Normal distribution

The density function of the Normal distribution has the following expression:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[\frac{-1}{2}\left[\frac{x-\mu}{\sigma}\right]^2\right]$$

for x in $(-\infty, \infty)$.

Distribution parameters

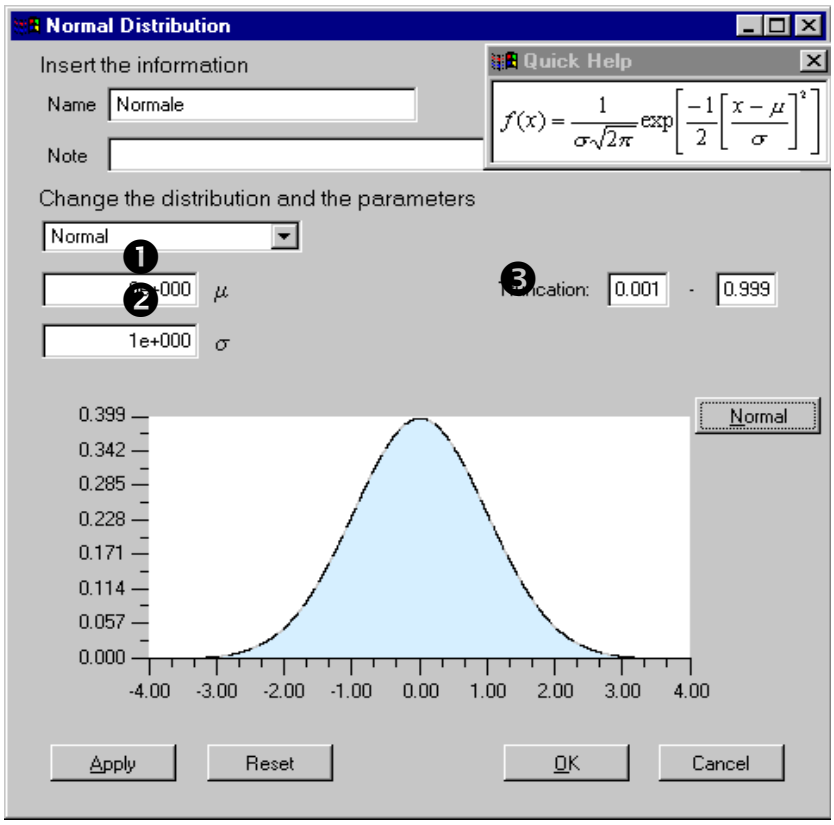

Figure 89 Normal distribution panel

❶ Mean value (μ), with μ in (- ∞, ∞); the default value is μ = 0e+000.

❷ Standard deviation value (σ),with σ > 0; the default value is σ = 1e+000.

❸ Truncation value; the default value is in [0.001, 0.999].

There is the possibility to see the density formula through Quick Help by pressing the Normal button and close it by pushing again this button. The Quick Help functionality is the same for all distribution panels.

LogNormal distribution

The density function of the LogNormal distribution has the following expression:

$$f(x) = \frac{1}{x \cdot \sigma \cdot \sqrt{2\pi}} \exp\left[\frac{-1}{2}\left[\frac{\ln(x) - \mu}{\sigma}\right]^2\right] \cdot 1_{(0,\infty)}(x)$$

for x in $(0, \infty)$.

