Computer Programs for Spectral Analysis

of Economic Time Series

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The first version of Tukey-Hanning's power-spectrum program was obtained from Miss Ruth Weiss of the Bell Telephone Laboratories at Murray Hill, N. J., in the summer of 1960. After having been in use for about one year, it was replaced by the version that is presented in this Research Memorandum. — The first version of subroutine Parcor for computing the partial correlation coefficients of spectra was written in the winter of 1962 in cooperation with Thomas Wonnacott, at that time a graduate student in the Department of Mathematics. The version of subroutine Parcor which is presented in the Appendix of this Research Memorandum has been written by Richard Sebastian, a junior in the Department of Mathematics. — The computation of the spectrum of the residuals has been included in the cross-spectrum programs following a suggestion of Michael Godfrey, who joined the Econometric Research Program in February 1963.

In the preparation of these programs, use has been made, through the good offices of the International Business Machines Corporation, of the Massachusetts Institute of Technology's IBM 704 computer during the summer and fall of 1960. Thereafter the computations were shifted to Princeton, where they were first performed on the Institute for Defense Analyses' CDC 1604 computer, and since the fall of 1962 on Princeton University's IBM 7090 computer.

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ABSTRACT

The computer programs which have been used in the past three years by Princeton University's Econometric Research Program for spectral analysis of economic time series are presented in this Research Memorandum.

There are essentially three programs. The first program computes power spectra of an arbitrary number of series. The second program computes power spectra of sets of up to fourteen series and cross spectra of every combination of two series in the set. The third program computes, in addition to the power- and cross-spectra, the multiple and partial correlation of these spectra of sets of up to six series. Of each of these three programs, there is a Tukey-Hanning and a Parzen-version; both versions are presented here.

The programs are written in the Fortran-language for a computer of a little over thirty-two- thousand memory-locations. In the power- and cross-spectra programs one to two thousand locations have been saved to enable the inclusion of a subroutine that will instruct the computer to plot the results. In the multiple and partial correlation subroutine of the third program use has been made of the facility to perform complex-arithmetic operations on the IBM 7090. However, a version of this subroutine which uses only ordinary-arithmetic operations is given in the Appendix.

The Tukey-Hanning version of each program is fully described and printed in extenso. The Parzen-version only to the extent that it deviates from the former. In addition, the inputs and outputs of both versions of the third program, applied to a series of only 24 observations, have been printed. For a description of the results derived from these programs the reader is referred to the forthcoming publication, "Spectral Analysis of Economic Time Series," by C. W. J. Granger in association with M. Hatanaka (Princeton University Press, 1964).

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POWER SPECTRUM PROGRAM

This program is designed to compute the spectrum of a series. Provision has also been made for filtering the series before the computation of the spectrum takes place and for recoloring afterwards. This particular program can be used for series of up to 16,000 observations. Moreover, since the computations are performed on one series at the time, there is no limitation on the number of series that can be processed by this program.

There are two versions of the program depending on the particular type of spectral window that is to be used. In the first version, the Tukey-Hanning estimates are computed where the second one produces the Parzen estimates. The first version will here be completely described; the second one only to the extent that it deviates from the first.

I- Tukey-Hanning version

a) Main program

The first card to be read is a control card[1] indicating how many series (nrsers) have to be processed. The second card indicates the number of observations (nrdata) contained in each series, whether the series has first to be filtered or not (indicated by a positive number or a zero in the field named "nrfics"), and at how many frequency-points (nrlags) the spectrum has to be computed. As a general rule the number of frequency-points should not exceed one-fourth of the number of observations minus one.

After the control cards the data are read, which are supposed to be given in fields of width 12, in fixed point format and with an accuracy of 8 decimals at the most.

Immediately after the data have been read, the machine is instructed to

1) All control cards have fields of width 10.

print them, so that the series, on which the computation is to be performed, is identified. This has been found to be good practice when a great number of series have to be processed.

The next step depends on whether one wants to filter the series first before computing its power spectrum or not. Usually, when the spectrum is computed for the first time, one has not a good idea of the power at the various frequencies and will therefore refrain from filtering the series. A zero in the field of the control card called "nrfics" is all that is needed in that case. However, if one wants first to remove certain frequencies, e.g., the trend or the seasonal from the original series in order to get a better idea of the power at other frequencies, one can achieve this by putting a positive number in the field "nrfics". This will then instruct the machine to compute a moving linear combination of the series according to the formula.

$$X'(i) = c(1)\,X(i) + c(2)\,X(i+1) + \ldots + c(k)\,X(i+k-1)$$

or, in abbreviated form,

$$(1) \qquad X'(i) = \sum_{j=1}^{k} c(j)\,X(i+j-1) \quad \text{for} \quad i = 1, 2, \ldots, n-(k-1)$$

k stands here for the number of filter coefficients or the length of the filter. Hence, if the original series X has n observations, the length of the filtered series X' will then be $n - (k-1)$. The $c(j)$ in the formula stand for the filter coefficients; they are supposed to be given in the form of fractions, e.g., -0.333..., + 0.666..., - 0.333... .

After the data have been read and printed and the series has or has not been filtered, its power spectrum can be computed. This is done in a separate subroutine called "Subroutine POWERT," which will be described later.

for $i = 1, 2, \ldots, (m+1)$[1] where m is the maximum number of lags and n the number of observations.

The computation of the AUCVX (i) is performed in the first five DO-loops of the subroutine.

Next, the finite cosine series transform function of the auto-covariances is calculated according to the formula[2]

$$(5) \qquad \text{AUCVTX}\ (i) = \sum_{j=1}^{m+1} \text{AUCVX}'\ (j) \cos \frac{(j-1)(i-1)\pi}{m} \quad \text{for } i = 1, 2, \ldots, (m+1)$$

where

$$\text{AUCVX}'\ (1) = \text{AUCVX}\ (1),\ \text{AUCVX}'\ (i) = 2\ \text{AUCVX}\ (i)$$

$$\text{for } 2 \leq i \leq m \text{ and } \text{AUCVX}'\ (m+1) = \text{AUCVX}\ (m+1)$$

The third and last step is to weight the values of this auto-covariance transform function according to the spectral window formulae:[3]

$$(6) \qquad \begin{cases} \text{SPECX}\ (1) = .5\ \text{AUCVTX}\ (1) + .5\ \text{AUCVTX}\ (2) \\ \text{SPECX}\ (i) = .25\ \text{AUCVTX}\ (i-1) + .5\ \text{AUCVTX}\ (i) + .25\ \text{AUCVTX}\ (i+1) \\ \qquad \text{for } i = 2, 3, \ldots, m \\ \text{SPECX}\ (m+1) = .5\ \text{AUCVTX}\ (m) + .5\ \text{AUCVTX}\ (m+1) \end{cases}$$

To produce these Tukey-Hanning estimates of the powerspectrum it will take the IBM 7090 for series of:

180	observations and	30	frequency-points	.26	minutes
180	"	45	"	.26	"
300	"	45	"	.27	"
300	"	60	"	.27	"
300	"	75	"	.27	"

1) Though i actually runs from 0 through m, it starts here at 1 since zero-subscripts are not acceptable in the IBM 7090 Fortran language.
2) Blackman-Tukey, op. cit., Section 21, p. 53.
3) Blackman-Tukey, op. cit., Section B,5, p. 98.

It should here be observed that even for series of 24 observations and 5 frequency-points it will take the IBM 7090 one quarter of a minute to produce the spectrum. From this it can be concluded that most of the time stated here is used for storage of the program in the computer prior to its execution.

The main program and subroutine POWERT are given on the following 3 pages.

As for the input, the first control card contains only in its first field a number, being the number of series that have to be processed. The second control card contains in its first field the number of data, in its second field the number of filter coefficients if any and in its third field the number of frequency-points at which the spectrum has to be computed. All control cards have fields of width 10 and all fields are right-adjusted.

For the way in which the data are supposed to be given the reader is referred to page 60.

On the same and following 6 pages the output for the unfiltered series is shown and on page 68/76 the output for the filtered series. However, in this program AUCVX(i), AUCVTX(i), SPECX(i) and RSPECX(i) are printed next to each other rather than below each other.

Finally, it should be observed that if the series is not filtered beforehand, SPECX(i) and RSPECX(i) are identical. This last remark applies to all following programs as well.

TUKEY-HANNING VERSION OF POWER SPECTRUM 7/12/63

```
      DIMENSION C(50),X(16000),AUCVX(4000),AUCVTX(4000),SPECX(4000),B(50
     1),FLTFCN(4000),RSPECX(4000)
      EQUIVALENCE (X,FLTFCN),(X(5001),RSPECX),(X(9901),B)
      COMMON X,AUCVX,AUCVTX,SPECX,NRSERS,NRDATA,NRLAGS,NRLSP1,PI,K
      READ INPUT TAPE 5,1,NRSERS
      K=1
   44 READ INPUT TAPE 5,1,NRDATA,NRFICS,NRLAGS
    1 FORMAT(4I10)
      WRITE OUTPUT TAPE 6,2
    2 FORMAT (//4X,6HNRDATA,4X,6HNRFICS,4X,6HNRLAGS)
      WRITE OUTPUT TAPE 6,1,NRDATA,NRFICS,NRLAGS
      IF (NRFICS) 39,39,3
    3 READ INPUT TAPE 5,4,(C(I),I=1,NRFICS)
    4 FORMAT (6F12.8)
      WRITE OUTPUT TAPE 6,5
    5 FORMAT (/26X,20H FILTER COEFFICIENTS)
      WRITE OUTPUT TAPE 6,4,(C(I),I=1,NRFICS)
   39 READ INPUT TAPE 5,4,(X(I),I=1,NRDATA)
      WRITE OUTPUT TAPE 6,7,K
    7 FORMAT (/25X,20H ORIGINAL SERIES NO I2//)
      WRITE OUTPUT TAPE 6,4,(X(I),I=1,NRDATA)
      IF (NRFICS) 16,16,8
    8 NRDATA=NRDATA-(NRFICS-1)
      DO 10 I=1,NRDATA
      CX=0.0
      DO 9 J=1,NRFICS
      IPJM1=I+J-1
    9 CX=CX+C(J)*X(IPJM1)
   10 X(I)=CX
      WRITE OUTPUT TAPE 6,11,K
   11 FORMAT (/25X,20H FILTERED SERIES NO I2//)
      WRITE OUTPUT TAPE 6,4,(X(I),I=1,NRDATA)
   16 CALL POWERT
      IF (NRFICS) 17,17,19
   17 DO 18 I=1,NRLSP1
   18 RSPECX(I)=SPECX(I)
      GO TO 27
   19 DO 22 I=1,NRFICS
      B(I)=0.0
      NRFCS=NRFICS-(I-1)
      DO 20 J=1,NRFCS
      JPIM1=J+I-1
   20 B(I)=B(I)+C(J)*C(JPIM1)
      IF (I-1) 22,22,21
   21 B(I)=2.0*B(I)
   22 CONTINUE
      FNRLS=NRLAGS
      ANG=PI/FNRLS
      DO 23 I=1,NRLSP1
      FI=I-1
      FLTFCN(I)=0.0
      DO 23 J=1,NRFICS
      FJ=J-1
   23 FLTFCN(I)=FLTFCN(I)+B(J)*COSF(FJ*FI*ANG)
      DO 26 I=1,NRLSP1
```

```
      IF (FLTFCN(I)) 24,24,25
   24 RSPECX(I)=10.0**35
      GO TO 26
   25 RSPECX(I)=SPECX(I)/FLTFCN(I)
   26 CONTINUE
   27 WRITE OUTPUT TAPE 6,29,K
   29 FORMAT (/7X,104HAUTO COVARIANCE FUNCTION,TRANSFORMED AUTO COVARIAN
     1CE FUNCTION,SPECTRUM AND RECOLORED SPECTRUM OF SERIES I2)
      WRITE OUTPUT TAPE 6,30
   30 FORMAT (/9X,1HI,8X,8HAUCVX(I),13X,1HI,7X,9HAUCVTX(I),13X,1HI,8X,
     18HSPECX(I),13X,1HI,7X,9HRSPECX(I),4X//)
      DO 31 I=1,NRLSP1
      IM1=I-1
   31 WRITE OUTPUT TAPE 6,32,IM1,AUCVX(I),IM1,AUCVTX(I),IM1,SPECX(I),
     1IM1,RSPECX(I)
   32 FORMAT (4(5X,I5,1PE20.7))
   42 IF (NRSERS-K) 45,45,43
   43 K=K+1
      GO TO 44
   45 CALL EXIT
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

SUBROUTINE POWERT

7/12/63

```
      SUBROUTINE POWERT                                                 PWT 0780
      DIMENSION X(16000),SUMXL(4000),SUMXU(4000),PRODXX(4000),AUCVX(4000PWT 0790
     1),ACXPR(4000),AUCVTX(4000),SPECX(4000),WEIGTS(4000)               PWT 0800
      EQUIVALENCE (X,ACXPR),(X(5001),WEIGTS),(AUCVX,SUMXL),(AUCVTX,SUMXUPWT 0810
     1),(SPECX,PRODXX)                                                  PWT 0820
      COMMON X,AUCVX,AUCVTX,SPECX,NRSERS,NRDATA,NRLAGS,NRLSP1,PI,K      PWT 0830
      NRLSP1=NRLAGS+1                                                   PWT 0840
      NRDTML=NRDATA-NRLAGS                                              PWT 0850
      SUMX=0.0                                                          PWT 0860
      DO 1 J=NRLSP1,NRDTML                                              PWT 0870
    1 SUMX=SUMX+X(J)                                                    PWT 0880
      SUMXL(NRLSP1)=SUMX                                                PWT 0890
      SUMXU(NRLSP1)=SUMX                                                PWT 0900
      DO 2 J=1,NRLAGS                                                   PWT 0910
      SUMXL(NRLSP1)=SUMXL(NRLSP1)+X(J)                                  PWT 0920
      JJ=NRDATA-(J-1)                                                   PWT 0930
    2 SUMXU(NRLSP1)=SUMXU(NRLSP1)+X(JJ)                                 PWT 0940
      DO 3 J=1,NRLAGS                                                   PWT 0950
      JJ=NRLSP1-J                                                       PWT 0960
      JJJ=NRDATA-(JJ-1)                                                 PWT 0970
      SUMXL(JJ)=SUMXL(JJ+1)+X(JJJ)                                      PWT 0980
    3 SUMXU(JJ)=SUMXU(JJ+1)+X(JJ)                                       PWT 0990
      DO 4 J=1,NRLSP1                                                   PWT 1000
      PRODXX(J)=0.0                                                     PWT 1010
      MN=NRDATA-(J-1)                                                   PWT 1020
      JM=J                                                              PWT 1030
      DO 4 I=1,MN                                                       PWT 1040
      PRODXX(J)=PRODXX(J)+X(I)*X(JM)                                    PWT 1050
    4 JM=JM+1                                                           PWT 1060
      DO 5 I=1,NRLSP1                                                   PWT 1070
      DENOM =NRDATA-(I-1)                                               PWT 1080
      FDEN=1.0/DENOM                                                    PWT 1090
    5 AUCVX(I)=FDEN*(PRODXX(I)-FDEN*SUMXU(I)*SUMXL(I))                  PWT 1100
      ACXPR(1)=AUCVX(1)                                                 PWT 1110
      DO 10 I=2,NRLAGS                                                  PWT 1120
   10 ACXPR(I)=2.0*AUCVX(I)                                             PWT 1130
      ACXPR(NRLSP1)=AUCVX(NRLSP1)                                       PWT 1140
      FNRLS=NRLAGS                                                      PWT 1150
      PI=3.14159265359                                                  PWT 1160
      ANG=PI/FNRLS                                                      PWT 1170
      DO 11 I=1,NRLSP1                                                  PWT 1180
      AUCVTX(I)=0.0                                                     PWT 1190
      FI=I-1                                                            PWT 1200
      DO 11 J=1,NRLSP1                                                  PWT 1210
      FJ=J-1                                                            PWT 1220
      ANGLE=FJ*FI*ANG                                                   PWT 1230
   11 AUCVTX(I)=AUCVTX(I)+ACXPR(J)*COSF(ANGLE)                          PWT 1240
      SPECX(1)=0.5*(AUCVTX(1)+AUCVTX(2))                                PWT 1250
      DO 17 I=2,NRLAGS                                                  PWT 1260
   17 SPECX(I)=0.25*(AUCVTX(I-1)+AUCVTX(I+1))+0.5*AUCVTX(I)             PWT 1270
      SPECX(NRLSP1)=0.5*(AUCVTX(NRLAGS)+AUCVTX(NRLSP1))                 PWT 1280
      RETURN                                                            PWT 1290
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

II. The Parzen-version of the power spectrum program

The differences between this version and the Tukey-Hanning one are all located in the subroutine in which the spectral estimates are computed.

b) Subroutine POWERP[1)]

In this subroutine the auto-covariance-function is first weighted and then transformed contrary to the procedure described in subroutine POWERT. The computation of the auto-covariance function is moreover much simpler; on the other hand the weights are of a much more complicated nature.

The auto-covariance function is now computed according to the formula:[2)]

$$(7) \qquad AUCVX(i) = \frac{1}{n}\left[\sum_{t=1}^{n-(i-1)} X_t X_{t-(i-1)} - \frac{1}{n}\left(\sum_{t=1}^{n} X_t\right)\left(\sum_{t=1}^{n} X_t\right)\right]$$

for $i = 1, 2, \ldots, (m+1)$ where m is the maximum number of lags.

The auto-covariance function is then weighted:

$$(8) \qquad WACVX(i) = WEIGTS(i) * AUCVX(i)$$

for $i = 1, 2, \ldots, (m+1)$ as before.

The weights suggested by Parzen are:[3)]

$$(9) \qquad \begin{cases} WEIGTS(i) = 1 - 6\left(\frac{i}{m}\right)^2\left(1 - \frac{1}{m}\right) & \text{for } 1 \leq i \leq \frac{m}{2}\,. \\ WEIGTS(i) = 2\left(1 - \frac{1}{m}\right)^3 & \text{for } \frac{m}{2} + 1 \leq i \leq m + 1 \end{cases}$$

where m is the maximum number of lags.

The weighted auto-covariance function is then transformed into the Parzen-spectral estimates:

1) The last P in this word is meant to indicate that this subroutine will produce the Parzen-estimates of the power spectrum.
2) Privately communicated to me by Clive Granger.
3) See Table II of Parzen's article "Mathematical Considerations in the Estimation of Spectra," in Technometrics, Vol. 3, May 1961, p. 186.

$$(10) \qquad SPECX(i) = \sum_{j=1}^{m+1} ACXPR(j) \cos \frac{(j-1)(i-1)\pi}{m}$$

for $i = 1, 2, \ldots, (m+1)$ as before,

where $ACXPR(1) = WACVX(1)$

$ACXPR(j) = 2\ WACVX(j)$ for $j = 2, 3, \ldots, m$

and $ACXPR(m+1) = WACVX(m+1)$.

The time-estimates for this version are identical to those of the Tukey-Hanning version. As indicated before, it takes very little time to execute the program once it is stored in the machine.

The main program is the same as that of the Tukey-Hanning version. However, subroutine POWERP differs from POWERT and is given on the next page.

The input is the same as in the Tukey-Hanning version.

For the output the reader is referred to page 78/84 for the unfiltered series and page 86/94 for the filtered series. Comparing these spectral estimates with the Tukey-Hanning ones shows the difference in the results.

