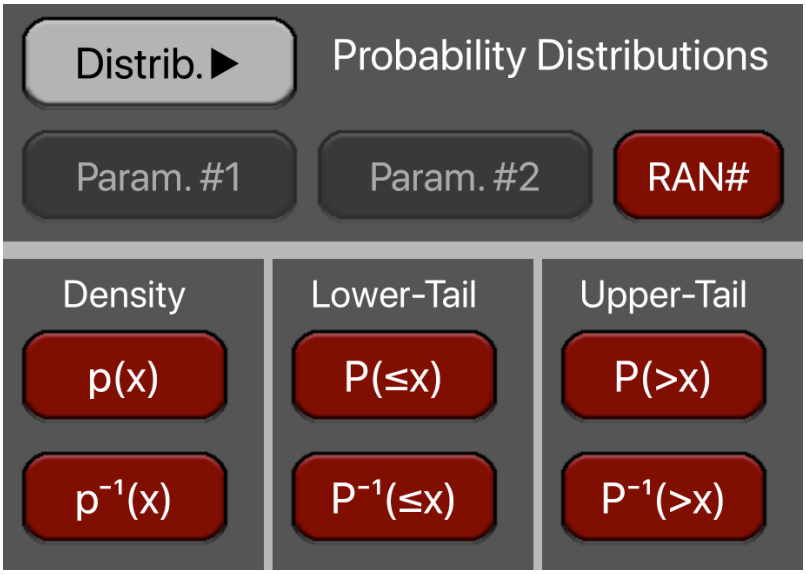
Probabilities Menu

This menu allows Probability Distributions calculations. To show it, touch the "**OPT**" key and in the "**2) Statistics:**" section, touch the "**Prob. Distrib.**" button.



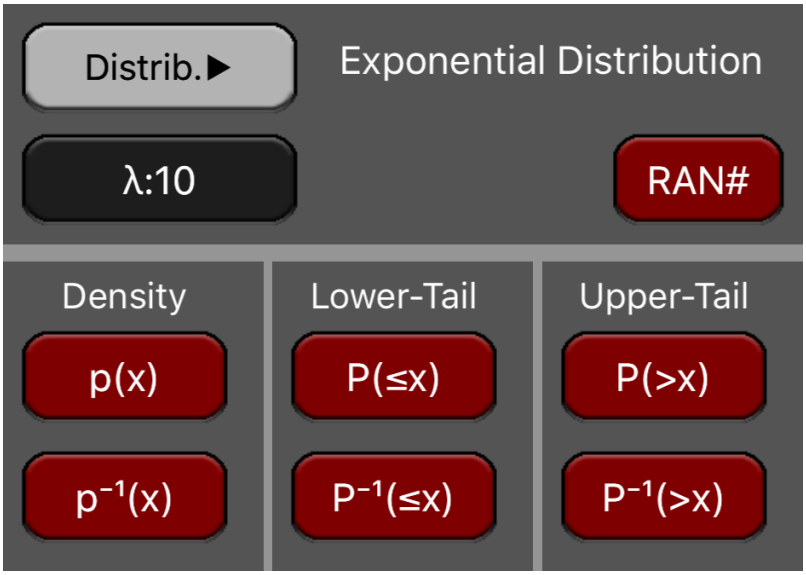
The available Probably Distributions available are:

- Exponential Distribution:
  Param.#1 = rate 'λ' (reciprocal of average 'μ').
- Normal Distribution:
  Param.#1 = mean 'μ' .
  Param.#2 = standard deviation '$\boldsymbol{\sigma}$'.
- Uniform Distribution:
  Param.#1 = range minimum value 'Min'.
  Param.#2 = range maximum value 'Max'.
- Weibull Distribution:
  Param.#1 = scale parameter 'k' .
  Param.#2 = shape parameter 'λ'.
- t-Student Distribution:
  Param.#1 = degrees of freedom 'DF' .