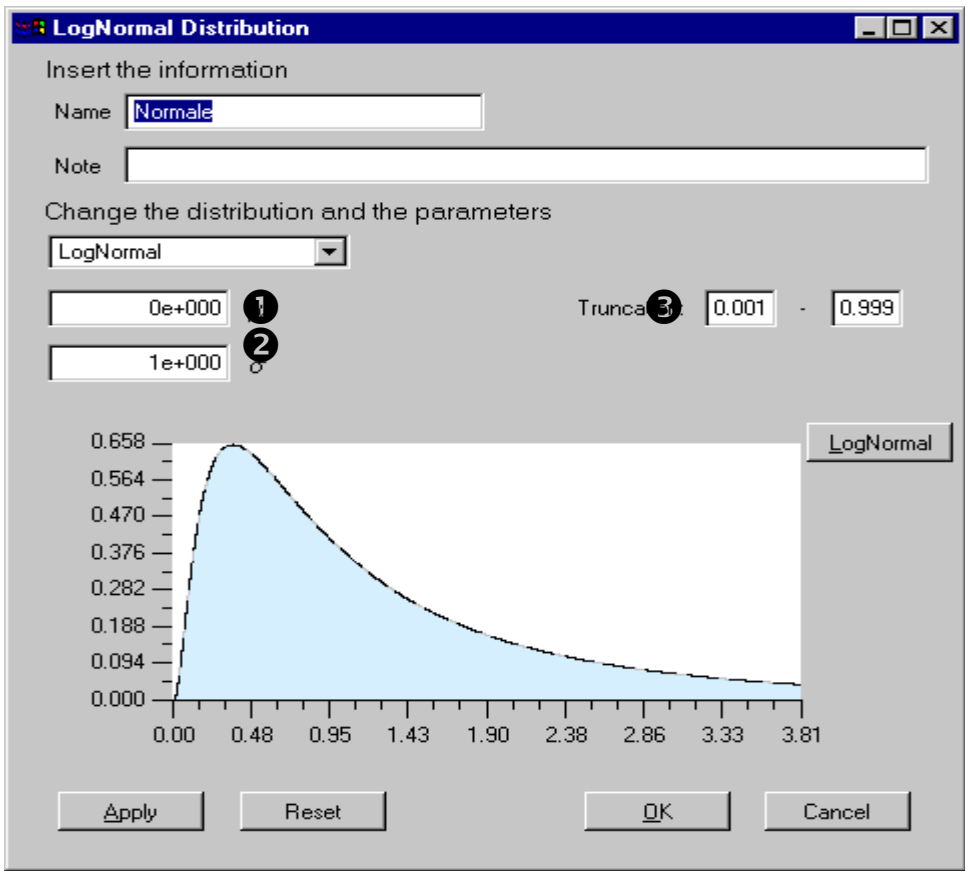

Figure 90 Log-Normal distribution panel

Distribution parameters

❶ μ parameter; the default value for μ is 0.

❷ σ parameter; the default value for σ is 1.

❸ Truncation value; the default value is in [0.001, 0.999].

Mean value: $\exp\left(\mu + \frac{1}{2}\sigma^2\right)$

Standard deviation: $\exp\left(2\mu + 2\sigma^2\right) - \exp\left(2\mu - \sigma^2\right)$

Uniform distribution

The density function of the Uniform distribution has the following expression:

$$f(x) = \sum_{i=1}^{n} \frac{Weight_i}{RightVal_i - LeftVal_i}$$

with *n* number of intervals.

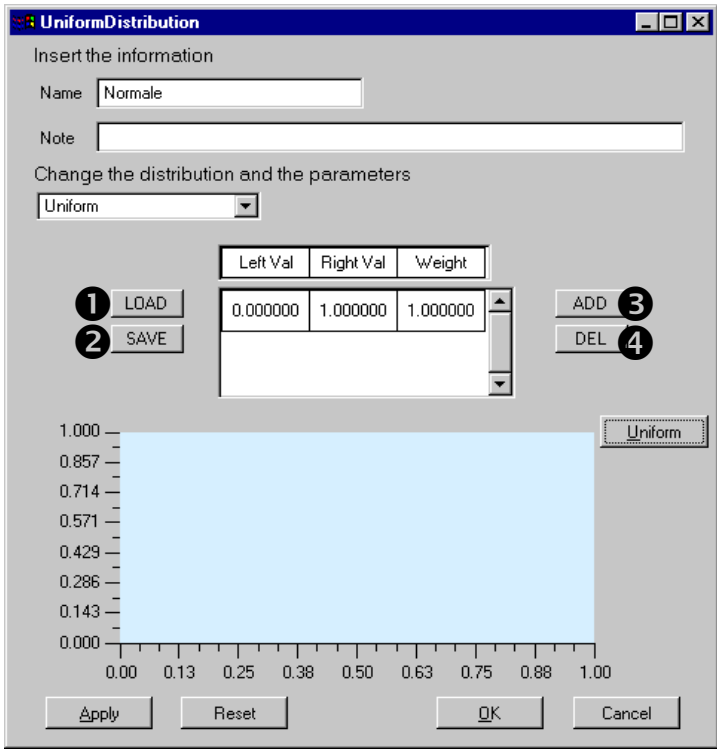

Figure 91 Uniform distribution panel

Buttons description

❶ **LOAD button**. The user can select this button to load a set of intervals for the current uniform distribution. This list of intervals will overwrite any previous list of intervals present in the matrix.

