**Mathematics Advanced - Normal distribution transcript**

(Duration 6 minutes 26)

This is the HSC hub Mathematics curriculum support for the New South Wales Department of Education. My name is Meaghan Rodder. This question is for the NESA sample exam and incorporates material from the statistical analysis strand in the Mathematics Advanced course. This question looks at the normal distribution.

We acknowledge that there may be different approaches, methods or techniques to answering this question, and we encourage you to discuss and share these with each other. Please take a moment to pause the video and read the question before we move on.

[See student resource booklet for question]

The first part of the question is asking us to find the missing value from the table. Looking at the table, we can see that we have X values in the top row and if of X values in the second. The F of X values are the height of the graph at the different expositions we can see at X equals 0 we have a height of 0.3989 and X equals one. We have a height of 0.2420. Although it is tempting to read the F of X values from the graph, you can see that the answers in the table of much more accurate than that.

To find accurate F of X values, we need to use the equation of the normal curve that was given in the question. Our first step is to write down the equation of the curve and to show that we have substituted X equals 2 into the equation. Be careful entering the equation into your calculator. You may need to use brackets if you enter it all in one step, make sure you write down your full calculator display. Checking the question, we can see that we have to round out answer to four significant figures. Remembering that leading zeros are not significant means that our final answer will be 0.05399. Checking our answer, it is between zero and one which is a requirement for all probabilities. Looking at the shape of the graph, our FX values get smaller as our X values get larger, so our F of X value for X equals two should be between the F of X values for one and three, which it is. So our answer is reasonable.

The second part of the question is asking us to use the trapezoidal rule, which is on your reference sheet. And the table from part A. The trapezoidal rule is used to approximate the area under a curve, so the question is asking us to find the area under the curve between minus three and three because the curve is symmetrical, we can simply find the area between zero and three and then double it. Using the values in the table, you can see that we will be splitting the curve up into three trapeziums. B and A in the formula are our start and end points so zero and three in this case. N is how many trapeziums we're dividing our area into. In this case, it will be three. F of A and F of B are the corresponding F of X values for A&B values. And F of X one and F of X two come from the remaining F of X values in our table. These are the Heights of our trapeziums.

We now have all the information we need to substitute into our formula, remembering to double our formula. Again, be careful when in putting this into your calculator. You can see that we end up with the approximate area as indicated in the question. These types of questions are great because you have you know what the correct answer is. If your answer doesn't agree with the answer given, go back and re enter the values into your calculator. If you still don't get the correct answer, consider the method you have used and if it is correct.

In the last part of the question we have a normal distribution with a mean of one hundred and a standard deviation of fifteen. We are being asked to find the probability of an IQ above one hundred and forty five. We're also being told to use the result from Part B. This gives us a hint about how to answer the question. From the previous question we know that the probability of being between three standard deviations either side of the mean is 0.9953. So how far does the score of one hundred and forty five sit above the mean?

Using Z scores, we can see that an IQ of one hundred and forty five is three standard deviations above the mean. If the whole area under the curve is equal to 1, this means that the probability of being outside of three standard deviations from the mean is 0.0047. But this is shared between each of the extremes of the graph. To find the probability of X greater than one hundred and forty five, or Z greater than three, we need to divide that probability in half. So the probability of X being greater than one hundred and forty five is 0.00235. Checking our answer, we know that for a normal distribution approximately, only 0.3 percent of scores will lie outside of three standard deviations from the mean. This means that only 0.15 percent of scores will be above three standard deviations of the mean. Our value of 0.235 percent is only slightly more than this, and given we estimated the area between minus three and three, it's a reasonable answer.

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