Normal distribution

Intro

We will take a look at how to use the GDC to solve normal distribution problems. In general there are two types of normal distribution problems. Those that require the use of symmetry of the distribution curve (the bell curve) and those that require the use of GDC. We will analyse the later.

Intro

We will take a look at how to use the GDC to solve normal distribution problems. In general there are two types of normal distribution problems. Those that require the use of symmetry of the distribution curve (the bell curve) and those that require the use of GDC. We will analyse the later.

Intro

We will take a look at how to use the GDC to solve normal distribution problems. In general there are two types of normal distribution problems. Those that require the use of symmetry of the distribution curve (the bell curve) and those that require the use of GDC. We will analyse the later.

Normal distribution problems

The GDC allows you to do two things:

- calculate the area under the curve (which corresponds to the probability), if you specify the bounds of the area,
- calculate the upper bound of the region under the curve, if you specify the area.

Example 1

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights between $97g$ and $101g$.

What we want is the area under the curve between 97 and 101. We will use the **normalcdf** (TI) or **Ncd** (Casio) function. On Ti go to DISTR→2:normalcdf. On Casio go to STAT→DIST→NORM→Ncd. In each case you will need to specify the lower bound, the upper bound, standard deviation (σ) and the mean (μ). In our example we have

Lower: 97

Upper: 101

standard deviation = 2.5

mean = 100

You than press Paste/Execute and you should get the answer: 0.54035 or 54.035%.

Example 1

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights between $97g$ and $101g$.
What we want is the area under the curve between 97 and 101. We will use the **normalcdf** (TI) or **Ncd** (Casio) function. On Ti go to DISTR→2:normalcdf. On Casio go to STAT→DIST→NORM→Ncd.
In each case you will need to specify the lower bound, the upper bound, standard deviation (σ) and the mean (μ). In our example we have

Lower: 97

Upper: 101

standard deviation = 2.5

mean = 100

You than press Paste/Execute and you should get the answer: 0.54035 or 54.035%.

Example 1

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights between $97g$ and $101g$.

What we want is the area under the curve between 97 and 101. We will use the **normalcdf** (TI) or **Ncd** (Casio) function. On Ti go to DISTR→2:normalcdf. On Casio go to STAT→DIST→NORM→Ncd. In each case you will need to specify the lower bound, the upper bound, standard deviation (σ) and the mean (μ). In our example we have

Lower: 97

Upper: 101

standard deviation = 2.5

mean = 100

You than press Paste/Execute and you should get the answer: 0.54035 or 54.035%.

Example 1

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights between $97g$ and $101g$.
What we want is the area under the curve between 97 and 101. We will use the **normalcdf** (TI) or **Ncd** (Casio) function. On Ti go to DISTR→2:normalcdf. On Casio go to STAT→DIST→NORM→Ncd.
In each case you will need to specify the lower bound, the upper bound, standard deviation (σ) and the mean (μ). In our example we have

Lower: 97

Upper: 101

standard deviation $= 2.5$

mean $= 100$

You than press Paste/Execute and you should get the answer: 0.54035 or 54.035%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights less $96g$

What we want is the area under the curve to the left of 96. Again we use the **normalcdf** (TI) or **Ncd** (Casio) function. The upper bound is 96, but the lower bound is not specified so we will take a number which is very low compared to the mean and standard deviation. We can take 0 or even -1000.

We have:

Lower: 0

Upper: 96

standard deviation = 2.5

mean = 100

The probability is 0.054799 or 5.4799%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights less $96g$

What we want is the area under the curve to the left of 96. Again we use the **normalcdf** (TI) or **Ncd** (Casio) function. The upper bound is 96, but the lower bound is not specified so we will take a number which is very low compared to the mean and standard deviation. We can take 0 or even -1000.

We have:

- Lower: 0
- Upper: 96
- standard deviation = 2.5
- mean = 100

The probability is 0.054799 or 5.4799%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights less $96g$

What we want is the area under the curve to the left of 96. Again we use the **normalcdf** (TI) or **Ncd** (Casio) function. The upper bound is 96, but the lower bound is not specified so we will take a number which is very low compared to the mean and standard deviation. We can take 0 or even -1000.

We have:

- Lower: 0
- Upper: 96
- standard deviation = 2.5
- mean = 100

The probability is 0.054799 or 5.4799%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights less $96g$

What we want is the area under the curve to the left of 96. Again we use the **normalcdf** (TI) or **Ncd** (Casio) function. The upper bound is 96, but the lower bound is not specified so we will take a number which is very low compared to the mean and standard deviation. We can take 0 or even -1000.

We have:

Lower: 0

Upper: 96

standard deviation $= 2.5$

mean $= 100$

The probability is 0.054799 or 5.4799%.

Example 1 ctd.

Note that if we changed the lower bound from 0 to -1000, so we input:

Lower: -1000

Upper: 96

standard deviation $= 2.5$

mean $= 100$

We get the same result. This is because the numbers 0 and -1000 are so many standard deviations from the mean, that the area to the left of 0 is virtually 0.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights more $103g$

What we want is the area under the curve to the right of 103. We use the **normalcdf** (TI) or **Ncd** (Casio) function. The lower bound is 103, but the upper bound is not specified so we will take a number which is very high compared to the mean and standard deviation. We can take 200 or even 10000.

We have:

Lower: 103

Upper: 200

standard deviation = 2.5

mean = 100

The probability is 0.11506 or 11.506%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights more $103g$

What we want is the area under the curve to the right of 103. We use the **normalcdf** (TI) or **Ncd** (Casio) function. The lower bound is 103, but the upper bound is not specified so we will take a number which is very high compared to the mean and standard deviation. We can take 200 or even 10000.

