Goldsmith Functions

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24th of July 2025

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1 Abstract

This paper presents the Goldsmith functions. These functions describe a fully adjustable system for quality scoring, notation and handling. One of the main advantages is standardisation. Since the functions are customizable in terms of range, sensitivity and scaling, they can operate from single-digit ppq (parts per quadrillion) up to 12N (99.9999999999%) inputs and even beyond that range, offering a standardized notation for almost all branches of industry, science, medicine, education, engineering and mathematics.

2 Introduction

text (introduction)

3 Proceedings

3.1 Inputs

The formulas have several inputs. While some are used as placeholders in definitions, others have actual meaning in the context of the application of the functions.

3.1.1 Definition of Input Variables

Universal input variables of the function set:

• r is a variable which controls the sensitivity of the $\Lambda_0, \Lambda_{n_s}, \Phi_e, \Phi_0$, and Φ_{n_s} functions. $r \in \mathbb{Z}$
• n_s is a variable which controls the scaling factor of the $Rd_{n_s}, Ex_{n_s}, \Phi_{n_s}$, and Λ_{n_s} functions. $n_s \in \mathbb{N}_0$
• n_r is a variable which controls the rounding precision of the Γ_{n_r} and $\mho_{n_r}$ functions. In Γ_{n_r} n_r controls the number of decimal digits, while in $\mho_{n_r}$ it controls the total number of relevant digits. $n_r \in \mathbb{N}_0$
• s is the score calculated from c using Φ_0 or Φ_{n_s}. $s \in [100 \cdot (1 - 10^{n_s}); 100]$
• q controls whether Γ_{n_r} and $\mho_{n_r}$ use flooring (truncation) or rounding. $q \in \{0; 1\}$
• c is the main input variable of the Φ functions and describes the „purity“ or other quality which should be converted into a score. $c \in [0; 1]$, except for Φ_0, where $c \in [\Theta(r); 1]$.
• λ is a variable which controls the weight in the averaging function Ξ_λ. A higher λ value results in a higher weight for lower inputs, while a λ value close to 0 results in a less adjusted average. $\lambda \in [0; \infty)$

3.2 Formulas

$$Rd_{n_s}(x) = x \cdot 10^{n_s} + 100 \cdot (1 - 10^{n_s}) \tag{1}$$

$$Ex_{n_s}(x) = Rd_{-n_s}(x) \tag{2}$$

$$\Theta(r) = (1 + 10^{-r})^{-9} \tag{3}$$

$$\beta(r) = 9 \cdot \log_{10}(1 + 10^{-r}) \tag{4}$$

$$\Phi_e(c; r) = 100 \cdot \sqrt{1 + \frac{\log_{10}(c)}{\beta(r)}} \tag{5}$$

$$\Phi_0(c; r) = \begin{cases} \Phi_e(c; r) & \text{for} \quad c \geq \Theta(r) \\ 0 & \text{for} \quad c < \Theta(r) \end{cases} \tag{6}$$

$$\Phi_{n_s}(c; r) = Rd_{n_s}(\Phi_0(c; r)) \tag{7}$$

$$\Lambda_0(s; r) = 10^{\beta(r) \cdot \left(\left(\frac{s}{100}\right)^2 - 1\right)} \tag{8}$$

$$\Lambda_{n_s}(s; r) = \Lambda_0(Ex_{n_s}(s); r) \tag{9}$$

$$\delta(x) = -\log_{10}(1 - x) \tag{10}$$

$$\delta_s(x) = \lfloor \delta(x) \rfloor \tag{11}$$

$$\chi(x) = \sum_{k=1}^{x} \left(\frac{9}{10^k}\right) = 1 - 10^{-x} \tag{12}$$

$$\Gamma_{n_r}(x; q) = \frac{\lfloor x \cdot 10^{n_r} + 0.5 \cdot q \rfloor}{10^{n_r}} \tag{13}$$

$$\mho_{n_r}(x; q) = \begin{cases} \Gamma_{n_r - 1 - \lfloor \log_{10}(|x|) \rfloor}(x; q) & \text{for} \quad x \neq 0 \\ 0 & \text{for} \quad x = 0 \end{cases} \tag{14}$$