SUBROUTINE POWERP 7/12/63

```
      SUBROUTINE POWERP
      DIMENSION X(16000),WEIGTS(4000),PRODXX(4000),AUCVX(4000),
     1WACVX(4000),ACXPR(4000),SPECX(4000)
      EQUIVALENCE (X,ACXPR),(X(5001),WEIGTS),(AUCVX,DUMACX),(WACVX,
     1DUMWCX),(SPECX,PRODXX)
      COMMON X,AUCVX, WACVX,SPECX,NRSERS,NRDATA,NRLAGS,NRLSP1,PI,K
      NRLSP1=NRLAGS+1
      NRDTML=NRDATA-NRLAGS
      FNRLS=NRLAGS
      PI=3.14159265359
      ANG=PI/FNRLS
      SUMX=0.0
      DO 1 J=1,NRDATA
    1 SUMX=SUMX+X(J)
      NRLSO2=FNRLS/2.0+1.0
      DO 2 I=1,NRLSO2
      FI=I-1
    2 WEIGTS(I)=1.0-(6.0*FI**2/FNRLS**2)*(1.0-FI/FNRLS)
      NLO2P1=NRLSO2+1
      DO 3 I=NLO2P1,NRLSP1
      FI=I-1
    3 WEIGTS(I)=2.0*(1.0-FI/FNRLS)**3
      DO 4 J=1,NRLSP1
      PRODXX(J)=0.0
      MN=NRDATA-(J-1)
      JM=J
      DO 4 I=1,MN
      PRODXX(J)=PRODXX(J)+X(I)*X(JM)
    4 JM=JM+1
      DENOM =NRDATA
      FDEN=1.0/DENOM
      DO 5 I=1,NRLSP1
    5 AUCVX(I)=FDEN*(PRODXX(I)-FDEN*SUMX*SUMX)
      DO 10 I=1,NRLSP1
   10 WACVX(I)=WEIGTS(I)*AUCVX(I)
      ACXPR(1)=WACVX(1)
      DO 15 I=2,NRLAGS
   15 ACXPR(I)=2.0*WACVX(I)
      ACXPR(NRLSP1)=WACVX(NRLSP1)
      DO 17 I=1,NRLSP1
      SPECX(I)=0.0
      FI=I-1
      DO 17 J=1,NRLSP1
      FJ=J-1
      ANGLE=FI*FJ*ANG
   17 SPECX(I)=SPECX(I)+ACXPR(J)*COSF(ANGLE)
      RETURN
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

POWER- AND CROSS-SPECTRUM PROGRAM

This program is designed to compute for several sets of series:

a) the spectrum of each series in the set.

b) the cross spectrum of every combination of two series in the set.

c) the following cross spectral estimates of every such combination:

1) cross amplitude
2) coherency (squared)
3) gain
4) phase

d) the spectrum of the residuals for every such combination.

In general, the sets contain more than two series and the computations have been arranged in such a way that first the spectrum of each series in the set is computed before the calculation of the other statistics takes place. This way all spectra are computed only once, resulting in some saving of machine time. The price that has to be paid for this is, of course, the storage of the spectra, once they have been computed so that they can be called in when needed in the computation of the other statistics.

The program is designed for series with a maximum of 1200 observations, since not many economic time series seem to contain more observations. This allows the inclusion of up to fourteen series per set. But it is, of course, possible to use this program for sets of more and shorter or fewer and longer series. All that has to be done is to change the numbers in the dimension statements at the beginning of the main program and the subroutines.

Similar to the power spectrum program, there are also two versions of this program, one producing the Tukey-Hanning estimates, the other the Parzen estimates. Again the first version will here be completely described and the second one only to the extent that it deviates from the first.

I. Tukey-Hanning version

a) Main program

The first two cards are control cards.[1] The first one indicates how many sets (nrsets) there are, the second one how many series (nrsers) there are in each set, the number of observations (nrdata) contained in each series, whether the series have first to be filtered or not (indicated by a positive number or a zero in the field called "nrfics")and at how many frequency-points (nrlags) the spectra and cross spectra have to be computed.

After these control cards, the data are read and stored in a two-dimensional array XX (i,ℓ) , where the second index identifies the series. This is done to insure that in the computation of the cross spectra the series are matched with their own spectra rather than with those of other series. For, as explained in the introduction, the spectra are in this program computed in a separate subroutine, the result of which is stored in a special two-dimensional array SPECXX (i,ℓ) . By also storing the series in the same order as their spectra the chances of an improper matching of series and spectra are practically eliminated.

It is, of course, possible to save the storage locations now set aside for the series by reading them once more after their spectra have been computed and before the computation of the cross spectra is to be started. But then one has to make sure that the series are properly matched with their spectra.

The data are again supposed to be given in fields of width 12, in fixed point format and with an accuracy of 8 decimals at most. Immediately after the series has been read, it is printed for reasons which were given before.

Then, it is again possible to filter the series before the spectrum is computed and to recolor the latter afterwards. The reader is referred to

1) All control cards have fields of width 10.

the Power Spectrum Program (especially page 2 and 3) for the meaning of the terms "filtering" and "recoloring". Here it should suffice to remark that if one wants to make use of this facility, it is necessary that all series of a set should pass the same filter and be recolored in the same way. Finally, it should be remarked that the filtered series are stored back at the same locations in which the original series were stored.

The next step is the computation of the spectrum,which takes place in subroutine POWERT. The result is stored in a special two-dimensional array SPECXX (i,ℓ), where the second index again identifies the series.

After all sepctra have been computed, the cross spectra and cross spectral estimates are computed for every combination of two series in the set. This computation takes place in a separate subroutine, subroutine CROSST, which will be described later.

Once all spectra and cross spectra have been computed, they need to be recolored if the series have been filtered beforehand. For a description of this recoloring procedure, one is again referred to the Power Spectrum Program.

Finally, the spectra of the "residuals", being somewhat similar to the residuals in ordinary regression analysis, are computed. This should give one an idea of possible other periodicities in the second series Y which are not shared by the first series X. The computation of the spectra of the residuals is based on the formula:

(11) SPECRS (i) = (1 - COHSQ (i)) * RSPECY (i).

COHSQ stands here for the square of the coherency of series Y on series X and will be defined later; it is computed in subroutine CROSST. RSPECY (i) stands here for the (original or recolored) spectrum of the Y series.

The reader should however be cautioned that the coherency, as it is computed in subroutine CROSST, will not always lie in the range from 0 to 1. On the contrary, it is quite possible by using this subroutine to obtain coherencies between plus or minus 10 at some frequency-points. It will be clear that in those cases not much meaning can be attached to the resulting spectrum of the residuals.

b) Subroutine POWERT

This subroutine is identical to the one described on page 3 and 4 except for the printing of the results which now takes place in the subroutine.

c) Subroutine CROSST

Analogous to subroutine POWERT, the first step in computing the cross spectra is the calculation of the cross covariance functions of Series X and Y according to the formulae:[1)]

$$(12) \qquad \text{CRCVXY}(i) = \frac{1}{n-(i-1)} \left[\sum_{t=1}^{n-(i-1)} X_t Y_{t-(i-1)} - \frac{1}{n-(i-1)} \left(\sum_{t=i}^{n} Y_t \right) \left(\sum_{t=1}^{n-(i-1)} X_t \right) \right]$$

$$(13) \qquad \text{CRCVYX}(i) = \frac{1}{n-(i-1)} \left[\sum_{t=1}^{n-(i-1)} Y_t X_{t-(i-1)} - \frac{1}{n-(i-1)} \left(\sum_{t=i}^{n} X_t \right) \left(\sum_{t=1}^{n-(i-1)} Y_t \right) \right]$$

for $i = 1, 2, \ldots, (m+1)$ where m is the maximum number of lags and n the number of observations

The computation of these cross covariance functions is performed in the first five DO-loops of the subroutine.

Next, the cross-covariance-transform functions are computed according to the formulae:[2)]

1) See Granger-Hatanaka "Spectral Analysis of Economic Time Series," 1963, Section 6.3.
2) See Granger-Hatanaka, op. cit., Section 6.3.

(14) $$CO(i) = \frac{1}{2} \sum_{j=1}^{m+1} (CRCVXY'(j) + CRCVYX'(j)) \cos \frac{(j-1)(i-1)\pi}{m}$$

and

(15) $$QUAD(i) = \frac{1}{2} \sum_{j=1}^{m+1} (CRCVXY'(j) - CRCVYX'(j)) \sin \frac{(j-1)(i-1)\pi}{m}$$

for $i = 1, 2, \ldots, (m+1)$

where CRCVXY' (1) = CRCVXY (1), CRCVXY' (i) = 2CRCVXY (i) for $2 \leq i \leq m$ and CRCVXY' (m+1) = CRCVXY (m+1) and similarly for the CRCVYX'(i).

The third and last step is to weight these cross-variance transform functions according to the spectral window formulae:

(16) $$\begin{cases} WCO(1) = .5\ CO(1) + .5\ CO(2) \\ WCO(i) = .25\ CO(i-1) + .50\ CO(i) + .25\ CO(i+1) \quad \text{for } i = 2, 3, \ldots, m. \\ WCO(m+1) = .5\ CO(m) + .5\ CO(m+1) \end{cases}$$

(17) $$\begin{cases} WQUAD(1) = .5\ QUAD(1) \\ WQUAD(i) = .25\ QUAD(i-1) + .50\ QUAD(i) + .25\ QUAD(i+1) \quad \text{for } i = 2, 3, \ldots, m. \\ WQUAD(m+1) = .5\ QUAD(m+1) \end{cases}$$

The resulting WCO(i) and WQUAD(i) are the real respectively imaginary parts of the cross-spectra.

Finally, four cross spectral estimates are computed in this subroutine, namely:

1) The Cross Amplitude according to the formula:

(18) $$CRAMPL(i) = \sqrt{WCO^2(i) + WQUAD^2(i)} \quad \text{for } i = 1, 2, \ldots, (m+1)$$

2) The Coherency (squared) defined as:

(19) $$\text{COHSQ (i)} = \frac{\text{WCO}^2\text{(i)} + \text{WQUAD}^2\text{(i)}}{\text{SPECX(i)} * \text{SPECY(i)}} \quad \text{for } i = 1, 2, \ldots, (m+1)$$

where SPECX (i) and SPECY (i) stand for the spectral estimates of series X and Y. As has been remarked the coherency, as it is computed in this subroutine, will not always lie in the range from 0 to 1.

3) The Gain.

This is something similar to the coefficient of regression of series Y on series X. It is defined as:

(20) $$\text{GAIN (i)} = \frac{\sqrt{\text{WCO}^2\text{(i)} + \text{WQUAD}^2\text{(i)}}}{\text{SPECX (i)}} \quad \text{for } i = 1, 2, \ldots, (m+1)$$

4) The Phase, computed according to the formula:

(21) $$\text{PHASE (i)} = \text{ARCTAN } \left(\frac{\text{WQUAD(i)}}{\text{WCO(i)}}\right) \quad \text{for } i = 1, 2, \ldots, (m+1).$$

Given a set of 4 series, it will take the IBM 7090 for series of

180	observations and	30	frequency-points	.66	minutes
180	"	45	"	.95	"
300	"	45	"	1.09	"
300	"	60	"	1.48	"
300	"	75	"	1.94	"

to produce 4 powerspectra and 6 cross-spectra (one for each combination of 2 series).

Comparing the first time-estimate with the one given on page 4 one may conclude that it takes this computer for a series of 180 observations and 30 frequency-points .40 minutes to compute 2 sets of 6 cross-spectra and the 4 cross-spectral estimates associated with each of them. From the time-estimates which has just been given it can also be concluded that the number of frequency-points has a greater influence on the required amount of time than the number of observations.

The main program and the two subroutine POWERT and CROSST are given on the following 8 pages. The only difference between subroutine POWERT of the powerspectrum program and that of this program is that the printing of the results takes now place in the subroutine.

As for the input, the first control card contains only in its first field a number, being the number of sets that have to be processed. The second control card contains in its first field the number of series in the set, in its second field the number of observations of each series (all series in a set have to be of the same length!), in its third field the number of filter coefficients if any and in its fourth field the number of frequency-points at which the spectrum has to be computed. As before, all control cards have fields of width 10 and all fields are right-adjusted.

The format in which the data are supposed to be given is shown on page 60.

The output is shown on page 60/66 for the unfiltered series and page 68/76 for the filtered series.

```
      DIMENSION C(50),XX(1200,14),X(1200),SPECX(300),SPECXX(300,14),
     1Y(1200),SPECY(300),B(50),FLTFCN(300),RSPECX(300),RSPECY(300),
     2COHSQ(300),SPECRS(300),WEIGTS(300)
      EQUIVALENCE (X(301),RSPECX),(X(901),SPECRS),(Y(301),RSPECY),
     1(Y(901),FLTFCN)
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,NRSERS,NRDATA,NRLAGS,NRLSP1,
     1PI,L,M
      READ INPUT TAPE 5,1,NRSETS
      K=1
   44 READ INPUT TAPE 5,1,NRSERS,NRDATA,NRFICS,NRLAGS
    1 FORMAT(4I10)
      WRITE OUTPUT TAPE 6,2
    2 FORMAT (//4X,6HNRSERS,4X,6HNRDATA,4X,6HNRFICS,4X,6HNRLAGS)
      WRITE OUTPUT TAPE 6,1,NRSERS,NRDATA,NRFICS,NRLAGS
      IF (NRFICS) 6,6,3
    3 READ INPUT TAPE 5,4,(C(I),I=1,NRFICS)
    4 FORMAT (6F12.8)
      WRITE OUTPUT TAPE 6,5
    5 FORMAT (/26X,20H FILTER COEFFICIENTS)
      WRITE OUTPUT TAPE 6,4,(C(I),I=1,NRFICS)
    6 L=1
   39 READ INPUT TAPE 5,4,(XX(I,L),I=1,NRDATA)
      WRITE OUTPUT TAPE 6,7,L
    7 FORMAT (/25X,20H ORIGINAL SERIES NO I2//)
      WRITE OUTPUT TAPE 6,4,(XX(I,L),I=1,NRDATA)
      IF (NRFICS) 50,50,8
    8 NRDATA=NRDATA-(NRFICS-1)
      DO 10 I=1,NRDATA
      CX=0.0
      DO 9 J=1,NRFICS
      IPJM1=I+J-1
    9 CX=CX+C(J)*XX(IPJM1,L)
   10 XX(I,L)=CX
      WRITE OUTPUT TAPE 6,11,L
   11 FORMAT (/25X,20H FILTERED SERIES NO I2//)
      WRITE OUTPUT TAPE 6,4,(XX(I,L),I=1,NRDATA)
   50 DO 51 I=1,NRDATA
   51 X(I)=XX(I,L)
      CALL POWERT
      DO 52 I=1,NRLSP1
   52 SPECXX(I,L)=SPECX(I)
      IF (NRFICS) 54,54,53
   53 NRDATA=NRDATA+(NRFICS-1)
   54 IF (NRSERS-L) 56,56,55
   55 L=L+1
      GO TO 39
   56 L=1
      IF (NRFICS) 58,58,57
   57 NRDATA=NRDATA-(NRFICS-1)
   58 DO 59 I=1,NRDATA
   59 X(I)=XX(I,L)
      DO 60 I=1,NRLSP1
   60 SPECX(I)=SPECXX(I,L)
      M=L+1
   61 DO 62 I=1,NRDATA
```

```
62 Y(I)=XX(I,M)
   DO 63 I=1,NRLSP1
63 SPECY(I)=SPECXX(I,M)
16 CALL CROSST
   IF (NRFICS) 17,17,19
17 DO 18 I=1,NRLSP1
   RSPECX(I)=SPECX(I)
18 RSPECY(I)=SPECY(I)
   GO TO 27
19 DO 22 I=1,NRFICS
   B(I)=0.0
   NRFCS=NRFICS-(I-1)
   DO 20 J=1,NRFCS
   JPIM1=J+I-1
20 B(I)=B(I)+C(J)*C(JPIM1)
   IF (I-1) 22,22,21
21 B(I)=2.0*B(I)
22 CONTINUE
   FNRLS=NRLAGS
   ANG=PI/FNRLS
   DO 23 I=1,NRLSP1
   FI=I-1
   FLTFCN(I)=0.0
   DO 23 J=1,NRFICS
   FJ=J-1
23 FLTFCN(I)=FLTFCN(I)+B(J)*COSF(FJ*FI*ANG)
   DO 26 I=1,NRLSP1
   IF (FLTFCN(I)) 24,24,25
24 RSPECX(I)=10.0**35
   RSPECY(I)=10.0**35
   GO TO 26
25 RSPECX(I)=SPECX(I)/FLTFCN(I)
   RSPECY(I)=SPECY(I)/FLTFCN(I)
26 CONTINUE
27 DO 28 I=1,NRLSP1
28 SPECRS(I)=(1.0-COHSQ(I))*RSPECY(I)
   WRITE OUTPUT TAPE 6,29,L,M
29 FORMAT (/21X,29HRECOLORED SPECTRUM OF SERIES I2,5H AND I2,40H AND
  1SPECTRAL ESTIMATES OF THE RESIDUALS//)
   WRITE OUTPUT TAPE 6,30
30 FORMAT (24X,1HI,8X,9HRSPECX(I),12X,1HI,8X,9HRSPECY(I),12X,1HI,8X,
  19HSPECRS(I),18X//)
   DO 31 I=1,NRLSP1
   IM1=I-1
31 WRITE OUTPUT TAPE 6,32,IM1,RSPECX(I),IM1,RSPECY(I),IM1,SPECRS(I)
32 FORMAT (I5X,3(6X,I4,1PE20.7))
   IF (NRSERS-M) 36,36,33
33 M=M+1
   GO TO 61
36 IF (NRSERS-(L+1)) 42,42,37
37 L=L+1
   GO TO 58
42 IF (NRSETS-K) 45,45,43
43 K=K+1
   GO TO 44
45 CALL EXIT
```

```
END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

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```
      SUBROUTINE POWERT
      DIMENSION X(1200),SUMXL(300),SUMXU(300),PRODXX(300),AUCVX(300),    PCT 1140
     1ACXPR(300),AUCVTX(300),SPECX(300),Y(1200),SPECY(300),COHSQ(300),   PCT 1150
     2WEIGTS(300)                                                        PCT 1160
      EQUIVALENCE (X,AUCVX),(X(301),ACXPR),(X(601),AUCVTX),(Y,DUMY),     PCT 1170
     1(SPECX,SUMXL),(SPECY,DUMSPY),(COHSQ,SUMXU),(WEIGTS,PRODXX)         PCT 1180
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,NRSERS,NRDATA,NRLAGS,NRLSP1,   PCT 1190
     1PI,L,M                                                             PCT 1200
      NRLSP1=NRLAGS+1                                                    PCT 1210
      NRDTML=NRDATA-NRLAGS                                               PCT 1220
      SUMX=0.0                                                           PCT 1230
      DO 1 J=NRLSP1,NRDTML                                               PCT 1240
    1 SUMX=SUMX+X(J)                                                     PCT 1250
      SUMXL(NRLSP1)=SUMX                                                 PCT 1260
      SUMXU(NRLSP1)=SUMX                                                 PCT 1270
      DO 2 J=1,NRLAGS                                                    PCT 1280
      SUMXL(NRLSP1)=SUMXL(NRLSP1)+X(J)                                   PCT 1290
      JJ=NRDATA-(J-1)                                                    PCT 1300
    2 SUMXU(NRLSP1)=SUMXU(NRLSP1)+X(JJ)                                  PCT 1310
      DO 3 J=1,NRLAGS                                                    PCT 1320
      JJ=NRLSP1-J                                                        PCT 1330
      JJJ=NRDATA-(JJ-1)                                                  PCT 1340
      SUMXL(JJ)=SUMXL(JJ+1)+X(JJJ)                                       PCT 1350
    3 SUMXU(JJ)=SUMXU(JJ+1)+X(JJ)                                        PCT 1360
      DO 4 J=1,NRLSP1                                                    PCT 1370
      PRODXX(J)=0.0                                                      PCT 1380
      MN=NRDATA-(J-1)                                                    PCT 1390
      JM=J                                                               PCT 1400
      DO 4 I=1,MN                                                        PCT 1410
      PRODXX(J)=PRODXX(J)+X(I)*X(JM)                                     PCT 1420
    4 JM=JM+1                                                            PCT 1430
      DO 5 I=1,NRLSP1                                                    PCT 1440
      DENOM =NRDATA-(I-1)                                                PCT 1450
      FDEN=1.0/DENOM                                                     PCT 1460
    5 AUCVX(I)=FDEN*(PRODXX(I)-FDEN*SUMXU(I)*SUMXL(I))                   PCT 1470
      ACXPR(1)=AUCVX(1)                                                  PCT 1480
      DO 10 I=2,NRLAGS                                                   PCT 1490
   10 ACXPR(I)=2.0*AUCVX(I)                                              PCT 1500
      ACXPR(NRLSP1)=AUCVX(NRLSP1)                                        PCT 1510
      FNRLS=NRLAGS                                                       PCT 1520
      PI=3.14159265359                                                   PCT 1530
      ANG=PI/FNRLS                                                       PCT 1540
      DO 11 I=1,NRLSP1                                                   PCT 1550
      AUCVTX(I)=0.0                                                      PCT 1560
      FI=I-1                                                             PCT 1570
      DO 11 J=1,NRLSP1                                                   PCT 1580
      FJ=J-1                                                             PCT 1590
      ANGLE=FJ*FI*ANG                                                    PCT 1600
   11 AUCVTX(I)=AUCVTX(I)+ACXPR(J)*COSF(ANGLE)                           PCT 1610
      SPECX(1)=0.5*(AUCVTX(1)+AUCVTX(2))                                 PCT 1620
      DO 17 I=2,NRLAGS                                                   PCT 1630
   17 SPECX(I)=0.25*(AUCVTX(I-1)+AUCVTX(I+1))+0.5*AUCVTX(I)              PCT 1640
      SPECX(NRLSP1)=0.5*(AUCVTX(NRLAGS)+AUCVTX(NRLSP1))                  PCT 1650
      WRITE OUTPUT TAPE 6,18,L                                           PCT 1660
   18 FORMAT (/17X,84H AUTO COVARIANCE FUNCTION,AUTO COVARIANCE TRANSFORPCT 1670
     1M FUNCTION AND SPECTRUM OF SERIES I2)                              PCT 1680
                                                                         PCT 1690
```

```
      WRITE OUTPUT TAPE 6,19                                            PCT 1700
   19 FORMAT (/24X,1HI,8X,8HAUCVX(I),13X,1HI,8X,9HAUCVTX(I),12X,1HI,8X, PCT 1710
     18HSPECX(I),19X//)                                                 PCT 1720
      DO 20 I=1,NRLSP1                                                  PCT 1730
      IM1=I-1                                                           PCT 1740
   20 WRITE OUTPUT TAPE 6,21,IM1,AUCVX(I),IM1,AUCVTX(I),IM1,SPECX(I)    PCT 1750
   21 FORMAT (15X,3(6X,I4,1PE20.7))                                     PCT 1760
      RETURN                                                            PCT 1770
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

