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Solutions published January 25, 2017, 9:47 AM by Sydney B Riemann amounts are a way to estimate an area using rectangles. There are three different methods for these problems - using left endpoints, endpoints on the right, or midpoints. To perform these problems, add the values in the interval and multiply them by the distance between points. published January 22, 2017, 10:26 am from Sydney B x11.1 1.21.31.4f(x)810121314.5Use the middle point of Riemann's sum with two subintervals of the same length and values from the table on approximately published January 22, 2017, 9:53 Sydney from Sydney posted B Jan 22, 2017, 9:38 a.m. from Sydney B [updated Jan 22, 2017, 10:18] t(seconds) 01020304050607080v(t)(tracks per second) 51422293540444749Rocket A has a positive speed afterwards , what was dropped up from an initial height of 0 feet at a time of t = 0 seconds. The speed of the rocket shall be recorded for the selected values t at an integral value of 0s t ≤ 80 seconds, as shown in the table above.1. Use Riemann's totals with 3 subintervals of the same length for approximate published January 22, 2017, 9:09 a.m. by Sydney B [updated January 22, 2017, 9:53 AM] published Jan 22, 2017, 8:52 AM by Sydney B [updated Jan 22, 2017, 8:53 AM] Right Reimann SumLeft Reimann Approximate sum area below curve with rectangular approximation method. Enter f(x), change the limits x1 and x2, and then select right-handed, left-handed, or medium rectangular approximation. To adjust the number of rectangles, change n. Page 2 Integration is the best way to find an area from curve to axis: we get a formula for an accurate response. But integration can sometimes be hard or impossible to do! But don't worry, because we can add up a lot of slices to get an approximate answer. Here we go! Examples Let's use f(x) = ln(x) from x = 1 to x = 4 Actually we can integrate that and get a real answer 2.5451774447956.... But imagine that we can not, and all we can do is calculate the values ln(x): at x = 1: ln(1) = 0 when x = 2: ln(2) = 0.693147... etc. Let's use the width of the cut 1 to make it easy to see what is happening (but smaller slices are better). And there are several different methods that we can use: Left Rectangular Aproximation Method (LRAM) This method uses rectangles whose height is the value of the leftmost. Areas are: x=1 to 2: ln(1) × 1 = 0 × 1 = 0 x=2 to 3: ln(2) × 1 = 0.693147... × 1 = 0.693147... x=3 to 4: ln(3) × 1 = 1.098612... × 1 = 1.098612... Adding these up gets 1.791759, much lower than 2.545177. Why? Because we're missing all the area between the tops of the rectangles and the curves. This is made worse by the curve, which is constantly increasing. When the curve goes up and down more, the error is usually smaller. The rectangular approximation method (RRAM) now calculates the height of the rectangle using the rightmost value. Areas are: x=1 to 2: ln(2) × 1 = 0.693147... × 1 = x=2 to 3: ln(3) × 1 = 1.098612... × 1 = 1.098612... x=3 to 4: ln(4) × 1 = 1.386294... × 1 = 1.386294... Adding these up gets 3.178054, which is now much higher than 2.545177 because we have included areas between rectangles and curves. Midpoint Rectangular Approximation Method (MRAM) We can also use the center point! Areas are: x=1 to 2: ln(1.5) × 1 = 0.405465... × 1 = 0.405465... x=2 to 3: ln(2.5) × 1 = 1 = 5 0.916291... × 1 = 0.916291... x=3 to 4: LN(3.5) × 1 = 1.252763... × 1 = 1.252763... Adding these up gets 2.574519..., which is pretty close to 2.545177. Trapezoidal rule We can use both sides for the triangular effect at the top, which usually makes trapezoids. The calculation only averages the values left and right. Areas are: x=1 to 2: ln(1) + ln(2) 2 × 1 = 0 + 0.693147...2 × 1 = 0.346573... x=2 to 3: ln(2) + ln(3)2 × 1 = 0.693147 ... + 1.098612...2 × 1 = 0.895879... x=3 to 4: ln(3) + ln(4)2 × 1 = 1.098612... + 1.386294...2 × 1 = 1.242453... Adding these up gets 2.484907, which is still slightly lower than 2.545177, mainly because the curve is concaving down in the interval. Note that in practice each value is used twice (except the first and last) and then the whole amount is broken down by 2: ln(1) + ln(2) 2 × 1 + ln(2) + ln(3) 2 × 1 + ln(3) + ln(4) 2 × 1 1 1 2 × (ln(1) + ln(2) + ln(2) + ln(3) + ln(4) 1 2 × (ln(1) + 2 ln(2) + 2 ln(3) + ln(4)) So we can have a general formula : Δx 2 × (f(x0) + 2f(x1) + 2f(x2) + ... 