# Applied Unimathematics (Universal Mathematics)

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**Classical applied mathematics** [1] has many fundamental defects. Absolute error $\Delta$ [1] is multiplication-noninvariant ($\Delta_{1=?0} = 1$, $\Delta_{10\ =?\ 0} = 10$) and insufficient for quality estimation ($\Delta_{1000=?999} = \Delta_{1=?0} = 1$). Relative error $\delta$ [1] applies to formal equalities a =? b of two numbers only ($\delta_{1-2+3-4=?-1}$ is unclear), is ambiguous (either $\delta_a = |a - b|/|a|$ or $\delta_b = |a - b|/|b|$), and can exceed 1: $\delta_{0;1=?0} = +\infty$, $\delta_{1=?-1} = 2$ also for $\delta_{mean} = |a - b|/((|a|+|b|)/2)$, $\delta_{max} = |a - b|/\max(|a|, |b|)$. The least square method [1] is unreliable and not invariant by equivalent transformations ($x = 1 \wedge x = 2 \rightarrow x = 3/2$; $10x = 10 \wedge x = 2 \rightarrow x = 102/101$; $x = 1 \wedge 10x = 20 \rightarrow x = 201/101$), makes no sense by noncoinciding physical dimensions (units) in a problem, and can give completely paradoxical outputs: fitting two points (1,1) and (10,15) by line y = kx gives k = 151/101 with $\Delta_{(1,\ 1)} = 51/101$, $\Delta_{(10,\ 15)} = 5/101$. There is no estimating the confidence, or reliability, of exactness at all, e.g., for exact solutions $x_1=1+10^{-10}$ and $x_2=1+10^{10}$ to inequation $x \geq 1$.

**Applied unimathematics** [2-5] surely provides universally modeling, estimating, and approximating objects. A general problem is a quantisystem ${}_{q(\lambda)}R_\lambda[_{\varphi\in\Phi}\ f_\varphi[_{\omega\in\Omega}\ z_\omega]]$ $(\lambda \in \Lambda)$ of known relations $R_\lambda$ over unknown functions $f_\varphi$ of known variables $z_\omega$ , all of them belonging to their vector spaces, and indexes $\lambda$, $\varphi$, and $\omega$ belonging to their sets $\Lambda$, $\Phi$, and $\Omega$. Here $[_{\omega\in\Omega}\ z_\omega]$ is a set of indexed elements $z_\omega$; $q(\lambda)$ is the own quantity-weight of the $\lambda$-th relation; and $Q(\Omega)$ is the uniquantity of $\Omega$. Introduce extended division: $a//b = a/b$ by $a \neq 0$ and $a//b = 0$ by $a = 0$ and any b. The linear and quadratic unierrors (always in [0, 1]) for formal vector equality $(\Sigma z(\omega\in\Omega) = )\Sigma_{\omega\in\Omega}\ z_\omega$ =? 0 are

$E_{\Sigma z(\omega\in\Omega)\ =?\ 0} = ||\Sigma_{\omega\in\Omega} z_\omega||//\Sigma_{\omega\in\Omega}||z_\omega||$: $E_{1=?0} = 1$, $E_{1=?-1} = 1$, $E_{100-99=?0} = 1/199$, $E_{1-2+3-4=?-1} = 1/11$;

${}^2E_{\Sigma z(\omega\in\Omega)\ =?\ 0} = ||\Sigma_{\omega\in\Omega}\ z_\omega||//((Q(\Omega)\Sigma_{\omega\in\Omega}\ ||z_\omega||^2)^{1/2}$: ${}^2E_{1=?0} = 1/2^{1/2}$, ${}^2E_{1=?-1}=1$, ${}^2E_{1-2+3-4=?-1}=1/155^{1/2}$

both irreproachably correcting and generalizing the relative error. Unireserve R in [-1, 1], unireliability S and unirisk r both in [0, 1] based on unierror E additionally estimate and discriminate exact objects, models, solutions, and problems via the confidence in their exactness, e.g., for equation x = 1 (Fig. 1) and inequation x ≥ 1 (Fig. 2):

