

# fn accuracy\_to\_discrete\_gaussian\_scale

Michael Shoemate

October 19, 2025

This document contains materials associated with `accuracy_to_discrete_gaussian_scale`.  
By `discrete_gaussian_scale_to_accuracy`, the relationship between  $\alpha$ ,  $a$  and  $scale$ , is:

$$1 - \alpha = \frac{\sum_{y=0}^{a-1} (1 + 1[y \neq 0]) e^{-(y/s)^2/2}}{\sum_{z \in \mathbb{Z}} e^{-(z/s)^2/2}}$$

A closed-form expression for  $s$  doesn't exist, so we use a numerical approach by a binary search. A loose upper bound is provided by `accuracy_to_gaussian_scale`. The binary search finds the smallest  $s$  such that

$$\alpha \leq 1 - \frac{\sum_{y=0}^{a-1} (1 + 1[y \neq 0]) e^{-(y/s)^2/2}}{\sum_{z \in \mathbb{Z}} e^{-(z/s)^2/2}}$$