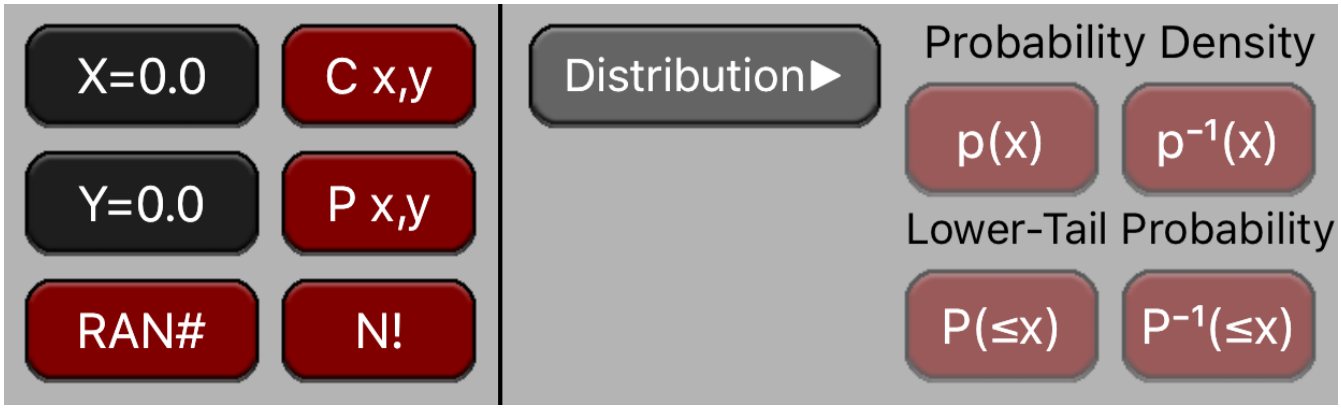
Probabilities Menu

This menu combines in one view the Combinations & Permutations menu with an additional Probability Distributions calculations menu. To show it, in the main menu, touch the "**Math**" button and select the "**PROB**" option.



Button	Combinations & Permutations
[X]	Stores the number of total items for the combinations and permutations calculations.
[Y]	Stores the number of items to be taken for the combinations and permutations calculations.
[C x,y]	Calculates the number of combinations. **Cx,y = x! / [y! • (x - y)!]**
[P x,y]	Calculates the number of permutations. **Px,y = x! / (x - y)!**
[RAN#]	Enters a random number in the range $0 \leq x < 1$
N!	Calculates the factorial of the current number.

Button	Probability Distributions
[Distribution▶]	Shows the list of available Probability Distribution functions to select (Exponential, Normal, t-Student or Weibull).
[p(x)]	Calculates the distribution probability density of the current number.
[p^{-1}(x)]	Calculates the distribution inverse probability density of the current number.
[P(≤x)]	Calculates the distribution lower-tail cumulative probability of the current number.
[P^{-1}(≤x)]	Calculates the distribution inverse lower-tail cumulative probability of the current number.

Example: Combinations

Using 10 colored balls, how many different color combinations of three balls can be chosen?

Keystrokes	Description
Type “10” **[X]**	Type the number of total items (10 colored balls).
Type “3” **[Y]**	Type the size os the sample (3 balls)
[Cy,x]	Calculate the number of possible combinations. **Result = 120.00**

Example: Permutations

Using 5 books labeled A, B, C, D and E, how many different ways can three books be placed on a shelf?

Keystrokes	Description
Type “5” **[X]**	Type the number of total items (5 books).
Type “3” **[Y]**	Type the size os the sample (3 books).
[Py,x]	Calculate the number of possible permutations. **Result = 60.00**

