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Theory of Errors Formulas

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List of 21 Theory of Errors Formulas

Theory of Errors

1) Mean Error given Specified Error of Single Measurement

Open Calculator

fx $$E_m = \frac{E_s}{\sqrt{n_{obs}}}$$

ex $$0.125 = \frac{0.25}{\sqrt{4}}$$

2) Mean Error given Sum of Errors

Open Calculator

fx $$E_m = \frac{\Sigma E}{n_{obs}}$$

ex $$0.6 = \frac{2.40}{4}$$

3) Most Probable Error given Standard Deviation

Open Calculator

fx $$MPE = 0.6745 \cdot \sigma$$

ex $$0.897085 = 0.6745 \cdot 1.33$$

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4) Most Probable Value given Residual Error

Open Calculator

fx $$\mathrm{MPV} = \mathrm{x} - \mathrm{r}$$

ex $$79 = 159 - 80$$

5) Most Probable Value with Different Weightage

Open Calculator

fx $$\mathrm{MPV} = \mathrm{add}\frac{\mathrm{w_i} \cdot \mathrm{x_i}}{\mathrm{add}}(\mathrm{w_i})$$

ex $$78 = \mathrm{add}\frac{10 \cdot 78}{\mathrm{add}}(10)$$

6) Most Probable Value with Same Weightage for Observations

Open Calculator

fx $$\mathrm{MPV} = \frac{\Sigma \mathrm{x_i}}{\mathrm{n_{obs}}}$$

ex $$200 = \frac{800}{4}$$

7) Observed Value given Relative Error

Open Calculator

fx $$\mathrm{x} = \frac{\varepsilon_\mathrm{x}}{\mathrm{R_x}}$$

ex $$160 = \frac{320}{2}$$

8) Observed Value given Residual Error

Open Calculator

fx $x = r + MPV$

ex $159 = 80 + 79$

9) Observed Value given True Error

Open Calculator

fx $x = X - \varepsilon_x$

ex $160 = 480 - 320$

10) Probable Error of Mean

Open Calculator

fx $PE_m = \frac{PE_s}{n_{obs}^{0.5}}$

ex $0.005 = \frac{0.01}{(4)^{0.5}}$

11) Relative Error

Open Calculator

fx $R_x = \frac{\varepsilon_x}{x}$

ex $2.012579 = \frac{320}{159}$

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12) Residual Error

Open Calculator

fx $r = x - MPV$

ex $80 = 159 - 79$

13) Residual Variation given Most Probable Value

Open Calculator

fx $V = m - MPV$

ex $20.9 = 99.9 - 79$

14) Standard Deviation of Weighted Observations

Open Calculator

fx $\sigma_w = \sqrt{\frac{\Sigma WV^2}{n_{obs} - 1}}$

ex $22.36068 = \sqrt{\frac{1500}{4 - 1}}$

15) Standard Deviation used for Survey Errors

Open Calculator

fx $\sigma = \sqrt{\frac{\Sigma V^2}{n_{obs} - 1}}$

ex $40.82483 = \sqrt{\frac{5000}{4 - 1}}$

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16) Standard Error of Function where variables are Subjected to Addition

Open Calculator

fx $e_A = \sqrt{e_x^2 + e_y^2 + e_z^2}$

ex $200.4221 = \sqrt{(120)^2 + (115)^2 + (112)^2}$

17) Standard Error of Mean of Weighted Observations

Open Calculator

fx $\sigma_{nw} = \frac{\sigma_w}{\sqrt{\Sigma W}}$

ex $100.1388 = \frac{950}{\sqrt{90}}$

18) True Error

Open Calculator

fx $\varepsilon_x = X - x$

ex $321 = 480 - 159$

19) True Error given Relative Error

Open Calculator

fx $\varepsilon_x = R_x \cdot x$

ex $318 = 2 \cdot 159$

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20) True Value given True Error

Open Calculator

fx $$X = \varepsilon_x + x$$

ex $$479 = 320 + 159$$

21) Variance of Observations

Open Calculator

fx $$\sigma^2 = \frac{\Sigma V^2}{n_{obs} - 1}$$

ex $$1666.667 = \frac{5000}{4 - 1}$$

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Variables Used

- e_A Standard Error in Function
- E_m Error of Mean
- E_s Specified Error of a Single Measurement
- e_x Standard Error in x coordinate
- e_y Standard Error in y coordinate
- e_z Standard Error in z coordinate
- **m** Measured Value
- **MPE** Most Probable Error
- **MPV** Most Probable Value
- n_{obs} Number of Observations
- PE_m Probable Mean of Error
- PE_s Probable Error in Single Measurement
- **r** Residual Error
- R_x Relative Error
- ΣV^2 Sum of Square of Residual Variation
- ΣW Sum of Weightage
- ΣWV^2 Sum of Weighted Residual Variation
- Σx_i Sum of Observed Values
- **V** Residual Variation
- w_i Weightage
- **x** Observed Value

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- X True Value
- x_i Measured Quantity
- ε_x True Error
- σ Standard Deviation
- σ_{nw} Standard Error of Mean
- σ_w Weighted Standard Deviation
- σ^2 Variance
- ΣE Sum of Errors of Observations

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Constants, Functions, Measurements used

- Function: **add**, add
  Summation operator add(a1,a2,a3,...,an)
- Function: **sqrt**, sqrt(Number)
  Square root function

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