2f(xn-1) + f(xn)) By the way, this method is only the average of left-wing and right methods: Trapezoidal approximation = LRAM + RRAM 2 Note: previous methods 4 are also called Riemann sums after mathematician Bernhard Riemann. Simpson's Rule Of Improving the Trapezoid Rule is Simpson's rule. It is based on the use of a dish at the top instead of a straight line. Parabolas often get pretty close to the actual curve: It sounds hard, but we end up with a formula like trapezoidal formula (but we break down 3 and use the formula 4,2,4,2,4): Δx 3 × (f(x0) + 4f (x1) + 2f (x2) + 4f(xn-1) + f(xn)) But: n must be even. So let's take 6 slices 0.5 each: 0.5 3 × (f(1) + 4f (1.5) + 2f (2) + 4f (2.5) + 2f(3) + 4f(3.5) + f(4)) Wiring ln(1) etc gives: 0.5 3 × (15.2679...) 2.544648..., that's a great result compared to 2.545177.... Plus and Minus When the curve is below the line, the integral value is negative! So we get net worth. If we want the total area (let's say we wanted to paint it), we can use the absolute value of the abs(). Or manually find where the curve interseachs the isline, and then work out separate integrals and reverse the negatives before adding them. Error and accuracy Compare them all: f(x)=ln(x) N = 3 N = 6 N = 100 Estimate error Estimate error LRAM 1.791759 0.753418 2.183140 0.362037 0.020850 RRAM 3.178054 - 0.632877 2.876287 -0.331110 2.565916 -0 .020739 MRAM 2.574519 -0.029342 2.552851 -0.007674 2.545206 -0 .000029 Trapezoidal Rule 2.484907 0.060271 2.529713 0.015464 2.545121 (1) 0.000055 Simpson Rule (N Must Be Even) 2.544648 0.000529 2.545177 <0.000001 Simpson Rule Rules! And it's just as easy to use as the others. Of course, another feature will bring different results. Why not try it yourself? Maximum error In practice, we will not know the real answer ... So how do we know how good our estimate is? You can get a good feeling by trying different widths of the cut. And there are also these formulas for maximum error approximation (these are for the worst case and the actual error will hopefully be much smaller): For Midpoint: | E | = K(b-a)3 24n2 For trapezoidal: | E | = K(b-a)3 12n2 For Simpson: | E | = M(b-a)5 180n4 If: | E | is the absolute value of the maximum error (can be plus or minus) and is the beginning of interval b is the end of the interval n is the number of slices K is the largest second derivative in the interval. M is the largest fourth derivation in the interval. (The biggest thing we mean is maximum absolute value.) a, b and n are easy, but how do we find K and M ? We'll find some derivatives first. we will need them: 1. derivation: f'(x) = 1/x 2. derivative: f'(x) = -1/x2 3. derivative: f(3)(x) = 2/x3 4. derivative: f(4)(x) = -6/x4 5. derivation: f(5)(x) = 24/x5 The largest K can be at the beginning, end or somewhere between: Start: f'(1) = -1/12 = -1 End: f'(4) = -1/42 = -1/16 Mean: use the third derivation to see if there are zeros in the interval 1 to 4, which could indicate a change of direction. Does f(3)(x) = 0 between 1 and 4? Cha So the maximum is at the beginning or the end. So K = 1 (maximum absolute value) Same for M but higher derivatives: Start: f(4)(1) = -6/14 = -6 End: f(4)(4) = -6/44 = -6/256 Mean: use 5. Does f(5)(x) = 24/x5 equal zero between 1 and 4? Cha So M = 6 (maximum absolute value) For only 6 slices are the maximum errors: Midpoint: | E | = 1(4-1)3 24×62 = 0.03125 trapezoid: | E | = 1(4-1)3 12×62 = 0.0625 Simpsons: | E | = 6(4-1)5 180×64 = 0.00625 Shapes that we know, the curve can have the shape we know, and we can use geometric formulas such as the following examples: f(x) = 2 - x, from 0 to 2 A = 1/2 × 2 × 2 = 2 f(x) = 2, from 0 to 3 A = 2 × 3 = 6 f(x) = √(1 - x2), from -1 to +1 A = π r2 / 2 = π / 2 Conclusion We can estimate the conclusion We can estimate the conclusion area below Curve slicing function up There are many ways to find the area of each slice, such as: Left Rectangular Aproximation Method (LRAM) Right Rectangular Aproximation Method (RRAM) Midpoint Rectangular Aproximation Method (MRAM) Simpson Rule Trapezoid rule We can use error formulas to find the largest error rule to find the largest error method to find the biggest error patterns error in our estimate Basic geometric patterns can sometimes help us find areas under the Copyright © 2018 MathsIsFun.com MathsIsFun.com

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