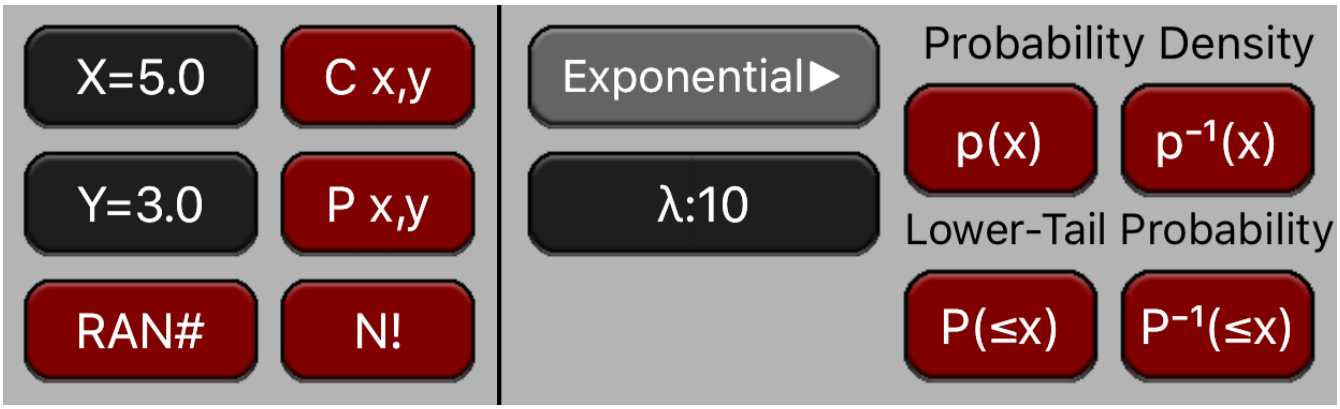
Example: Random Number Generator

Store a seed value of 42 and generate a sequence of 5 random numbers.

Keystrokes	Description
Type “42” **[STO]** **[RAN#]**	Store the initial random seed.
[RAN#]	Generate the 1st random number. **Result = 0.7431**
[RAN#]	Generate the 2nd random number. **Result = 0.0673**
[RAN#]	Generate the 3rd random number. **Result = 0.1505**
[RAN#]	Generate the 4th random number. **Result = 0.9077**

The following examples assumes the “Probability” menu is already visible in the calculator and the display format is set to 6 decimal places (**[↴] [DISP] [6]**).

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 if : $\mathbf{P(x)} = \int_{-\infty}^{x} \mathbf{p(x)}\, dx$

Example: Exponential Distribution

Consider an Exponential random variable with a rate of 10.

1. What is the probability for a value equal to 0.2 => $p(0.2) = ?$
2. If the probability is 5%, what is the value => $p^{-1}(0.05) = ?$
3. What is the probability of a value ≤ 0.2 => $P(x \le 0.2) = ?$
4. What is the value 'z' for probability of $x \le z$ is 5% => $P^{-1}(x \le z) = 0.05$?

Keystrokes	Description
[Exponential▶]	Select the Exponential Probability Distribution
"10" **[λ]**	Type the distribution rate and enter it.
Type "0.2"	Type the z-value
[p(x)]	Calculate the probability. **Result 1 = 1.353353**
Type "0.05"	Type the probability
[p^{-1}(x)]	Calculate the z-value. **Result 2 = 0.529832**
Type "0.2"	Type the z-value
[P(≤ x)]	Calculate the probability. **Result 3 = 0.864665**
Type "0.05"	Type the probability
[P^{-1}(≤ x)]	Calculate the z-value. **Result 4 = 0.005129**

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 : $\mathbf{P(x)} = \int_{-\infty}^{x} \mathbf{p(x)}\, dx$

Example: Normal Distribution

Consider a Normal random variable with a mean of 7.35 and a standard deviation of 2.33.

1. What is the probability for a value equal to 5.35 => p(5.35) = ?
2. IF the probability is 5%, what is the value => $p^{-1}(0.05)$ = ?
3. What is the probability of a value ≤ 5.35 => P(x ≤ 5.35) = ?
4. What is the value 'z' for probability of x ≤ z is 5% => $P^{-1}(x \le z) = 0.05$?

Keystrokes	Description
[Normal▶]	Select the Normal Probability Distribution
"7.35" **[μ]**	Type the distribution mean and enter it.
"2.33" **[σ]**	Type the distribution standard deviation and enter it.
Type "5.35"	Type the z-value
[p(x)]	Calculate the probability. **Result 1 = 0.118457**
Type "0.05"	Type the probability
[$p^{-1}(x)$]	Calculate the z-value. **Result 2 = 11.005837**
Type "5.35"	Type the z-value
[P(≤ x)]	Calculate the probability. **Result 3 = 0.195344**
Type "0.05"	Type the probability
[P^{-1}(≤ x)]	Calculate the z-value. **Result 4 = 3.517491**

