Area Under Curves and Volume of Revolving a Curve

by idlecool

Problem Submissions Leaderboard Discussions

Definite Integrals via Numerical Methods

This relates to definite integration via numerical methods.

Consider the algebraic expression given by:

$(a_1)x^{b_1} + (a_2)x^{b_2} + (a_3)x^{b_3} \ldots\ldots (a_n)x^{b_n}$

For the purpose of numerical computation, the area under the curve $y = f(x)$ between the limits a and b can be computed by the Limit Definition of a Definite Integral.

Here is some background about **areas and volume computation**.

Using equal subintervals of length $= 0.001$, you need to:

1. Evaluate the area bounded by a given polynomial function of the kind described above, between the given limits of L and R.

2. Evaluate the volume of the solid obtained by revolving this polynomial curve around the x-axis.

An absolute error margin of 0.02 will be tolerated.

Input Format

The first line contains N integers separated by spaces, which are the values of $a_1, a_2 \ldots a_N$.
The second line contains N integers separated by spaces, which are the values of $b_1, b_2 \ldots b_N$.
The third line contains two space separated integers, L and R, the lower and upper range limits in which the integration needs to be performed, respectively.

Constraints

$-1000 <= a <= 1000$
$-20 <= b <= 20$
$1 <= L < R <= 20$

Output Format

The first line should contain the area between the curve and the x-axis, bound between the specified limits.
The second line should contain the volume of the solid obtained by rotating the curve around the x-axis, between the specified limits.

Sample Input

```
1 2 3 4 5
6 7 8 9 10
1 4
```

Explanation

The algebraic expression represented by:

$(1)x^6+(2)x^7+(3)x^8+(4)x^9+(5)x^{10}$

We need to find the area of the curve enclosed under this curve, between the limits $x = 1$ and 4. We also need to find the volume of the solid formed by revolving this curve around the x-axis between the limits $x = 1$ and 4.

Sample Output

```
2435300.3
26172951168940.8
```

Scoring

All test cases are weighted equally. You need to clear all the tests in a test case.

Solved score: 30.00pts

Submissions: 2969
Max Score: 30
Difficulty: Easy

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Current Buffer (saved locally, editable) Racket

```
#lang racket
(require racket/format)

(define (f coef deg x)
  (if (eq? coef '()) 0 (+ (* (car coef) (expt x (car deg)))
                          (f (cdr coef) (cdr deg) x))))

(define (circle-area x)
  (* pi (sqr x)))

(define (integrate-iter f lb ub steps i acc)
  (define dx (/ (- ub lb) steps))
  (if (> i steps)
      (* dx acc)
      (integrate-iter
       f lb ub steps (+ i 1)
       (+ acc
          (f (+ lb (* dx i)))))))

(define (integrate f lb ub)
  (integrate-iter f lb ub 10000.0 0 0))

(define (area f lb ub)
  (integrate f lb ub))

(define (volume f lb ub)
  (integrate (lambda (x) (circle-area (f x))) lb ub))

(define (main coef deg lb ub)
  (displayln (~r (integrate (lambda (x) (f coef deg x)) lb ub) #:precision '(= 1)))
  (displayln (~r (volume (lambda (x) (f coef deg x)) lb ub) #:precision '(= 1))))

(define coef (map string->number (string-split (read-line) " ")))
(define deg (map string->number (string-split (read-line) " ")))
(define lb (read))
(define ub (read))

(main coef deg lb ub)
```

Line: 1 Col: 1

Upload Code as File Test against custom input Run Code Submit Code