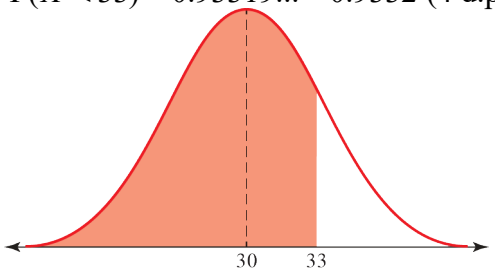
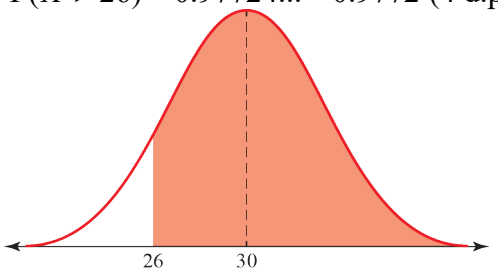
The normal distribution 3B

1 Use the Normal CD function on your calculator, with $\mu = 30$ and $\sigma = 2$.

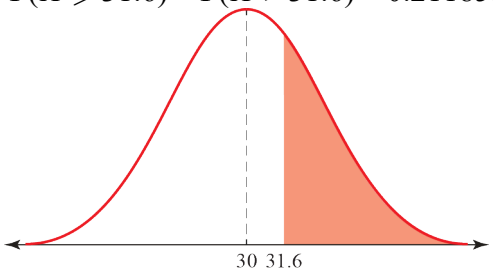
a Set a small value for the lower limit, e.g. 0.
$P(X < 33) = 0.93319... = 0.9332$ (4 d.p.)



b Set a large value for the upper limit, e.g. 1000.
$P(X > 26) = 0.97724... = 0.9772$ (4 d.p.)

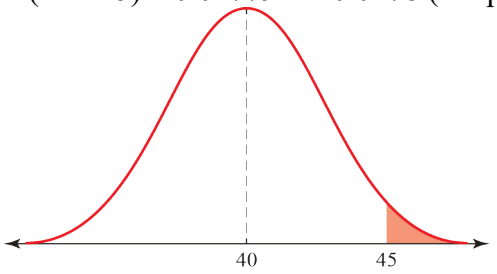


c Set a large value for the upper limit, e.g. 1000.
$P(X \geqslant 31.6) = P(X > 31.6) = 0.21185... = 0.2119$ (4 d.p.)

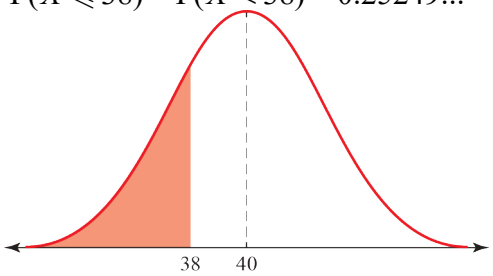


2 Use the Normal CD function on your calculator, with $\mu = 40$ and $\sigma = \sqrt{9} = 3$.

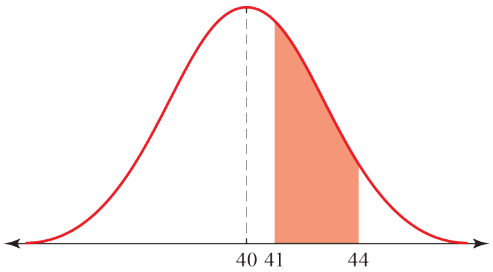
a Set a large value for the upper limit, e.g. 1000.
$P(X > 45) = 0.04779... = 0.0478$ (4 d.p.)



2 b Set a small value for the lower limit, e.g. 0.
$P(X \leqslant 38) = P(X < 38) = 0.25249... = 0.2525$ (4 d.p.)

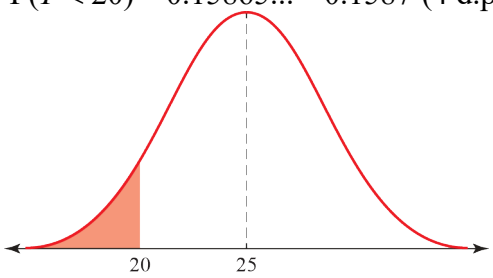


c $P(41 \leqslant X \leqslant 44) = P(41 < X < 44) = 0.27823... = 0.2782$ (4 d.p.)

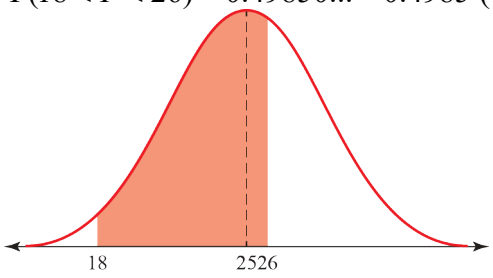


3 Use the Normal CD function on your calculator, with $\mu = 25$ and $\sigma = \sqrt{25} = 5$.

a Set a small value for the lower limit, e.g. 0.
$P(Y < 20) = 0.15865... = 0.1587$ (4 d.p.)



b $P(18 < Y < 26) = 0.49850... = 0.4985$ (4 d.p.)



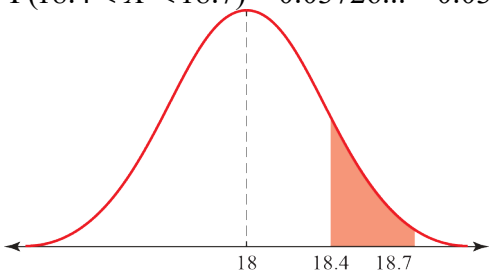
c Set a large value for the upper limit, e.g. 1000.
$P(Y > 23.8) = 0.59483... = 0.5948$ (4 d.p.)

