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.

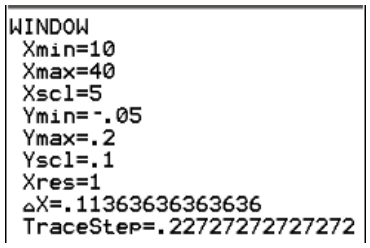
The time taken for a student to complete a language test follows a normal distribution with a mean of 25 minutes and a standard deviation of 3 minutes. They take a test each week (35 weeks in the school year). Estimate the number of tests during the year which are

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

First you are going to set up a suitable window to show the normal probability curve.

Press [f2] window

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. You can leave the last three items as they are.

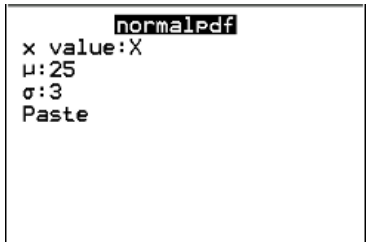


Press [f1] y= to display the equation entry screen.

Press 2nd vars ([distr]) 1:normalpdf(

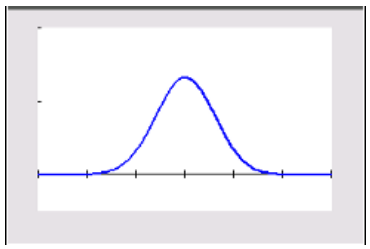
Set the x value to X, μ to 25 and σ to 3.

Navigate to Paste and press enter.



Press enter and press [f5] graph.

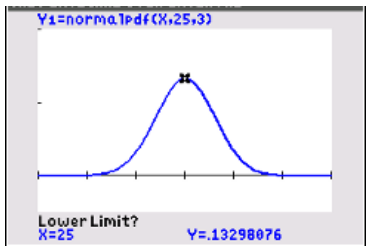
The GDC shows a normal probability curve with a mean of 25 and standard deviation of 3.



To show the area press 2nd [f4] [calc] 7:∫f(x)dx

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

The GDC asks you to set the lower limit.



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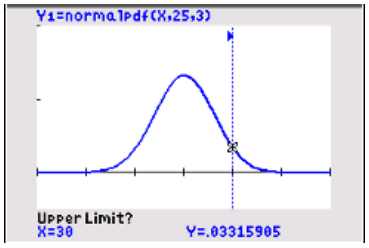
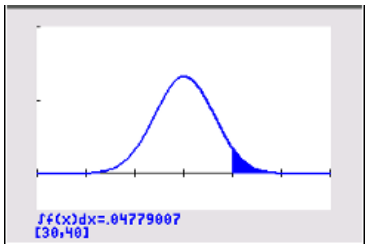
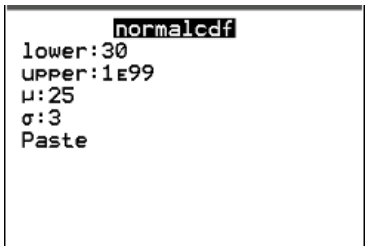
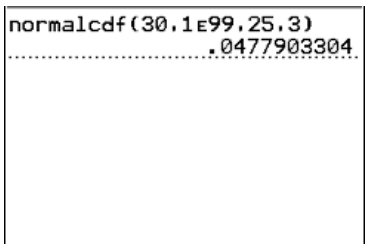
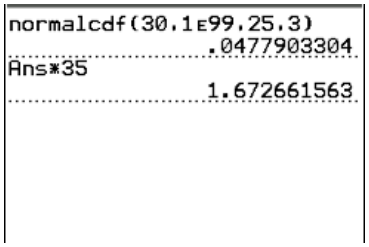
Type 30 and press enter. The GDC asks you to set the upper limit.	
Type 40 for the upper limit, and press enter. 40 is the extreme limit of the graph window. The GDC shows the area defined by the integral and its value. $P(X > 30) = 0.0478$	
Press 2nd [quit]. Press 2nd vars ([distr]) 2:normalcdf(Set the Lower Bound to 40, the Upper Bound to 1E99, μ to 25 and σ to 3. Navigate to Paste and press enter. 1E99 means 1×10^{99} – a very large number. To enter E press 2nd , ([EE]).	
Press enter. $P(X > 30) = 0.0478$	
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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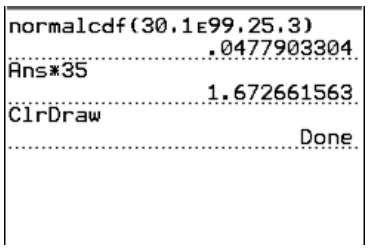
Press 2nd apps ([draw]) 1:ClrDraw and press enter. This will clear the shading from the graph



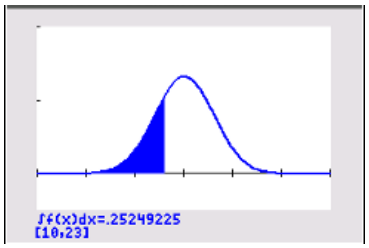
Press [f5] graph.

To show the area press 2nd [f4] [calc] 7:∫f(x)dx

Set the lower limit to 10 (the extreme limit of the graph window) and the upper limit to 23.

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

$P(X < 23) = 0.252$



Press 2nd [quit].

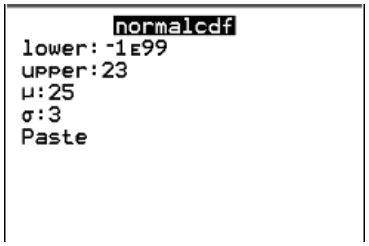
Press 2nd vars ([distr]) 2:normalcdf(

Set the Lower Bound to -1E99, the Upper Bound to 23, μ to 25 and σ to 3.

Navigate to Paste and press enter.

–1E99 means -1×10^{99} - a very small number.

To enter E press 2nd , ([EE]).

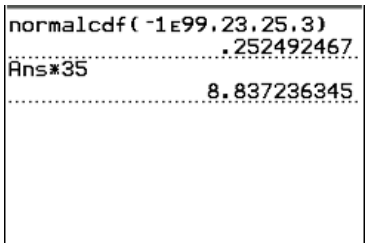


Press enter and then multiply by 35.

$P(X < 23) = 0.252$

$0.252 \times 35 = 8.84$

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



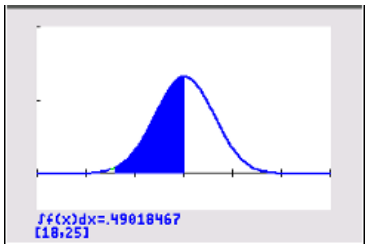
Press 2nd apps ([draw]) 1:ClrDraw and press enter.

Press 2nd [f4] [calc] 7:∫f(x)dx

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

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

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



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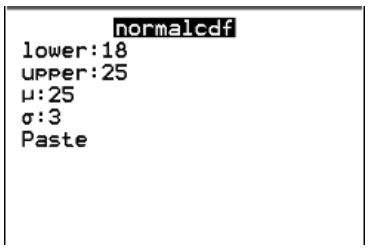
Press 2nd [quit]. Press 2nd vars ([distr]) 2:normalcdf(Set the Lower Bound to 18, the Upper Bound to 25, μ to 25 and σ to 3. Navigate to Paste and press enter.	
Press enter and then multiply by 35. $P(18 < X < 25) = 0.490$ $0.490 \times 35 = 17.2$ The student could expect 17 tests between 18 and 25 minutes in the school year. (Rounding off to the nearest whole number).