SUBROUTINE CROSST 7/12/63

```
      SUBROUTINE CROSST                                                 PCT 1790
      DIMENSION X(1200),Y(1200),SUMXL(300),SUMYL(300),SUMXU(300),SUMYU  PCT 1800
     1(300),PRODXY(300),PRODYX(300),CRCVXY(300),CRCVYX(300),CCXYPR(300) PCT 1810
     2,CCYXPR(300),CO(300),QUAD(300),WCO(300),WQUAD(300),RSQ(300),CRAMPLPCT 1820
     3(300),SPECX(300),SPECY(300),COHSQ(300),GAIN(300),PHASE(300),WEIGTSPCT 1830
     4(300)                                                             PCT 1840
      EQUIVALENCE (X,CRCVXY),(X(301),CO),(X(601),WCO),(X(901),RSQ),(Y,  PCT 1850
     1CRCVYX),(Y(301),QUAD),(Y(601),WQUAD),(Y(901),PHASE),(SUMXL,ACXPR),PCT 1860
     2(SUMYL,ACYPR),(SUMYU,CCXYPR),(SUMXU,CCYXPR),(PRODXY,CRAMPL),      PCT 1870
     3(PRODYX,GAIN)                                                     PCT 1880
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,NRSERS,NRDATA,NRLAGS,NRLSP1,  PCT 1890
     1PI,L,M                                                            PCT 1900
      NRLSP1=NRLAGS+1                                                   PCT 1910
      NRDTML=NRDATA-NRLAGS                                              PCT 1920
      SUMX=0.0                                                          PCT 1930
      SUMY=0.0                                                          PCT 1940
      DO 1 J=NRLSP1,NRDTML                                              PCT 1950
      SUMX=SUMX+X(J)                                                    PCT 1960
    1 SUMY=SUMY+Y(J)                                                    PCT 1970
      SUMXL(NRLSP1)=SUMX                                                PCT 1980
      SUMXU(NRLSP1)=SUMX                                                PCT 1990
      SUMYL(NRLSP1)=SUMY                                                PCT 2000
      SUMYU(NRLSP1)=SUMY                                                PCT 2010
      DO 2 J=1,NRLAGS                                                   PCT 2020
      SUMXL(NRLSP1)=SUMXL(NRLSP1)+X(J)                                  PCT 2030
      SUMYL(NRLSP1)=SUMYL(NRLSP1)+Y(J)                                  PCT 2040
      JJ=NRDATA-(J-1)                                                   PCT 2050
      SUMXU(NRLSP1)=SUMXU(NRLSP1)+X(JJ)                                 PCT 2060
    2 SUMYU(NRLSP1)=SUMYU(NRLSP1)+Y(JJ)                                 PCT 2070
      DO 3 J=1,NRLAGS                                                   PCT 2080
      JJ=NRLSP1-J                                                       PCT 2090
      JJJ=NRDATA-(JJ-1)                                                 PCT 2100
      SUMXL(JJ)=SUMXL(JJ+1)+X(JJJ)                                      PCT 2110
      SUMYL(JJ)=SUMYL(JJ+1)+Y(JJJ)                                      PCT 2120
      SUMXU(JJ)=SUMXU(JJ+1)+X(JJ)                                       PCT 2130
    3 SUMYU(JJ)=SUMYU(JJ+1)+Y(JJ)                                       PCT 2140
      DO 4 J=1,NRLSP1                                                   PCT 2150
      PRODXY(J)=0.0                                                     PCT 2160
      PRODYX(J)=0.0                                                     PCT 2170
      MN=NRDATA-(J-1)                                                   PCT 2180
      JM=J                                                              PCT 2190
      DO 4 I=1,MN                                                       PCT 2200
      PRODXY(J)=PRODXY(J)+X(I)*Y(JM)                                    PCT 2210
      PRODYX(J)=PRODYX(J)+Y(I)*X(JM)                                    PCT 2220
    4 JM=JM+1                                                           PCT 2230
      DO 5 I=1,NRLSP1                                                   PCT 2240
      DENOM =NRDATA-(I-1)                                               PCT 2250
      FDEN=1.0/DENOM                                                    PCT 2260
      CRCVXY(I)=FDEN*(PRODXY(I)-FDEN*SUMYU(I)*SUMXL(I))                 PCT 2270
    5 CRCVYX(I)=FDEN*(PRODYX(I)-FDEN*SUMXU(I)*SUMYL(I))                 PCT 2280
      CCXYPR(1)=CRCVXY(1)                                               PCT 2290
      CCYXPR(1)=CRCVYX(1)                                               PCT 2300
      DO 10 I=2,NRLAGS                                                  PCT 2310
      CCXYPR(I)=2.0*CRCVXY(I)                                           PCT 2320
   10 CCYXPR(I)=2.0*CRCVYX(I)                                           PCT 2330
      CCXYPR(NRLSP1)=CRCVXY(NRLSP1)                                     PCT 2340
```

```
      CCYXPR(NRLSP1)=CRCVYX(NRLSP1)
      FNRLS=NRLAGS
      PI=3.14159265359
      ANG=PI/FNRLS
      DO 11 I=1,NRLSP1
      CO(I)=0.0
      QUAD(I)=0.0
      FI=I-1
      DO 11 J=1,NRLSP1
      FJ=J-1
      ANGLE=FJ*FI*ANG
      CO(I)=CO(I)+.50*(CCXYPR(J)+CCYXPR(J))*COSF(ANGLE)
   11 QUAD(I)=QUAD(I)+.50*(CCXYPR(J)-CCYXPR(J))*SINF(ANGLE)
      WCO(1)=0.5*(CO(1)+CO(2))
      WQUAD(1)=0.5*QUAD(1)
      DO 17 I=2,NRLAGS
      WCO(I)=0.25*(CO(I-1)+CO(I+1))+0.5*CO(I)
   17 WQUAD(I)=0.25*(QUAD(I-1)+QUAD(I+1))+0.5*QUAD(I)
      WCO(NRLSP1)=0.5*(CO(NRLAGS)+CO(NRLSP1))
      WQUAD(NRLSP1)=0.5*QUAD(NRLSP1)
      WRITE OUTPUT TAPE 6,18,L,M
   18 FORMAT (/9X,93HCROSS COVARIANCE FUNCTIONS,CROSS COVARIANCE TRANSFO
     2RM FUNCTIONS AND CROSS SPECTRUM OF SERIES I2,5H AND I2)
      WRITE OUTPUT TAPE 6,19
   19 FORMAT (/24X,1HI,8X,9HCRCVXY(I),12X,1HI,10X,5HCO(I),14X,1HI,10X,
     26HWCO(I),19X//)
      DO 20 I=1,NRLSP1
      IM1=I-1
   20 WRITE OUTPUT TAPE 6,21,IM1,CRCVXY(I),IM1,CO(I),IM1,WCO(I)
   21 FORMAT (15X,3(6X,I4,1PE20.7))
      WRITE OUTPUT TAPE 6,22
   22 FORMAT (/24X,1HI,8X,9HCRCVYX(I),12X,1HI,9X,7HQUAD(I),13X,1HI,9X,
     28HWQUAD(I),18X//)
      DO 23 I=1,NRLSP1
      IM1=I-1
   23 WRITE OUTPUT TAPE 6,21,IM1,CRCVYX(I),IM1,QUAD(I),IM1,WQUAD(I)
      DO 26 I=1,NRLSP1
      RSQ(I)=WCO(I)**2+WQUAD(I)**2
      CRAMPL(I)=SQRTF(RSQ(I))
      COHSQ(I)=RSQ(I)/(SPECX(I)*SPECY(I))
      GAIN(I)=CRAMPL(I)/SPECX(I)
      ADDITN=PI
      IF (WCO(I)) 26,26,25
   25 ADDITN=ADDITN-SIGNF(PI,WQUAD(I))
   26 PHASE(I)=ATANF(WQUAD(I)/WCO(I))+ADDITN
      WRITE OUTPUT TAPE 6,27,L,M
   27 FORMAT (/38X,35HCROSS SPECTRAL ESTIMATES OF SERIES I2,5H AND I2)
      WRITE OUTPUT TAPE 6,28
   28 FORMAT (/9X,1HI,8X,9HCRAMPL(I),12X,1HI,11X,9HCOH.SQ(I),9X,1HI,12X,
     17HGAIN(I),10X,1HI,12X,8HPHASE(I)//)
      DO 29 I=1,NRLSP1
      IM1=I-1
   29 WRITE OUTPUT TAPE 6,30,IM1,CRAMPL(I),IM1,COHSQ(I),IM1,GAIN(I),IM1,
     1PHASE(I)
   30 FORMAT (6X,I4,1PE20.7,3(6X,I4,0PF20.8))
      RETURN
```

SUBROUTINE CROSST

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```
END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

II. Parzen-version of the power- and cross-spectrum program

As before, the differences between this version and the Tukey-Hanning one are all located in the subroutines in which the spectral- and cross-spectral estimates are computed.

b) Subroutine POWERP

This subroutine is identical to the one described on page 9 and 10 except for the printing of the results which now takes place in the subroutine.

c) Subroutine CROSSP

In analogy with the auto-covariance function the cross-covariance functions are first weighted and then transformed contrary to the procedure described in subroutine CROSST.

The computation of the cross-covariance functions is again much simpler; in analogy with formula (7) they are computed as follows:

$$(22) \qquad CRCVXY(i) = \frac{1}{n}\left[\sum_{t=1}^{n-(i-1)} X_t\, Y_{t-(i-1)} - \frac{1}{n}\left(\sum_{t=1}^{n} Y_t\right)\left(\sum_{t=1}^{n} X_t\right)\right]$$

$$(23) \qquad CRCVYX(i) = \frac{1}{n}\left[\sum_{t=1}^{n-(i-1)} Y_t\, X_{t-(i-1)} - \frac{1}{n}\left(\sum_{t=1}^{n} X_t\right)\left(\sum_{t=1}^{n} Y_t\right)\right]$$

for $i = 1, 2, \ldots, (m+1)$

where m is the maximum number of lags.

These cross-covariance functions are then weighted:

$$(24) \qquad WCCVXY(i) = WEIGTS(i) * CRCVXY(i)$$

$$(25) \qquad WCCVYX(i) = WEIGTS(i) * CRCVYX(i)$$

for $i = 1, 2, \ldots, (m+1)$

where the weights are given in formula (9).

The weighted cross-covariance functions are then transformed into the

Parzen cross-spectral estimates:

$$(26) \quad WCO(i) = \sum_{j=1}^{m+1} \frac{1}{2}\Big(CCXYPR(j) + CCYXPR(j)\Big) \cos \frac{(j-1)(i-1)\pi}{m}$$

$$(27) \quad WQUAD(i) = \sum_{j=1}^{m+1} \frac{1}{2}\Big(CCXYPR(j) - CCYXPR(j)\Big) \sin \frac{(j-1)(i-1)\pi}{m}$$

for i = 1, 2, ..., (m+1) as before

where CCXYPR(1) = WCCVXY(1)

CCXYPR(j) = WCCVXY(j) for j = 2, 3, ..., m

CCXYPR(m+1) = WCCVXY(m+1)

and similarly for CCYXPR(1) through CCYXPR(m+1).

The computation of the four cross-spectral estimates, namely, the cross-amplitude, coherency (squared), gain and phase is according to formulae (18), (19), (20) and (21).

It should here be observed that the resulting coherencies do now all lie in the range from 0 to 1. As a matter of fact, this has been the main reason for deviating from the Tukey-Hanning computational procedures. Consequently, the spectra of the residuals which result from these coherencies assume their full meaning.

The time-estimates for this version are again identical to those of the Tukey-Hanning version.

The main program is also identical to that of the Tukey-Hanning version. The two subroutines, however, are different and are given in the next 4 pages.

The input is the same as before.

For the output the reader is referred to page 78/84 for the unfiltered series and page 86/94 for the filtered series. It appears that all coherencies now lie in the range from 0 to 1, even if the series is filtered beforehand. This is not always so in the Tukey-Hanning version as can be seen on page 73 for instance.

```
      SUBROUTINE POWERP
      DIMENSION X(1200),WEIGTS(300),PRODXX(300),AUCVX(300),WACVX(300),
     1ACXPR(300),SPECX(300),Y(1200),SPECY(300),COHSQ(300)
      EQUIVALENCE (X,AUCVX),(X(301),WACVX),(X(601),ACXPR),(Y,PRODXX)
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,NRSERS,NRDATA,NRLAGS,NRLSP1,
     1PI,L,M
      NRLSP1=NRLAGS+1
      NRDTML=NRDATA-NRLAGS
      FNRLS=NRLAGS
      PI=3.14159265359
      ANG=PI/FNRLS
      SUMX=0.0
      DO 1 J=1,NRDATA
    1 SUMX=SUMX+X(J)
      NRLSO2=FNRLS/2.0+1.0
      DO 2 I=1,NRLSO2
      FI=I-1
    2 WEIGTS(I)=1.0-(6.0*FI**2/FNRLS**2)*(1.0-FI/FNRLS)
      NLO2P1=NRLSO2+1
      DO 3 I=NLO2P1,NRLSP1
      FI=I-1
    3 WEIGTS(I)=2.0*(1.0-FI/FNRLS)**3
      DO 4 J=1,NRLSP1
      PRODXX(J)=0.0
      MN=NRDATA-(J-1)
      JM=J
      DO 4 I=1,MN
      PRODXX(J)=PRODXX(J)+X(I)*X(JM)
    4 JM=JM+1
      DENOM =NRDATA
      FDEN=1.0/DENOM
      DO 5 I=1,NRLSP1
    5 AUCVX(I)=FDEN*(PRODXX(I)-FDEN*SUMX*SUMX)
      DO 10 I=1,NRLSP1
   10 WACVX(I)=WEIGTS(I)*AUCVX(I)
      ACXPR(1)=WACVX(1)
      DO 15 I=2,NRLAGS
   15 ACXPR(I)=2.0*WACVX(I)
      ACXPR(NRLSP1)=WACVX(NRLSP1)
      DO 17 I=1,NRLSP1
      SPECX(I)=0.0
      FI=I-1
      DO 17 J=1,NRLSP1
      FJ=J-1
      ANGLE=FI*FJ*ANG
   17 SPECX(I)=SPECX(I)+ACXPR(J)*COSF(ANGLE)
      WRITE OUTPUT TAPE 6,18,L
   18 FORMAT (/17X,84H AUTO COVARIANCE FUNCTION, WEIGHTED AUTO COVARIANC
     1E FUNCTION AND SPECTRUM OF SERIES I2)
      WRITE OUTPUT TAPE 6,19
   19 FORMAT (/24X,1HI,8X,8HAUCVX(I),13X,1HI,9X,8HWACVX(I),12X,1HI,8X,
     18HSPECX(I),19X//)
      DO 20 I=1,NRLSP1
      IM1=I-1
   20 WRITE OUTPUT TAPE 6,21,IM1,AUCVX(I),IM1, WACVX(I),IM1,SPECX(I)
   21 FORMAT (15X,3(6X,I4,1PE20.7))
```

SUBROUTINE POWERP


```
RETURN                                                          PCP 1700
END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

```
      SUBROUTINE CROSSP                                                 PCP 1720
      DIMENSION X(1200),Y(1200),PRODXY(300),PRODYX(300),CRCVXY(300),    PCP 1730
     1CRCVYX(300),WCCVXY(300),WCCVYX(300),WEIGTS(300),CCXYPR(300),      PCP 1740
     2CCYXPR(300),WCO(300),WQUAD(300),RSQ(300),CRAMPL(300),SPECX(300),  PCP 1750
     3SPECY(300),COHSQ(300),GAIN(300),PHASE(300)                        PCP 1760
      EQUIVALENCE (X,CRCVXY),(X(301),WCCVXY),(X(601),WCO),(X(901),RSQ), PCP 1770
     1(Y,CRCVYX),(Y(301),WCCVYX),(Y(601),WQUAD),(Y(901),PHASE),(PRODXY, PCP 1780
     2CRAMPL),(PRODYX,GAIN)                                             PCP 1790
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,NRSERS,NRDATA,NRLAGS,NRLSP1,  PCP 1800
     1PI,L,M                                                            PCP 1810
      NRLSP1=NRLAGS+1                                                   PCP 1820
      NRDTML=NRDATA-NRLAGS                                              PCP 1830
      FNRLS=NRLAGS                                                      PCP 1840
      PI=3.14159265359                                                  PCP 1850
      ANG=PI/FNRLS                                                      PCP 1860
      SUMX=0.0                                                          PCP 1870
      SUMY=0.0                                                          PCP 1880
      DO 1 J=1,NRDATA                                                   PCP 1890
      SUMX=SUMX+X(J)                                                    PCP 1900
    1 SUMY=SUMY+Y(J)                                                    PCP 1910
      DO 4 J=1,NRLSP1                                                   PCP 1920
      PRODXY(J)=0.0                                                     PCP 1930
      PRODYX(J)=0.0                                                     PCP 1940
      MN=NRDATA-(J-1)                                                   PCP 1950
      JM=J                                                              PCP 1960
      DO 4 I=1,MN                                                       PCP 1970
      PRODXY(J)=PRODXY(J)+X(I)*Y(JM)                                    PCP 1980
      PRODYX(J)=PRODYX(J)+Y(I)*X(JM)                                    PCP 1990
    4 JM=JM+1                                                           PCP 2000
      DENOM=NRDATA                                                      PCP 2010
      FDEN=1.0/DENOM                                                    PCP 2020
      DO 5 I=1,NRLSP1                                                   PCP 2030
      CRCVXY(I)=FDEN*(PRODXY(I)-FDEN*SUMY*SUMX)                         PCP 2040
    5 CRCVYX(I)=FDEN*(PRODYX(I)-FDEN*SUMX*SUMY)                         PCP 2050
      DO 10 I=1,NRLSP1                                                  PCP 2060
      WCCVXY(I)=WEIGTS(I)*CRCVXY(I)                                     PCP 2070
   10 WCCVYX(I)=WEIGTS(I)*CRCVYX(I)                                     PCP 2080
      CCXYPR(1)=WCCVXY(1)                                               PCP 2090
      CCYXPR(1)=WCCVYX(1)                                               PCP 2100
      DO 15 I=2,NRLAGS                                                  PCP 2110
      CCXYPR(I)=2.0*WCCVXY(I)                                           PCP 2120
   15 CCYXPR(I)=2.0*WCCVYX(I)                                           PCP 2130
      CCXYPR(NRLSP1)=WCCVXY(NRLSP1)                                     PCP 2140
      CCYXPR(NRLSP1)=WCCVYX(NRLSP1)                                     PCP 2150
      DO 17 I=1,NRLSP1                                                  PCP 2160
      WCO(I)=0.0                                                        PCP 2170
      WQUAD(I)=0.0                                                      PCP 2180
      FI=I-1                                                            PCP 2190
      DO 17 J=1,NRLSP1                                                  PCP 2200
      FJ=J-1                                                            PCP 2210
      ANGLE=FI*FJ*ANG                                                   PCP 2220
      WCO(I)=WCO(I)+          .50*(CCXYPR(J)+CCYXPR(J))*COSF(ANGLE)     PCP 2230
   17 WQUAD(I)=WQUAD(I)+         .50*(CCXYPR(J)-CCYXPR(J))*SINF(ANGLE)  PCP 2240
      WRITE OUTPUT TAPE 6,18,L,M                                        PCP 2250
   18 FORMAT (/9X,93HCROSS COVARIANCE FUNCTIONS, WEIGHTED CROSS COVARIANPCP 2260
     1CE FUNCTIONS AND CROSS SPECTRUM OF SERIES I2,5H AND I2)           PCP 2270
```

```
      WRITE OUTPUT TAPE 6,19
   19 FORMAT (/24X,1HI,8X,9HCRCVXY(I),12X,1HI,8X,9HWCCVXY(I),12X,1HI,9X,
     16HWCO(I),19X//)
      DO 20 I=1,NRLSP1
      IM1=I-1
   20 WRITE OUTPUT TAPE 6,21,IM1,CRCVXY(I),IM1,WCCVXY(I),IM1,WCO(I)
   21 FORMAT (15X,3(6X,I4,1PE20.7))
      WRITE OUTPUT TAPE 6,22
   22 FORMAT (/24X,1HI,8X,9HCRCVYX(I),12X,1HI,8X,9HWCCVYX(I),12X,1HI,9X,
     18HWQUAD(I),18X//)
      DO 23 I=1,NRLSP1
      IM1=I-1
   23 WRITE OUTPUT TAPE 6,21,IM1,CRCVYX(I),IM1,WCCVYX(I),IM1,WQUAD(I)
      DO 26 I=1,NRLSP1
      RSQ(I)=WCO(I)**2+WQUAD(I)**2
      CRAMPL(I)=SQRTF(RSQ(I))
      COHSQ(I)=RSQ(I)/(SPECX(I)*SPECY(I))
      GAIN(I)=CRAMPL(I)/SPECX(I)
      ADDITN=PI
      IF (WCO(I)) 26,26,25
   25 ADDITN=ADDITN-SIGNF(PI,WQUAD(I))
   26 PHASE(I)=ATANF(WQUAD(I)/WCO(I))+ADDITN
      WRITE OUTPUT TAPE 6,27,L,M
   27 FORMAT (/38X,35HCROSS SPECTRAL ESTIMATES OF SERIES I2,5H AND I2)
      WRITE OUTPUT TAPE 6,28
   28 FORMAT (/9X,1HI,8X,9HCRAMPL(I),12X,1HI,11X,9HCOH.SQ(I),9X,1HI,12X,
     17HGAIN(I),10X,1HI,12X,8HPHASE(I)//)
      DO 29 I=1,NRLSP1
      IM1=I-1
   29 WRITE OUTPUT TAPE 6,30,IM1,CRAMPL(I),IM1,COHSQ(I),IM1,GAIN(I),IM1,
     1PHASE(I)
   30 FORMAT (6X,I4,1PE20.7,3(6X,I4,0PF20.8))
      RETURN
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

POWER- AND CROSS-SPECTRUM PLUS CORRELATION PROGRAM

In addition to the statistics which are computed in the power- and cross-spectrum program this program will also compute:

a) the multiple correlation coefficients of each series in the set,

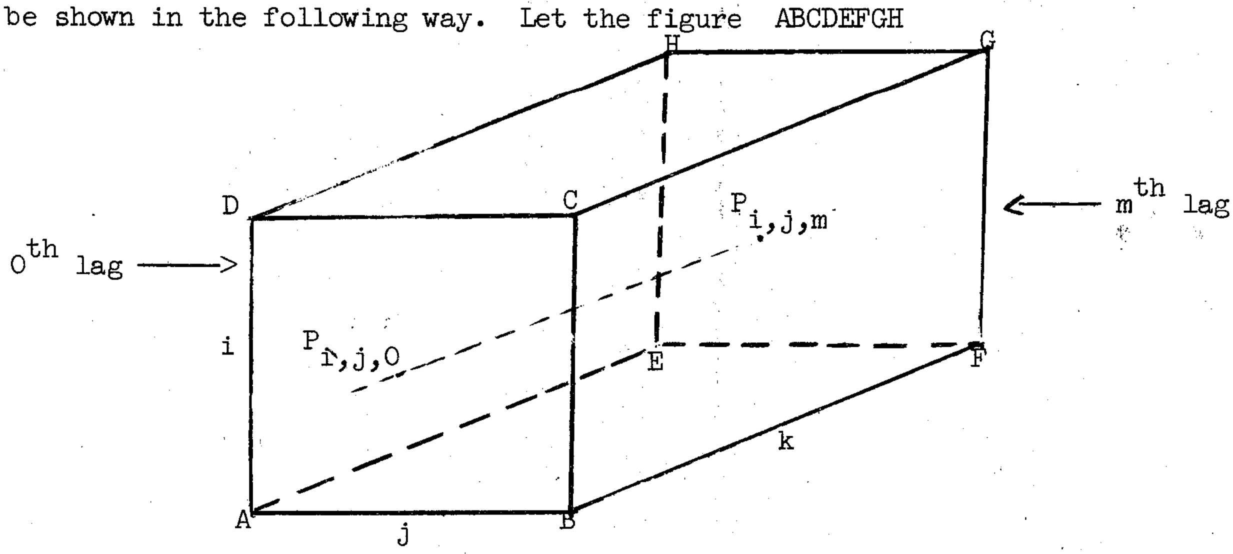
b) the partial correlation coefficients for every combination of two series in the set, and

c) two partial cross spectral estimates of that combination, namely:

1) the partial coherency (squared)

2) the partial gain

For a good understanding of the sequence in which the computations are performed, it is necessary to point out that there is a fundamental difference in the way in which on the one hand the spectra and cross spectra and on the other hand the correlation coefficients are computed. Geometrically this can be shown in the following way. Let the figure ABCDEFGH



represent a 3-dimensional block of spectra and cross spectra. In the power spectrum and cross spectrum program this block is built up along lines running from points $P_{i,j,o}$ on the front face ABCD to corresponding points $P_{i,j,m}$ on the back face EFGH. Now suppose that this 3-dimensional block is partitioned in as many (m) equally thick slices as there are lags. Then each computation of the correlation coefficients refers to the front face of a particular slice. In other words, the last computation takes place in a plane which is perpendicular to the direction in which the original block of spectra and cross-spectra is built up.

