Arithmetic sequence project pdf

Mathematical progressions are an integral part of any high school algebra curriculum, defined as any series of numbers that follow a pattern. Two common types of mathematical progressions taught in school are geometric progressions and arithmetic progressions. Different properties of arithmetic progressions can be incorporated into school projects. An arithmetic progression is any series of numbers in which each term has a constant difference with the preceding term. For example, "1,2,3..." is an arithmetic progression, because each term is one greater than the one preceding. To teach this to students, have them create arithmetic progressions given a common difference. Another activity is to have them identify which progressions are arithmetic and find the common difference between the terms. The most basic type of formula for any arithmetic progression is the recursive formula. In the recursive formula, a first term is specified as zero (0). The formula is "a(n+1) = a(n) + r," in which "r" is the common difference between subsequent terms. Basic projects that use the recursive formula include constructing the progression from a formula and constructing the formula from an arithmetic progression. This can be an expansion of the project from the previous section. The explicit formula for an arithmetic progression has the form "a(n) = a(1) + n*r," in which "a(n)" is the nth term (defined as any term in the arithmetic sequence) of the progression, "a(1)" is the first term, and "r" is the common difference. This formula can be easily changed into the recursive form and vice-versa. Have students practice constructing the explicit formula on the recursive formulas they obtained in the Section 2 project. To find the sum of an arithmetic sequence from "a(1)" to "a(n)" with common difference "r," plug the following into the formula: "n(n+1)/2 + r(n)(n-1)/2 + (a(1)-1)*n." Have students use the formula to sum the series of consecutive terms of an arithmetic progression and check their answer with the sum obtained just by adding the terms. Have them compile this with the other activities in Sections 1 to 3 to create their very own project on arithmetic progressions. 1. Arithmetic Sequences 2. Every day a radio station asks a question for a prize of $150. If the 5th caller does not answer correctly, the prize money increased by $150 each day until someone correctly answers their question. 3. Make a list of the prize amounts for a week (Mon - Fri) if the contest starts on Monday and no one answers correctly all week. 4. Monday : $150 Tuesday: $300 Wednesday: $450 Thursday: $600 Friday: $750 5. These prize amounts form a sequence, more specifically each amount is a term in an arithmetic sequence. To find the next term we just add $150. 6. Sequence: a list of numbers in a specific order. Term: each number in a sequence 7. Arithmetic Sequence: a sequence in which each term after the first term is found by adding a constant, called the common difference (d), to the previous term. 8. 150, 300, 450, 600, 750… The first term of our sequence is 150, we denote the first term as a1. What is a2? a2 : 300 (a2 represents the 2nd term in our sequence) 9. a3 = ? a4 = ? a5 = ? a3 : 450 a4 : 600 a5 : 750 an represents a general term (nth term) where n can be any number. 10. Sequences can continue forever. We can calculate as many terms as we want as long as we know the common difference in the sequence. 11. Find the next three terms in the sequence: 2, 5, 8, 11, 14, __, __, __ 2, 5, 8, 11, 14, 17, 20, 23 The common difference is? 3!!! 12. To find the common difference (d), just subtract any term from the term that follows it. FYI: Common differences can be negative. 13. What if I wanted to find the 50th (a50) term of the sequence 2, 5, 8, 11, 14, …? Do I really want to add 3 continually until I get there? There is a formula for finding the nth term. 14. Let's see if we can figure the formula out on our own. a1 = 2, to get a2 I just add 3 once. To get a3 I add 3 to a1 twice. To get a4 I add 3 to a1 three times. 15. What is the relationship between the term we are finding and the number of times I have to add d? The number of times I had to add is one less then the term I am looking for. 16. So if I wanted to find a50 then how many times would I have to add 3? 49 If I wanted to find a193 how many times would I add 3? 