Today we're going to talk about finding the sum of an arithmetic sequence. An arithmetic sequence is just a set of numbers in numerical order with a common difference between each consecutive term. And if that arithmetic sequence is finite, meaning it has a limited number of values then we can find the sum of that sequence. We're going to go over a formula that you can use to find the sum and we'll do some examples using that formula.

So here's an example of a sequence. If we want to find the sum of the sequence, we're going to sum or add together each individual value or term in our sequence. And that's pretty inefficient especially if your sequence has a lot of terms in it. So there's a formula that we can use to more quickly find the sum of a sequence. And we're going to start by looking for a couple of patterns involved in finding the sum of this sequence and then use those patterns to develop the formula that we can use to more quickly find the sum of a sequence.

So the first thing that we're going to look at is if I add terms together in a particular way, specifically if I add the first term and the last term together-- 5 plus 30-- that's going to give me 35. If I then add the second and the fifth terms together-- 10 plus 25-- that's also going to give me 35. And then you might guess that if I add the third and the fourth term together-- 15 plus 20-- that's also going to give me 35.

So the first pattern that we see is that if you add together these pairs of numbers, they all are equal to the same as the sum of the first term plus the last term. If I wanted to find the sum of this entire sequence, I would simply add up the first term and the last term some number of times. And the way that we know how many times we're adding the sum of the first term and the last term is by noticing that I added each pair of numbers, the number of times that I added each pair of numbers was 3, which is the same as half of the number of terms I have.

So I've got 1, 2, 3, 4, 5, 6 terms and I added three pairs of numbers. So, again, this is half the number of times I added was half of the number of terms. So how do we use those two patterns to come up with our formula? So I know that, again, I added together my first term and my last term. And the number of times that I added my first term and my last term was equal to half of the number of terms I have in my sequence. So if my number of terms in my sequences is n then I added the sum of the first and the last term, n over 2 or n divided by 2 times.

So I'm going to multiply n over 2 by whatever the sum of my first and my last term are. This is what our formula becomes for finding the sum of a sequence. And we use s sub n to indicate the sum of the first n terms. And, again, we know that a1 is our first term. And an is our nth term. So let's use this formula to more quickly find the sum of a few different sequences.

So here's my first example. I'm going to use our formula to find s5 which is the sum of the first five terms in a sequence. So to use the formula, I need to know what my a1 value is, my first term, which is 102. My value for an,

which would be my fifth term, which would be 86, and a value for n, which is how many terms. And that's going to be five.

So using my formula, I will have 5 for n over 2 multiplied by in parentheses my a1 value, 102, plus my value for an, which is a5 or 86. Starting by adding in my parentheses 102 plus 86 is going to give me 188. 5 divided by 2 is going to give me 2.5 times 188. And when I multiply those together, I'm going to get 470 for my value of s5, which, again, is the sum of the first five terms in my sequence.

So here's my second example. I, again, want to find the sum of the first number of terms. In this case, we want to find the sum of the first 50 terms. And so my value for n is going to be 50. However, I also need to know my value for a1 and an. And although I can see that a1 is going to be 1, I don't know what an is, which would be a50. I only know the first five terms in my sequence. I don't know the 50th.

So right now I am not able to use my formula. So to figure out what an or a50 is going to be, I am going to use my formula for an arithmetic sequence, which is an is equal to a1 plus d times n minus 1. And to use this formula to figure out what my an or a50 is going to be, I need to know my first term, which I do. And I need to know the common difference, which is the numerical distance between any two consecutive terms.

To find that I'm going to work backwards and subtract. 1.01 minus 1 is going to give me 0.01. So in my formula, I can substitute 0.01 from my common difference or d. I know that n is going to be 50. And, again, I know that my first term is 1. And that's going to give me my 50th term in the sequence. So to find that I'm going to start by simplifying in my parentheses.

50 minus 1 is 49. 0.01 times 49 is going to give me 0.49 and when I add 1 to that, I see that my value for a50 is going to be equal to 1.49. So now that I know what my value for a50 is, I can use my formula to find the sum of the sequence, the sum of the first 50 terms of the sequence.

So here now I can have the sum of the first 50 terms is going to be equal to my value for n which is 50 over 2. My value for a1, which is 1, and my value which we just found for a50 which is 1.49. This should be a plus here. So starting in my parentheses, again, I'm going to add 1 plus 1.49, which would give me 2.49. 50 divided by 2 is going to give me 25. And 25 times 2.49 is going to give me 62.25, which will be the value of s50 or the sum of the first 50 terms in my sequence.

So we talked about the fact that when you want to find the sum of a sequence it's pretty inefficient to actually sum the values of each term. So instead, we saw how we can use a formula where n is the number of terms that you're summing, a1 is the first term, and an is the last or the nth term that you want to sum. And we did an example in which we didn't have the nth term so we saw that if your an or your nth term is not given, you can determine an

using this formula for an arithmetic sequence. Where here, a1 again is just your first term, d is your common difference, and n is the number of terms that you are summing.

So I hope that these notes and examples helped you understand a little bit more about finding the sum of an arithmetic sequence. Keep using your notes and keep on practicing and soon you'll be a pro. Thanks for watching.