Algebraically, this can be stated as follows: let the power- and cross-spectra be elements of a 3-dimensional matrix identified by three indices, the first two of which, i and j, indicate the series that are involved in the computation and the third one, k, the lag to which the computation is related. In the computation of the spectra and cross spectra the third index, k, changes most rapidly, running from 0 through m where m stands for the maximum number of lags. On the other hand, in the computation of the correlation coefficients the i and j change most rapidly, running from 1 to n, where n is the number of series in the set.

From the foregoing presentation it will be clear that all spectra and cross spectra have first to be computed and stored before the computation of the correlation coefficients can start. In order to include as many series in the set as possible, it has become necessary to economize on the memory-space needed for the storage of intermediate results. The computations have therefore been arranged in such a way that the spectra and cross spectra are computed simultaneously in one subroutine rather than in two separate ones. The consequence of this arrangement is, of course, that the spectrum of a particular series is computed several times in this program rather than only once. To put it differently, machine time has been sacrificed in this program in exchange for memory-space.

Also, only two partial cross spectral estimates, the coherency (squared) and the phase, are computed in this program and not the partial cross amplitude and partial gain nor the partial residuals, though it could have been done without much effort. The main reason for this is again the desire to save as much memory-space as possible in order to increase the number of series in the set. Moreover, the idea of partial correlation in combination with spectral analysis is a rather novel one and has still to be further explored.[1] Therefore, it has been decided to compute only those estimates the meaning of which is most readily understood.

As presented here, the program will process series of up to 1200 observations, since this seems at the moment to be the maximum number of observations for an economic series. Given this limitation, it becomes possible to perform the computations on sets of up to six series. But again, one can suit one's own need by changing simultaneously the dimension statements at the beginning of the program and the subroutines.

In the computation of the correlation coefficients extensive use has been made of the facility to perform complex arithmetic operations on the IBM 7090. However, in order to make this program also suitable for machines which do not have this facility, the subroutine in which these correlation coefficients are computed is also given in a form which involves only ordinary arithmetic. For this the reader is referred to the Appendix.

Finally, there are also two versions of this program, one producing the Tukey-Hanning statistics, the other one the Parzen statistics. As before, the first version will here be completely described, after which a brief indication of the differences between the two versions follows.

I- Tukey-Hanning version

a) Main Program

The first card is again a control card[2] indicating how many sets (nrsets) have to be processed. The second card indicates how many series

---

1) The reader is referred to Section 5.8 of earlier mentioned Granger-Hatanaka book for the meaning of these correlation-coefficients.

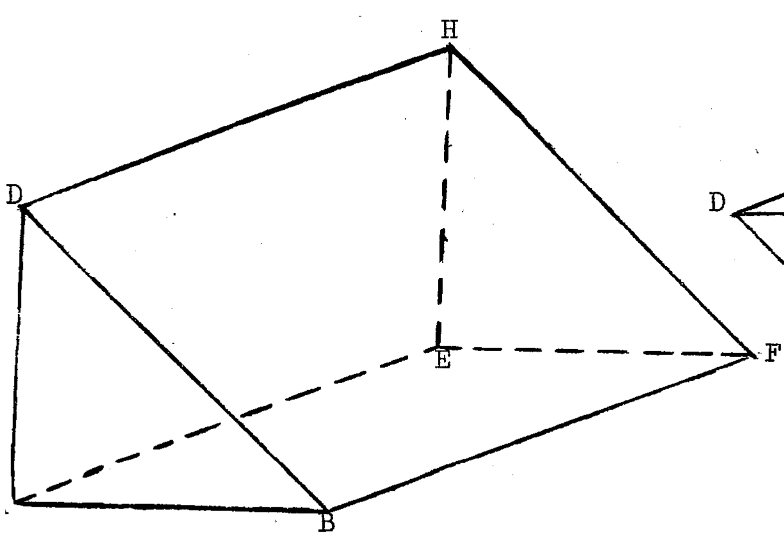
2) All control cards have fields of width 10.

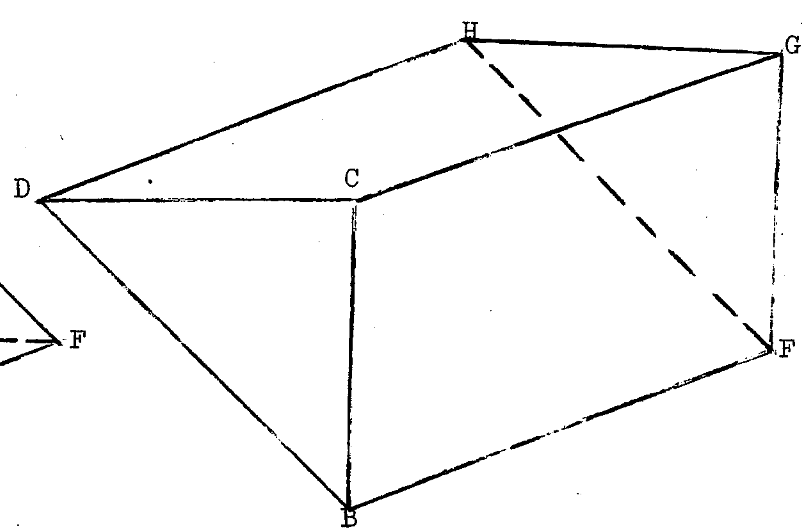
(nrsers) there are in each set, the number of observations (nrdata) contained in each series, whether the series have first to be filtered or not (indicated by a positive number or zero in the field called "nrfies"), and at how many frequency points (nrlags) the spectra and cross spectra have to be computed.

Then the first series is read and stored in the one-dimensional array X(i). As before the data are supposed to be given in fields of width 12, in fixed point format and with an accuracy of 8 decimals at most. Right after the series has been read, it is printed. This is followed by the reading of the second series, its storage in the one-dimensional array Y(i) and its printing.

Then, there is again the possibility of filtering both series before their spectra and cross spectra are computed. After the series have been filtered, they are stored back in the same locations in which the original series were stored.

The next step is the computation of the spectra and the cross-spectra of both series in subroutine POCROT. The results are stored in the 3-dimensional array SPECTR(i,j,k) in which the first two indices, i and j, indicate the series and the third index, k, the appropriate lag. To be more specific, let us assume that earlier presented three-dimensional block is separated by the diagonal plane BDFH in two equal parts as follows:





The spectra SPECX and SPECY are then stored in the BDFH plane, the WCO, the real part of the cross spectra in the BCDFGH block above the BDFH plane and the WQUAD, the imaginary part of the latter in the ABDEFH block below the BDFH plane. To put it in algebraic terms, the spectra are stored in that part of the SPECTR-matrix for which the i and j indices are the same, the cross-spectra WCO and WQUAD at those parts of the matrix for which the i and j indices are different.

After the first combination of two series of the set has been processed, the next combination has to be read in from data cards. It should here be observed that the order in which these series are supposed to be given is such that the second series is changed most rapidly. Hence, the series should be paired off as follows: (1,2), (1,3), (1,4) .... (1,n), (2,3), (2.4) .... (2,n), ..., ((n-2), (n-1)), ((n-2), n), ((n-1), n) where n stands for the number of series in the set.

Only after the spectra and cross spectra of all series have been computed and stored, the computation of the correlation coefficients can be started. This is done in subroutine PARCOC (or PARCOR if there is no facility to do complex arithematic) to be described later.

This is then followed by a recoloring of the spectra and cross spectra if the series have been filtered beforehand.

Finally, the spectra of the residuals are computed, a description of which has been given in the cross spectrum program.

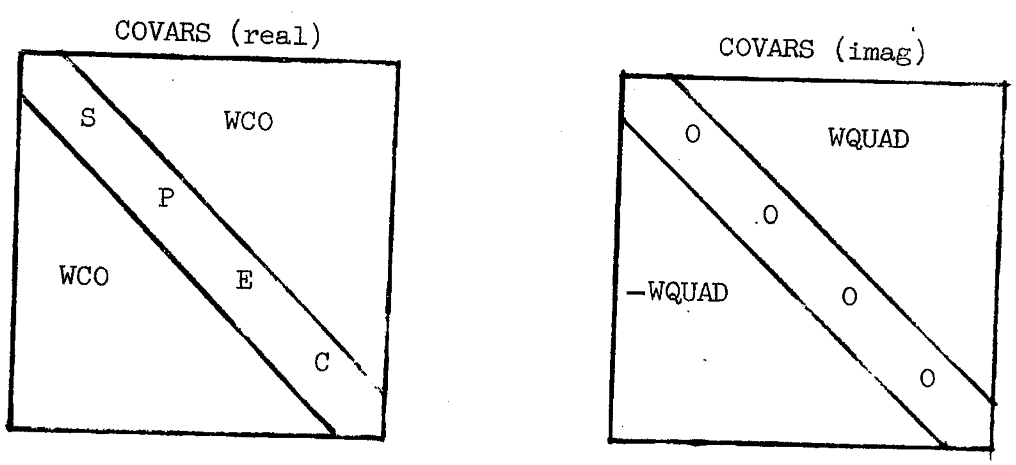
b) Subroutine POCROT

This subroutine is a combination of the two subroutines POWERT and CROSST. The only difference is that the results are now also stored in the three-dimensional matrix SPECTR (i,j,k).

c) Subroutine PARCOC

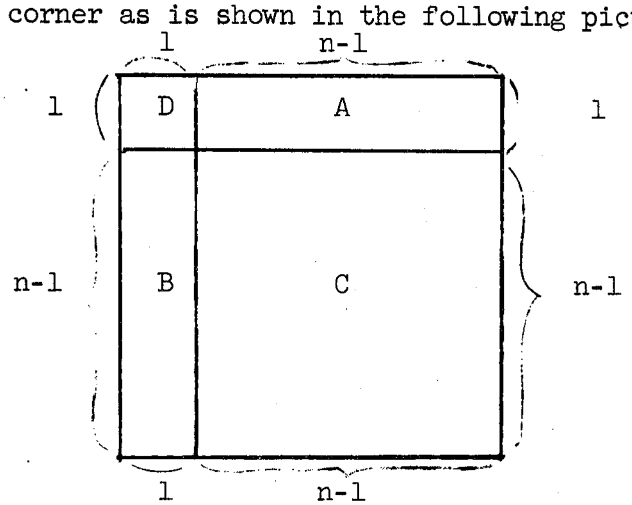
As has already been explained in the introduction, the computation of the correlation coefficients is performed in a plane which is perpendicular to the direction in which the original block of spectra and cross spectra has been built up. Stated differently, there is no change in the third index (k) of earlier mentioned three-dimensional matrix as long as a set of correlation-coefficients is in the process of being computed. In other words, the result of that computation is a set of correlation coefficients at a particular lag k.

The input of this subroutine consists of the output of subroutine POCROT, being the spectra SPECX and SPECY and the real (WCO) and imaginary (WQUAD) part of the cross spectra. From these spectra at some fixed lag k the covariance matrix COVARS is built up, which is an Hermitian matrix. That is to say, its elements (except those along the principal diagonal) are complex numbers or to be more precise, the elements below the principal diagonal are the complex conjugates of the ones above that diagonal. In order to operate on such a matrix computationally, it is broken up in two separate matrices, the elements of the first one consisting of the real part of the complex numbers, the elements of the second one of their imaginary part. This is illustrated in the following picture:



As has already been said in the introduction, in this subroutine extensive use has been made of the facility to perform complex arithmetic on the IBM 7090. This made it feasible to write a concise and at the same time efficient computer program. However, another version of this subroutine, which does not require complex arithmetic, will be presented in the Appendix to suit the needs of those who have no IBM 7090 at their command.

Returning to the matrix COVARS, the elements of which are complex numbers, it will now be shown how the multiple correlation coefficients and the partial correlation coefficients are obtained from it. To this end the COVARS-matrix is partitioned such that there is one single element in the upper left corner as is shown in the following picture:



Assuming that COVARS is an nxn Hermitian matrix, A will then be a 1 x(n-1) vector, B a (n-1) x 1 vector and C a (n-1) x (n-1) matrix. The computation of the multiple correlation coefficients of series (ℓ) is then performed according to the formula:

(28) COREIN (ℓ) = A * CI * B / COVARS (1,1)

for $\ell = 1, 2, \ldots, n$ where n stands for the number of series. CI stands here for the inverse of the complex matrix C; its computation is based on a method, which is given by Lanczos.[1)] It essentially

1) C. Lanczos, "Applied Analysis," 1956, Chap. II, Section 20, pp. 137-138.

amounts to the construction of a matrix with twice the dimensions of the original matrix by putting the imaginary parts of the elements in matrix-form to the right of and below the matrix formed by their real parts. The inverse of this 2 n x 2 n matrix can then be obtained by one of the conventional methods. The method which has been adopted for this program is a rather special one and will be described later.

Once CORELN (1) has been computed and stored, the stage is set for the computation of CORELN (2). This is done by placing the first row and first column in the $(n+1)^{st}$ row and $(n+1)^{st}$ column of the COVARS-matrix for temporary storage. Then all rows of this matrix are shifted one row upwards and all columns are shifted one column to the left. The result will be that the second row and second column will now occupy the position of the former first row and first column and that the second diagonal element will now be in the upper left corner. The same computational procedure will then produce CORELN (2). This process is carried on till all n multiple correlation coefficients are computed and stored. The last row of the three-dimensional matrix CORELN (n,n,k), where k stands for the particular lag at which the computation is performed, has been saved for the storage of the n multiple correlation coefficients.

To compute the partial correlation coefficients for every combination of two series in the set, the COVARS-matrix is now partitioned in such a way that the matrix in the upper left corner is a 2 x 2 matrix consisting of 4 (complex) elements. Consequently, A becomes then a 2 x (n-2) matrix, B a (n-2) x 2 matrix and C a (n-2) x (n-2) matrix. Having computed the inverse of the latter, it is again premultiplied by A and postmultiplied by B; the result will then be a 2 x 2 matrix, the elements of which will in general be complex numbers as well. This latter matrix is then subtracted from the 2 x 2 covariance matrix in the upper left corner resulting in a D-matrix of size 2 x 2 from which the partial correlation coefficients are derived.

It should here be remarked that since the elements of the D-matrix are complex numbers, the partial correlation coefficients will have a real and an imaginary part. The real part of the partial correlation coefficients is then computed according to the formula:

(29) real part of CORELN (ℓ,m) = real part of $D(1,2)/D(1,1) * D(2,2)$

for $\ell = 1, 2, \ldots, (n-1)$ and $m = (\ell+1), (\ell+2), \ldots, n$

where n stands again for the number of series.

Similarly, the computation of the imaginary part of the partial correlation coefficients is based on the formula:

(30) imag. part of CORELN (ℓ,m) = imag. part of $D(1,2)/D(1,1) * D(2,2)$

for $\ell = 1, 2, \ldots, (n-1)$

and $m = (\ell+1), (\ell+2), \ldots, n$.

Once they have been computed, the real and imaginary parts of the partial correlation coefficients are stored in compact form in the first (n-1) rows of the three-dimensional matrix CORELN (n,n,k).

Finally, the partial phase and partial coherency (squared) are computed according to the formulae:

(31) $$\text{PHASE}(\ell,m) = \arctan\left(\frac{\text{imag. part of CORELN }(\ell,m)}{\text{real part of CORELN }(\ell,m)}\right)$$

(32) $$\text{COHSQ}(\ell,m) = (\text{real part of CORELN}(\ell,m))^2 + (\text{imag. part of CORELN }(\ell,m))^2$$

for $\ell = 1, 2, \ldots, (n-1)$ and

$m = (\ell+1), (\ell+2), \ldots, n$ where n stands for

the number of series.

Once the real and imaginary part of the first partial correlation coefficient CORELN (1,2), the first partial phase PHASE (1,2) and the first partial coherency (squared) COHSQ (1,2) have been computed, the second column and second row of the COVARS-matrix are placed in the $(n+1)^{st}$ column and $(n+1)^{st}$ row. Then all columns except the first one are shifted one place to the left and all rows, except the first one, one place upwards. This brings the third column and third row where the second column and second row were before, so that the real and imaginary part of CORELN (1,3), of PHASE (1,3) and of COHSQ (1,3) can be computed. This process is continued until the second index has run through all values from 2 to n. Then the first column and first row are placed in the $(n+1)^{st}$ column and $(n+1)^{st}$ row of the COVARS-matrix and all columns are now shifted one place to the left and all rows one place upwards. This will place the second column and second row where the first column and first row were before, so that the stage is set for the computation of CORELN (2,3), PHASE (2,3) and COHSQ (2,3). After this computation, the same procedure of interchanging columns and rows which was described before will make the second index run through all values from 3 to n and so on. Consequently, the partial correlation coefficient, the partial phase and partial coherency are computed in the sequence (1,2), (1,3), ... (1,n), (2,3), (2,4) ... (2,n) ... ((n-2), n), ((n-1), n). Once they have been computed, they are stored in compact form in the three-dimensional matrix CORESP ((n-1),n, k).

Once all these statistics have been computed at a particular lag k, the whole process is repeated for the next value of k. This is continued till k has run through all values from 1 to m, where m is the maximum number of lags.

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The main program and the three subroutines POCROT, PARCOC and INVERT are given on the following 11 pages.

As for the input, the control cards are the same as for the power- and cross-spectrum programs. Also the format of the data is the same. However, the series are now supposed to be given in all possible combinations of two series at a time! Consequently, the data deck of this program contains for a set of 3 series 2x as many cards as that of the power- and cross-spectrum program, for a set of 4 series 3x as many and so on.

The output is shown on page 60/68 for the unfiltered series and page 68/77 for the filtered series.