192 17. So to find a50 I need to take d, which is 3, and add it to my a1, which is 2, 49 times. That's a lot of adding. But if we think back to elementary school, repetitive adding is just multiplication. 18. 3 + 3 + 3 + 3 + 3 = 15 We added five terms of three, that is the same as multiplying 5 and 3. So to add three forty-nine times we just multiply 3 and 49. 19. So back to our formula, to find a50 we start with 2 (a1) and add 3•49. (3 is d and 49 is one less than the term we are looking for) So… a50 = 2 + 3(49) = 149 20. a50 = 2 + 3(49) using this formula we can create a general formula. a50 will become an so we can use it for any term. 2 is our a1 and 3 is our d. 21. a50 = 2 + 3(49) 49 is one less than the term we are looking for. So if I am using n as the term I am looking for, I multiply d by n - 1. 22. Thus my formula for finding any term in an arithmetic sequence is an = a1 + d(n-1). All you need to know to find any term is the first term in the sequence (a1) and the common difference. 23. Let's go back to our first example about the radio contest. Suppose no one correctly answered the question for 15 days. What would the prize be on day 16? 24. an = a1 + d(n-1) We want to find a16. What is a1? What is d? What is n-1? a1 = 150, d = 150, n -1 = 16 - 1 = 15 So a16 = 150 + 150(15) = $2400 25. 17, 10, 3, -4, -11, -18, … What is the common difference? Subtract any term from the term after it. -4 - 3 = -7 d = - 7 26. 17, 10, 3, -4, -11, -18, … Arithmetic Means: the terms between any two nonconsecutive terms of an arithmetic sequence. 27. 17, 10, 3, -4, -11, -18, … Between 10 and -18 there are three arithmetic means 3, -4, -11. Find three arithmetic means between 8 and 14. 28. So our sequence must look like 8, __, __, __, 14. In order to find the means we need to know the common difference. We can use our formula to find it. 29. 8, __, __, __, 14 a1 = 8, a5 = 14, & n = 5 14 = 8 + d(5 - 1) 14 = 8 + d(4) subtract 8 6 = 4d divide by 4 1.5 = d 30. 8, __, __, __, 14 so to find our means we just add 1.5 starting with 8. 8, 9.5, 11, 12.5, 14 31. 72 is the __ term of the sequence -5, 2, 9, … We need to find 'n' which is the term number. 72 is an, -5 is a1, and 7 is d. Plug it in. 32. 72 = -5 + 7(n - 1) 72 = -5 + 7n - 7 72 = -12 + 7n 84 = 7n n = 12 72 is the 12th term. 33. Arithmetic Series 34. The African-American celebration of Kwanzaa involves the lighting of candles every night for seven nights. The first night one candle is lit and blown out. 35. The second night a new candle and the candle from the first night are lit and blown out. The third night a new candle and the two candles from the second night are lit and blown out. 36. This process continues for the seven nights. We want to know the total number of lightings during the seven nights of celebration. 37. The first night one candle was lit, the 2nd night two candles were lit, the 3rd night 3 candles were lit, etc. So to find the total number of lightings we would add: 1 + 2 + 3 + 4 + 5 + 6 + 7 38. 1 + 2 + 3 + 4 + 5 + 6 + 7 = 28 Series: the sum of the terms in a sequence. Arithmetic Series: the sum of the terms in an arithmetic sequence. 39. Arithmetic sequence: 2, 4, 6, 8, 10 Corresponding arithmetic series: 2 + 4 + 6 + 8 + 10 Arithmetic Sequence: -8, -3, 2, 7 Arithmetic Series: -8 + -3 + 2 + 7 40. Sn is the symbol used to represent the first 'n' terms of a series. Given the sequence 1, 11, 21, 31, 41, 51, 61, 71, … find S4 We add the first four terms 1 + 11 + 21 + 31 = 64 41. Find S8 of the arithmetic sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, … 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 = 36 42. What if we wanted to find S100 for the sequence in the last example. It would be a pain to have to list all the terms and try to add them up. Let's figure out a formula!! :) 43. Let's find S7 of the sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, … If we add S7 in too different orders we get: S7 = 1 + 2 + 3 + 4 + 5 + 6 + 7 S7 = 7 + 6 + 5 + 4 + 3 + 2 + 1 2S7 = 8 + 8 + 8 + 8 + 8 + 8 + 8 44. S7 = 1 + 2 + 3 + 4 + 5 + 6 + 7 S7 = 7 + 6 + 5 + 4 + 3 + 2 + 1 2S7 = 8 + 8 + 8 + 8 + 8 + 8 + 8 2S7 = 7(8) S7 =7 /2(8) 7 sums of 8 45. S7 =7 /2(8) What do these numbers mean? 7 is n, 8 is the sum of the first and last term (a1 + an) So Sn = n /2(a1 + an) 46. Sn = n /2(a1 + an) Find the sum of the first 10 