Button	Descriptions
[Distribution▶]	Shows the list of available Probability Distribution functions to select (Exponential, Normal, Uniform, Weibull or t-Student).
[Param.#1]	Is available if the selected Probability Distribution has at least one parameter.
[Param.#2]	Is available if the selected Probability Distribution has at two parameters.
[RAN#]	Generates a random number with the selected probability distribution.
[p(x)]	Calculates the distribution probability density of the 'x' value.
[$p^{-1}(x)$]	Calculates the distribution inverse probability density of the 'x' value.
[P(≤x)]	Calculates the distribution Lower-tail cumulative probability of the 'x' value.
[$P^{-1}(\leq x)$]	Calculates the distribution inverse Lower-tail cumulative probability of the 'x' value.
[P(>x)]	Calculates the distribution Upper-tail cumulative probability of the 'x' value.
[$P^{-1}(>x)$]	Calculates the distribution inverse Upper-tail cumulative probability of the 'x' value.

Exponential Probability Distribution

When the Exponential probability density function is selected, the distribution "rate parameter" (λ) can be entered in the corresponding button.



The Probability Density Function is:

$$\mathbf{p(x)} = \lambda\, e^{-\lambda x}$$

The Lower-Tail cumulative probability is : $\mathbf{P(\le x)} = \int_{-\infty}^{x} \mathbf{p(x)}\, dx$

The Upper-Tail cumulative probability is : $\mathbf{P(> x) = 1 - P(\le x)}$

Example: Exponential Distribution

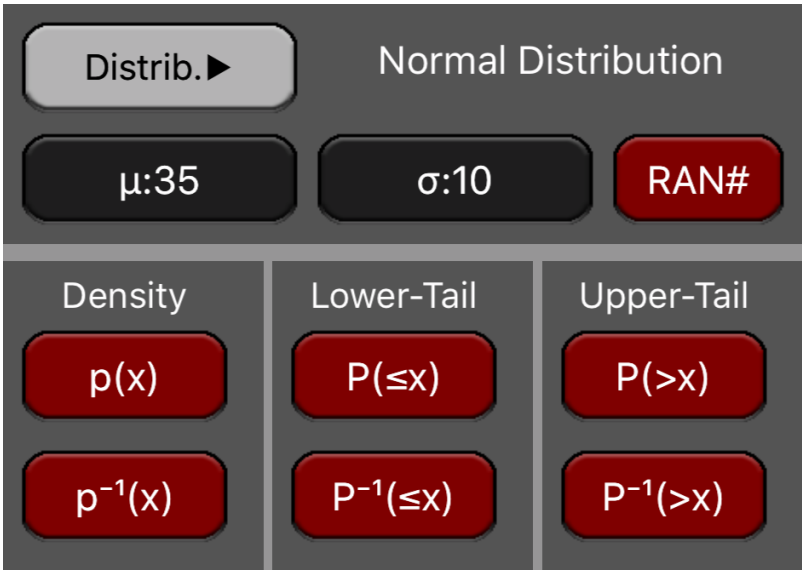
If the lifetime of a light bulb is "Exponentially" distributed with an average of 500 hours:

1. What is the probability to fail at 100 hours?
2. What lifetime has a probability is 0.1%?
3. What is the probability of a failure before 100 hours?
4. What lifetime gives a probability less than 25% for failure?
5. What is the probability to have a lifetime bigger than 700 hours?
6. What lifetime gives a probability bigger than 25% for failure?

Keystrokes	Description
[Distrib.▶] "Exponential"	Select the Exponential Probability Distribution
"500" **[1/x] [λ]**	Enter the distribution rate.
100 **[p(x)]**	Calculate the probability. **Result #1 = 0.0016**
0.001 **[p^{-1}(x)]**	Calculate the x-value. **Result #2 = 346.5736**
100 **[P(≤ x)]**	Calculate the probability. **Result #3 = 0.1813**
0.25 **[P^{-1}(≤ x)]**	Calculate the z-value. **Result #4 = 143.8410**
700 **[P(>x)]**	Calculate the probability. **Result #5 = 0.2466**
0.25 **[P^{-1}(>x)]**	Calculate the z-value. **Result #6 = 693.1472**

Normal Probability Distribution

When the Normal probability density function is selected, the distribution "mean" (μ) and standard deviation (σ) can be entered in the corresponding buttons.