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TUKEY- VERSION OF POWER AND CROSSSPECTRUM PLUS CORRELATION PROGRAM   7/12/63

```
      DIMENSION C(50),X(1200),Y(1200),SPECX(300),SPECY(300),B(50),FLTFCN
     1(300),RSPECX(300),RSPECY(300),COHSQ(300),SPECRS(300),WEIGTS(300),
     2SPECTR(6,6,300)
      EQUIVALENCE (X(301),RSPECX),(X(901),SPECRS),(Y(301),RSPECY),
     1(Y(901),FLTFCN)
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,SPECTR,NRSERS,NRDATA,NRLAGS,
     1NRLSP1,PI,L,M
      READ INPUT TAPE 5,1,NRSETS
      K=1
   44 READ INPUT TAPE 5,1,NRSERS,NRDATA,NRFICS,NRLAGS
    1 FORMAT(4I10)
      WRITE OUTPUT TAPE 6,2
    2 FORMAT (//4X,6HNRSERS,4X,6HNRDATA,4X,6HNRFICS,4X,6HNRLAGS)
      WRITE OUTPUT TAPE 6,1,NRSERS,NRDATA,NRFICS,NRLAGS
      IF (NRFICS) 6,6,3
    3 READ INPUT TAPE 5,4,(C(I),I=1,NRFICS)
    4 FORMAT (6F12.8)
      WRITE OUTPUT TAPE 6,5
    5 FORMAT (/26X,20H FILTER COEFFICIENTS)
      WRITE OUTPUT TAPE 6,4,(C(I),I=1,NRFICS)
    6 L=1
   39 M=L+1
   35 READ INPUT TAPE 5,4,(X(I),I=1,NRDATA)
      WRITE OUTPUT TAPE 6,7,L
    7 FORMAT (/25X,20H ORIGINAL SERIES NO I2//)
      WRITE OUTPUT TAPE 6,4,(X(I),I=1,NRDATA)
      IF (NRFICS) 12,12,8
    8 NRDATA=NRDATA-(NRFICS-1)
      DO 10 I=1,NRDATA
      CX=0.0
      DO 9 J=1,NRFICS
      IPJM1=I+J-1
    9 CX=CX+C(J)*X(IPJM1)
   10 X(I)=CX
      WRITE OUTPUT TAPE 6,11,L
   11 FORMAT (/25X,20H FILTERED SERIES NO I2//)
      WRITE OUTPUT TAPE 6,4,(X(I),I=1,NRDATA)
      NRDATA=NRDATA+(NRFICS-1)
   12 READ INPUT TAPE 5,4,(Y(I),I=1,NRDATA)
      WRITE OUTPUT TAPE 6,7,M
      WRITE OUTPUT TAPE 6,4,(Y(I),I=1,NRDATA)
      IF (NRFICS) 16,16,13
   13 NRDATA=NRDATA-(NRFICS-1)
      DO 15 I=1,NRDATA
      CY=0.0
      DO 14 J=1,NRFICS
      IPJM1=I+J-1
   14 CY=CY+C(J)*Y(IPJM1)
   15 Y(I)=CY
      WRITE OUTPUT TAPE 6,11,M
      WRITE OUTPUT TAPE 6,4,(Y(I),I=1,NRDATA)
   16 CALL POCROT
      IF (NRFICS) 17,17,19
   17 DO 18 I=1,NRLSP1
      RSPECX(I)=SPECX(I)
```

```
 18 RSPECY(I)=SPECY(I)
    GO TO 27
 19 DO 22 I=1,NRFICS
    B(I)=0.0
    NRFCS=NRFICS-(I-1)
    DO 20 J=1,NRFCS
    JPIM1=J+I-1
 20 B(I)=B(I)+C(J)*C(JPIM1)
    IF (I-1) 22,22,21
 21 B(I)=2.0*B(I)
 22 CONTINUE
    FNRLS=NRLAGS
    ANG=PI/FNRLS
    DO 23 I=1,NRLSP1
    FI=I-1
    FLTFCN(I)=0.0
    DO 23 J=1,NRFICS
    FJ=J-1
 23 FLTFCN(I)=FLTFCN(I)+B(J)*COSF(FJ*FI*ANG)
    DO 26 I=1,NRLSP1
    IF (FLTFCN(I)) 24,24,25
 24 RSPECX(I)=10.0**35
    RSPECY(I)=10.0**35
    GO TO 26
 25 RSPECX(I)=SPECX(I)/FLTFCN(I)
    RSPECY(I)=SPECY(I)/FLTFCN(I)
 26 CONTINUE
 27 DO 28 I=1,NRLSP1
 28 SPECRS(I)=(1.0-COHSQ(I))*RSPECY(I)
    WRITE OUTPUT TAPE 6,29,L,M
 29 FORMAT (/21X,29HRECOLORED SPECTRUM OF SERIES I2,5H AND I2,40H AND
   1SPECTRAL ESTIMATES OF THE RESIDUALS//)
    WRITE OUTPUT TAPE 6,30
 30 FORMAT (24X,1HI,8X,9HRSPECX(I),12X,1HI,8X,9HRSPECY(I),12X,1HI,8X,
   19HSPECRS(I),18X//)
    DO 31 I=1,NRLSP1
    IM1=I-1
 31 WRITE OUTPUT TAPE 6,32,IM1,RSPECX(I),IM1,RSPECY(I),IM1,SPECRS(I)
 32 FORMAT (15X,3(6X,I4,1PE20.7))
    IF (NRSERS-M) 36,36,33
 33 M=M+1
    IF (NRFICS) 35,35,34
 34 NRDATA=NRDATA+(NRFICS-1)
    GO TO 35
 36 IF (NRSERS-(L+1)) 40,40,37
 37 L=L+1
    IF (NRFICS) 39,39,38
 38 NRDATA=NRDATA+(NRFICS-1)
    GO TO 39
 40 IF (NRSERS-2) 42,42,41
 41 CALL PARCOC
 42 IF (NRSCTS-K) 45,45,43
 43 K=K+1
    GO TO 44
 45 CALL EXIT
    END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

```
      SUBROUTINE POCROT
      DIMENSION X(1200),Y(1200),SUMXL(300),SUMYL(300),SUMXU(300),SUMYU
     1(300),PRODXX(300),PRODXY(300),PRODYX(300),PRODYY(300),AUCVX(300),
     2AUCVY(300),CRCVXY(300),CRCVYX(300),ACXPR(300),ACYPR(300),CCXYPR
     3(300),CCYXPR(300),AUCVTX(300),AUCVTY(300),CO(300),QUAD(300),SPECX
     4(300),SPECY(300),WCO(300),WQUAD(300),RSQ(300),CRAMPL(300),COHSQ
     5(300),GAIN(300),PHASE(300),WEIGTS(300),SPECTR(6,6,300)
      EQUIVALENCE (X,AUCVX,WCO),(X(301),CRCVXY),(X(601),AUCVTX),(X(901),
     1CO),(Y,AUCVY,WQUAD),(Y(301),CRCVYX),(Y(601),AUCVTY),(Y(901),QUAD),
     2(SPECX,SUMXL,ACXPR),(SPECY,SUMYL,ACYPR),(COHSQ,SUMXU,CCXYPR),
     3(WEIGTS,SUMYU,CCYXPR),(PRODXX,RSQ),(PRODXY,CRAMPL),(PRODYX,GAIN),
     4(PRODYY,PHASE)
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,SPECTR,NRSERS,NRDATA,NRLAGS,
     1NRLSP1,PI,L,M
      NRLSP1=NRLAGS+1
      NRDTML=NRDATA-NRLAGS
      SUMX=0.0
      SUMY=0.0
      DO 1 J=NRLSP1,NRDTML
      SUMX=SUMX+X(J)
    1 SUMY=SUMY+Y(J)
      SUMXL(NRLSP1)=SUMX
      SUMXU(NRLSP1)=SUMX
      SUMYL(NRLSP1)=SUMY
      SUMYU(NRLSP1)=SUMY
      DO 2 J=1,NRLAGS
      SUMXL(NRLSP1)=SUMXL(NRLSP1)+X(J)
      SUMYL(NRLSP1)=SUMYL(NRLSP1)+Y(J)
      JJ=NRDATA-(J-1)
      SUMXU(NRLSP1)=SUMXU(NRLSP1)+X(JJ)
    2 SUMYU(NRLSP1)=SUMYU(NRLSP1)+Y(JJ)
      DO 3 J=1,NRLAGS
      JJ=NRLSP1-J
      JJJ=NRDATA-(JJ-1)
      SUMXL(JJ)=SUMXL(JJ+1)+X(JJJ)
      SUMYL(JJ)=SUMYL(JJ+1)+Y(JJJ)
      SUMXU(JJ)=SUMXU(JJ+1)+X(JJ)
    3 SUMYU(JJ)=SUMYU(JJ+1)+Y(JJ)
      DO 4 J=1,NRLSP1
      PRODXX(J)=0.0
      PRODXY(J)=0.0
      PRODYX(J)=0.0
      PRODYY(J)=0.0
      MN=NRDATA-(J-1)
      JM=J
      DO 4 I=1,MN
      PRODXX(J)=PRODXX(J)+X(I)*X(JM)
      PRODYY(J)=PRODYY(J)+Y(I)*Y(JM)
      PRODXY(J)=PRODXY(J)+X(I)*Y(JM)
      PRODYX(J)=PRODYX(J)+Y(I)*X(JM)
    4 JM=JM+1
      DO 5 I=1,NRLSP1
      DENOM =NRDATA-(I-1)
      FDEN=1.0/DENOM
      AUCVX(I)=FDEN*(PRODXX(I)-FDEN*SUMXU(I)*SUMXL(I))
      AUCVY(I)=FDEN*(PRODYY(I)-FDEN*SUMYU(I)*SUMYL(I))
```

```
      CRCVXY(I)=FDEN*(PRODXY(I)-FDEN*SUMYU(I)*SUMXL(I))
    5 CRCVYX(I)=FDEN*(PRODYX(I)-FDEN*SUMXU(I)*SUMYL(I))
      WRITE OUTPUT TAPE 6,6,L,M
    6 FORMAT (/32X,46HAUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES I2,
     15H AND I2//)
      WRITE OUTPUT TAPE 6,7
    7 FORMAT (9X,1HI,9X,8HAUCVX(I),12X,1HI,9X,8HAUCVY(I),12X,1HI,8X,
     19HCRCVXY(I),12X,1HI,8X,9HCRCVYX(I),3X//)
      DO  8 I=1,NRLSP1
      IM1=I-1
    8 WRITE OUTPUT TAPE 6, 9,IM1,AUCVX(I),IM1,AUCVY(I),IM1,CRCVXY(I),IM1
     1,CRCVYX(I)
    9 FORMAT (4(6X,I4,1PE20.7))
      ACXPR(1)=AUCVX(1)
      ACYPR(1)=AUCVY(1)
      CCXYPR(1)=CRCVXY(1)
      CCYXPR(1)=CRCVYX(1)
      DO 10 I=2,NRLAGS
      ACXPR(I)=2.0*AUCVX(I)
      ACYPR(I)=2.0*AUCVY(I)
      CCXYPR(I)=2.0*CRCVXY(I)
   10 CCYXPR(I)=2.0*CRCVYX(I)
      ACXPR(NRLSP1)=AUCVX(NRLSP1)
      ACYPR(NRLSP1)=AUCVY(NRLSP1)
      CCXYPR(NRLSP1)=CRCVXY(NRLSP1)
      CCYXPR(NRLSP1)=CRCVYX(NRLSP1)
      FNRLS=NRLAGS
      PI=3.14159265359
      ANG=PI/FNRLS
      DO 11 I=1,NRLSP1
      AUCVTX(I)=0.0
      AUCVTY(I)=0.0
      CO(I)=0.0
      QUAD(I)=0.0
      FI=I-1
      DO 11 J=1,NRLSP1
      FJ=J-I
      ANGLE=FJ*FI*ANG
      AUCVTX(I)=AUCVTX(I)+ACXPR(J)*COSF(ANGLE)
      AUCVTY(I)=AUCVTY(I)+ACYPR(J)*COSF(ANGLE)
      CO(I)=CO(I)+.50*(CCXYPR(J)+CCYXPR(J))*COSF(ANGLE)
   11 QUAD(I)=QUAD(I)+.50*(CCXYPR(J)-CCYXPR(J))*SINF(ANGLE)
      WRITE OUTPUT TAPE 6,12,L,M
   12 FORMAT (/27X,56HAUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF S
     1ERIES I2,5H AND I2//)
      WRITE OUTPUT TAPE 6,13
   13 FORMAT (9X,1HI,8X,9HAUCVTX(I),12X,1HI,8X,9HAUCVTY(I),12X,1HI,10X,
     15HCO(I),14X,1HI,9X,7HQUAD(I),4X//)
      DO 14 I=1,NRLSP1
      IM1=I-1
   14 WRITE OUTPUT TAPE 6, 9,IM1,AUCVTX(I),IM1,AUCVTY(I),IM1,CO(I),IM1,
     1QUAD(I)
      SPECX(1)=0.5*(AUCVTX(1)+AUCVTX(2))
      SPECY(1)=0.5*(AUCVTY(1)+AUCVTY(2))
      WCO(1)=0.5*(CO(1)+CO(2))
      WQUAD(1)=0.5*QUAD(1)
```

```
      DO 17 I=2,NRLAGS
      SPECX(I)=0.25*(AUCVTX(I-1)+AUCVTX(I+1))+0.5*AUCVTX(I)
      SPECY(I)=0.25*(AUCVTY(I-1)+AUCVTY(I+1))+0.5*AUCVTY(I)
      WCO(I)=0.25*(CO(I-1)+CO(I+1))+0.5*CO(I)
   17 WQUAD(I)=0.25*(QUAD(I-1)+QUAD(I+1))+0.5*QUAD(I)
      SPECX(NRLSP1)=0.5*(AUCVTX(NRLAGS)+AUCVTX(NRLSP1))
      SPECY(NRLSP1)=0.5*(AUCVTY(NRLAGS)+AUCVTY(NRLSP1))
      WCO(NRLSP1)=0.5*(CO(NRLAGS)+CO(NRLSP1))
      WQUAD(NRLSP1)=0.5*QUAD(NRLSP1)
      WRITE OUTPUT TAPE 6,18,L,M
   18 FORMAT (/36X,38HSPECTRUM AND CROSS SPECTRUM OF SERIES I2,5H AND I2
     1//)
      WRITE OUTPUT TAPE 6,19
   19 FORMAT (9X,1HI,9X,8HSPECX(I),12X,1HI,9X,8HSPECY(I),12X,1HI,10X,
     16HWCO(I),13X,1HI,9X,8HWQUAD(I),3X//)
      DO 20 I=1,NRLSP1
      IM1=I-1
   20 WRITE OUTPUT TAPE 6, 9,IM1,SPECX(I),IM1,SPECY(I),IM1,WCO(I),IM1,
     1WQUAD(I)
      DO 24 I=1,NRLSP1
      SPECTR(L,L,I)=SPECX(I)
      SPECTR(M,M,I)=SPECY(I)
      SPECTR(L,M,I)=WCO(I)
   24 SPECTR(M,L,I)=WQUAD(I)
      DO 26 I=1,NRLSP1
      RSQ(I)=WCO(I)**2+WQUAD(I)**2
      CRAMPL(I)=SQRTF(RSQ(I))
      COHSQ(I)=RSQ(I)/(SPECX(I)*SPECY(I))
      GAIN(I)=CRAMPL(I)/SPECX(I)
      ADDITN=PI
      IF (WCO(I)) 26,26,25
   25 ADDITN=ADDITN-SIGNF(PI,WQUAD(I))
   26 PHASE(I)=ATANF(WQUAD(I)/WCO(I))+ADDITN
      WRITE OUTPUT TAPE 6,27,L,M
   27 FORMAT (/38X,35HCROSS SPECTRAL ESTIMATES OF SERIES I2,5H AND I2)
      WRITE OUTPUT TAPE 6,28
   28 FORMAT (/9X,1HI,8X,9HCRAMPL(I),12X,1HI,11X,9HCOH.SQ(I),9X,1HI,12X,
     17HGAIN(I),10X,1HI,12X,8HPHASE(I)//)
      DO 29 I=1,NRLSP1
      IM1=I-1
   29 WRITE OUTPUT TAPE 6,30,IM1,CRAMPL(I),IM1,COHSQ(I),IM1,GAIN(I),IM1,
     1PHASE(I)
   30 FORMAT (6X,I4,1PE20.7,3(6X,I4,0PF20.8))
      RETURN
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

```
      SUBROUTINE PARCOC
      DIMENSION SPECTR(6,6,300),CC(10,10),CORELN(6,6,300),CORESP(5,6,300
     1),X(1200),SPECX(300),Y(1200),SPECY(300),COHSQ(300),WEIGTS(300)
I     DIMENSION COVARS(7,7),A(2,5),B(5,2),C(5,5),CI(5,5),AXCI(2,5),
I    1AXCIXB(2,2),D(2,2)
      EQUIVALENCE (X,DUMX),(Y,DUMY),(SPECX,DUMSPX),(SPECY,DUMSPY),(COHSQ
     1,DUMCOS),(WEIGTS,DUMWET),(SPECTR,CORELN)
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,SPECTR,NRSERS,NRDATA,NRLAGS,
     1NRLSP1,PI,L,M
      NSP1=NRSERS+1
      NSM1=NRSERS-1
      NSM1X2=NSM1*2
      NSM2=NRSERS-2
      NSM2X2=NSM2*2
      KK=1
   43 DO 1 J=1,NRSERS
      DO 1 I=1,J
      COVARS(I,J)=SPECTR(I,J,KK)
      COVARS(J,I)=SPECTR(I,J,KK)
      COVARS(I,J+7)=SPECTR(J,I,KK)
    1 COVARS(J,I+7)=-SPECTR(J,I,KK)
      DO 2 I=1,NRSERS
    2 COVARS(I,I+7)=0.0
      L=1
   15 DO 3 I=1,NSM1
I     A(1,I)=COVARS(1,I+1)
I   3 B(I,1)=COVARS(I+1,1)
      DO 4 I=1,NSM1
      DO 4 J=1,NSM1
I   4 C(I,J)=COVARS(I+1,J+1)
      DO 5 I=1,NSM1
      II=I+NSM1
      DO 5 J=1,NSM1
      JJ=J+NSM1
      CC(I,J)=C(I,J)
      CC(I,JJ)=C(I,J+5)
      CC(II,J)=-C(I,J+5)
    5 CC(II,JJ)=C(I,J)
      CALL INVERT (NSM1X2,CC,SING)
      IF (SING) 8,8,6
    6 WRITE OUTPUT TAPE 6,7
    7 FORMAT (/40X,39H INVERSE NOT COMPUTABLE BY THIS ROUTINE)
      GO TO 12
    8 DO 9 I=1,NSM1
      DO 9 J=1,NSM1
      JJ=J+NSM1
      CI(I,J)=CC(I,J)
    9 CI(I,J+5)=CC(I,JJ)
      DO 10 I=1,NSM1
I     AXCI(1,I)=(0.0,0.0)
      DO 10 J=1,NSM1
I  10 AXCI(1,I)=AXCI(1,I)+A(1,J)*CI(J,I)
I     AXCIXB(1,1)=(0.0,0.0)
      DO 11 I=1,NSM1
I  11 AXCIXB(1,1)=AXCIXB(1,1)+AXCI(1,I)*B(I,1)
      CORELN(NRSERS,L,KK)=AXCIXB(1,1)/COVARS(1,1)
```

```
   12 DO 13 I=1,NRSERS
I     COVARS(NSP1,I)=COVARS(1,I)
I  13 COVARS(I,NSP1)=COVARS(I,1)
I     COVARS(NSP1,NSP1)=COVARS(1,1)
      DO 14 I=1,NRSERS
      DO 14 J=1,NRSERS
I  14 COVARS(I,J)=COVARS(I+1,J+1)
      L=L+1
      IF (L-NRSERS) 15,15,16
   16 L=1
   17 M=1
   18 DO 19 I=1,2
      DO 19 J=1,NSM2
I     A(I,J)=COVARS(I,J+2)
I  19 B(J,I)=COVARS(J+2,I)
      DO 20 I=1,NSM2
      DO 20 J=1,NSM2
I  20 C(I,J)=COVARS(I+2,J+2)
      DO 21 I=1,NSM2
      II=I+NSM2
      DO 21 J=1,NSM2
      JJ=J+NSM2
      CC(I,J)=C(I,J)
      CC(I,JJ)=C(I,J+5)
      CC(II,J)=-C(I,J+5)
   21 CC(II,JJ)=C(I,J)
      CALL INVERT (NSM2X2,CC,SING)
      IF (SING) 23,23,22
   22 WRITE OUTPUT TAPE 6,7
      GO TO 34
   23 DO 24 I=1,NSM2
      DO 24 J=1,NSM2
      JJ=J+NSM2
      CI(I,J)=CC(I,J)
   24 CI(I,J+5)=CC(I,JJ)
      DO 25 I=1,2
      DO 25 K=1,NSM2
I     AXCI(I,K)=(0.0,0.0)
      DO 25 J=1,NSM2
I  25 AXCI(I,K)=AXCI(I,K)+A(I,J)*CI(J,K)
      DO 26 I=1,2
      DO 26 K=1,2
I     AXCIXB(I,K)=(0.0,0.0)
      DO 26 J=1,NSM2
I  26 AXCIXB(I,K)=AXCIXB(I,K)+AXCI(I,J)*B(J,K)
      DO 27 I=1,2
      DO 27 J=1,2
I  27 D(I,J)=COVARS(I,J)-AXCIXB(I,J)
      DIVISR=D(1,1)*D(2,2)
      IF (DIVISR) 28,28,29
   28 DIVISR =10.0**36
      GO TO 30
   29 DIVISR=SQRTF(DIVISR)
   30 CORELN(L,M,KK)=D(1,2)/DIVISR
      NRSRML=NRSERS-L
      LPM=L+M
```

```
      CORELN(NRSRML,LPM,KK)=D(1,4)/DIVISR
      ADDITN=PI
      IF (CORELN(L,M,KK)) 32,32,31
   31 ADDITN=ADDITN-SIGNF(PI,CORELN(NRSRML,LPM,KK))
   32 CORESP(L,M,KK)=ATANF(CORELN(NRSRML,LPM,KK)/CORELN(L,M,KK))+ADDITN
   33 CORESP(NRSRML,LPM,KK)=CORELN(L,M,KK)**2+CORELN(NRSRML,LPM,KK)**2
   34 DO 35 I=1,NRSERS
I     COVARS(NSP1,I)=COVARS(2,I)
I  35 COVARS(I,NSP1)=COVARS(I,2)
I     COVARS(NSP1,NSP1)=COVARS(2,2)
      DO 36 I=1,NSP1
      DO 36 J=2,NRSERS
I  36 COVARS(I,J)=COVARS(I,J+1)
      DO 37 I=2,NRSERS
      DO 37 J=1,NSP1
I  37 COVARS(I,J)=COVARS(I+1,J)
      M=M+1
      IF (M-NRSRML) 18,18,38
   38 DO 39 I=1,NRSERS
I     COVARS(NSP1,I)=COVARS(1,I)
I  39 COVARS(I,NSP1)=COVARS(I,1)
I     COVARS(NSP1,NSP1)=COVARS(1,1)
      DO 40 I=1,NRSERS
      DO 40 J=1,NRSERS
I  40 COVARS(I,J)=COVARS(I+1,J+1)
      M=M+1
      IF (M-NRSERS) 38,38,41
   41 L=L+1
      IF (L-NRSERS) 17,42,42
   42 KK=KK+1
      IF (KK-NRLSP1) 43,43,44
   44 WRITE OUTPUT TAPE 6,45,NRSERS
   45 FORMAT (/18X,37H MULTIPLE CORRELATION COEFFICIENT OF  I2,44H  TIME
     1SERIES AT SUCCESSIVE FREQUENCY-POINTS //)
      WRITE OUTPUT TAPE 6,46,(L,L=1,NRSERS)
   46 FORMAT (5(5X,1HI,6X,10HTIMESERIESI2))
      WRITE OUTPUT TAPE 6,47
   47 FORMAT (/1X)
      DO 48 K=1,NRLSP1
      KM1=K-1
   48 WRITE OUTPUT TAPE 6,49,(KM1,CORELN(NRSERS,L,K),L=1,NRSERS)
   49 FORMAT (5(I6,F18.8))
      WRITE OUTPUT TAPE 6,50,NRSERS
   50 FORMAT (/18X,36H PARTIAL CORRELATION COEFFICIENT OF  I3,45H   TIME
     1SERIES AT SUCCESSIVE FREQUENCY-POINTS //)
      WRITE OUTPUT TAPE 6,51
   51 FORMAT (11X,1HI,11X,9HREAL PART,7X,1HI,11X,9HIMAG PART,7X,1HI,11X,
     19HCOH.SQ(I),7X,1HI,12X,8HPHASE(I),4X)
   52 FORMAT (/50X,10HTIMESERIES I3,4H AND I3//)
      DO 53 L=1,NSM1
      NRSRML=NRSERS-L
      DO 53 M=1,NRSRML
      LPM=L+M
      WRITE OUTPUT TAPE 6,52,L,LPM
      DO 53 K=1,NRLSP1
      KM1=K-1
```

```
53 WRITE OUTPUT TAPE 6,54,KM1,CORELN(L,M,K),KM1,CORELN(NRSRML,LPM,K),CCT 4380
  1KM1,CORESP(NRSRML,LPM,K),KM1,CORESP(L,M,K)                          CCT 4390
54 FORMAT (4X,2(I8,F20.8),2(I8,F20.8))                                  CCT 4400
   RETURN                                                               CCT 4410
   END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

SUBROUTINE INVERT (N,A,SING) 7/12/63

