The ABC Outlier Removal Criterion Averages the. AEDC and Chauvenet's Criteria
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References

1. Dieter, George, "Engineering Design, A Materials & Processing Approach", McGraw-Hill. 2nd. Ed. ISBN 0-07-016896-2. Pp. 493-494.

2. Dr. R. B. Abernethy et al., "Measurement Uncertainty Handbook", Revised 1980. ISBN 087664-483-3 Pp. 163-166.

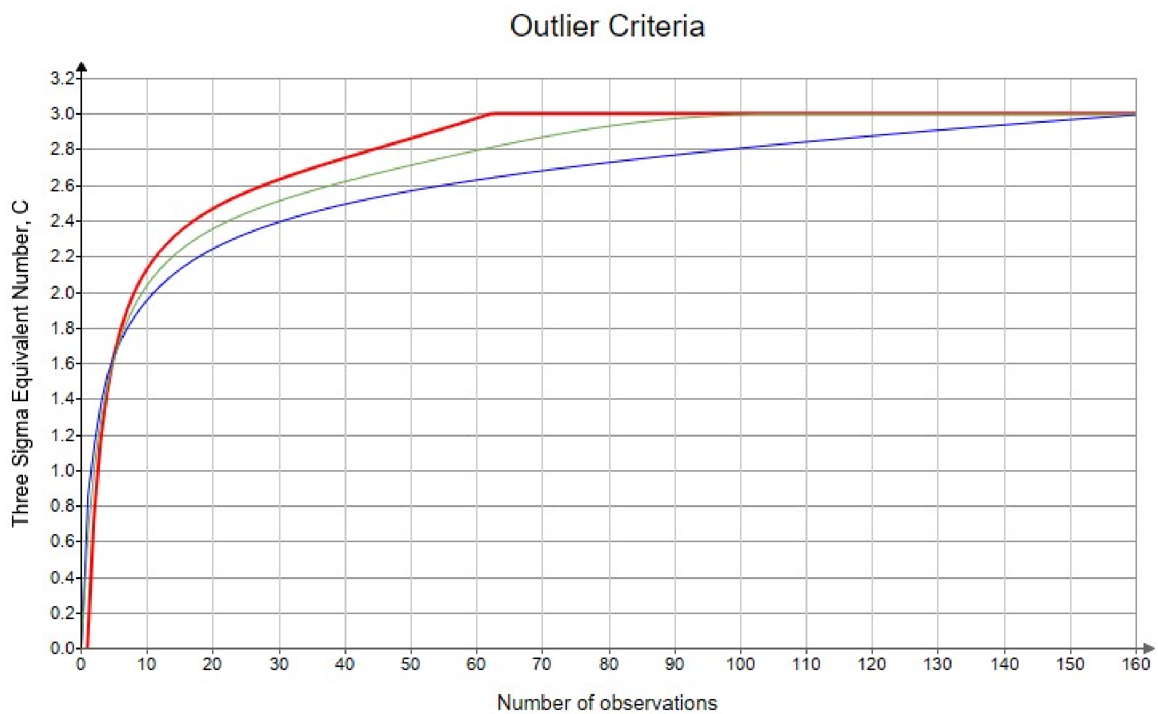
$\mathbf{ORIGIN} \equiv 0$

$n \equiv 0, 1 .. 160$

Inputs

$\mathbf{Y}_1 := C_A(n)$ $\quad \mathbf{Y}_2 := C_C(n)$ $\quad \mathbf{Y}_3 := C_{ABC}(n)$

