Universal Mathematics and Physics: Dimensions and Units Relativity

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Physical and mathematical modeling and measurement are based on the unity and relativity of abstractness and concreteness, as well as of quality and quantity. Excessive abstractness can lead to losing physical sense, e.g. of probability densities, via ignoring or mixing distinct measurement units, e.g. in approximation and empirical formulae in physics and by different dimensions units in mathematics.

Universal mathematics and physics [1-5] introduce the canonic one-dimensional unit $U = Q]0, 1] = \Omega$ (uniquantity Q as a universal point measure; Ω the continuum cardinality $\mathbb{C}$) and its powers U^r. $U^0 = 1$ is the absolute unit interpretable via anyone point. Pointwise probability distribution function $g(x)$ explicitly expresses the strictly positive uninumber [1-4] probability that any random variable X takes namely the value x from point set $S(X)$. Additionally discover the both mathematical and physical sense of classical probability density, or differential probability function, $f(x)$. It is natural and corresponds to the axioms system of classical probability theory that namely the integral probability function $F(x)$ varying between 0 for impossible events and 1 for certain events is always one-dimensional pure-number. Hence its unit $UF(x) = U$. Denote Ux the unit and Vx the usual value of x , as well as $Ug(x)$ the unit and $Vg(x) = f(x)$ the usual value of $g(x)$. Then $\int_{x\in X} Vg(x)\, d(Vx) = \int_{x\in X} Vg(x)\, Ux^{-1}\, d(Vx\, Ux) = 1 = U^0$ as usual by ignoring units. For the desired equality $\int_{x\in X} g(x)\, dx = 1 = U^0$, it is necessary and sufficient that $Ug(x) = Ux^{-1} = 1/Ux$ and $g(x) = Vg(x)\, Ug(x) = f(x)\, Ux^{-1}$. Hence $f(x) = g(x)\, Ux$ and has the sense of the product of the pointwise probability distribution function $g(x)$ and of the variable unit Ux . If X and hence x are, e.g., n-dimensional ($n \geq 1$) with $x = (x_1 , x_2 , \ldots , x_n)$, then $Ux = \Pi_{i=1}^n Ux_i$, $Ug(x) = 1/\Pi_{i=1}^n Ux_i$, and $g(x) = f(x) / \Pi_{i=1}^n Ux_i$. If $Ux_1 = Ux_2 = \ldots = Ux_n$, denote this common unit as Ux' and obtain $Ux = Ux'^n$, $Ug(x) = 1/Ux'^n$, and $g(x) = f(x)/Ux'^n$. If all the n coordinates x_i are one-dimensional pure-number whose units Ux'_i are simply U , then $Ux = U^n$, $Ug(x) = 1/U^n$, and $g(x) = f(x)/U^n = f(x)/\Omega^n$ in the universal point measure. If $n = 1$, then $Ux = U$, $Ug(x) = 1/U$, and $g(x) = f(x)/U = f(x)/\Omega$. New simple and very suitable bounded continual distributions with explicit both integral and differential distribution functions provide efficiently fitting known and unknown distributions and estimating given data. Normal integral distribution function approximation with mean m and variance σ^2

$$\Phi_{m\,,\,\sigma\,,\,k}(x) = 0.5[1+\mathrm{sign}(x-m)] - 0.5\,\mathrm{sign}(x-m)\, e^{0.5}\exp\{-[x - m + \mathrm{sign}(x-m)\, k^{0.5}\, \sigma]^2/k/2/\sigma^2\}$$

by $k = \pi/2$ provides the exact value $\varphi_{m\,,\,\sigma\,,\,\pi/2}(m) = 1/[(2\pi)^{1/2}\sigma]$ and the relative errors at most 0.7 % by $x \geq 0$ and by $k=1.5$ the relative errors less than 0.4 % (Figures 1, 2).

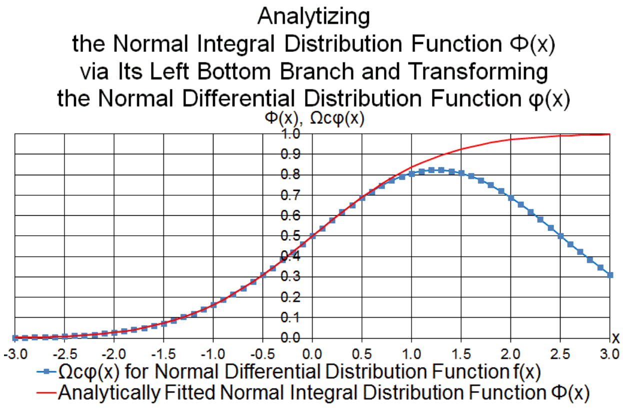

Figure 1. Analytizing normal $\Phi(x)$ via $\varphi(x)$

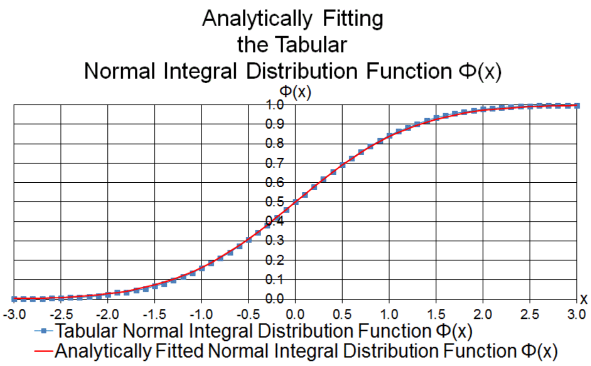

Figure 2. Quality of analytically fitting tabular normal distribution function $\Phi(x)$

Analytically fitting any normal integral distribution function via an appropriate proportionally transformed normal differential distribution function also provides the coincidence of their inflection points. That is much more suitable than exclusively tabular data on the only standard normal integral distribution function with m = 0 and σ = 1, which requires recalculation in computing. This is especially important because namely normal distributions are the most typical in nature, science, and engineering.
Universal mathematics and physics create fundamentally new opportunities to obtain reliable measurement data even by great data scatter, e.g. in aeronautical fatigue, and to discover new phenomena and laws of nature and science.

Keywords: Ph. D. & Dr. Sc. Lev Gelimson, "Collegium" All World Academy of Sciences, Academic Institute for Creating Fundamental Sciences, Mathematical Journal, Universal Mathematics and Physics, unimathematics, Unimathematik, Dimensions and Units Relativity, physical and mathematical modeling and measurement, losing physical sense, canonic one-dimensional unit, uniquantity, universal point measure, continuum cardinality, absolute unit, pointwise probability distribution function, strictly positive uninumber probability, both mathematical and physical sense of classical probability density, differential probability function, classical probability theory, integral probability function, impossible event, certain event, variable unit, normal integral distribution function approximation, mean, variance, relative error, analytically fitting tabular normal distribution function, inflection point, appropriate proportionally transformed normal differential distribution function, reliable measurement data, great data scatter, quantianalysis, uninumber, quantioperation, quantiset, multiquantity, uniquantity, aeronautical fatigue, general problem theory, elastic mathematics, general strength theory, corrections and generalizations of the least square method.

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