The Probability Density Function is:

$$\mathbf{p(x) =} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

The Lower-Tail cumulative probability if : $\mathbf{P(\leq x) =} \int_{-\infty}^{x} \mathbf{p(x)}\, dx$

The Upper-Tail cumulative probability is : $\mathbf{P(> x) = 1 - P(\leq x)}$

Example: Normal Distribution

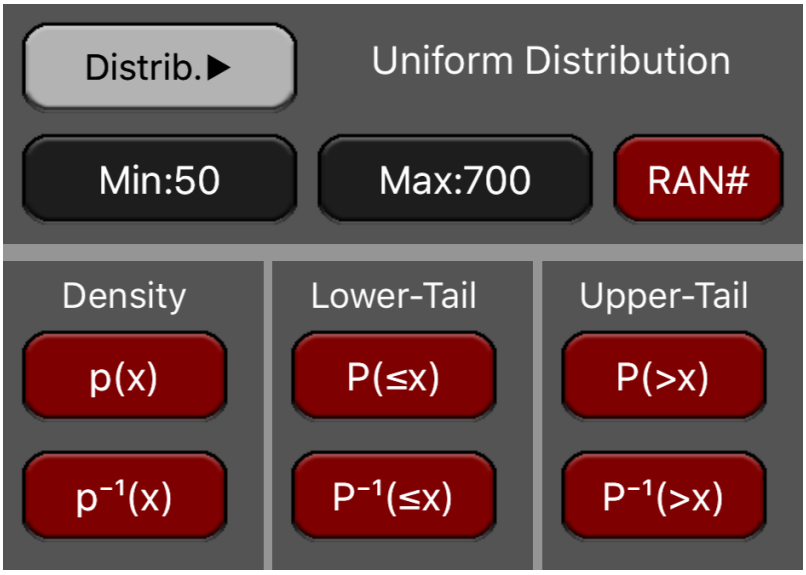
If the lifetime of a light bulb is 'Normally' distributed with an average of 500 hours and a standard deviation of 250:

1. What is the probability to fail at 100 hours?
2. What lifetime has a probability is 0.1%?
3. What is the probability of a failure before 100 hours?
4. What lifetime gives a probability less than 25% for failure?
5. What is the probability to have a lifetime bigger than 700 hours?
6. What lifetime gives a probability bigger than 25% for failure?

Keystrokes	Description
[Distrib.▶] "Normal"	Select the Normal Probability Distribution
"500" **[μ]**	Type the distribution mean and enter it.
"250" **[σ]**	Type the distribution standard deviation and enter it.
100 **[p(x)]**	Calculate the probability. **Result #1 = 0.00044**
0.001 **[$p^{-1}(x)$]**	Calculate the x-value. **Result #2 = 741.7012**
100 **[P(≤ x)]**	Calculate the probability. **Result #3 = 0.0548**
0.25 **[P^{-1}(≤ x)]**	Calculate the z-value. **Result #4 = 331.3776**
700 **[P(>x)]**	Calculate the probability. **Result #5 = 0.2119**
0.25 **[P^{-1}(>x)]**	Calculate the z-value. **Result #6 = 668.6224**

Uniform Probability Distribution

When the Normal probability density function is selected, the distribution "Minimum" (Min) and Maximum (Max) can be entered in the corresponding buttons.



