

## Chapter 11 / Example 18

# Normal probabilities

In these examples you will see how normal probabilities can be found graphically and by using the normalcdf function.

The time taken for a student to complete a language test follows a normal distribution with a mean of 25 minutes and a standard deviation of 3 minutes. They take a test each week (35 weeks in the school year). Estimate the number of tests during the year which are

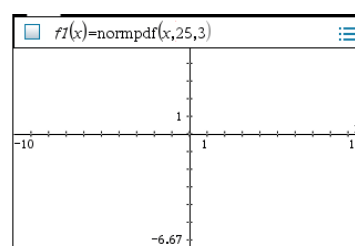
- a** longer than 30 minutes    **b** less than 23 minutes    **c** between 18 and 25 minutes.

Open a new document and add a Graphs page.

The entry line is displayed at the top of the work area.

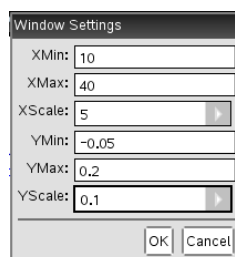
The default graph type is function, so  $f1(x)=$  is displayed.

Type `normpdf(x, 25, 3)` and press **enter**.



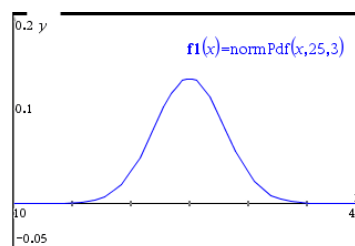
Press **menu** 4:Window/Zoom | 1:Window Settings...

Set the axes to show  $10 \leq x \leq 40$  and  $-0.05 \leq y \leq 0.2$  with scales of 5 and 0.1.



Press **enter** when you have finished.

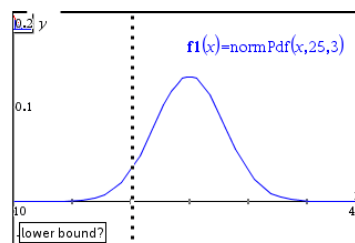
The GDC shows a normal probability curve with a mean of 25 and standard deviation of 3.



To show the area press **menu** 6:Analyze Graph | 6:Integral.

You need to give the lower and upper bounds of the region.

The GDC shows a line and asks you to set the lower bound.



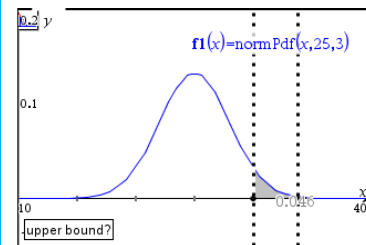
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Do not use the line to set the lower bound as you need to enter an exact value.

Type 30 and press **enter**.

The GDC shows a line and asks you to set the upper bound.

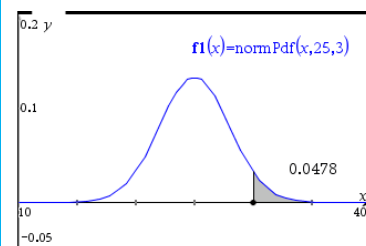


Type 40, the upper bound, and press **enter**.

40 is the extreme limit of the graph window.

The GDC shows the area defined by the integral and its value.

$$P(X > 30) = 0.0478.$$



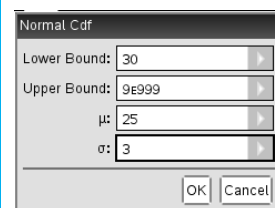
Add a new Calculator page by pressing **ctrl** **doc** **(+page)**.

Press **menu** 5:Probability | 5:Distributions | 2:Normal Cdf...

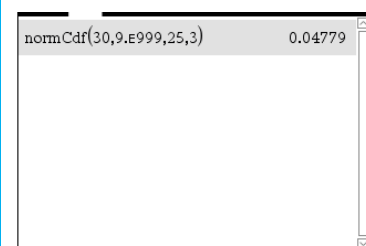
Set the Lower Bound to 30, the Upper Bound to 9E999  $\mu$  to 25 and  $\sigma$  to 3.

9E999 means  $9 \times 10^{999}$  - a very large number.

To enter E press **EE**.



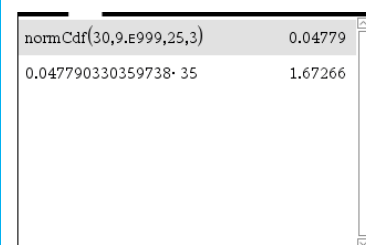
$$P(X > 30) = 0.0478$$



Since there are 35 weeks in the school year, multiply the probability by 35.

$$0.0478 \times 35 = 1.67.$$

The student could expect 2 tests longer than 30 minutes in the school year. (Rounding off to the nearest whole number).



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Return to the Graph page by pressing **ctrl** **del**

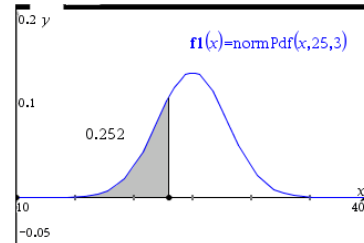
Use the touchpad to select the integral and press **del** to remove the previous shaded area.

To show the area press **menu** 6:Analyze Graph | 6:Integral

Set the lower bound to 10 and the upper bound to 23.

(10 is the lowest value of  $x$  in the window.)

$$P(X < 23) = 0.252.$$



Return to the Calculator page by pressing **ctrl** **del**

Press **menu** 5:Probability | 5:Distributions | 2:Normal Cdf...

Set the Lower Bound to  $-9E999$ , the Upper Bound to 23,  $\mu$  to 25 and  $\sigma$  to 3.

$-9E999$  means  $-9 \times 10^{999}$  – a very small number.

To enter E press **EE**.

$$P(X < 23) = 0.252.$$

$$0.252 \times 35 = 8.84.$$

The student could expect 9 tests shorter than 23 minutes in the school year. (Rounding off to the nearest whole number).

normCdf(-9.E999,23,25,3)	0.252492
0.25249246700516	35
	8.83724

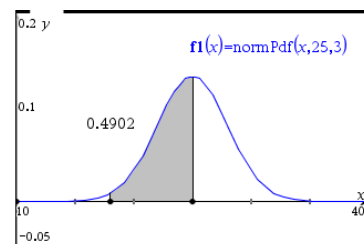
Return to the Graph page by pressing **ctrl** **del**

Use the touchpad to select the integral and press **del** to remove the previous shaded area.

To show the area press **menu** 6:Analyze Graph | 6:Integral.

Set the lower bound to 18 and the upper bound to 25.

$$P(18 < X < 25) = 0.490.$$



Return to the Calculator page by pressing **ctrl** **del**

Press **menu** 5:Probability | 5:Distributions | 2:Normal Cdf...

Set the Lower Bound to 18, the Upper Bound to 25,  $\mu$  to 25 and  $\sigma$  to 3.

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$$P(18 < X < 25) = 0.490 .$$

$$0.490 \times 35 = 17.2 .$$

The student could expect 17 tests between 18 and 25 minutes in the school year. (Rounding off to the nearest whole number).

normCdf(18,25,25,3)	0.490185
0.49018469367986	35
	17.1565