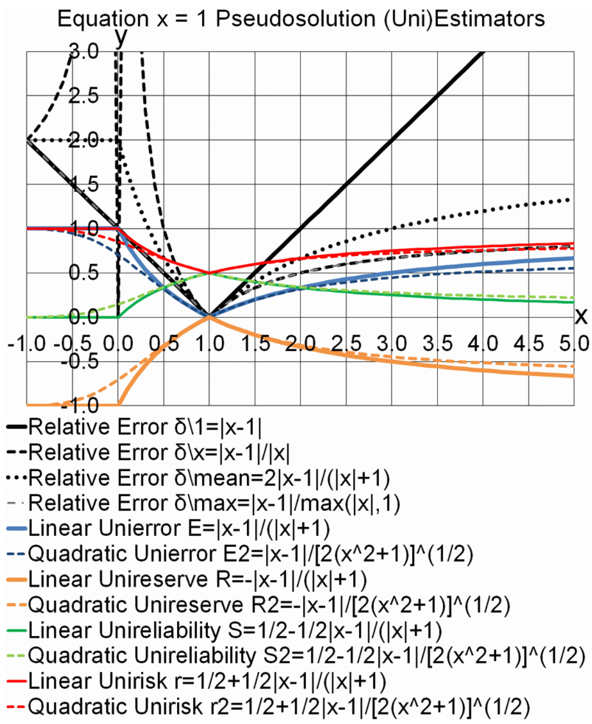


Figure 1. Equation x = 1 (Uni)Estimators

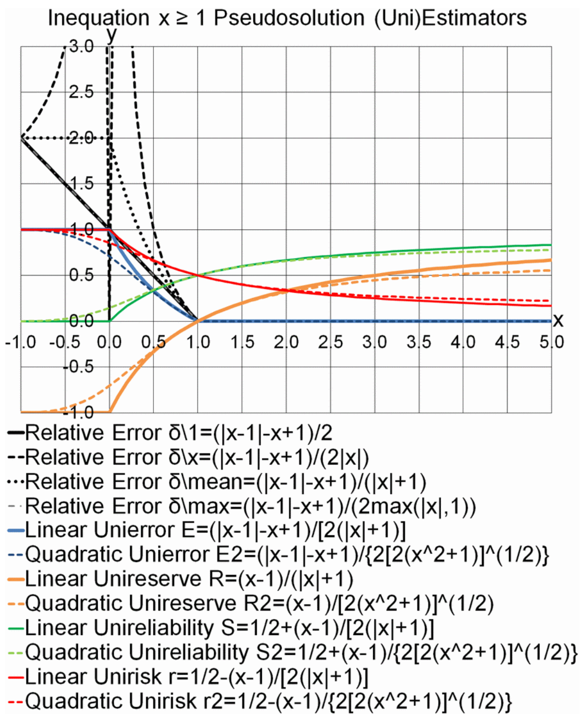


Fig. 2. Inequation x ≥ 1 (Uni)Estimators

$$R_{x\geq 1}(x_1) = E_{x\leq ?1}(1 + 10^{-10}) = 10^{-10}/(2 + 10^{-10}),\ R_{x\geq 1}(x_2) = E_{x\leq ?1}(1 + 10^{10}) = 10^{10}/(2 + 10^{10});$$
$$S_{x\geq 1}(x_1)=[1+R_{x\geq 1}(x_1)]/2=(1+10^{-10})/(2+10^{-10}),S_{x\geq 1}(x_2)=[1+R_{x\geq 1}(1+10^{10})]/2=(1+10^{10})/(2+10^{10});$$
$$r_{x\geq 1}(x_1) = [1 - R_{x\geq 1}(x_1)]/2 = 1/(2 + 10^{-10}),\ r_{x\geq 1}(x_2) = [1 - R_{x\geq 1}(x_2)]/2 = 1/(2 + 10^{10}).$$
In fitting two points (1,1) and (10,15) by line $y = kx$, the linear unierror $E_{\Sigma a(j) =? 0}$ gives
$$|k-1|/(|k|+1)=|10k-15|/(|10k|+|15|),\ k = 1.5^{1/2},\ \Delta_{k =? 1}=1.5^{1/2} - 1,\ \Delta_{10k=?15}=15 - 10\times 1.5^{1/2},$$
$$E_{k =? 1} = E_{10k=?15} = (1.5^{1/2} - 1)/(1.5^{1/2} + 1).$$
All these uniestimators for the first time evaluate and precisely measure both the possible inconsistency of a uniproblem (as a unisystem which includes unknown unisubsystems) and its pseudosolutions including quasisolutions, supersolutions, and antisolutions also for truly multidimensional and multicriterial decision-making.
Applied unimathematics creates fundamentally new theories for setting and solving many earlier principally unsolvable urgent problems, e.g., in aeronautical fatigue.

**Keywords:** Ph. D. & Dr. Sc. Lev Gelimson, "Collegium" All World Academy of Sciences, Academic Institute for Creating Fundamental Sciences, Mathematical Journal, Universal Mathematics, Unimathematik, Applied Unimathematics, classical applied mathematics, quality estimation, multiplication-noninvariant absolute error, ambiguous relative error, fundamental defect, formal equality, unreliable paradoxical senseless least square method, equivalent transformation noninvariance, estimating confidence, exactness reliability, inequation, modeling, estimating, approximating, general problem, relation quantisystem, unknown function, known variable, vector space, quantity-weight, uniquantity, extended division, linear unierror, quadratic unierror, unireserve, unireliability, unirisk, uniestimator, evaluator, precise measure, uniproblem inconsistency, unisystem, unknown unisubsystem, pseudosolution, quasisolution, supersolution, antisolution, truly multidimensional multicriterial decision-making, aeronautical fatigue, General Problem Theory, Elastic Mathematics, General Strength Theory.

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