We have:

Lower: 103

Upper: 200

standard deviation = 2.5

mean = 100

The probability is 0.11506 or 11.506%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights more $103g$

What we want is the area under the curve to the right of 103. We use the **normalcdf** (TI) or **Ncd** (Casio) function. The lower bound is 103, but the upper bound is not specified so we will take a number which is very high compared to the mean and standard deviation. We can take 200 or even 10000.

We have:

Lower: 103

Upper: 200

standard deviation = 2.5

mean = 100

The probability is 0.11506 or 11.506%.

Example 1 ctd.

The weights of packet of crisps are normally distributed with a mean of $100g$ and a standard deviation of $2.5g$. Calculate the probability that a randomly chosen packet weights more $103g$

What we want is the area under the curve to the right of 103. We use the **normalcdf** (TI) or **Ncd** (Casio) function. The lower bound is 103, but the upper bound is not specified so we will take a number which is very high compared to the mean and standard deviation. We can take 200 or even 10000.

We have:

Lower: 103

Upper: 200

standard deviation $= 2.5$

mean $= 100$

The probability is 0.11506 or 11.506%.

Example 2

The height of students at a certain school is normally distributed with a mean of $158cm$ and a standard deviation of $12cm$. 9.12% of students are shorter than k cm find the value of k.

This time we will use the **InverseNormal** function. On TI we go DISTR→invNORM on Casio STAT→DIST→NORM→InvN.

We need to specify area (our probability) and the standard deviation and the mean.

Note: some calculators also allow you to specify the tail. If you cannot specify the tail this means that the calculator will always calculate the **upper bound**. If you can specify the tail, the if you choose the left tail, the GDC will calculate the upper bound. If you choose the right tail, then the GDC will calculate the lower bound.

Example 2

The height of students at a certain school is normally distributed with a mean of 158cm and a standard deviation of 12cm. 9.12% of students are shorter than k cm find the value of k.
This time we will use the **InverseNormal** function. On Ti we go DISTR→invNORM on Casio STAT→DIST→NORM→InvN.
We need to specify area (our probability) and the standard deviation and the mean.

Note: some calculators also allow you to specify the tail. If you cannot specify the tail this means that the calculator will always calculate the **upper bound**. If you can specify the tail, the if you choose the left tail, the GDC will calculate the upper bound. If you choose the right tail, then the GDC will calculate the lower bound.

Example 2

The height of students at a certain school is normally distributed with a mean of $158cm$ and a standard deviation of $12cm$. 9.12% of students are shorter than k cm find the value of k.
This time we will use the **InverseNormal** function. On Ti we go DISTR→invNORM on Casio STAT→DIST→NORM→InvN.
We need to specify area (our probability) and the standard deviation and the mean.

Note: some calculators also allow you to specify the tail. If you cannot specify the tail this means that the calculator will always calculate the **upper bound**. If you can specify the tail, the if you choose the left tail, the GDC will calculate the upper bound. If you choose the right tail, then the GDC will calculate the lower bound.

Example 2

The height of students at a certain school is normally distributed with a mean of $158cm$ and a standard deviation of $12cm$. 9.12% of students are shorter than k cm find the value of k.
This time we will use the **InverseNormal** function. On Ti we go DISTR→invNORM on Casio STAT→DIST→NORM→InvN.
We need to specify area (our probability) and the standard deviation and the mean.

Note: some calculators also allow you to specify the tail. If you cannot specify the tail this means that the calculator will always calculate the **upper bound**. If you can specify the tail, the if you choose the left tail, the GDC will calculate the upper bound. If you choose the right tail, then the GDC will calculate the lower bound.

Example 2

The height of students at a certain school is normally distributed with a mean of $158cm$ and a standard deviation of $12cm$. 9.12% of students are shorter than s cm find the value of s.

We want to calculate the upper bound, so we input

Area: 0.0912

standard deviation = 12

mean = 158

Optionally you input Tail: Left. The answer is $s = 142$ correct to 3sf.

Example 2

The height of students at a certain school is normally distributed with a mean of 158cm and a standard deviation of 12cm. 9.12% of students are shorter than s cm find the value of s.
We want to calculate the upper bound, so we input

Area: 0.0912

standard deviation $= 12$

mean $= 158$

Optionally you input Tail: Left. The answer is $s = 142$ correct to 3sf.

Example 2 ctd.

The height of students at a certain school is normally distributed with a mean of $158cm$ and a standard deviation of $12cm$. 28% of students are taller than t cm find the value of t.

We want to calculate the lower bound, so we need to change things first. We have 28% taller than t, so 72% are shorter than t and now we want the upper bound. We input:

Area: 0.72

standard deviation = 12

mean = 158

The answer is $t = 165$ correct to 3sf.

You could have also used Area:0.28, but Tail: right.

Example 2 ctd.

The height of students at a certain school is normally distributed with a mean of 158*cm* and a standard deviation of 12*cm*. 28% of students are taller than t *cm* find the value of t.
We want to calculate the lower bound, so we need to change things first. We have 28% taller than t, so 72% are shorter than t and now we want the upper bound. We input:

Area: 0.72

standard deviation $= 12$

mean $= 158$

The answer is $t = 165$ correct to 3sf.

You could have also used Area:0.28, but Tail: right.

Example 2 ctd.

The height of students at a certain school is normally distributed with a mean of $158cm$ and a standard deviation of $12cm$. 28% of students are taller than $t\ cm$ find the value of t.
We want to calculate the lower bound, so we need to change things first. We have 28% taller than t, so 72% are shorter than t and now we want the upper bound. We input:

Area: 0.72

standard deviation $= 12$

mean $= 158$

The answer is $t = 165$ correct to 3sf.

You could have also used Area:0.28, but Tail: right.

There will be a short test on this material on Monday.