The Probability Density Function is:

$$p(x) = \begin{cases} 1 / (Max - Min) & \text{for } Min < x < Max \\ 0 & \text{for any other value} \end{cases}$$

The Lower-Tail cumulative probability if : $\mathbf{P(\leq x)} = \int_{-\infty}^{x} \mathbf{p(x)}\, dx$

The Upper-Tail cumulative probability is : $\mathbf{P(> x) = 1 - P(\leq x)}$

Example: Uniform Distribution

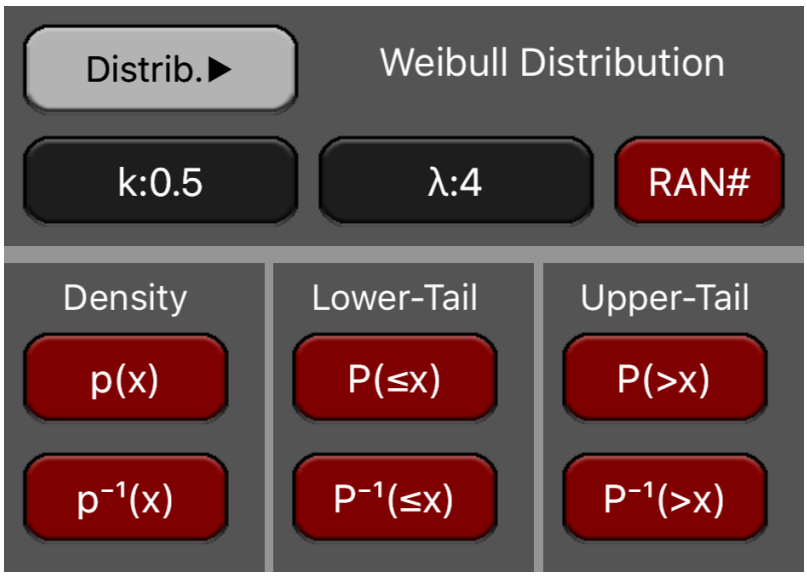
If the lifetime of a light bulb is 'Uniformly' distributed with minimum of 50 hours and a maximum of 700:

1. What is the probability to fail at 100 hours?
2. What lifetime has a probability is 0.1%?
3. What is the probability of a failure before 100 hours?
4. What lifetime gives a probability less than 25% for failure?
5. What is the probability to have a lifetime bigger than 700 hours?
6. What lifetime gives a probability bigger than 25% for failure?

Keystrokes	Description
[Distrib.▶] "Uniform"	Select the Normal Probability Distribution
"50" **[Min]**	Type the distribution mean and enter it.
"700" **[Max]**	Type the distribution standard deviation and enter it.
100 **[p(x)]**	Calculate the probability. **Result #1 = 0.001538**
0.001 **[$p^{-1}(x)$]**	No Solution.
100 **[P(≤ x)]**	Calculate the probability. **Result #3 = 0.0769**
0.25 **[$P^{-1}(\leq x)$]**	Calculate the z-value. **Result #4 = 212.5**
700 **[P(>x)]**	Calculate the probability. **Result #5 = 0.0**
0.25 **[$P^{-1}(>x)$]**	Calculate the z-value. **Result #6 = 537.5**

Weibull Probability Distribution

When the Weibull probability density function is selected, the distribution "shape" parameter (k) and the "scale" parameter (λ) can be entered in the corresponding buttons.



The Probability Density Function is:

$$\mathbf{p(x) =}\ \frac{k}{\lambda}\left(\frac{x}{\lambda}\right)^{k-1} e^{-(x/\lambda)^k}$$

The Lower-Tail cumulative probability if : $\mathbf{P(\leq x) = \int_{-\infty} p(x)}\ dx$