❷ **SAVE button**. This button allows the user to save in a file the current intervals for the uniform distribution.

❸ **ADD button**. This button is used to insert a new interval for the current uniform distribution. For each interval, the user has to insert the left bound, the right bound and the relative weight of the interval. The intervals can't overlap and the sum of the weights must be equal to 1.

❹ **DEL button**. With this button the user may delete any interval present in the matrix. The user must select one interval before pressing the DEL button. After deleting an interval, the weight of the remaining elements must be corrected.

Parameters area

This area contains the parameters that characterise the uniform distribution: RightVal_i and LeftVal_i are the extreme values of i-th subinterval so that

$(\text{RightVal}_i - \text{LeftVal}_i) > 0$ for each *i*;

Weight_i is the weight of the i-th subinterval, the sum of all the weights must be equal to 1.

The user can modify each value double clicking the matrix item.

Mean Value: $\sum_{i=1}^{n}\left(\frac{LeftVal_i + RightVal_i}{2}\right) * w_i$

Standard deviation: $\sqrt{\sum_{i=1}^{n}\left(\frac{\left(LeftVal_i^3 - RightVal_i^3\right)}{LeftVal_i - RightVal_i} * \frac{1}{3} * w_i\right)}$

LogUniform distribution

The density function of the LogUniform distribution has the following expression:

$$f(x) = \sum_{i=1}^{n} \frac{Weight_i}{x \cdot (\ln(RightVal_i) - \ln(LeftVal_i))}$$

with *n* number of intervals.

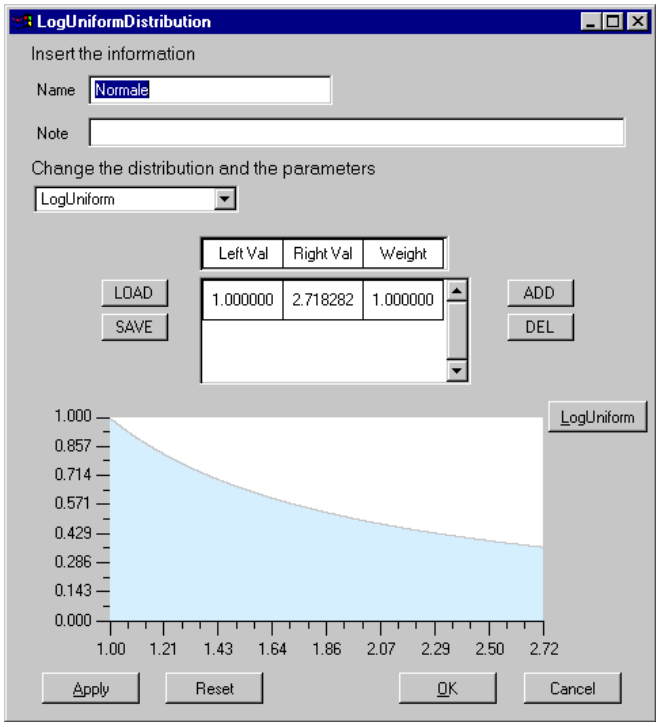

Figure 92 LogUniform distribution panel

Mean Value (μ)**:** $\sum_{i=1}^{n} \frac{RightVal_i - LeftVal_i}{\log(RightVal_i) - \log(LeftVal_i)}$

Standard deviation:

$$\sqrt{\sum_{i*1}^{n}\left(\frac{RightVal_i^2 - LeftVal_i^2}{2 \cdot (\log(RightVal_i) - \log(LeftVal_i))}\right) + \mu^2 - 2\mu \cdot \frac{RightVal_i - LeftVal_i}{\log(RightVal_i) - \log(LeftVal_i)}}$$