4 Use the Normal CD function on your calculator, with $\mu = 18$ and $\sigma = \sqrt{10}$.

a Set a large value for the upper limit, e.g. 1000.
$P(X \geqslant 20) = P(X > 20) = 0.26354... = 0.2635$ (4 d.p.)

b Set a small value for the lower limit, e.g. 0.
$P(X < 15) = 0.17139... = 0.1714$ (4 d.p.)

4 c $P(18.4 < X < 18.7) = 0.03726... = 0.0373$ (4 d.p.)



5 Use the Normal CD function on your calculator, with $\mu = 15$ and $\sigma = 1.5$.

a i Set a large value for the upper limit, e.g. 1000.
$P(M > 14) = 0.74750... = 0.7474$ (4 d.p.)

ii Set a small value for the lower limit, e.g. 0.
$P(M < 14) = 0.25249... = 0.2525$ (4 d.p.)

b $P(M > 14) + P(M < 14) = 0.7475 + 0.2525 = 1$
The sum is 1, as the combined probabilities include every possible value.

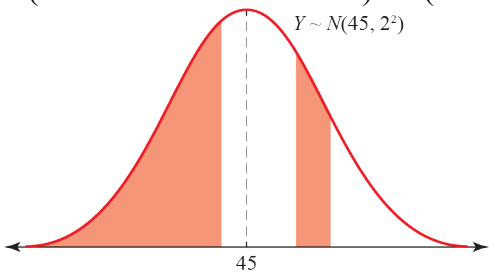
6 a Use the Normal CD function on your calculator, with $\mu = 4.5$, $\sigma = \sqrt{0.4}$ and a small value for the lower limit.
$P(T < 4.2) = 0.31762... = 0.3176$ (4 d.p.)

b $P(T > 4.2) = 1 - P(T < 4.2) = 1 - 0.3176 = 0.6824$ (4 d.p.)

7 Use the Normal CD function on your calculator, with $\mu = 45$ and $\sigma = 2$.

a $P(Y < 41 \text{ or } Y > 47) = 1 - P(41 < Y < 47)$
Using your calculator, $P(41 < Y < 47) = 0.81859...$
So $P(Y < 41 \text{ or } Y > 47) = 1 - 0.81859... = 0.1814$ (4 d.p.)

b $P(Y < 44 \text{ or } 46.5 < Y < 47.5) = P(Y < 44) + P(46.5 < Y < 47.5)$



Using your calculator, $P(Y < 44) = 0.30853...$ and $P(46.5 < Y < 47.5) = 0.12097...$
so $P(Y < 44 \text{ or } 46.5 < Y < 47.5) = 0.30853... + 0.12097... = 0.4295$ (4 d.p.)

8 Use the Normal CD function on your calculator, with $\mu = 6$ and $\sigma = 0.8$.

a i A suitable upper limit is 10, giving $P(X < 7) = 0.10564... = 0.1056$ (4 d.p.)

ii A suitable lower limit is 2, giving $P(X < 5) = 0.10564... = 0.1056$ (4 d.p.)

b Since these are independent events, the probability is $P(X < 5)^3$, i.e.
$(0.10564...)^3 = 0.00117... = 0.0012$ (4 d.p.)

9 Use the Normal CD function on your calculator, with $\mu = 500$ and $\sigma = 14$.

a i A suitable upper limit is 570, giving $P(W > 505) = 0.36049... = 0.3605$ (4 d.p.)

ii A suitable lower limit is 430, giving $P(W < 490) = 0.23752... = 0.2375$ (4 d.p.)

b Since these are independent events, the probability is $P(W > 490)^4$.
$P(W > 490) = 1 - P(W < 490) = 1 - 0.23752... = 0.76248...$
So the probability is $(0.76248\ldots)^4 = 0.33799\ldots = 0.3380$ (4 d.p.).

10 Use the Normal CD function on your calculator, with $\mu = 165$ and $\sigma = 3.5$.

a A suitable lower limit is 10, giving $P(h < 160) = 0.07656... = 0.0766$ (4 d.p.)

b $P(168 < h < 174) = 0.19061... = 0.1906$ (4 d.p.)

c Use the binomial distribution $X \sim B(20, 0.1906)$.
Using the binomial CD function on your calculator:
$P(X \geqslant 5) = 1 - P(X \leqslant 4) = 1 - 0.67035... = 0.3296$ (4 d.p.)

11 Use the Normal CD function on your calculator, with $\mu = 13$ and $\sigma = 0.1$.

a A suitable lower limit is 12.5, giving $P(D < 12.8) = 0.02274... = 0.0227$ (4 d.p.)

b P('perfect') = $P(12.9 < D < 13.1) = 0.68268... = 0.6827$ (4 d.p.)
Use the binomial distribution $X \sim B(40, 0.6827)$.
Using the binomial CD function on your calculator:
$P(X > 25) = 1 - P(X \leqslant 25) = 1 - 0.26549... = 0.7345$ (4 d.p.)

12 Use the Normal CD function on your calculator, with $\mu = 480$ and $\sigma = 40$.

a A suitable upper limit is 680, giving $P(X > 490) = 0.40129... = 0.4013$ (4 d.p.)

b $P(470 < X < 490) = 0.19741... = 0.1974$ (4 d.p.)
Use the binomial distribution $Y \sim B(30, 0.1974)$.
Using the binomial CD function on your calculator:
$P(X \geqslant 15) = 1 - P(X \leqslant 14) = 1 - 0.99980141... = 0.0001986$ (4 s.f.)