

RECOMP II USERS' PROGRAM NO. 1063

PROGRAM TITLE: AUTOCORRELATION

PROGRAM CLASSIFICATION: General

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PURPOSE: The purpose of this program is to provide a fast and accurate method of determining autocorrelation coefficients, autocovariance coefficients, and the average lagged product function.

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I. INTRODUCTION

For a given set of evenly spaced points  $x_i$  there exists for each  $x$  a function of  $x$  which we will call  $u(x)$ .

To calculate the autocorrelation coefficients, A-C, of the set  $u(x)$  we have the expression:

$$(A-C)_k = \frac{\frac{1}{n-k} \sum_{i=1}^{n-k} u_i \cdot u_{i+k} - \left( \frac{1}{n-k} \sum_{i=1}^{n-k} u_i \right) \left( \frac{1}{n-k} \sum_{i=1}^{n-k} u_{i+k} \right)}{\left[ \frac{1}{n-k} \sum_{i=1}^{n-k} u_i^2 - \left( \frac{1}{n-k} \sum_{i=1}^{n-k} u_i \right)^2 \right]^{\frac{1}{2}} \left[ \frac{1}{n-k} \sum_{i=1}^{n-k} u_{i+k}^2 - \left( \frac{1}{n-k} \sum_{i=1}^{n-k} u_{i+k} \right)^2 \right]^{\frac{1}{2}}}$$

To calculate the autocovariance coefficients R of the set  $u(x)$  we use the expression:

$$R_k = \frac{1}{n-k} \sum_{i=1}^{n-k} u_i \cdot u_{i+k}$$

To calculate the average lagged product function we use the expression:

$$A_k = \frac{1}{n-k} \sum_{i=1}^{n-k} u_i \cdot u_{i+k} - \left( \frac{1}{n-k} \sum_{i=1}^{n-k} u_i \right) \left( \frac{1}{n-k} \sum_{i=1}^{n-k} u_{i+k} \right)$$

$n$  = number of points in set  $u(x)$

$k$  = input parameter which may vary from 0 to  $\frac{n}{2} + 1$

II. RESTRICTIONS

A. The set  $u(x)$  may have a maximum of 320 points.

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III. USAGE

A. Computer Set-up

There are no special settings of any of the switches or output devices.

B. Data Preparation

The inputs required are

1. The number of points in  $u_i = n$
2. The input parameter  $k$
3. The set of  $u_i$  points which are entered in mixed decimal format, i.e., the number must consist of sign, integral value, decimal point, fractional value, enter code. The data may be prepared on the versatape unit or any unit that would prepare the tape in the proper format.
4. Operating Instructions
  - a. Enter program tape through photoreader
  - b. Push start #1 to set up L 0476
  - c. Enter  $k$  on the console as an integer, i.e.,
    - (1) N key
    - (2) + key
    - (3) Value of  $k$ , decimal point
    - (4) Clear key
  - d. Enter  $n$  on the console in the same manner.
  - e. Location counter will be set to L 0500. Enter the values for  $u_i$  in the following manner
    - (1) N key
    - (2) Sign ( $\pm$ )
    - (3) Integral value

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- (4) Decimal point
- (5) Fractional value (if none, put zero)
- (6) Enter key
  
- f. When all values have been entered push Start #2 for computations, answers will follow.
- g. To re-run the problem start with Step 4 b.
- h. If it is desired to use the same  $u(x)$  values but a different value of  $k$ , then put sense switch B on and follow the instructions except omit entering values for  $n$  and  $u(x)$ .

5. Coding information

- a. Locations of program            0000 - 0250
- Input data                            0476 - 1500
- Output subroutine                7000 - 7155
- Floating subroutine              6700 - 6742
- Special subroutine #1 \*        7500 - 7577
- Special subroutine #2            7600 - 7677
- Autocovariance subroutine      6000 - 6050

\* Special subroutine #1 computes

$$\frac{1}{n-k} \sum_{i=1}^{n-k} u^2_i \text{ or } u_i$$

Special subroutine #2 computes

$$\frac{1}{n-k} \sum_{i=1}^{n-k} u^2_{i+k} \text{ or } u_{i+k}$$

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b. Timing Chart

The chart below is given for some sample values of n & k. The time associated with each n & k is in minutes.

Example:

n = 25  
k = 10  
t = 1.42 minutes

k \ n	25	50	100
0	.27	.47	.88
1	.40	.72	1.42
2	.53	.92	1.92
5	.88	1.68	3.37
10	1.42	2.78	5.72
20	—	4.92	10.28
30	—	—	14.35
40	—	—	17.72
50	—	—	20.17

IV. SAMPLE PROBLEM

K EQUALS 17, N EQUALS 33

INPUTS  $u(x)$

25295770-01 84497500-03 41614645-02 34062726-02 22278967-02  
-24409999-03 -12219299-04 -10734296-02 -49617540-03 -49334309-03  
-64665789-03 -13443027-02 -90425010-03 -13871079-02 -16698878-02  
-14734123-02 -15389387-02 -21205175-02 -13483868-02 -21147560-02  
-16332553-02 -19483177-02 -16342171-02 -16587303-02 -17061975-02  
-16613898-02 -15976855-02 -13159799-02 -79933480-03 11337529-03  
46208499-03 -57859899-03 75959443-02

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SAMPLE OUTPUT FORMAT

R

99999999 00	28145843 00	53473863 00	45814525 00	33887107 00
74033377-01	92277908-01	-30696252-01	12887363-01	-23487192-02
-24389237-01	-12510160 00	-75628743-01	-15633973 00	-16510627 00
-18957687 00	-17987632 00	-25642682 00		

A

23636274-04	26838906-05	-52735338-05	42325359-05	29346018-05
48362326-06	62047902-06	-59106764-06	-24080535-06	-47708895-06
-80597123-06	-20282161-05	-16162693-05	-27346729-05	-30427679-05
-35236167-05	-36160351-05	-49165263-05		

A-C

23488012-04	27467215-05	53530658-05	43347305-05	30623060-05
65882804-06	84841573-06	-29109441-06	12670099-06	-23952290-07
-25838026-06	-13798009-05	-86825434-06	-18758428-05	-20670171-05
-24833658-05	-24657331-05	-36943286-05		