Weibull distribution

The density function of the Weibull distribution has the following expression:

$$f(x) = \frac{\beta}{\mathrm{n}} * \left[\frac{x-\mathrm{b}}{\mathrm{n}}\right]^{\beta-1} \cdot \exp\left[-\left(\frac{x-\beta}{\mathrm{n}}\right)^{\beta}\right]$$

Distribution parameters

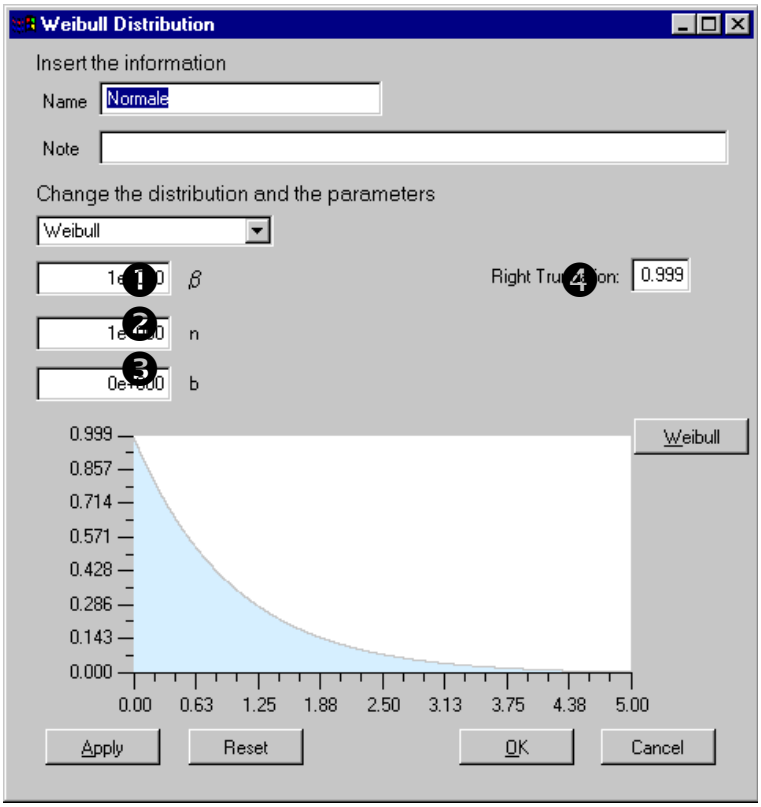

Figure 93 Weibull distribution panel

❶ β value with $\beta > 0$; the default value for β is 1.

❷ n value with n > 0; the default value for n is 1.

❸ b value with b >= 0; the default value for b is 0.

❹ Right truncation value; the default value is 0.999

Mean value: $n \cdot \Gamma\left(1+\frac{1}{\beta}\right)+b$

Standard deviation: $\sqrt{n^2 \cdot \left[\Gamma\left(1+\frac{2}{\beta}\right)-\Gamma^2\left(1+\frac{1}{\beta}\right)\right]}$

Constant factor

The user may insert constant factors using this panel. Constant factors are excluded by the sample generation process.