```
      SUBROUTINE INVERT (N,A,SING)                                      CCT 4430
C     DOUBLE PIVOT PROGRAM FOR MATRIX INVERSION                         CCT 4440
      DIMENSION A(10,10),P(10,10),Q(10,10)                              CCT 4450
      THRES =1.0E-20                                                    CCT 4460
      SING=0.0                                                          CCT 4470
      NLESS1=N-1                                                        CCT 4480
      DO 3 I=1,N                                                        CCT 4490
      DO 3 J=1,N                                                        CCT 4500
      IF (I-J) 1,2,1                                                    CCT 4510
    1 P(I,J)=0.0                                                        CCT 4520
      Q(I,J)=0.0                                                        CCT 4530
      GO TO 3                                                           CCT 4540
    2 P(I,J)=1.0                                                        CCT 4550
      Q(I,J)=1.0                                                        CCT 4560
    3 CONTINUE                                                          CCT 4570
      DO 20 K=1,NLESS1                                                  CCT 4580
      BIGA=0.0                                                          CCT 4590
      KPLUS1=K+1                                                        CCT 4600
      DO 8 I=K,N                                                        CCT 4610
      DO 8 J=K,N                                                        CCT 4620
      IF (A(I,J)) 4,5,5                                                 CCT 4630
    4 ABSA=-A(I,J)                                                      CCT 4640
      GO TO 6                                                           CCT 4650
    5 ABSA=A(I,J)                                                       CCT 4660
    6 IF (BIGA-ABSA) 7,8,8                                              CCT 4670
    7 BIGA=ABSA                                                         CCT 4680
      LARGJ=J                                                           CCT 4690
      LARGI=I                                                           CCT 4700
    8 CONTINUE                                                          CCT 4710
      IF (LARGJ-K) 25,12,9                                              CCT 4720
    9 DO 10 I=K,N                                                       CCT 4730
      ASTORE=A(I,K)                                                     CCT 4740
      A(I,K)=A(I,LARGJ)                                                 CCT 4750
   10 A(I,LARGJ)=ASTORE                                                 CCT 4760
      DO 11 I=1,N                                                       CCT 4770
      QSTORE=Q(I,K)                                                     CCT 4780
      Q(I,K)=Q(I,LARGJ)                                                 CCT 4790
   11 Q(I,LARGJ)=QSTORE                                                 CCT 4800
   12 IF (LARGI-K) 25,16,13                                             CCT 4810
   13 DO 14 J=K,N                                                       CCT 4820
      ASTORE=A(K,J)                                                     CCT 4830
      A(K,J)=A(LARGI,J)                                                 CCT 4840
   14 A(LARGI,J)=ASTORE                                                 CCT 4850
      DO 15 J=1,N                                                       CCT 4860
      PSTORE=P(K,J)                                                     CCT 4870
      P(K,J)=P(LARGI,J)                                                 CCT 4880
   15 P(LARGI,J)=PSTORE                                                 CCT 4890
   16 AMAG=ABSF(A(K,K))                                                 CCT 4900
      IF (AMAG-THRES) 24,24,17                                          CCT 4910
   17 DO 19 I=K,NLESS1                                                  CCT 4920
      RMPY=A(I+1,K)/A(K,K)                                              CCT 4930
      DO 18 L=KPLUS1,N                                                  CCT 4940
   18 A(I+1,L)=A(I+1,L)-RMPY*A(K,L)                                     CCT 4950
      A(I+1,K)=0.0                                                      CCT 4960
      DO 19 LL=1,N                                                      CCT 4970
   19 P(I+1,LL)=P(I+1,LL)-RMPY*P(K,LL)                                  CCT 4980
```

```
      DO 20 J=K,NLESS1
      CMPY=A(K,J+1)/A(K,K)
      A(K,J+1)=0.0
      DO 20 L=1,N
   20 Q(L,J+1)=Q(L,J+1)-CMPY*Q(L,K)
      AMAG=ABSF(A(N,N))
      IF (AMAG-THRES) 24,24,21
   21 DO 22 J=1,N
      DO 22 I=1,N
   22 Q(I,J)=Q(I,J)/A(J,J)
      DO 23 I=1,N
      DO 23 J=1,N
      A(I,J)=0.0
      DO 23 L=1,N
   23 A(I,J)=A(I,J)+Q(I,L)*P(L,J)
      GO TO 25
   24 SING=1.0
   25 RETURN
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

II. The Parzen-version of the power- and cross-spectrum plus correlation program

The only difference between this version and the Tukey-Hanning version is the way in which the auto- and cross-variance functions are computed, weighted and transformed. This is here done in subroutine POCROP, which deviates from subroutine POCROT in the same manner as subroutine POWERP deviates from POWERT and CROSSP from CROSST. Since these latter four subroutines have been described before, not much more needs to be said here.

Again, there is no difference between the time-estimates for this and the Tukey-Hanning version of the program.

The main-program and the two last subroutines are also identical to those of the Tukey-Hanning version. Only subroutine POCROP is different and is given on the following 3 pages.

The input is again the same as before.

The output is shown on page 78/86 for the unfiltered series and on page 86/95 for the filtered series. It appears that even if the series is filtered beforehand all multiple and partial correlation coefficients lie in the range of -1 to + 1. As can be seen on page 76/77 this is not always so in the Tukey-Hanning version.

```
      SUBROUTINE POCROP
      DIMENSION X(1200),Y(1200),WEIGTS(300),PRODXX(300),PRODXY(300),
     1PRODYX(300),PRODYY(300),AUCVX(300),AUCVY(300),CRCVXY(300),
     2CRCVYX(300),WACVX(300),WACVY(300),WCCVXY(300),WCCVYX(300),
     3ACXPR(300),ACYPR(300),CCXYPR(300),CCYXPR(300),SPECX(300),
     4SPECY(300),WCO(300),WQUAD(300),SPECTR(6,6,300),RSQ(300),
     5CRAMPL(300),COHSQ(300),GAIN(300),PHASE(300)
      EQUIVALENCE (X,AUCVX,WCO),(X(301),CRCVXY),(X(601),WCCVXY),(X(901),
     1ACXPR),(Y,AUCVY,WQUAD),(Y(301),CRCVYX),(Y(601),WCCVYX),(Y(901),
     2ACYPR),(SPECX,WACVX),(SPECY,WACVY),(COHSQ,CCXYPR),(WEIGTS,CCYXPR),
     3(PRODXX,RSQ),(PRODXY,CRAMPL),(PRODYX,GAIN),(PRODYY,PHASE)
      COMMON X,Y,SPECX,SPECY,COHSQ,WEIGTS,SPECTR,NRSERS,NRDATA,NRLAGS,
     1NRLSP1,PI,L,M
      NRLSP1=NRLAGS+1
      NRDTML=NRDATA-NRLAGS
      FNRLS=NRLAGS
      PI=3.14159265359
      ANG=PI/FNRLS
      SUMX=0.0
      SUMY=0.0
      DO 1 J=1,NRDATA
      SUMX=SUMX+X(J)
    1 SUMY=SUMY+Y(J)
      NRLS02=FNRLS/2.0+1.0
      DO 2 I=1,NRLS02
      FI=I-1
    2 WEIGTS(I)=1.0-(6.0*FI**2/FNRLS**2)*(1.0-FI/FNRLS)
      NL02P1=NRLS02+1
      DO 3 I=NL02P1,NRLSP1
      FI=I-1
    3 WEIGTS(I)=2.0*(1.0-FI/FNRLS)**3
      DO 4 J=1,NRLSP1
      PRODXX(J)=0.0
      PRODXY(J)=0.0
      PRODYX(J)=0.0
      PRODYY(J)=0.0
      MN=NRDATA-(J-1)
      JM=J
      DO 4 I=1,MN
      PRODXX(J)=PRODXX(J)+X(I)*X(JM)
      PRODYY(J)=PRODYY(J)+Y(I)*Y(JM)
      PRODXY(J)=PRODXY(J)+X(I)*Y(JM)
      PRODYX(J)=PRODYX(J)+Y(I)*X(JM)
    4 JM=JM+1
      DENOM=NRDATA
      FDEN=1.0/DENOM
      DO 5 I=1,NRLSP1
      AUCVX(I)=FDEN*(PRODXX(I)-FDEN*SUMX*SUMX)
      AUCVY(I)=FDEN*(PRODYY(I)-FDEN*SUMY*SUMY)
      CRCVXY(I)=FDEN*(PRODXY(I)-FDEN*SUMY*SUMX)
    5 CRCVYX(I)=FDEN*(PRODYX(I)-FDEN*SUMX*SUMY)
      WRITE OUTPUT TAPE 6,6,L,M
    6 FORMAT (/32X,46HAUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES I2,
     15H AND I2//)
      WRITE OUTPUT TAPE 6,7
    7 FORMAT (9X,1HI,9X,8HAUCVX(I),12X,1HI,9X,8HAUCVY(I),12X,1HI,8X,
```

```
    19HCRCVXY(I),12X,1HI,8X,9HCRCVYX(I),3X//)
      DO  8 I=1,NRLSP1
      IM1=I-1
    8 WRITE OUTPUT TAPE 6, 9,IM1,AUCVX(I),IM1,AUCVY(I),IM1,CRCVXY(I),IM1
     1,CRCVYX(I)
    9 FORMAT (4(6X,I4,1PE20.7))
      DO 10 I=1,NRLSP1
      WACVX(I)=WEIGTS(I)*AUCVX(I)
      WACVY(I)=WEIGTS(I)*AUCVY(I)
      WCCVXY(I)=WEIGTS(I)*CRCVXY(I)
   10 WCCVYX(I)=WEIGTS(I)*CRCVYX(I)
      WRITE OUTPUT TAPE 6,12,L,M
   12 FORMAT (/27X,56H WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF S
     1ERIES I2,5H AND I2//)
      WRITE OUTPUT TAPE 6,13
   13 FORMAT (9X,1HI,9X,8HWACVX(I),12X,1HI,9X,8HWACVY(I),12X,1HI,8X,
     19HWCCVXY(I),12X,1HI,8X,9HWCCVYX(I),3X//)
      DO 14 I=1,NRLSP1
      IM1=I-1
   14 WRITE OUTPUT TAPE 6, 9,IM1, WACVX(I),IM1, WACVY(I),IM1,WCCVXY(I),
     1IM1,WCCVYX(I)
      ACXPR(1)=WACVX(1)
      ACYPR(1)=WACVY(1)
      CCXYPR(1)=WCCVXY(1)
      CCYXPR(1)=WCCVYX(1)
      DO 15 I=2,NRLAGS
      ACXPR(I)=2.0*WACVX(I)
      ACYPR(I)=2.0*WACVY(I)
      CCXYPR(I)=2.0*WCCVXY(I)
   15 CCYXPR(I)=2.0*WCCVYX(I)
      ACXPR(NRLSP1)=WACVX(NRLSP1)
      ACYPR(NRLSP1)=WACVY(NRLSP1)
      CCXYPR(NRLSP1)=WCCVXY(NRLSP1)
      CCYXPR(NRLSP1)=WCCVYX(NRLSP1)
      DO 17 I=1,NRLSP1
      SPECX(I)=0.0
      SPECY(I)=0.0
      WCO(I)=0.0
      WQUAD(I)=0.0
      FI=I-1
      DO 17 J=1,NRLSP1
      FJ=J-1
      ANGLE=FI*FJ*ANG
      SPECX(I)=SPECX(I)+ACXPR(J)*COSF(ANGLE)
      SPECY(I)=SPECY(I)+ACYPR(J)*COSF(ANGLE)
      WCO(I)=WCO(I)+              .50*(CCXYPR(J)+CCYXPR(J))*COSF(ANGLE)
   17 WQUAD(I)=WQUAD(I)+              .50*(CCXYPR(J)-CCYXPR(J))*SINF(ANGLE)
      WRITE OUTPUT TAPE 6,18,L,M
   18 FORMAT (/36X,38HSPECTRUM AND CROSS SPECTRUM OF SERIES I2,5H AND I2
     1//)
      WRITE OUTPUT TAPE 6,19
   19 FORMAT (9X,1HI,9X,8HSPECX(I),12X,1HI,9X,8HSPECY(I),12X,1HI,10X,
     16HWCO(I),13X,1HI,9X,8HWQUAD(I),3X//)
      DO 20 I=1,NRLSP1
      IM1=I-1
   20 WRITE OUTPUT TAPE 6, 9,IM1,SPECX(I),IM1,SPECY(I),IM1,WCO(I),IM1,
```

```
      SUBROUTINE POCROP

     1WQUAD(I)
      DO 24 I=1,NRLSP1
      SPECTR(L,L,I)=SPECX(I)
      SPECTR(M,M,I)=SPECY(I)
      SPECTR(L,M,I)=WCO(I)
   24 SPECTR(M,L,I)=WQUAD(I)
      DO 26 I=1,NRLSP1
      RSQ(I)=WCO(I)**2+WQUAD(I)**2
      CRAMPL(I)=SQRTF(RSQ(I))
      COHSQ(I)=RSQ(I)/(SPECX(I)*SPECY(I))
      GAIN(I)=CRAMPL(I)/SPECX(I)
      ADDITN=PI
      IF (WCO(I)) 26,26,25
   25 ADDITN=ADDITN-SIGNF(PI,WQUAD(I))
   26 PHASE(I)=ATANF(WQUAD(I)/WCO(I))+ADDITN
      WRITE OUTPUT TAPE 6,27,L,M
   27 FORMAT (/38X,35HCROSS SPECTRAL ESTIMATES OF SERIES I2,5H AND I2)
      WRITE OUTPUT TAPE 6,28
   28 FORMAT (/9X,1HI,8X,9HCRAMPL(I),12X,1HI,11X,9HCOH.SQ(I),9X,1HI,12X,
     17HGAIN(I),10X,1HI,12X,8HPHASE(I)//)
      DO 29 I=1,NRLSP1
      IM1=I-1
   29 WRITE OUTPUT TAPE 6,30,IM1,CRAMPL(I),IM1,COHSQ(I),IM1,GAIN(I),IM1,
     1PHASE(I)
   30 FORMAT (6X,I4,1PE20.7,3(6X,I4,0PF20.8))
      RETURN
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)
```

NRSERS	NRDATA	NRFICS	NRLAGS
4	24	-0	5

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 2

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	3.1232636E-06	0	6.1824821E-06	0	2.1480901E-06	0	2.1480901E-06
1	5.9924381E-07	1	-1.6157465E-06	1	1.1720226E-06	1	-1.8525517E-07
2	-4.6694213E-07	2	3.1727271E-07	2	-8.1818173E-07	2	-7.7190078E-07
3	-6.1904757E-07	3	4.6643989E-08	3	2.6190473E-07	3	9.7301583E-07
4	-5.6999995E-07	4	-6.8324995E-07	4	-1.2750000E-07	4	-1.1439999E-06
5	-2.3822713E-07	5	-2.1649583E-06	5	-7.5429358E-07	5	1.1911358E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 1 AND 2

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	7.7154472E-07	0	1.4736420E-07	0	1.1906057E-06	0	-0.
1	5.3473729E-06	1	7.0058867E-06	1	3.4196827E-06	1	6.7494881E-07
2	4.6602783E-06	2	2.0078363E-06	2	2.0298449E-06	2	7.1487634E-07
3	2.3927464E-06	3	8.4858680E-06	3	4.0533124E-06	3	2.7027805E-06
4	2.1665404E-06	4	7.9622909E-06	4	1.9511027E-06	4	-4.3198666E-07
5	1.3272140E-06	5	1.0753691E-05	5	-2.6175902E-06	5	-3.0469476E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 2

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.0594588E-06	0	3.5766254E-06	0	2.3051442E-06	0	-0.
1	4.0316422E-06	1	4.0417435E-06	1	2.5149540E-06	1	5.1619349E-07
2	4.2651690E-06	2	4.8768567E-06	2	2.8831712E-06	2	1.2018705E-06
3	2.9030779E-06	3	6.7354658E-06	3	3.0218931E-06	3	1.4221127E-06
4	2.0132603E-06	4	8.7910351E-06	4	1.3344819E-06	4	4.5970171E-07
5	1.7468772E-06	5	9.3579907E-06	5	-3.3324372E-07	5	-1.5234738E-13

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 2

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	2.3051442E-06	0	0.48559938	0	0.75344836	0	6.28318530
1	2.5673818E-06	1	0.40451086	1	0.63680794	1	0.20243818
2	3.1236467E-06	2	0.46908071	2	0.73236177	2	0.39495339
3	3.3397967E-06	3	0.57044496	3	1.15043303	3	0.43985487

4	1.4114417E-06	4	0.11256048	4	0.70107262	4	0.33174837
5	3.3324372E-07	5	0.00679327	5	0.19076539	5	3.14159310

RECOLORED SPECTRUM OF SERIES 1 AND 2 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.0594588E-06	0	3.5766254E-06	0	1.8398183E-06
1	4.0316422E-06	1	4.0417435E-06	1	2.4068143E-06
2	4.2651690E-06	2	4.8768567E-06	2	2.5892173E-06
3	2.9030779E-06	3	6.7354658E-06	3	2.8932533E-06
4	2.0132603E-06	4	8.7910351E-06	4	7.8015119E-06
5	1.7468772E-06	5	9.3579907E-06	5	9.2944193E-06

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	3.1232636E-06	0	2.9256769E-06	0	1.0682291E-06	0	1.0682291E-06
1	5.9924381E-07	1	8.1455575E-07	1	-7.0567104E-07	1	4.2570884E-07
2	-4.6694213E-07	2	-1.3727269E-07	2	-7.2933878E-07	2	-1.1363637E-07
3	-6.1904757E-07	3	-1.8537413E-07	3	-8.1904755E-07	3	-6.6666664E-08
4	-5.6999995E-07	4	-2.6329999E-07	4	-7.1599997E-07	4	-8.9099993E-07
5	-2.3822713E-07	5	-1.9767313E-07	5	-2.8393352E-07	5	1.8310250E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 1 AND 3

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	7.7154472E-07	0	3.1852214E-06	0	-2.5978378E-06	0	-0.
1	5.3473729E-06	1	4.8970854E-06	1	2.2054476E-06	1	-1.8632705E-06
2	4.6602783E-06	2	3.5907519E-06	2	1.8332493E-06	2	-1.1621034E-06
3	2.3927464E-06	3	2.3793686E-06	3	6.7399065E-07	3	-1.0543218E-07
4	2.1665404E-06	4	1.6366465E-06	4	2.0102036E-06	4	-8.9785968E-07
5	1.3272140E-06	5	1.0638413E-06	5	-1.6565405E-07	5	-2.1318928E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.0594588E-06	0	4.0411534E-06	0	-1.9619512E-07	0	-0.
1	4.0316422E-06	1	4.1425360E-06	1	9.1157666E-07	1	-1.2221611E-06
2	4.2651690E-06	2	3.6144895E-06	2	1.6364842E-06	2	-1.0732274E-06
3	2.9030779E-06	3	2.4965339E-06	3	1.2978585E-06	3	-5.6770687E-07
4	2.0132603E-06	4	1.6791257E-06	4	1.1321859E-06	4	-4.7528794E-07

5	1.7468772E-06	5	1.3502439E-06	5	9.2227476E-07	5	-1.0659464E-13

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	1.9619512E-07	0	0.00311334	0	0.06412739	0	3.14159265
1	1.5246802E-06	1	0.13919039	1	0.37817845	1	5.35324341
2	1.9570124E-06	2	0.24842995	2	0.45883584	2	5.70273453
3	1.4165902E-06	3	0.27688047	3	0.48796149	3	5.87084353
4	1.2279021E-06	4	0.44600974	4	0.60990728	4	5.88573009
5	9.2227476E-07	5	0.36061686	5	0.52795625	5	6.28318518

RECOLORED SPECTRUM OF SERIES 1 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.0594588E-06	0	4.0411534E-06	0	4.0285718E-06
1	4.0316422E-06	1	4.1425360E-06	1	3.5659347E-06
2	4.2651690E-06	2	3.6144895E-06	2	2.7165420E-06
3	2.9030779E-06	3	2.4965339E-06	3	1.8052924E-06
4	2.0132603E-06	4	1.6791257E-06	4	9.3021929E-07
5	1.7468772E-06	5	1.3502439E-06	5	8.6332318E-07