$\mathbf{X}_1 := n$ $\quad \mathbf{X}_2 := n$ $\quad \mathbf{X}_3 := n$



1.0 Curve Fit of AEDC Criterion [2] of Outlier Elimination

$$A \equiv \begin{bmatrix} -1.6819236 \\ 1.6386898 \\ -0.00721312 \end{bmatrix} \qquad B \equiv \begin{bmatrix} 0.59286772 \\ -0.00355709 \end{bmatrix} \qquad R_A(n) \equiv \frac{A_0 + \sum_{i=1}^{2} \left(A_i \cdot n^i\right)}{1 + \sum_{i=0}^{1} \left(B_i \cdot n^{i+1}\right)}$$

$$C_A(n) \equiv \mathbf{if}\left(n < 63, R_A(n), 3\right)$$

Example: $N := 60$ $\qquad C_A(N) = 2.97$

2.0 Curve Fit of Chauvenet's Criterion Data [1] of Outlier Elimination Using TableCurve 2D version 4.0

$$a \equiv \begin{bmatrix} -7.909600000 \cdot 10^{-7} \\ 2.151047173 \\ -6.208589800 \cdot 10^{-1} \\ -1.004743600 \cdot 10^{-1} \\ 7.537507100 \cdot 10^{-2} \\ 2.336220000 \cdot 10^{-4} \end{bmatrix} \qquad b \equiv \begin{bmatrix} 1.417159025 \\ -7.748802200 \cdot 10^{-1} \\ 9.216111300 \cdot 10^{-2} \\ 2.900028200 \cdot 10^{-2} \\ 4.913140000 \cdot 10^{-5} \end{bmatrix} \qquad R_C(n) \equiv \frac{a_0 + \sum_{i=1}^{5} \left(a_i \cdot n^i\right)}{1 + \sum_{i=0}^{4} \left(b_i \cdot n^{i+1}\right)}$$

Determine the sample size, n, at which the

Constraints

Determine the sample size at which at which the Chauvenet's Criterion equals 3, that is $R_C(n) = 3$

$n > 90$

Guess Values

$n := 90$

Solver

$n := \mathbf{Find}(\mathbf{n}) = 161$

$$C_C(n) \equiv \mathbf{if}\left(n < 161, R_C(n), 3\right)$$

3.0 Curve fit ABC (AEDC -Banks-Chauvenet's) Criterion of Outlier Elimination Using TableCurve 2D version 4.0

$$\alpha \equiv \begin{bmatrix} 0.01312774 \\ 0.82253637 \\ -0.012970108 \\ 75.146453 \cdot 10^{-6} \end{bmatrix} \qquad \beta \equiv \begin{bmatrix} 0.29194636 \\ -0.0051556022 \\ 32.801336 \cdot 10^{-6} \\ -21.943137 \cdot 10^{-9} \end{bmatrix} \qquad R_B(n) \equiv \frac{\alpha_0 + \sum_{i=1}^{3} \left(\alpha_i \cdot n^i\right)}{1 + \sum_{i=0}^{3} \left(\beta_i \cdot n^{i+1}\right)}$$

Example: $N := 63$ $R_B(N) = 2.82$

Constraints

Determine the sample size at which at which the Banks' (ABC) Criterion equals 3, that is $R_B(n) = 3$

$n > 90$

Guess Values

$n := 90$

Solver

$n := \mathbf{Find}(n) = 102$

The number of sigma reaches the value 3 when n = 102. Therefore, redefine the ABC Outlier to be valid for $n \le 102$ else set the results to 3.

$C_{ABC}(n) \equiv \mathbf{if}\left(n \le 102, R_B(n), 3\right)$

Appendix

The ABC Outlier Limit Equation

The number of sigma, C, for small sample sizes, n < 102, is equivalent to three sigma for the entire population has been established by the average of two criteria, the U.S. Air Force AEDC (Arnold Engineering Development Center), and the Chauvenet's criteria. The author proposes the use of an Banks' or ABC outlier criterion for the improvements described in this report.

The proposed ABC criterion is due to the fact that the AEDC criterion does not pass through zero at sample size, n = 0, and that it has a sudden change in slope at n = 63. On the other hand, the Chauvenet's criterion reaches three sigma's at a sample size 161 and the slope is not zero.

Banks' (ABC) criterion removes the aforementioned limitations of AEDC's, and Chauvenet's criteria. It passes through the origin (n, C) is (0, 0) and it has a smooth slope at n=102 with value C = 3.

Inputs

$$\mathbf{Y}_1 := C_{ABC}(n) \qquad \mathbf{X}_1 := n$$