The Upper-Tail cumulative probability is : **P(> x) = 1 - P(≤ x)**

Example: Weibull Distribution

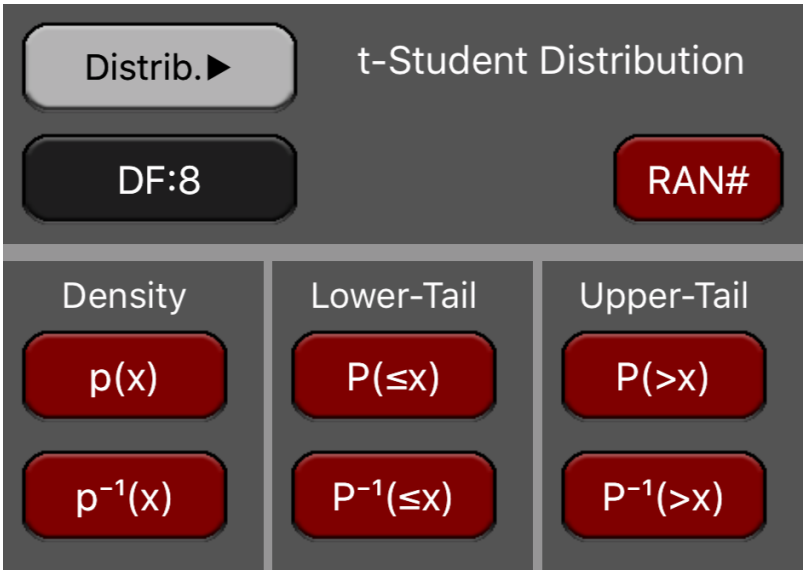
If that parts failure occurrence is Weibull distribution and has, the shape parameter, k = 0.5 and, scale parameter, λ = 4

1. What is the probability to fail at a time = 2?
2. What time failure has a probability of exactly 10%?
3. What is the probability of a failure before time = 5?
4. What time gives a probability less than 25% for failure?
5. What is the probability to have a time bigger than 10?
6. What time gives a probability bigger than 25% for failure?

Keystrokes	Description
[Distrib.▶] "Weibull"	Select the Weibull Probability Distribution
"0.5" **[k]**	Type the distribution mean and enter it.
"4" **[λ]**	Type the distribution standard deviation and enter it.
2 **[p(x)]**	Calculate the probability. **Result #1 = 0.0872**
0.1 **[p^{-1}(x)]**	Calculate the x-value. **Result #2 = 1.6981**
5 **[P(≤ x)]**	Calculate the probability. **Result #3 = 0.6731**
0.25 **[P^{-1}(≤ x)]**	Calculate the z-value. **Result #4 = 0.3310**
10 **[P(>x)]**	Calculate the probability. **Result #5 = 0.2057**
0.25 **[P^{-1}(>x)]**	Calculate the z-value. **Result #6 = 7.6872**

t-Student Probability Distribution

When the t-Student probability density function is selected, the distribution "Degrees of Freedom" parameter (DF) can be entered in the corresponding button.



The Probability Density Function is:

$$\mathbf{p(x)} = \frac{\Gamma\left(\frac{\nu+1}{2}\right)}{\sqrt{\nu\pi}\,\Gamma\left(\frac{\nu}{2}\right)}\left(1+\frac{t^2}{\nu}\right)^{-\frac{\nu+1}{2}}$$

The Lower-Tail cumulative probability if : $\mathbf{P(\leq x)} = \int_{-\infty}^{x} \mathbf{p(x)}\,dx$

The Upper-Tail cumulative probability is : $\mathbf{P(> x) = 1 - P(\leq x)}$

Example: t-Student Distribution

Consider a t-Student random variable with 8 degrees of freedom.

1. What is the probability of t-value = 1.86?
2. What t-value has a probability is 5%?
3. What is the probability of a t-value ≤ 0.2?
4. For a probability of 5% for a t-value ≤ x, What is x?
5. What is the probability of a t-value > 0.2?
6. For a probability of 5% for a value > x, What is x?

Keystrokes	Description
[Distrib.▶] "t-Student"	Select the t-Student Probability Distribution
"8" **[DF]**	Type the distribution mean and enter it.
1.86 **[p(x)]**	Calculate the probability. **Result #1 = 0.0767**
0.05 **[p^{-1}(x)]**	Calculate the x-value. **Result #2 = 2.1457**
0.2 **[P(≤ x)]**	Calculate the probability. **Result #3 = 0.5768**
0.05 **[P^{-1}(≤ x)]**	Calculate the z-value. **Result #4 = -1.8595**
0.2 **[P(>x)]**	Calculate the probability. **Result #5 = 0.4232**
0.05 **[P^{-1}(>x)]**	Calculate the z-value. **Result #6 = 1.8595**