

UNIVERSITY OF ILLINOIS
DIGITAL COMPUTER

LIBRARY ROUTINE E 3 - 186

TITLE: Integration by Simpson's Rule (Function Values)
(SADOI or DOI)

TYPE: Closed

NUMBER OF WORDS: 38

TEMPORARY STORAGE: Location 0

ACCURACY: $+ 2^{-39}$ + truncation error

DURATION: $3 + (4 + d)n$ milliseconds where d is the number of milliseconds required to evaluate f with the auxiliary routine.

DESCRIPTION: This routine computes $\frac{1}{b-a} \int_a^b f(x)dx$ by using the approximation

$$\frac{1}{b-a} \int_a^b f(x)dx \approx \frac{1}{3n} (f_0 + 4f_1 + 2f_2 + \dots + f_n)$$

where $f_i = f\left(\frac{[b-a]}{n} i + a\right)$ is the value of $f(x)$

calculated by an auxiliary routine at an odd number $n + 1$ of equally spaced points $a + \frac{b-a}{n} i$, $i = 0, 1, 2, \dots, n$, where $b > a$.

ENTRY: Place a in location 0 and b in A and enter with

q	50 pF
	50 qF
q + 1	26 --
	00 nF

where p is the location of the closed auxiliary subroutine which calculates $f(x)$.


AUXILIARY SUBROUTINE: The auxiliary subroutine placed at p must be a closed routine which takes x from A and places $f(x)$ in A.

RESULT: Control is returned to the left side of $q + 2$ with the result in A and Q.

NOTE: If $f(x)$ is tabulated use Library Routine E 2.

DATE June 2, 1955 RT: 6/17/60
 CODED BY L. Isaacson
 APPROVED BY J. P. Nash

LOCATION	ORDER		NOTES	PAGE 1
0	00 K(E3) L0 F 40 31L		b - a	
1	L5 F 40 32L		Store a	
2	41 33L K5 6F		Clear counter	
3	42 5L L4 28L		Plant q + 1	
4	42 27L 46 10L		Plant link	
5	46 18L L5 ()F			
6	L0 30L 40 35L		n	
7	L4 35L L4 35L			
8	40 34L 41 36L		3n	
9	L5 32L 50 9L			
10	26 ()F 40 37L		p	
11	F5 33L 40 33L		Step m	
12	F0 35L 32 24L		Test (m + 1 - n)	
13	50 31L 75 33L			
14	10 1F 32 15L			
15	L4 33L 66 35L			
16	S5 F S4 F			

LOCATION	ORDER	NOTES	PAGE 2
17	L4 32L 50 17L	$a + \frac{m}{n} (b - a)$	
18	26 ()F 40 F		
19	50 29L L5 37L		
20	74 F L4 36L		
21	40 36L S5 F		
22	40 37L L5 2L		
23	L0 29L 42 29L	 Binary switch	
24	26 11L 50 F		
25	L5 37L 70 28L		
26	L4 36L 66 34L		
27	S5 F 26 ()F	Link	
28	00 F 00 1F		
29	00 F 00 4F		
30	26 L 00 F		
31	00 F 00 F	b - a	
32	00 F 00 F	a	
33	00 F 00 F	m	

LOCATION	ORDER	NOTES	PAGE 3
34	00 F		
	00 F		
35	00 F		
	00 F		
36	00 F		
	00 F		
37	00 F		
	00 F	f(x)	