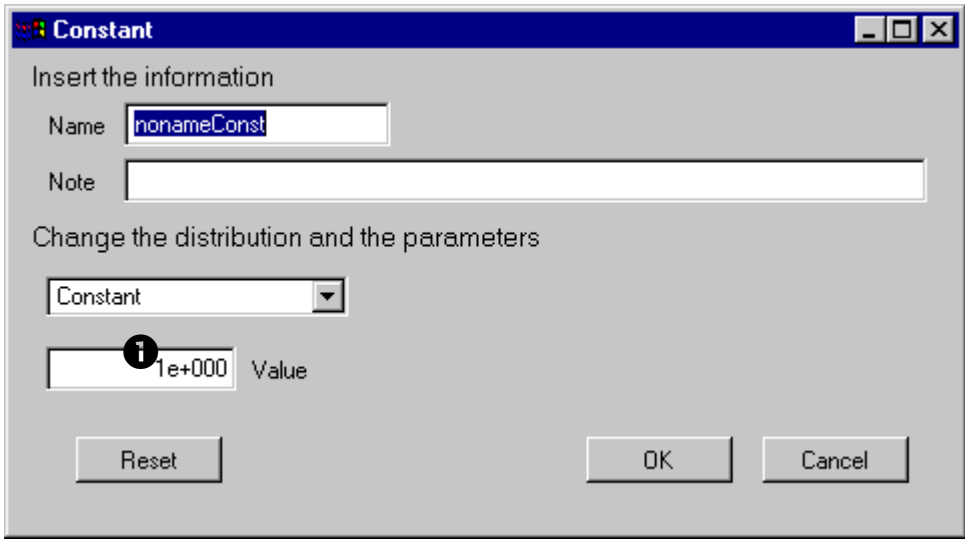

Figure 94 Constant distribution panel

❶ This field specifies the value of the constant factor; the default value for a constant is 1.

Exponential distribution

The density function of the Exponential distribution has the following expression:

$$f(x) = \lambda \cdot \exp[-\lambda \cdot (x - b)]$$

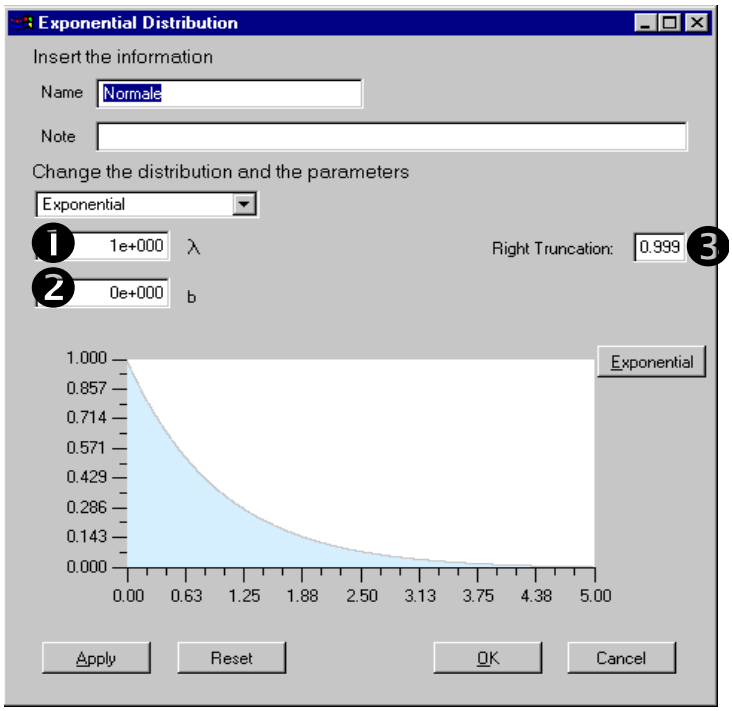

Figure 95 Exponential distribution panel

Distribution parameters

❶ λ value with $\lambda > 0$; the default value for λ is 1.
❷ b value with $b > 0$ and $x \geq b$; the default value for b is 0.
❸ Right truncation value; the default value is 0.999.

Mean value: $\frac{1}{\lambda} - b$

Standard deviation: $\frac{1}{\lambda^2}$

Gamma distribution

The density function of the Gamma distribution has the following expression:

