71	1.22	1.25	1.14	0.82	0.84	0.93	0.85	0.87	0.81	0.60	0.61	0.66	0.67	0.68	0.64	0.49	0.50	0.53
1.2	2.50	2.61	2.15	1.26	1.32	1.76	1.31	1.37	1.17	0.74	0.77	0.96	0.91	0.95	0.83	0.55	0.57	0.68	0.71	0.73	0.66	0.45	0.46	0.54
1.6	2.63	2.83	2.21	1.13	1.21	1.81	1.38	1.54	1.25	0.66	0.74	1.02	0.96	1.03	0.86	0.50	0.53	0.70	0.74	0.79	0.67	0.41	0.44	0.55
2	2.72	3.01	2.28	1.04	1.15	1.86	1.44	1.60	1.25	0.61	0.68	1.02	1.00	1.11	0.88	0.46	0.51	0.72	0.77	0.85	0.69	0.38	0.42	0.57
2.4	2.78	3.20	2.37	0.98	1.13	1.94	1.48	1.69	1.28	0.57	0.65	1.05	1.03	1.17	0.91	0.43	0.49	0.74	0.80	0.90	0.71	0.35	0.40	0.58
2.8	2.81	3.33	2.45	0.95	1.13	2.00	1.51	1.78	1.33	0.54	0.64	1.08	1.05	1.23	0.93	0.40	0.47	0.76	0.82	0.96	0.73	0.33	0.39	0.60
3.2	2.82	3.45	2.53	0.95	1.16	2.06	1.52	1.85	1.37	0.52	0.64	1.11	1.07	1.30	0.97	0.39	0.47	0.79	0.84	1.00	0.75	0.32	0.38	0.62
3.6	2.81	3.52	2.58	0.95	1.20	2.11	1.53	1.92	1.41	0.52	0.65	1.15	1.08	1.34	0.99	0.37	0.46	0.81	0.85	1.04	0.77	0.30	0.37	0.63
4	2.79	3.58	2.64	0.97	1.25	2.16	1.53	1.98	1.45	0.51	0.67	1.18	1.09	1.38	1.01	0.37	0.47	0.83	0.86	1.07	0.79	0.30	0.37	0.65



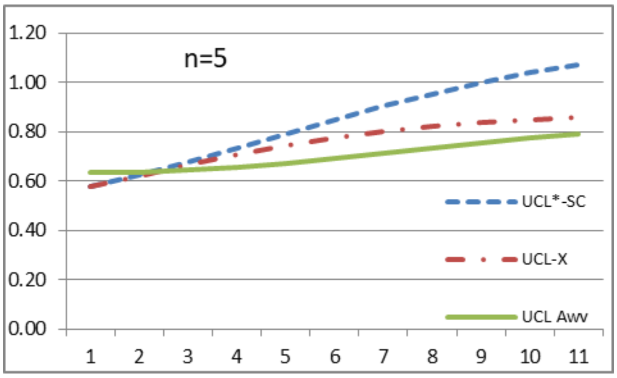


Fig (3,4,5,6) show that the A*(UCL) for X, SC and WV Control Chart for n = 2,3,4,5, from table(4) it is seen that the A_{UCL} of SC control char is better than X and WV control

Summary and Conclusion

Shewhart $\bar{X}$and R control charts are proposed based on a skewness correction (SC) method and no assumptions about the type of process distribution are needed. For skewed distributions, the control limits are asymmetric.

In general. Skewness correction provides an alternative method of designing individuals' control chart with non-normality; all the application results show that the new control chart skewness correction (SC) method is better than and Shewhart $\bar{X}$and R and WV control it provides false alarm rate type I error.

Increasing the skin's distribution leads to a relative increase in the type -I error produced due to the changes within the sample size. Our study shows that the Type I risks of the SC, WV, and Shewhart methods are compatible for approximately symmetric distributions. In general, all results show that SC is better.