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 : $\mathbf{P(x)} = \int_{-\infty}^{x} \mathbf{p(x)}\, dx$

Example: Weibull Distribution

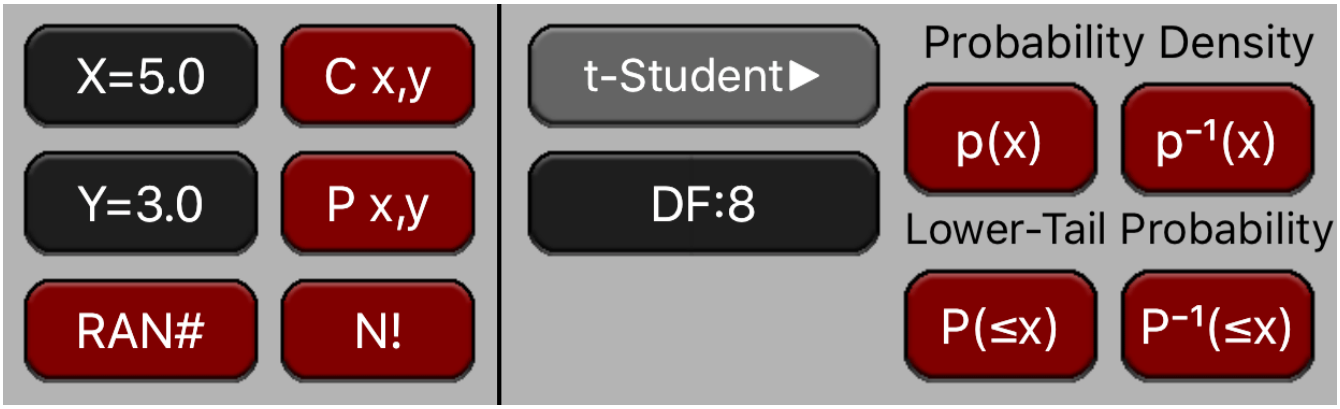
Consider a Weibull random variable with a shape factor of 20 and a scale factor of 100.

1. What is the probability for a value equal to 105 => p(105) = ?
2. If the probability is 5%, what is the value => $p^{-1}(0.05)$ = ?
3. What is the probability of a value ≤ 90 => P(x ≤ 90) = ?
4. What is the value 'z' for probability of x ≤ z is 5% => $P^{-1}(x \le z) = 0.05$?

Keystrokes	Description
[Weibull▶]	Select the Weibull Probability Distribution
"20" **[k]**	Type the distribution mean and enter it.
"100" **[λ]**	Type the distribution standard deviation and enter it.
Type "105"	Type the z-value
[p(x)]	Calculate the probability. **Result 1 = 0.035589**
Type "0.05"	Type the probability
[$p^{-1}(x)$]	Calculate the z-value. **Result 2 = 94.584178**
Type "90"	Type the z-value
[P(≤ x)]	Calculate the probability. **Result 3 = 0.114477**
Type "0.05"	Type the probability
[P^{-1}(≤ x)]	Calculate the z-value. **Result 4 = 86.199159**

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 : $\mathbf{P(x)} = \int_{-\infty}^{x} \mathbf{p(x)}\,dx$

Example: Weibull Distribution

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

1. What is the probability for a value equal to 0.5 => p(0.5) = ?
2. If the probability is 5%, what is the value => $p^{-1}(0.05)$ = ?
3. What is the probability of a value ≤ 0.5 => P(x ≤ 0.5) = ?
4. What is the value 'z' for probability of x ≤ z is 5% => $P^{-1}(x \le z) = 0.05$?

Keystrokes	Description
[t-Student▶]	Select the t-Student Probability Distribution
"8" **[DF]**	Type the distribution mean and enter it.
Type "0.5"	Type the z-value
[p(x)]	Calculate the probability. **Result 1 = 0.336694**
Type "0.05"	Type the probability
[p^{-1}(x)]	Calculate the z-value. **Result 2 = 2.145724**
Type "0.5"	Type the z-value
[P(≤ x)]	Calculate the probability. **Result 3 = 0.684732**
Type "0.05"	Type the probability
[P^{-1}(≤ x)]	Calculate the z-value. **Result 4 = 1.859548**