$$f(x) = \frac{\lambda^{r}}{\Gamma(r)} * (x-b)^{r-1} * \exp(-\lambda * (x-b))$$

Distribution parameters

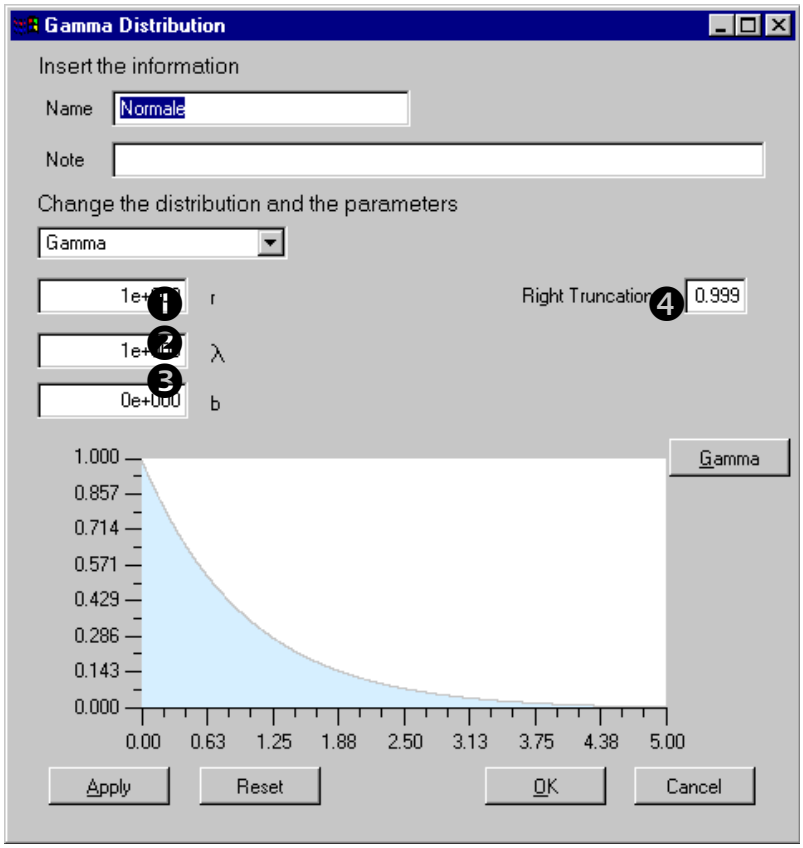

Figure 96 Gamma distribution panel

❶ r value with r > 0; the default value for r is 1.

❷ λ value with $\lambda > 0$; the default value for λ is 1.

❸ b value with b >= 0 & x >= b; the default value for b is 0.

❹ Right truncation value; the default value is 0.999.

Mean value: $\frac{r}{\lambda} + b$

Standard deviation: $\sqrt{\frac{r}{\lambda^2}}$

Beta distribution

The density function of the Beta distribution density function has the following expression:

$$f(x) = \frac{1}{B(\alpha,\beta)} * \frac{1}{\mathrm{b}-\mathrm{a}} * \left[\frac{x-\mathrm{a}}{\mathrm{b}-\mathrm{a}}\right]^{\alpha-1} * \left[\frac{\mathrm{b}-x}{\mathrm{b}-\mathrm{a}}\right]^{\beta-1}$$

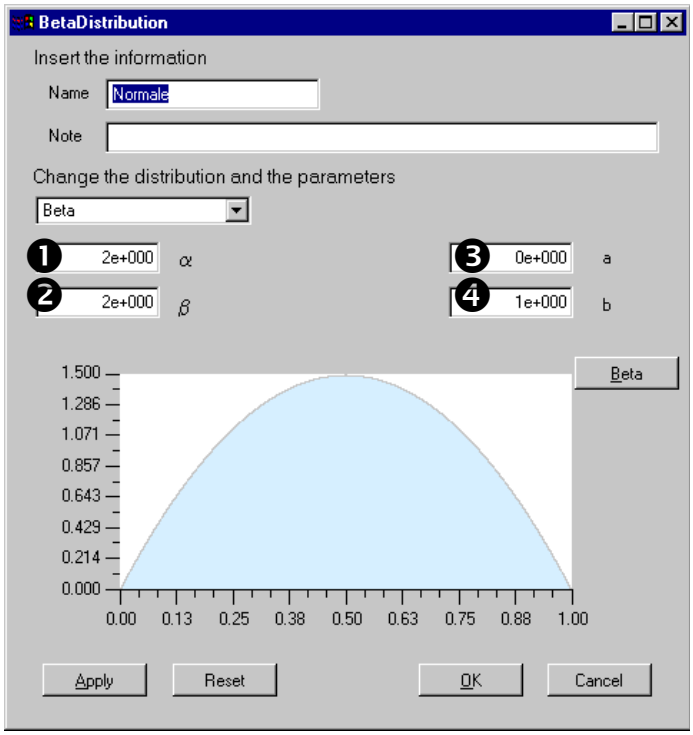

Figure 97 Beta distribution panel

Distribution parameters

❶ α value with $\alpha > 0$; the default value for α is 2.

❷ β value with $\beta > 0$; the default value for β is 2.

