Use of metaheuristic methods in the estimation of indices of non-normal processes

Research practice I: Project proposal presentation
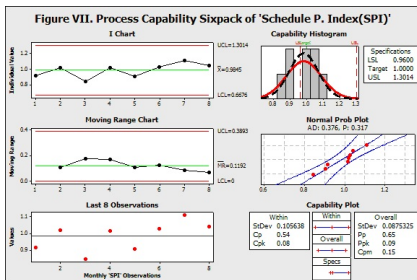
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Process monitoring using the Burr XII distribution

Taken from www.topkaizen.com

Improvements:

- Liu and Chen modify the Clements method [Liu and Chen, 2006].

- Ahmad, Abdollahian, and Zeephongseku show that the method of Burr is better [Ahmad et al., 2008].

- Abbasi uses a neural network type Multilayer perceptron (MLP) to estimate the distribution parameters [Abbasi et al., 2010].

BUT...

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Process monitoring using the Burr XII distribution

there is not direct method of estimation

Skewness	Kurtosis	Clements's						Burr	
a_3	a_4	$ZP_{.00135}$	$ZP_{.5}$	$ZP_{.99865}$	$BZP_{.00135}$	$BZP_{.5}$	$BZP_{.99865}$	c	k
0	2	-1.966	0.000	1.966	-1.843	0.022	2.396	-18.148445	0.062932
0	2.2	-2.210	0.000	2.210	-1.959	0.037	2.697	-13.840637	0.093482
0	2.4	-2.442	0.000	2.442	-2.076	0.047	2.911	-12.134081	0.120321
0	2.6	-2.663	0.000	2.663	-2.197	0.053	3.078	-11.251863	0.146295
0	2.8	-2.839	0.000	2.839	-2.735	0.008	2.914	3.938938	19.864823
0	3	-3.000	0.000	3.000	-2.884	0.010	3.081	4.873717	6.157568
0	3.2	-3.140	0.000	3.140	-3.020	0.011	3.221	6.065153	3.745010
0	3.4	-3.261	0.000	3.261	-3.148	0.011	3.340	7.695948	2.700685
0	3.6	-3.366	0.000	3.366	-3.269	0.011	3.442	10.182078	2.089559
0	3.8	-3.458	0.000	3.458	-3.388	0.009	3.529	14.723762	1.664480
0	4	-3.539	0.000	3.539	-3.509	0.015	3.609	27.068908	1.325754
0	4.2	-3.611	0.000	3.611	-3.642	0.001	3.659	-195.260000	0.959315

Taken from [Liu and Chen, 2006]

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Agenda

Parameter estimation problem

The distribution probability density function is defined by:

$$f(x) = \frac{k\,c\,x^{c-1}}{(1+x^c)^{k+1}}; \quad x > 0,\ c > 0,\ k > 0$$

k: shape parameter.
c: scale parameter.

logarithm of the likelihood function for the Burr XII distribution is:

$$\underbrace{\ln(L) = n(\ln(c) + \ln(k)) + (c-1)\sum_{i=1}^{n}\ln(x_i) - (k+1)\left(\sum_{i=1}^{n}\ln(1+x_i^c)\right)}_{\text{There is not analytical solution}}$$

Parameter estimation problem

Used methods

- Maximum likelihood
- Pseudo-Maximum likelihood
- Neural network type multilayer perceptron
- Minimum variance linear unbiased estimators

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Heuristics are not yet considered

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Objectives

General Objective

Propose an accurate parameter estimation method for the Burr type XII distribution.

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Specific Objectives

- Identify which heuristics methods are appropriate to find a general way to estimate the parameters of the Burr XII distribution.

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- Establish the found estimation method in a programming language.

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General Objective

Propose an accurate parameter estimation method for the Burr type XII distribution.

Specific Objectives

- Identify which heuristics methods are appropriate to find a general way to estimate the parameters of the Burr XII distribution.
- Establish the found estimation method in a programming language.
- Compare the results obtained with the estimation method with other proposed in the literature, using experimental data.

Importance and originality of this research

The importance and originality of this research is:

- It is not proposed a precise method of parameter estimation for Burr type XII distribution.

- A suitable monitoring on production processes requires the use of methods that consider all data generating process (DGP).

- Find another estimation method in which the use of tables is not required.

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Schedule of Activities

Activity	Start	End
Review of literature	July 20	September 29
Proposal report	July 25	August 9
Oral presentation of the proposal report	August 9	August 14
Identification of the method	August 10	September 15
Oral progress report	September 15	September 25
Method implementation	September 15	September 29
Validation with experimental data	September 29	October 15
Project report	August 15	November 6
Project presentation	October 24	November

Table: Schedule of Activities.

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References

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📄 Liu, P.-H. and Chen, F.-L. (2006).
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The International Journal of Advanced Manufacturing Technology, 27(9-10):975–984.

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Thanks for your attention!!

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