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تصحيح انحراف البناء لوحات سيطرة $\bar{X}$ و R تحت ظروف غير – طبيعية

كاوه محمد جمال رشيد

كلية الادارة والاقتصاد- قسم الاحصاء / جامعة السليمانية

ملخص

تعتبر مخططات شيوارت أدوات قوية في التحكم في العمليات الإحصائية (SPC) وتستخدم على نطاق واسع. عادة، المخططات (شيوارت) تعتمد على افتراضات ان يكون بيانات الطبيعية. أي ان مخططات السيطرة تفرض على افتراضات ان يكون توزيع الطبيعي، وهو ما لا يحدث دائما بالنسبة للبيانات الصناعية. تصحيح الانحرافات وسيلة او تقنية بديلة لبناء مخططات السيطرة غير طبيعية ويقترح من هذه الورقة استخدام مخطط السيطرة SC لتصحيح الانحراف لرصد أو بناء مخطط السيطرة و R لتوزيع الانحراف. مخطط SC عنصر جديد لتحكم مقارنة مع عنصر مخطط السيطرة تباين، .(WV) weighted و Shewhart . كما يتم تحقيق احتمال تجاوز الاكتشافات خارج نطاق السيطرة تحت منحنى طبيعي ، واحتمال أن يكون الحد الأقصى الانحراف عن وسط هو 3 σ في كلا الاتجاهين هو 0.0027 .التغيير مع حجم العينة يؤدي إلى زيادة في توزيع الانحراف، مما يؤدي إلى زيادة نسبية في خطأ من النوع الثاني.

الكلمات المفتاحية: مخطط التحكم ، تصحيح الانحراف، مخططات R، شيوارت، مخطط التحكم في التباين المرجح.

ڕاستکردنەوەی لادانەکان بۆ دروستکردنی هێلکاری $\bar{X}$ و R لە ژێر بارۆدوخی ناسروشتی

کاوه محمد جمال رشيد

کۆلێژی کارگێری و ئابووری- بەشی ئامار/ زانکۆی سلێمانی

پوختە

هێڵکاریەکانی شیوارت ئامرازی بەهێزن لە پرۆسەی کۆنترۆڵی ئاماردا (SPC) و بە شێوەیەکی فراوان بەکارهێنراون. زۆربەی کات، هێڵکاریەکانی شیوارت پشت بە گریمانەی سروشتی دەبەستێت. کە واتە هێڵکاریەکانی کۆنترۆڵ پشت بە گریمانە سروشتیەکا دەبەستن، کە هەمیشە وا نیە بۆ داتای پیشەسازیەکان. لەم تویزینەوەیەدا راستکردنەوەی لادان ئامرازیکە یان تەکنیکێکی جێگرەوەیە بۆ دروستکردنی هێڵکاری کۆنترۆڵی نا ئاسایی پێشنیارەکانی ئەم تویزینەوەیە بۆ بەکارهێنانی نەخشەی کۆنترۆڵی SC بۆ چاودێریکردن یان دروستکردنی نەخشەی کۆنترۆڵی و R بۆ دابەشکردنی لادانی. نەخشەی SC یان نەخشەی کۆنترۆڵی نوێ بە بەراورد لەگەڵ کۆنترۆڵ شیوارت و جیاوازی لادان (WV). ئەگەری تێپەڕاندنی دۆزینەوەی خالی دەرەوەی کۆنترۆڵیش لە ژێر چەماوەیەکی ئاساییدا ئەنجامدەدرێت، ئەگەری سنووری لادان لە ناوەند σ3 لە هەردوو ئاڕاستە 0.0027 بێت.

گۆڕان لە قەبارەی نموونە دەبێتە هۆی زیادبوونی دابەشکردنی لادان، ئەمەش دەبێتە هۆی زیادبوونی ڕێژە لە هەڵەی جۆری دووەم.

وشە کلیلەکان: هێلکاری ڕوون کردنەوەی کونترول، ڕاستکردنەوەی بەلاداچوو، هێلکاری روونکردنەوەی R، شیوارت، جیاوازی کێشراو.