❸ a value with a < b; the default value for a is 0.

❹ b value; the default value for b is 1.

Mean value: $\frac{\alpha}{\alpha+\beta} * (b-a)$

Standard deviation: $\sqrt{\frac{\alpha * \beta}{(\alpha+\beta+1) * (\alpha+\beta)^2}} * (b-a)^2$

Triangular distribution

The density function of the Triangular distribution has the following expression:

$$f(x) = \begin{cases} \dfrac{2*(x-\alpha)}{(\beta-\alpha)*(\gamma-\alpha)} & \alpha \le x \le \beta \\ \dfrac{2*(\gamma-x)}{(\gamma-\beta)*(\gamma-\alpha)} & \beta \le x \le \gamma \end{cases}$$

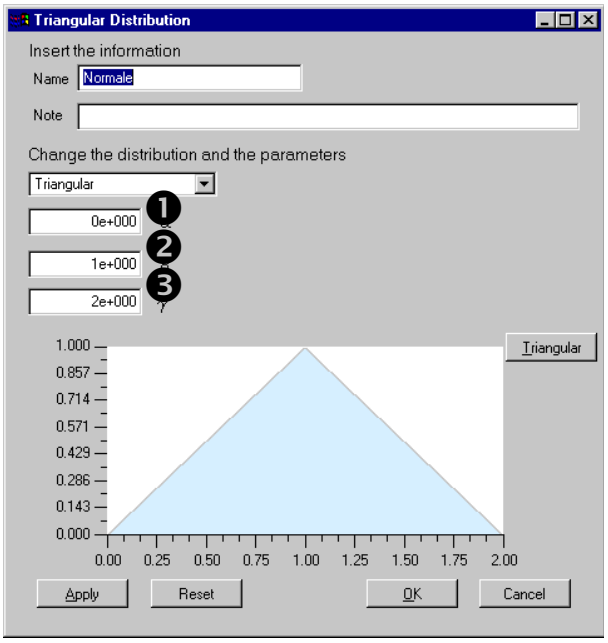

Figure 98 Triangular distribution panel

Distribution parameters

❶ α value; the default value for α is 0.

❷ β value; the default value for β is 1.

❸ γ value with $\alpha <= \gamma < \beta$ or $\alpha < \gamma. <= \beta$; the default value for γ is 0.5.

Height of β point (h)**:** $\dfrac{2}{(\gamma-\alpha)}$

Mean value (μ)**:**

$$\frac{h}{3(\beta-\alpha)}\cdot\left[\beta^3-\alpha^3\right]-\frac{\alpha\cdot h}{2(\beta-\alpha)}\left[\beta^2-\alpha^2\right]+$$

$$+\frac{-h}{3(\gamma-\beta)}\left[\gamma^3-\beta^3\right]+\frac{1}{2}\left(\frac{\beta\cdot h}{(\gamma-\beta)}+h\right)\cdot\left[\gamma^2-\beta^2\right]$$

Standard deviation:

$$\left(\frac{h}{4(\beta-\alpha)}\left[\beta^4-\alpha^4\right]-\frac{\alpha\cdot h}{3(\beta-\alpha)}\left[\beta^3-\alpha^3\right]+\ +\frac{-h}{4(\gamma-\beta)}\left[\gamma^4-\beta^4\right]+\frac{1}{3}\left(\frac{\beta\cdot h}{\gamma-\beta}+h\right)\cdot\left[\gamma^3-\beta^3\right]-\mu^2\right)^{1/2}$$

Relation

This panel represents a special case among the input factors selection panels; the user can create a relation between inputs factors using the expression editor.