terms of the arithmetic series with a1 = 6 and a10 =51 S10 = 10/2(6 + 51) = 5(57) = 285 47. Find the sum of the first 50 terms of an arithmetic series with a1 = 28 and d = -4 We need to know n, a1, and a50. n= 50, a1 = 28, a50 = ?? We have to find it. 48. a50 = 28 + -4(50 - 1) = 28 + -4(49) = 28 + -196 = -168 So n = 50, a1 = 28, & an =-168 S50 = (50/2)(28 + -168) = 25(-140) = -3500 49. To write out a series and compute a sum can sometimes be very tedious. Mathematicians often use the greek letter sigma & summation notation to simplify this task. 50. This means to find the sum of the sums n + 1 where we plug in the values 1 - 5 for n n + 1 n = 1 5 ! last value of n First value of n formula used to find sequence 51. Basically we want to find (1 + 1) + (2 + 1) + (3 + 1) + (4 + 1) + (5 + 1) = 2 + 3 + 4 + 5 + 6 = 20 n + 1 n = 1 5 ! 52. So Try: First we need to plug in the numbers 2 - 7 for x. n + 1 = 20 n = 1 5 ! 3x - 2 x = 2 7 ! 53. [3(2)-2]+[3(3)-2]+[3(4)-2]+ [3(5)-2]+[3(6)-2]+[3(7)-2] = (6-2)+(9-2)+(12-2)+(15-2)+ (18-2)+ (21-2) = 4 + 7 + 10 + 13 + 17 + 19 = 70 3x - 2 x = 2 7 ! 54. Geometric Sequences 55. What if your pay check started at $100 a week and doubled every week. What would your salary be after four weeks? 56. Starting $100. After one week - $200 After two weeks - $400 After three weeks - $800 After four weeks - $1600. These values form a geometric sequence. 57. Geometric Sequence: a sequence in which each term after the first is found by multiplying the previous term by a constant value called the common ratio. 58. Find the first five terms of the geometric sequence with a1 = -3 and common ratio (r) of 5. -3, -15, -75, -375, -1875 59. Find the common ratio of the sequence 2, -4, 8, -16, 32, … To find the common ratio, divide any term by the previous term. 8 ÷ -4 = -2 r = -2 60. Just like arithmetic sequences, there is a formula for finding any given term in a geometric sequence. Let's figure it out using the pay check example. 61. To find the 5th term we look 100 and multiplied it by two four times. Repeated multiplication is represented using exponents. 62. Basically we will take $100 and multiply it by 24 a5 = 100•24 = 1600 A5 is the term we are looking for, 100 was our a1, 2 is our common ratio, and 4 is n-1. 63. Thus our formula for finding any term of a geometric sequence is an = a1•rn-1 Find the 10th term of the geometric sequence with a1 = 2000 and a common ratio of 1 /2. 64. a10 = 2000• (1 /2)9 = 2000 • 1 /512 = 2000 /512 = 500 /128 = 250 /64 = 125 /32 Find the next two terms in the sequence -64, -16, -4 … 65. -64, -16, -4, __, __ We need to find the common ratio so we divide any term by the previous term. -16/-64 = 1/4 So we multiply by 1/4 to find the next two terms. 66. Just like with arithmetic sequences, the missing terms between two nonconsecutive terms in a geometric sequence are called geometric means. 67. Looking at the geometric sequence 3, 12, 48, 192, 768 the geometric means between 3 and 768 are 12, 48, and 192. Find two geometric means between -5 and 625. 68. -5, __, __, 625 We need to know the common ratio. Since we only know nonconsecutive terms we will have to use the formula and work backwards. 69. -5, __, __, 625 625 is a4, -5 is a1. 625 = -5•r4-1 divide by -5 -125 = r3 take the cube root of both sides -5 = r 70. -5, __, __, 625 Now we just need to multiply by -5 to find the means. -5 • -5 = 25 -5, 25, __, 625 25 • -5 = -125 -5, 25, -125, 625 71. Geometric Series 72. Geometric Series - the sum of the terms of a geometric sequence. Geo. Sequence: 1, 3, 9, 27, 81 Geo. Series: 1+3 + 9 + 27 + 8.What is the sum of the geometric series? 73. 1 + 3 + 9 + 27 + 81 = 121 The formula for the sum Sn of the first n terms of a geometric series is given by Sn= 1 - r a1- a1rn or Sn= 1 - r a1(1 - rn) 74. Find You can actually do it two ways. Let's use the old way. Plug in the numbers 1 - 4 for n and add. [-3(2)1-1]+[-3(2)2-1]+[-3(2)3-1]+[- 3(2)4-1] - 3 (2)n - 1 n = 1 4 ! 75. [-3(1)] + [-3(2)] + [-3(4)] + [-3(8)] = -3 + -6 + -12 + -24 = -45 The other method is to use the sum of geometric series formula. 76. use a1 = -3, r = 2, n = Sn= 1 - r a1(1 - rn) - 3 (2)n - 1 n = 1 4 ! 77. Sn= 1 - r a1(1 - rn) - 3 (2)n - 1 n = 1 4 ! S4= 1 - 2 - 3 (1 - 24) 78. S4= 1 - 2 - 3 (1 - 24) S4= - 1 - 3 (1 - 16) S4= - 1 - 3 (- 15) = - 1 45 =- 45

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