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	3.1232636E-06	0	3.4341664E-06	0	1.0916666E-06	0	1.0916666E-06
1	5.9924381E-07	1	1.1377694E-06	1	8.6483924E-07	1	-3.1228729E-07
2	-4.6694213E-07	2	3.2161161E-07	2	9.0351233E-07	2	5.4297518E-07
3	-6.1904757E-07	3	3.0721091E-07	3	8.4285707E-07	3	-1.4285696E-08
4	-5.6999995E-07	4	-1.5460748E-06	4	-3.5350000E-07	4	-4.7649992E-07
5	-2.3822713E-07	5	-1.6978669E-06	5	-1.4670359E-06	5	5.1523544E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 1 AND 4

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	7.7154472E-07	0	2.1773335E-06	0	2.6133772E-06	0	-0.
1	5.3473729E-06	1	9.4834841E-06	1	2.8770213E-06	1	1.9222775E-06
2	4.6602783E-06	2	4.6649680E-07	2	-1.3105310E-06	2	7.1063660E-07
3	2.3927464E-06	3	3.4500251E-06	3	6.4042996E-07	3	5.2075928E-07
4	2.1665404E-06	4	2.7855857E-06	4	1.5432584E-06	4	1.0919002E-06
5	1.3272140E-06	5	-2.0685370E-07	5	8.0293105E-07	5	2.3600913E-14

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.0594588E-06	0	5.8304088E-06	0	2.7451993E-06	0	-0.
1	4.0316422E-06	1	5.4026996E-06	1	1.7642222E-06	1	1.1387979E-06
2	4.2651690E-06	2	3.4666257E-06	2	2.2409732E-07	2	9.6607748E-07
3	2.9030779E-06	3	2.5380332E-06	3	3.7839683E-07	3	7.1101383E-07
4	2.0132603E-06	4	2.2035857E-06	4	1.1324694E-06	4	6.7613990E-07
5	1.7468772E-06	5	1.2893660E-06	5	1.1730947E-06	5	1.1800456E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	2.7451993E-06	0	0.42247803	0	0.89728264	0	6.28318530
1	2.0998430E-06	1	0.20243278	1	0.52084061	1	0.57320224
2	9.9172844E-07	2	0.06651849	2	0.23251797	2	1.34286131
3	8.0543455E-07	3	0.08804496	3	0.27744159	3	1.08172694
4	1.3189587E-06	4	0.39213224	4	0.65513572	4	0.53824691
5	1.1730947E-06	5	0.61098081	5	0.67153817	5	0.00000001

RECOLORED SPECTRUM OF SERIES 1 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.0594588E-06	0	5.8304088E-06	0	3.3671891E-06
1	4.0316422E-06	1	5.4026996E-06	1	4.3090160E-06
2	4.2651690E-06	2	3.4666257E-06	2	3.2360310E-06
3	2.9030779E-06	3	2.5380332E-06	3	2.3145721E-06
4	2.0132603E-06	4	2.2035857E-06	4	1.3394887E-06
5	1.7468772E-06	5	1.2893660E-06	5	5.0158812E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.1824821E-06	0	2.9256769E-06	0	1.6113019E-06	0	1.6113019E-06
1	-1.6157465E-06	1	8.1455575E-07	1	-5.6984872E-07	1	-5.2703210E-07
2	3.1727271E-07	2	-1.3727269E-07	2	4.1938015E-07	2	-3.3363632E-07
3	4.6643989E-08	3	-1.8537413E-07	3	-3.0741495E-07	3	5.2054416E-07
4	-6.8324995E-07	4	-2.6329999E-07	4	-1.6136999E-06	4	-6.2649995E-07
5	-2.1649583E-06	5	-1.9767313E-07	5	-7.8698061E-07	5	-5.4185591E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 2 AND 3

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	1.4736420E-07	0	3.1852214E-06	0	-2.0913240E-06	0	-0.
1	7.0058867E-06	1	4.8970854E-06	1	3.1613203E-06	1	-6.7670326E-07
2	2.0078363E-06	2	3.5907519E-06	2	-3.2612426E-07	2	1.8274360E-06
3	8.4858680E-06	3	2.3793686E-06	3	2.0254717E-06	3	-9.3555369E-07
4	7.9622909E-06	4	1.6366465E-06	4	3.7389956E-06	4	-9.4850253E-07
5	1.0753691E-05	5	1.0638413E-06	5	1.0050157E-06	5	-1.1891239E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.5766254E-06	0	4.0411534E-06	0	5.3499818E-07	0	-0.
1	4.0417435E-06	1	4.1425360E-06	1	9.7629811E-07	1	1.1850738E-07
2	4.8768567E-06	2	3.6144895E-06	2	1.1336359E-06	2	5.1065378E-07
3	6.7354658E-06	3	2.4965339E-06	3	1.8659537E-06	3	-2.4804347E-07
4	8.7910351E-06	4	1.6791257E-06	4	2.6271196E-06	4	-7.0813972E-07
5	9.3579907E-06	5	1.3502439E-06	5	2.3720056E-06	5	-5.9456195E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	5.3499818E-07	0	0.01980276	0	0.14958183	0	6.28318530
1	9.8346426E-07	1	0.05776731	1	0.24332674	1	0.12079346
2	1.2433413E-06	2	0.08769882	2	0.25494726	2	0.42323355
3	1.8823678E-06	3	0.21071909	3	0.27947107	3	6.15102887
4	2.7208858E-06	4	0.50153054	4	0.30950686	4	6.01989305
5	2.3720056E-06	5	0.44528347	5	0.25347380	5	6.28318524

RECOLORED SPECTRUM OF SERIES 2 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.5766254E-06	0	4.0411534E-06	0	3.9611273E-06
1	4.0417435E-06	1	4.1425360E-06	1	3.9032328E-06
2	4.8768567E-06	2	3.6144895E-06	2	3.2975030E-06
3	6.7354658E-06	3	2.4965339E-06	3	1.9704665E-06
4	8.7910351E-06	4	1.6791257E-06	4	8.3699291E-07
5	9.3579907E-06	5	1.3502439E-06	5	7.4900261E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.1824821E-06	0	3.4341664E-06	0	1.8249999E-06	0	1.8249999E-06
1	-1.6157465E-06	1	1.1377694E-06	1	1.8456332E-06	1	-1.1637046E-07
2	3.1727271E-07	2	3.2161161E-07	2	3.2355373E-07	2	1.1840908E-06
3	4.6643989E-08	3	3.0721091E-07	3	6.4625856E-08	3	-1.7197277E-07
4	-6.8324995E-07	4	-1.5460748E-06	4	-1.8209499E-06	4	-1.6921248E-06
5	-2.1649583E-06	5	-1.6978669E-06	5	-1.9912187E-06	5	-3.5329636E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 2 AND 4

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	1.4736420E-07	0	2.1773335E-06	0	2.6922799E-07	0	-0.
1	7.0058867E-06	1	9.4834841E-06	1	7.7374569E-06	1	4.8411451E-07
2	2.0078363E-06	2	4.6649680E-07	2	-1.0313501E-06	2	1.3436161E-06
3	8.4858680E-06	3	3.4500251E-06	3	7.0730152E-08	3	2.1101980E-06
4	7.9622909E-06	4	2.7855857E-06	4	2.5285926E-06	4	2.2723964E-06
5	1.0753691E-05	5	-2.0685370E-07	5	-6.3008856E-07	5	5.1390248E-14

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.5766254E-06	0	5.8304088E-06	0	4.0033424E-06	0	-0.
1	4.0417435E-06	1	5.4026996E-06	1	3.6781979E-06	1	5.7796127E-07
2	4.8768567E-06	2	3.4666257E-06	2	1.4363717E-06	2	1.3203862E-06
3	6.7354658E-06	3	2.5380332E-06	3	4.0967568E-07	3	1.9591021E-06
4	8.7910351E-06	4	2.2035857E-06	4	1.1244567E-06	4	1.6637477E-06
5	9.3579907E-06	5	1.2893660E-06	5	9.4925200E-07	5	2.5695124E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	4.0033424E-06	0	0.76855156	0	1.11930715	0	6.28318530
1	3.7233290E-06	1	0.63486775	1	0.92121854	1	0.15585725
2	1.9510467E-06	2	0.22515851	2	0.40006233	2	0.74334978
3	2.0014783E-06	3	0.23433481	3	0.29715513	3	1.36465284
4	2.0080984E-06	4	0.20816131	4	0.22842570	4	0.97645766
5	9.4925200E-07	5	0.07467998	5	0.10143758	5	0.00000002

RECOLORED SPECTRUM OF SERIES 2 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.5766254E-06	0	5.8304088E-06	0	1.3494390E-06
1	4.0417435E-06	1	5.4026996E-06	1	1.9726999E-06
2	4.8768567E-06	2	3.4666257E-06	2	2.6860854E-06
3	6.7354658E-06	3	2.5380332E-06	3	1.9432836E-06
4	8.7910351E-06	4	2.2035857E-06	4	1.7448844E-06
5	9.3579907E-06	5	1.2893660E-06	5	1.1930762E-06

ORIGINAL SERIES NO 3

```
0.00189999  0.00060000  0.00080000 -0.00240000 -0.00099999  0.00170000
0.00120000 -0.00060000 -0.00020000  0.00110000 -0.00370000  0.00070000
0.00080000  0.00049999  0.00060000 -0.00240000 -0.00150000 -0.
```

0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 3 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	2.9256769E-06	0	3.4341664E-06	0	1.0587499E-06	0	1.0587499E-06
1	8.1455575E-07	1	1.1377694E-06	1	6.9981089E-07	1	-1.2606804E-07
2	-1.3727269E-07	2	3.2161161E-07	2	-4.7249997E-07	2	7.7549579E-07
3	-1.8537413E-07	3	3.0721091E-07	3	1.2659863E-07	3	-6.5986392E-07
4	-2.6329999E-07	4	-1.5460748E-06	4	2.3969998E-07	4	-1.5021999E-06
5	-1.9767313E-07	5	-1.6978669E-06	5	-3.1415511E-07	5	-1.3125208E-06

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 3 AND 4

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	3.1852214E-06	0	2.1773335E-06	0	-6.7361460E-07	0	0.
1	4.8970854E-06	1	9.4834841E-06	1	3.6160582E-06	1	1.0703584E-06
2	3.5907519E-06	2	4.6649680E-07	2	2.1886634E-07	2	-2.0670123E-06
3	2.3793686E-06	3	3.4500251E-06	3	6.2810806E-07	3	2.7133850E-06
4	1.6366465E-06	4	2.7855857E-06	4	7.3147101E-07	4	1.3964612E-06
5	1.0638413E-06	5	-2.0685370E-07	5	8.7210615E-07	5	1.2812170E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 3 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	4.0411534E-06	0	5.8304088E-06	0	1.4712218E-06	0	0.
1	4.1425360E-06	1	5.4026996E-06	1	1.6943420E-06	1	1.8426114E-08
2	3.6144895E-06	2	3.4666257E-06	2	1.1704747E-06	2	-8.7570292E-08
3	2.4965339E-06	3	2.5380332E-06	3	5.5163836E-07	3	1.1890548E-06
4	1.6791257E-06	4	2.2035857E-06	4	7.4078905E-07	4	1.3765769E-06
5	1.3502439E-06	5	1.2893660E-06	5	8.0178858E-07	5	6.4060848E-14

CROSS SPECTRAL ESTIMATES OF SERIES 3 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	1.4712218E-06	0	0.09186540	0	0.36405987	0	0.
1	1.6944422E-06	1	0.12828516	1	0.40903500	1	0.01087465
2	1.1737460E-06	2	0.10994977	2	0.32473354	2	6.20850837
3	1.3107845E-06	3	0.27116138	3	0.52504174	3	1.13641866
4	1.5632442E-06	4	0.66045082	4	0.93098697	4	1.07710540
5	8.0178858E-07	5	0.36925916	5	0.59381017	5	0.00000007

RECOLORED SPECTRUM OF SERIES 3 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	4.0411534E-06	0	5.8304088E-06	0	5.2947959E-06
1	4.1425360E-06	1	5.4026996E-06	1	4.7096134E-06

2	3.6144895E-06	2	3.4666257E-06	2	3.0854710E-06
3	2.4965339E-06	3	2.5380332E-06	3	1.8498166E-06
4	1.6791257E-06	4	2.2035857E-06	4	7.4822572E-07
5	1.3502439E-06	5	1.2893660E-06	5	8.1325579E-07

MULTIPLE CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	TIMESERIES 1	I	TIMESERIES 2	I	TIMESERIES 3	I	TIMESERIES 4	I	TIMESERIES
0	0.53255957	0	0.80252898	0	0.22618321	0	0.81074058		
1	0.62371673	1	0.77945502	1	0.41589282	1	0.72592821		
2	0.77046347	2	0.71797463	2	0.62261297	2	0.33646934		
3	0.74317279	3	0.75107665	3	0.52388808	3	0.40578461		
4	0.56438456	4	0.62999599	4	0.84812717	4	0.71125903		
5	0.93320153	5	0.90329854	5	0.91846833	5	0.81687626		

PARTIAL CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	REAL PART	I	IMAG PART	I	COH.SQ(I)	I	PHASE(I)
			TIMESERIES 1 AND 2				
0	0.27981345	0	-0.	0	0.07829557	0	6.28318530
1	0.62097134	1	-0.08018726	1	0.39203539	1	6.15476394
2	0.68454778	2	0.39103600	2	0.62151482	2	0.51899836
3	0.60029384	3	0.52635302	3	0.63740019	3	0.71986303
4	-0.22470364	4	0.31807557	4	0.15166380	4	2.18583626
5	-0.90360726	5	-0.00000001	5	0.81650607	5	3.14159265
			TIMESERIES 1 AND 3				
0	-0.28193199	0	-0.	0	0.07948565	0	3.14159265
1	0.17655735	1	-0.54256605	1	0.32555041	1	5.02699322
2	0.44057027	2	-0.60414551	2	0.55909395	2	5.34247422
3	0.25636794	3	-0.45353413	3	0.27141773	3	5.22687799
4	0.35649733	4	-0.24672475	4	0.18796345	4	5.67779440
5	0.87922494	5	-0.00000006	5	0.77303649	5	6.28318518
			TIMESERIES 1 AND 4				
0	0.21569803	0	-0.	0	0.04652564	0	6.28318530
1	-0.27808478	1	0.32562475	1	0.18336263	1	2.27761024
2	-0.24845605	2	0.15979059	2	0.08726344	2	2.57005915
3	0.20337644	3	-0.14587204	3	0.06264063	3	5.66097480
4	0.16190577	4	0.04383875	4	0.02813531	4	0.26442667
5	0.83330656	5	0.00000001	5	0.69439982	5	0.00000002
			TIMESERIES 2 AND 3				
0	-0.17223429	0	-0.	0	0.02966464	0	3.14159265
1	-0.20284967	1	0.30883483	1	0.13652693	1	2.15195274
2	0.01455782	2	0.58919068	2	0.34735758	2	1.54609315
3	0.22896823	3	0.32633234	3	0.15891925	3	0.95896968
4	0.66259620	4	-0.17743840	4	0.47051810	4	6.02153194
5	0.92836722	5	-0.00000007	5	0.86186569	5	6.28318518

TIMESERIES 2 AND 4

0	0.76833905	0	-0.	0	0.59034488	0	6.28318530
1	0.74441735	1	-0.09253135	1	0.56271924	1	6.15951920
2	0.27525624	2	-0.01895643	2	0.07612534	2	6.21442550
3	-0.06775727	3	0.40379798	3	0.16764385	3	1.73704745
4	-0.28601240	4	-0.02770799	4	0.08257083	4	3.23816815
5	0.70005032	5	0.00000000	5	0.49007045	5	0.00000000

TIMESERIES 3 AND 4

0	0.41431809	0	0.	0	0.17165948	0	0.
1	0.43676769	1	0.08982154	1	0.19883393	1	0.20282289
2	0.35485086	2	0.02767484	2	0.12668502	2	0.07783252
3	0.09720800	3	0.21173853	3	0.05428260	3	1.14040515
4	0.34915038	4	0.52427502	4	0.39677028	4	0.98327756
5	-0.57632029	5	-0.00000005	5	0.33214507	5	3.14159274

NRSERS	NRDATA	NRFICS	NRLAGS
4	24	3	5

FILTER COEFFICIENTS

-0.33333333 0.66666666 -0.33333333

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

FILTERED SERIES NO 1

-0.00099999	0.00066666	0.00000000	-0.00133333	0.00033333	-0.
-0.	0.00099999	0.	-0.00200000	0.00099999	0.00166667
-0.00200000	0.00166667	-0.00099999	0.	-0.00133333	0.00233333
-0.00066666	-0.00066666	0.	0.00033333		

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

FILTERED SERIES NO 2

0.00099999	-0.00099999	0.00096666	-0.00076666	0.00060000	-0.00080000
0.00076666	-0.00213333	0.00546666	-0.00786667	0.00480000	0.00096666
-0.00150000	0.	0.00106666	-0.00183333	0.00009999	0.00020000
0.00066666	0.00006666	-0.00070000	0.00040000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 2

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2757115E-06	0	6.0587409E-06	0	9.7722667E-07	0	9.7722667E-07
1	-6.6666659E-07	1	-4.6380669E-06	1	9.4986085E-09	1	-6.4179885E-07
2	-1.5222220E-07	2	1.7632164E-06	2	-8.6233319E-07	2	-7.4316661E-07
3	1.5666357E-07	3	-2.4441055E-07	3	5.5989528E-07	3	1.6334562E-06

I		I		I		I	
4	2.0370369E-07	4	5.8688608E-07	4	2.1358023E-07	4	-1.5494511E-06
5	-4.9404069E-07	5	-1.6730679E-06	5	-8.1380230E-07	5	9.4267578E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 1 AND 2

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	-1.3537226E-07	0	-6.7907687E-07	0	-3.3865601E-07	0	-0.
1	1.7056159E-07	1	5.1843885E-07	1	3.0808091E-07	1	2.8475553E-07
2	4.8835762E-07	2	-5.7557395E-07	2	-4.2117069E-08	2	-4.9634284E-07
3	2.8074582E-06	3	7.7125981E-06	3	3.7687096E-06	3	2.9972307E-06
4	1.5335053E-06	4	1.1879294E-05	4	2.8156038E-06	4	-1.5611435E-06
5	2.8927211E-06	5	2.2196968E-05	5	-3.5896320E-06	5	-5.6172112E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 2

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.7594664E-08	0	-8.0319011E-08	0	-1.5287551E-08	0	-0.
1	1.7352713E-07	1	-5.4443280E-08	1	5.8847185E-08	1	1.8292056E-08
2	9.8868375E-07	2	1.7699723E-06	2	9.9813908E-07	2	5.7232513E-07
3	1.9091948E-06	3	6.6822290E-06	3	2.5777265E-06	3	9.8424376E-07
4	2.1917974E-06	4	1.3417038E-05	4	1.4525713E-06	4	-3.1264207E-08
5	2.2131132E-06	5	1.7038131E-05	5	-3.8701408E-07	5	-2.8086056E-13

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 2

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	1.5287551E-08	0	-0.16537753	0	0.86887429	0	3.14159265
1	6.1624593E-08	1	-0.40197261	1	0.35512944	1	0.30137178
2	1.1505814E-06	2	0.75650340	2	1.16375074	2	0.52062509
3	2.7592407E-06	3	0.59677083	3	1.44523790	3	0.36474188
4	1.4529077E-06	4	0.07178257	4	0.66288411	4	6.26166523
5	3.8701408E-07	5	0.00397217	5	0.17487315	5	3.14159337

RECOLORED SPECTRUM OF SERIES 1 AND 2 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	1.1653775E 35
1	1.0704366E-05	1	-3.3584419E-06	1	-4.7084435E-06
2	4.6591342E-06	2	8.3409263E-06	2	2.0309872E-06
3	2.5069302E-06	3	8.7743175E-06	3	3.5380608E-06
4	1.5069460E-06	4	9.2247355E-06	4	8.5625602E-06
5	1.2448762E-06	5	9.5839490E-06	5	9.5458797E-06

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

FILTERED SERIES NO 1

-0.00099999	0.00066666	0.00000000	-0.00133333	0.00033333	-0.
-0.	0.00099999	0.	-0.00200000	0.00099999	0.00166667
-0.00200000	0.00166667	-0.00099999	0.	-0.00133333	0.00233333

-0.00066666	-0.00066666	0.	0.00033333

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

FILTERED SERIES NO 3

-0.00049999	0.00113333	-0.00153333	-0.00043333	0.00106666	0.00043333
-0.00073333	-0.00030000	0.00203333	-0.00306667	0.00143333	0.00013333
-0.00013333	0.00103333	-0.00130000	-0.00020000	0.00033333	0.00066666
-0.00143333	0.00023333	0.00096666	0.00020000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2757115E-06	0	1.2769167E-06	0	6.7936172E-07	0	6.7936172E-07
1	-6.6666659E-07	1	-7.0180892E-07	1	-6.3754085E-07	1	-1.6931214E-07
2	-1.5222220E-07	2	-1.4369998E-07	2	1.1244444E-07	2	-2.9688885E-07
3	1.5666357E-07	3	3.0212983E-07	3	2.4850720E-07	3	5.2788543E-07
4	2.0370369E-07	4	-8.0960211E-08	4	-1.2283949E-07	4	-5.2791488E-07
5	-4.9404069E-07	5	-1.8854271E-08	5	-3.5378696E-07	5	1.4186850E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 1 AND 3

