UNIVERSITY OF ILLINOIS

DIGITAL COMPUTER

LIBRARY ROUTINE K 10 - 191

TITLE Calculate Autocorrelation of a Time Series

TYPE Closed with four program parameters

NUMBER OF WORDS 85 - total

68 - main routine

8 - constants at S3

9 - Library Routine R 1 at SJ

TEMPORARY STORAGE 0, 1, 2, 3

ACCURACY Maximum error is 2^{-38} for the individual R_k values.

DURATION Approximately (3.5) (kN) milliseconds

DESCRIPTION If a set of fractions or integers $x_1, x_2, \ldots, x_i, \ldots, x_n$ are stored at locations $y_1, y_2, \ldots, y_i, \ldots y_n$ in the form $0 \leq |x_i| \leq 10^4 \times 2^{-39}$, this program computes

$$R_k = \frac{\overline{x_i \cdot x_{i+k}} - \overline{x_i} \cdot \overline{x_{i+k}}}{\sigma_i \cdot \sigma_{i+k}} \qquad \begin{matrix} k = 0, 1, 2, \ldots, m' \\ i = 1, 2, \ldots, N-k \end{matrix}$$

$$\text{where } \sigma_i = \sqrt{\overline{x_i^2} - \overline{x_i}^2}$$

and stores $R_{k/2}$ in locations $z_1, z_2, \ldots, z_i, \ldots, z_{m'}$. When the main routine is located at t the routine is entered by

p	50 pF
p+1	26 tF

with y_1 in location 0

m' in location 1

N in location 7S3

z_1 in A

RESTRICTION $m' < N/4$

REMARKS If $(R_k)/2$ is not the form of storage desired, the values δR_k may be stored by changing word 61 relative from S5 F 40F to 75 68L 40 F and storing the value 2δ as a fraction in relative location 68.

DATE 7/13/55 RT: 9/13/58

CODED BY L. Augenstein

APPROVED BY J. P. Nash

LOCATION	ORDER		NOTES PAGE 1
0	42 61L		
	F4 1F		
1	42 6S3		
	K5 F		
2	42 67L		Set subroutine parameters
	L5 F		
3	42 1L		
	42 8L		
4	42 10L		
	L4 7S3		
5	42 5S3		
	41 3F		
6	41 1S3		
	41 2S3		
7	41 3S3		
	41 4S3		
8	41 S3		
	L5 F		Put x_i in location 0 and form Σx_i
9	40 F		
	L4 S3		
10	40 S3		
	L5 F		
11	40 1F		
	L4 1S3		
12	40 1S3		
	50 F		
13	75 1F		Form $\Sigma x_i \cdot x_{i+k}$
	S5 F		
14	L4 2S3		
	40 2S3		
15	50 F		Form Σx_i^2
	75 F		
16	L5 3S3		
	S4 F		

LOCATION	ORDER		NOTES PAGE 2
17	40 3S3		
	50 1F		
18	75 1F		Form Σx_{i+k}^2
	S5 F		
19	L4 4S3		
	40 4S3		
20	F5 8L		Step and test i and i+k
	42 8L		
21	F5 10L		
	42 10L		
22	L0 5S3		
	32 8L		
23	L3 3F		Test for k = 0
	32 24L		
24	22 32L		
	L5 7S3		
25	40 F		
	50 3F		Scale N to N x $2^{2n} \geq 4 \Sigma x_i^2$
26	F5 3F		
	42 3F		
27	L5 F		
	00 2F		
28	40 F		
	L0 3S3		
29	32 30L		
	26 26L		
30	00 F		Set n shifts
	F5 3F		
31	42 34L		
	42 33L		
32	41 3F		
	L5 7S3		
33	L0 3F		(N - k) (2^n) in location 0
	00 F		
34	40 F		(N - k) (2^{2n}) in location 1
	00 F		

LOCATION	ORDER		NOTES PAGE 3
35	40 1F		$(\overline{x_i})\ 2^{-n}$ in S3
	50 S3		
36	S5 F		
	66 F		
37	S5 F		
	40 S3		
38	50 1S3		
	S5 F		
39	66 F		$(\overline{x_{i+k}})\ 2^{-n}$ in 1S3
	S5 F		
40	40 1S3		
	50 2S3		$(\overline{x_i \cdot x_{i+k}})\ 2^{-2n}$ in 2S3
41	S5 F		
	66 1F		
42	S5 F		
	40 2S3		
43	50 3S3		
	S5 F		
44	66 1F		$(\overline{x_i^2})\ (2^{-2n})$ in 3S3
	S5 F		
45	40 3S3		$(\overline{x_{i+k}^2})\ (2^{-2n})$ in 4S3
	50 4S3		
46	S5 F		
	66 1F		
47	S5 F		
	40 4S3		
48	50 S3		
	71 1S3		
49	L4 2S3		Numerator x 2^{-2n} in 2S3
	40 2S3		
50	50 S3		
	71 S3		
51	L4 3S3		σ_i in S3
	00 1F		
52	22 52L		
	50 52L		

LOCATION	ORDER	NOTES PAGE 4
53	26 SJ	
	40 S3	
54	50 1S3	
	71 1S3	
55	L4 4S3	
	00 1F	$(\sigma_{i+k})\ (2^{-n+1/2})$ in A
56	22 56L	
	50 56L	
57	26 SJ	
	50 S3	
58	40 1F	$2\sigma^2\ (2^{-2n})$ in location 1
	75 1F	
59	40 1F	
	50 2S3	
60	S5 F	Store $R_{k/2}$ in 3k
	66 1F	
61	S5 F	
	40 F	
62	F5 3F	Step k
	42 3F	
63	L5 1L	
	42 8L	
64	L4 3F	Reset loops and test
	42 10L	
65	F5 61L	
	42 61L	
66	L0 6S3	
	36 6L	
67	22 67L	
	22 F	Exit
	00 (S3)K	
	00 F	
	00 F	
	00 F	
	00 F	

LOCATION	ORDER	NOTES	PAGE 5
	00 F		
	00 F		
	00 F		
	00 F		
	00 F	— Constants and storage	
	00 F		
	NO 83		
	L5 F		
	35 F		
	40 F		
	00 F		
	00 F		
	00 (SJ)K		
	Routine R 1 - 116	Square Root Routine	

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