$$\Xi_\lambda(x_1; \ldots; x_n) = \frac{\sum_{i=1}^{n} \left(x_i \cdot \left(e^{-\lambda \cdot x_i}\right)\right)}{\sum_{i=1}^{n} \left(e^{-\lambda \cdot x_i}\right)} \tag{15}$$

$$\varkappa_n(f(x); q) = \frac{\left\lfloor \frac{q}{2} + n \cdot f\left(\frac{\lfloor \frac{q}{2} + n \cdot x \rfloor}{n}\right) \right\rfloor}{n} \tag{16}$$

3.3 Explanation

3.3.1 Explanation of Functions

• $Rd_{n_s}(x)$: Rd_{n_s} describes a scaling function. It is mainly used to convert the output of Φ_0 from a 0 to 100 range to an $100 \cdot (1 - 10^n)$ to 100 range. $Rd_{n_s}(Rd_{n_s}(x)) = Rd_{2 \cdot n_s}(x)$; $Rd_{n_s}(100) = 100; Rd_0(x) = x$

• $Ex_{n_s}(x)$: Ex_{n_s} is the inverse scaling function of Rd_{n_s}. Its mainly used to convert the input of Λ_{n_s} from a $100 \cdot (1 - 10^n)$ to 100 range to an 0 to 100 range. $Ex_{n_s}(Ex_{n_s}(x)) = Ex_{2 \cdot n_s}(x)$; $Ex_{n_s}(100) = 100; Ex_0(x) = x$

• $\Theta(r)$: Θ is a function used to determine the minimum c value required to get a Φ_0 score above 0 and it is equal to $\Lambda_0(0; r)$. It also defines the lower bound of the domain of the Φ_e

function.
• $\beta(r)$: β is an intermediate function for r, and it forms the implementation of the sensitivity control in $\Phi_e; \Phi_0; \Phi_{n_s}; \Lambda_0$ and Λ_{n_s}. It is not intended to be used as a stand-alone function.
• $\Phi_e(c; r)$: Φ_e is the main conversion function of the Goldsmith functions and converts a c between $\Theta(r)$ and 1 to an s value between 0 and 100.
• $\Phi_0(c; r)$: Φ_0 is used to extend the domain of Φ_e to 0 to 1.
• $\Phi_{n_s}(c; r)$:
• $\Lambda_0(s; r)$:
• $\Lambda_{n_s}(s; r)$:
• $\delta(x)$:
• $\delta_s(x)$:
• $\chi(x)$:
• $\Gamma_{n_r}(x)$:
• $\mho_{n_r}(x)$:
• $\Xi_\lambda(x_1; \ldots; x_n)$:
• $\varkappa_n(f(x); q)$:

3.4 Outputs

3.4.1 Interpretation of outputs

3.5 Examples

There are several possible areas of application for the Goldsmith functions. Some of these applications include the purity of precious metals, reliability, accuracy of AI algorithms, data fidelity, purity of silicon in the semiconductor industry and many more.
Below are some example values.

• 99.999998% *gold* $\hat{=}$ $88.19r8-0$ *gold*
• 99.99999999954% *silicon* $\hat{=}$ $69.92r12-0$ *silicon*
• 10.0% *gold content in ore* $\hat{=}$ $79.43r0-0$ *gold content in ore*
• 58.3% *gold content in* $14k$ *gold* $\hat{=}$ $60.91r1-0$ *gold content in* $14k$ *gold*
• 93.0% *process yield* $\hat{=}$ $43.55r2-0$ *process yield*
• 0.6% *copper content in ore* $\hat{=}$ $42.42r0-0$ *copper content in ore*
• 99.5% *uptime* $\hat{=}$ $66.54r4-0$ *uptime*

The general notation is given by the following standard.

• $[100 \cdot c]\%$ $[quantity]$ $\hat{=}$ $[\Phi_{n_s}(c; r)]r[r]-[n_s]$ $[quantity]$

The notation standard is intended for the use in various fields listed in the abstract and is deliberately kept concise.

4 Conclusions

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5 References

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6 Appendices

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