Panel description

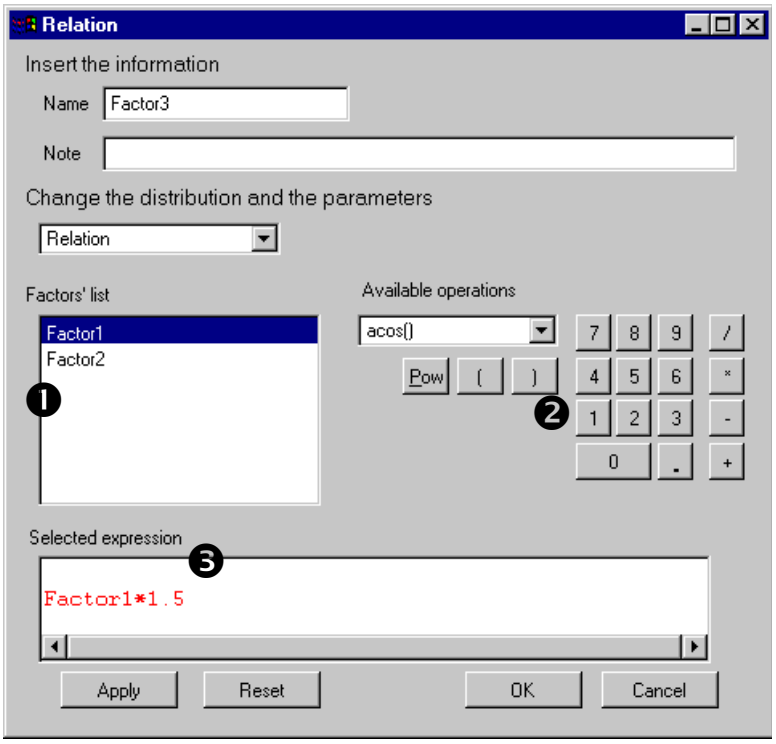

Figure 99 Relation panel

❶ **Factors list**. This field shows the available inputs factors; by double clicking an input factor, it is possible to insert that factor in the expression visualized in ❸.

❷ **Available operations**. In this section of the panel the user can select some functions and basic operations to apply to the inputs factors. This section has the same functionality of a calculator with field ❸ as display.

❸ **Expression field**. This field displays the current expression; it is possible to insert the expression through "Available operations" or directly through the keyboard.

Discrete distribution

The density function of the discrete distribution has the following expression:

$$f(x) = Weight_i I_{(x_1..x_n)}$$

where $I_{(x_1..x_n)}$ is 1 in the x's points 0 otherwise.

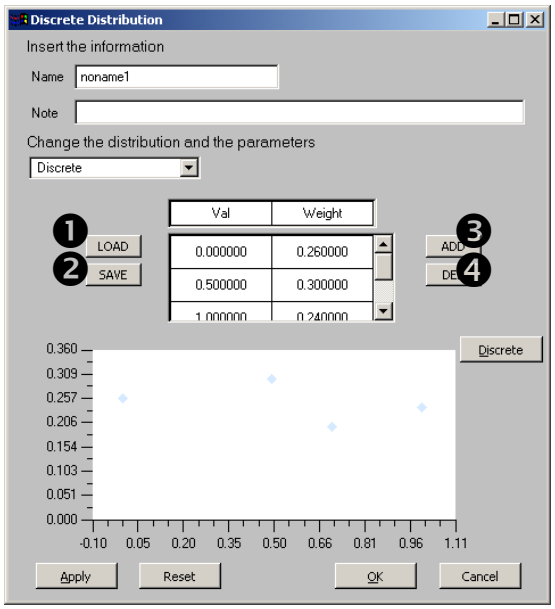

Figure 100 Uniform distribution panel

Buttons description

❶ **LOAD button**. The user can select this button to load a set of points for the current discrete distribution. This list of points will overwrite any previous list of points present in the matrix.

❷ **SAVE button**. This button allows the user to save in a file the current points for the discrete distribution.

❸ **ADD button**. This button is used to insert a new point for the current discrete distribution. For each interval, the user has to insert the value of the point and the relative weight of the point. Points can't overlap and the sum of the weights must be equal to 1.

❹ **DEL button**. With this button the user may delete any point present in the matrix. The user must select one interval before pressing the DEL button. After deleting an interval, the weight of the remaining elements must be corrected.

Parameters area

This area contains the parameters that characterise the discrete distribution. Weight_i is the weight of point i the sum of weights must be equal to 1.

By double clicking an item in the 'Parameters area' the user can modify its value .

Mean Value: $\sum_{i=1}^{n} w_i * x_i$ for each x in which the distribution is defined

Standard deviation: $\sqrt{\sum_i (x_i - \mu_x)^2 * w_i}$