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	-1.3537226E-07	0	9.3838749E-09	0	-2.9225664E-07	0	-0.
1	1.7056159E-07	1	1.5678671E-08	1	3.6211951E-07	1	8.6474004E-08
2	4.8835762E-07	2	5.1793955E-07	2	-3.5591913E-07	2	-4.2574707E-07
3	2.8074582E-06	3	2.4008442E-06	3	1.6108914E-06	3	-1.3644805E-07
4	1.5335053E-06	4	2.6225245E-06	4	1.9355537E-06	4	-1.1683187E-06
5	2.8927211E-06	5	1.6458087E-06	5	-1.9417471E-08	5	-1.8928342E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.7594664E-08	0	1.2531273E-08	0	3.4931433E-08	0	-0.
1	1.7352713E-07	1	1.3967019E-07	1	1.9015811E-08	1	-6.3199764E-08
2	9.8868375E-07	2	8.6310050E-07	2	3.1529316E-07	2	-2.2536705E-07
3	1.9091948E-06	3	1.9855381E-06	3	1.2003543E-06	3	-4.6674048E-07
4	2.1917974E-06	4	2.3229255E-06	4	1.3656453E-06	4	-6.1827143E-07
5	2.2131132E-06	5	2.1341666E-06	5	9.5806812E-07	5	-9.4641711E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	3.4931433E-08	0	5.53422308	0	1.98534252	0	6.28318530
1	6.5998570E-08	1	0.17972063	1	0.38033573	1	5.00465679
2	3.8755655E-07	2	0.17601569	2	0.39199243	2	5.66260481
3	1.2879042E-06	3	0.43756103	3	0.67457976	3	5.91234028
4	1.4990820E-06	4	0.44138245	4	0.68395095	4	5.85806167
5	9.5806811E-07	5	0.19433939	5	0.43290515	5	6.28318518

RECOLORED SPECTRUM OF SERIES 1 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	-4.5342231E 35
1	1.0704366E-05	1	8.6158332E-06	1	7.0673901E-06
2	4.6591342E-06	2	4.0673280E-06	2	3.3514144E-06
3	2.5069302E-06	3	2.6071753E-06	3	1.4663769E-06
4	1.5069460E-06	4	1.5971016E-06	4	8.9216896E-07
5	1.2448762E-06	5	1.2004688E-06	5	9.6717039E-07

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

FILTERED SERIES NO 1

-0.00099999	0.00066666	0.00000000	-0.00133333	0.00033333	-0.
-0.	0.00099999	0.	-0.00200000	0.00099999	0.00166667
-0.00200000	0.00166667	-0.00099999	0.	-0.00133333	0.00233333
-0.00066666	-0.00066666	0.	0.00033333		

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

FILTERED SERIES NO 4

-0.00110000	-0.00006666	0.00113333	-0.00043333	-0.00053333	0.00053333
0.00006666	-0.00189999	0.00226666	-0.00066666	-0.00086667	0.00143333
-0.00040000	0.00056666	-0.00049999	-0.00006666	-0.00143333	0.00153333
-0.00099999	-0.00030000	0.00246666	-0.00150000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2757115E-06	0	1.3543915E-06	0	4.7619370E-07	0	4.7619370E-07
1	-6.6666659E-07	1	-7.5986636E-07	1	-5.8251451E-08	1	-7.5502635E-07
2	-1.5222220E-07	2	-1.8387776E-07	2	-1.3811109E-07	2	5.3822213E-07
3	1.5666357E-07	3	5.9954439E-07	3	1.2437672E-07	3	-1.0249300E-08
4	2.0370369E-07	4	-4.2904316E-07	4	1.9444441E-07	4	-3.8799720E-07
5	-4.9404069E-07	5	-1.3965395E-07	5	-4.7001148E-07	5	4.5651665E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 1 AND 4

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	-1.3537226E-07	0	-3.3174826E-07	0	-2.3145824E-08	0	-0.
1	1.7056159E-07	1	4.7458069E-07	1	6.9946837E-08	1	2.3671043E-07
2	4.8835762E-07	2	-1.9261179E-07	2	-2.5770911E-07	2	-3.6793244E-07
3	2.8074582E-06	3	2.9661088E-06	3	4.4308099E-07	3	1.5350146E-06

4	1.5335053E-06	4	3.3953297E-06	4	1.4428977E-06	4	8.3847157E-07
5	2.8927211E-06	5	5.8884745E-07	5	1.3886497E-06	5	-5.4070944E-14

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.7594664E-08	0	7.1416213E-08	0	2.3400506E-08	0	-0.
1	1.7352713E-07	1	1.0620033E-07	1	-3.5240315E-08	1	2.6372104E-08
2	9.8868375E-07	2	7.6386647E-07	2	-5.9760019E-10	2	2.5896503E-07
3	1.9091948E-06	3	2.2837338E-06	3	5.1783764E-07	3	8.8514208E-07
4	2.1917974E-06	4	2.5864039E-06	4	1.1793815E-06	4	8.0298941E-07
5	2.2131132E-06	5	1.9920886E-06	5	1.4157737E-06	5	-2.7035472E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	2.3400506E-08	0	0.43578545	0	1.32997747	0	6.28318530
1	4.4015539E-08	1	0.10512809	1	0.25365219	1	2.49914810
2	2.5896572E-07	2	0.08879934	2	0.26192978	2	1.57310399
3	1.0254913E-06	3	0.24119493	3	0.53713284	3	1.04145440
4	1.4267911E-06	4	0.35910711	4	0.65096848	4	0.59776200
5	1.4157737E-06	5	0.45464813	5	0.63972041	5	6.28318524

RECOLORED SPECTRUM OF SERIES 1 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	5.6421455E 34
1	1.0704366E-05	1	6.5511783E-06	1	5.8624654E-06
2	4.6591342E-06	2	3.5996914E-06	2	3.2800411E-06
3	2.5069302E-06	3	2.9987308E-06	3	2.2754521E-06
4	1.5069460E-06	4	1.7782532E-06	4	1.1396698E-06
5	1.2448762E-06	5	1.1205499E-06	5	6.1109396E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

FILTERED SERIES NO 2

0.00099999	-0.00099999	0.00096666	-0.00076666	0.00060000	-0.00080000
0.00076666	-0.00213333	0.00546666	-0.00786667	0.00480000	0.00096666
-0.00150000	0.	0.00106666	-0.00183333	0.00009999	0.00020000
0.00066666	0.00006666	-0.00070000	0.00040000		

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

FILTERED SERIES NO 3

-0.00049999	0.00113333	-0.00153333	-0.00043333	0.00106666	0.00043333
-0.00073333	-0.00030000	0.00203333	-0.00306667	0.00143333	0.00013333
-0.00013333	0.00103333	-0.00130000	-0.00020000	0.00033333	0.00066666
-0.00143333	0.00023333	0.00096666	0.00020000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.0587409E-06	0	1.2769167E-06	0	1.7111797E-06	0	1.7111797E-06
1	-4.6380669E-06	1	-7.0180892E-07	1	-1.5398158E-06	1	-1.1197781E-06
2	1.7632164E-06	2	-1.4369998E-07	2	8.1564988E-07	2	7.3777757E-09
3	-2.4441055E-07	3	3.0212983E-07	3	8.9535248E-08	3	6.3097251E-07
4	5.8688608E-07	4	-8.0960211E-08	4	-7.2063437E-07	4	-2.9252397E-07
5	-1.6730679E-06	5	-1.8854271E-08	5	5.5618602E-07	5	-5.5572464E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 2 AND 3

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	-6.7907687E-07	0	9.3838749E-09	0	-4.1780643E-07	0	0.
1	5.1843885E-07	1	1.5678671E-08	1	4.1063499E-07	1	-2.4475394E-07
2	-5.7557395E-07	2	5.1793955E-07	2	-6.7227879E-07	2	8.0101677E-07
3	7.7125981E-06	3	2.4008442E-06	3	2.1367850E-06	3	-9.6347826E-07
4	1.1879294E-05	4	2.6225245E-06	4	5.1597080E-06	4	-1.2789049E-06
5	2.2196968E-05	5	1.6458087E-06	5	3.4599044E-06	5	-3.7465147E-14

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	-8.0319011E-08	0	1.2531273E-08	0	-3.5857184E-09	0	0.
1	-5.4443280E-08	1	1.3967019E-07	1	-6.7203807E-08	1	7.7877226E-08
2	1.7699723E-06	2	8.6310050E-07	2	3.0071559E-07	2	9.8450342E-08
3	6.6822290E-06	3	1.9855381E-06	3	2.1902498E-06	3	-6.0121117E-07
4	1.3417038E-05	4	2.3229255E-06	4	3.9790263E-06	4	-8.8032204E-07
5	1.7038131E-05	5	2.1341666E-06	5	4.3098062E-06	5	-1.8732574E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	3.5857184E-09	0	-0.01277435	0	-0.04464345	0	3.14159265
1	1.0286503E-07	1	-1.39151371	1	-1.88939807	1	2.28275812
2	3.1642114E-07	2	0.06553950	2	0.17877180	2	0.31638924
3	2.2712659E-06	3	0.38880906	3	0.33989644	3	6.01528925
4	4.0752443E-06	4	0.53286277	4	0.30373650	4	6.06545198
5	4.3098062E-06	5	0.51081683	5	0.25295064	5	6.28318524

RECOLURED SPECTRUM OF SERIES 2 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	1.0127743E 35
1	-3.3584419E-06	1	8.6158332E-06	1	2.0604883E-05
2	8.3409263E-06	2	4.0673280E-06	2	3.8007573E-06
3	8.7743175E-06	3	2.6071753E-06	3	1.5934819E-06
4	9.2247355E-06	4	1.5971016E-06	4	7.4606560E-07
5	9.5839490E-06	5	1.2004688E-05	5	5.8724911E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

FILTERED SERIES NO 2

0.00099999	-0.00099999	0.00096666	-0.00076666	0.00060000	-0.00080000
0.00076666	-0.00213333	0.00546666	-0.00786667	0.00480000	0.00096666
-0.00150000	0.	0.00106666	-0.00183333	0.00009999	0.00020000
0.00066666	0.00006666	-0.00070000	0.00040000		

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

FILTERED SERIES NO 4

-0.00110000	-0.00006666	0.00113333	-0.00043333	-0.00053333	0.00053333
0.00006666	-0.00189999	0.00226666	-0.00066666	-0.00086667	0.00143333
-0.00040000	0.00056666	-0.00049999	-0.00006666	-0.00143333	0.00153333
-0.00099999	-0.00030000	0.00246666	-0.00150000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.0587409E-06	0	1.3543915E-06	0	7.2584011E-07	0	7.2584011E-07
1	-4.6380669E-06	1	-7.5986636E-07	1	2.4307127E-07	1	-1.4479488E-06
2	1.7632164E-06	2	-1.8387776E-07	2	-7.1221102E-07	2	1.1776332E-06
3	-2.4441055E-07	3	5.9954439E-07	3	8.0142186E-07	3	-1.1935364E-07
4	5.8688608E-07	4	-4.2904316E-07	4	-4.9459869E-07	4	-7.2414941E-07
5	-1.6730679E-06	5	-1.3965395E-07	5	-1.6627066E-07	5	3.7838518E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 2 AND 4

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	-6.7907687E-07	0	-3.3174826E-07	0	-4.4423790E-07	0	-0.
1	5.1843885E-07	1	4.7458069E-07	1	5.6405700E-07	1	2.0724410E-07
2	-5.7557395E-07	2	-1.9261179E-07	2	-8.4538332E-07	2	-2.6210080E-07
3	7.7125981E-06	3	2.9661088E-06	3	7.9076672E-07	3	2.3961755E-06
4	1.1879294E-05	4	3.3953297E-06	4	3.1472457E-06	4	3.5320883E-06
5	2.2196968E-05	5	5.8884745E-07	5	3.8926622E-07	5	2.9391503E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	-8.0319011E-08	0	7.1416213E-08	0	5.9909549E-08	0	-0.
1	-5.4443280E-08	1	1.0620033E-07	1	-4.0376807E-08	1	3.8096848E-08
2	1.7699723E-06	2	7.6386647E-07	2	-8.3985735E-08	2	5.1980449E-07
3	6.6822290E-06	3	2.2837338E-06	3	9.7084895E-07	3	2.0155846E-06

I		I		I		I	
4	1.3417038E-05	4	2.5864039E-06	4	1.8686311E-06	4	2.3650881E-06
5	1.7038131E-05	5	1.9920886E-06	5	1.7682560E-06	5	1.4695752E-13

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	5.9909549E-08	0	-0.62571552	0	-0.74589500	0	6.28318530
1	5.5512669E-08	1	-0.53298387	1	-1.01964225	1	2.38524014
2	5.2654564E-07	2	0.20506339	2	0.29748807	2	1.73098376
3	2.2372145E-06	3	0.32798080	3	0.33480063	3	1.12191902
4	3.0142037E-06	4	0.26181359	4	0.22465491	4	0.90212769
5	1.7682560E-06	5	0.09212121	5	0.10378227	5	0.00000008

RECOLORED SPECTRUM OF SERIES 2 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	1.6257155E 35
1	-3.3584419E-06	1	6.5511783E-06	1	1.0042851E-05
2	8.3409263E-06	2	3.5996914E-06	2	2.8615264E-06
3	8.7743175E-06	3	2.9987308E-06	3	2.0152046E-06
4	9.2247355E-06	4	1.7782532E-06	4	1.3126824E-06
5	9.5839490E-06	5	1.1205499E-06	5	1.0173234E-06

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

FILTERED SERIES NO 3

-0.00049999	0.00113333	-0.00153333	-0.00043333	0.00106666	0.00043333
-0.00073333	-0.00030000	0.00203333	-0.00306667	0.00143333	0.00013333
-0.00013333	0.00103333	-0.00130000	-0.00020000	0.00033333	0.00066666
-0.00143333	0.00023333	0.00096666	0.00020000		

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

FILTERED SERIES NO 4

-0.00110000	-0.00006666	0.00113333	-0.00043333	-0.00053333	0.00053333
0.00006666	-0.00189999	0.00226666	-0.00066666	-0.00086667	0.00143333
-0.00040000	0.00056666	-0.00049999	-0.00006666	-0.00143333	0.00153333
-0.00099999	-0.00030000	0.00246666	-0.00150000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 3 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2769167E-06	0	1.3543915E-06	0	4.5480022E-07	0	4.5480022E-07
1	-7.0180892E-07	1	-7.5986636E-07	1	2.8626350E-07	1	-9.0908780E-07

2	-1.4369998E-07	2	-1.8387776E-07	2	-6.0914435E-07	2	7.6078879E-07
3	3.0212983E-07	3	5.9954439E-07	3	1.9646351E-07	3	-9.4072007E-08
4	-8.0960211E-08	4	-4.2904316E-07	4	2.0049380E-07	4	-2.7959186E-07
5	-1.8854271E-08	5	-1.3965395E-07	5	1.6955010E-08	5	1.9772777E-07

AUTO AND CROSS COVARIANCE TRANSFORM FUNCTIONS OF SERIES 3 AND 4

I	AUCVTX(I)	I	AUCVTY(I)	I	CO(I)	I	QUAD(I)
0	9.3838749E-09	0	-3.3174826E-07	0	1.1425519E-07	0	-0.
1	1.5678671E-08	1	4.7458069E-07	1	-7.7204963E-08	1	-4.1771019E-08
2	5.1793955E-07	2	-1.9261179E-07	2	1.3971627E-07	2	-2.9574093E-07
3	2.4008442E-06	3	2.9661088E-06	3	4.7563295E-07	3	2.2278891E-06
4	2.6225245E-06	4	3.3953297E-06	4	1.2085101E-06	4	1.9996221E-06
5	1.6458087E-06	5	5.8884745E-07	5	9.4043798E-07	5	1.0912514E-13

SPECTRUM AND CROSS SPECTRUM OF SERIES 3 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.2531273E-08	0	7.1416213E-08	0	1.8525112E-08	0	-0.
1	1.3967019E-07	1	1.0620033E-07	1	2.4890383E-08	1	-9.4820741E-08
2	8.6310050E-07	2	7.6386647E-07	2	1.6946513E-07	2	3.9865904E-07
3	1.9855381E-06	3	2.2837338E-06	3	5.7487305E-07	3	1.5399148E-06
4	2.3229255E-06	4	2.5864039E-06	4	9.5827276E-07	4	1.5567833E-06
5	2.1341666E-06	5	1.9920886E-06	5	1.0744740E-06	5	5.4562570E-14

CROSS SPECTRAL ESTIMATES OF SERIES 3 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	1.8525112E-08	0	0.38346851	0	1.47831050	0	6.28318530
1	9.8033178E-08	1	0.64791283	1	0.70189048	1	4.96909672
2	4.3318294E-07	2	0.28461898	2	0.50189165	2	1.16885123
3	1.6437204E-06	3	0.59584343	3	0.82784629	3	1.21350387
4	1.8280758E-06	4	0.55623301	4	0.78697133	4	1.01902382
5	1.0744740E-06	5	0.27155317	5	0.50346304	5	0.00000004

RECOLORED SPECTRUM OF SERIES 3 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	6.1653149E 34
1	8.6158332E-06	1	6.5511783E-06	1	2.3065858E-06
2	4.0673280E-06	2	3.5996914E-06	2	2.5751508E-06
3	2.6071753E-06	3	2.9987308E-06	3	1.2119567E-06
4	1.5971016E-06	4	1.7782532E-06	4	7.8913007E-07
5	1.2004688E-06	5	1.1205499E-06	5	8.1626098E-07

MULTIPLE CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	TIMESERIES 1	I	TIMESERIES 2	I	TIMESERIES 3	I	TIMESERIES 4	I	TIMESERIES
0	6.13729382	0	-1.04548125	0	4.94167292	0	-0.53450330		
1	0.01233464	1	-12.66164374	1	-0.32784887	1	0.34041330		
2	0.97841720	2	0.97655186	2	0.90792426	2	0.47111055		
3	0.76191115	3	0.74758040	3	0.75783399	3	0.62393541		
4	0.57357744	4	0.63422869	4	0.81350547	4	0.58573191		

5 0.69958804 5 0.72865435 5 0.75057337 5 0.57945452

PARTIAL CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	REAL PART	I	IMAG PART	I	COH.SQ(I)	I	PHASE(I)
			TIMESERIES 1 AND 2				
0	0.27680436	0	-0.	0	0.07662065	0	6.28318530
1	0.	1	0.	1	0.	1	3.14159265
2	0.77848087	2	0.60354434	2	0.97029824	2	0.65948793
3	0.52546024	3	0.52969042	3	0.55668040	3	0.78940722
4	-0.39680877	4	0.21098331	4	0.20197115	4	2.65290761
5	-0.66167445	5	-0.00000001	5	0.43781307	5	3.14159268
			TIMESERIES 1 AND 3				
0	2.38578343	0	-0.	0	5.69196254	0	6.28318530
1	0.11545856	1	0.01606138	1	0.01358864	1	0.13822245
2	0.39748474	2	-0.84403961	2	0.87039699	2	5.15251243
3	0.24130233	3	-0.48433290	3	0.29280517	3	5.17460823
4	0.46879356	4	-0.32154713	4	0.32315996	4	5.68198287
5	0.59660165	5	-0.00000001	5	0.35593352	5	6.28318524
			TIMESERIES 1 AND 4				
0	-0.	0	-0.	0	0.	0	3.14159265
1	-0.42144915	1	0.24080658	1	0.23560719	1	2.62248498
2	0.35302630	2	-0.01617102	2	0.12488907	2	6.23741043
3	-0.03177848	3	-0.01336366	3	0.00118846	3	3.53966734
4	0.13480057	4	0.17433336	4	0.04856332	4	0.91259021
5	0.64411227	5	0.00000000	5	0.41488062	5	0.00000000
			TIMESERIES 2 AND 3				
0	0.59299348	0	0.	0	0.35164127	0	0.
1	-0.	1	0.	1	0.	1	3.14159265
2	0.20318047	2	0.89292766	2	0.83860210	2	1.34706163
3	0.30282237	3	0.24841807	3	0.15341292	3	0.68702242
4	0.68239787	4	-0.17401615	4	0.49594847	4	6.03349984
5	0.80656671	5	-0.00000002	5	0.65054985	5	6.28318524
			TIMESERIES 2 AND 4				
0	0.	0	-0.	0	0.	0	3.14159265
1	-0.	1	-0.	1	0.	1	3.14159265
2	-0.28160814	2	0.28697309	2	0.16165670	2	2.34675908
3	-0.02063167	3	0.15846049	3	0.02553539	3	1.70026876
4	-0.10115992	4	0.11762165	4	0.02406818	4	2.28109321
5	0.35996699	5	-0.00000000	5	0.12957623	5	6.28318524
			TIMESERIES 3 AND 4				
0	-0.	0	-0.	0	0.	0	3.14159265
1	0.52598144	1	-0.34769534	1	0.39754853	1	5.69908744
2	-0.07946700	2	-0.14444140	2	0.02717832	2	4.20941699
3	0.27093575	3	0.50631038	3	0.32975638	3	1.07945064
4	0.30467390	4	0.28346727	4	0.17317987	4	0.74935673
5	-0.10407704	5	-0.00000000	5	0.01083203	5	3.14159268

NRSERS	NRDATA	NRFICS	NRLAGS
4	24	-0	5

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 2

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	3.1232636E-06	0	6.1824821E-06	0	2.1480901E-06	0	2.1480901E-06
1	5.8159718E-07	1	-1.5521006E-06	1	1.1230902E-06	1	-1.1857637E-07
2	-4.1840276E-07	2	3.0456596E-07	2	-7.4774297E-07	2	-6.3107635E-07
3	-5.4340273E-07	3	2.9149307E-08	3	2.1475692E-07	3	9.3142357E-07
4	-5.0173606E-07	4	-5.7210065E-07	4	-1.5607638E-07	4	-8.8524296E-07
5	-2.1006943E-07	5	-1.7166839E-06	5	-6.6024302E-07	5	1.2725695E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 2

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	3.1232636E-06	0	6.1824821E-06	0	2.1480901E-06	0	2.1480901E-06
1	4.6993052E-07	1	-1.2540972E-06	1	9.0745687E-07	1	-9.5809704E-08
2	-1.7740277E-07	2	1.2913597E-07	2	-3.1704302E-07	2	-2.6757638E-07
3	-6.9555551E-08	3	3.7311114E-09	3	2.7488887E-08	3	1.1922222E-07
4	-8.0277773E-09	4	-9.1536105E-09	4	-2.4972222E-09	4	-1.4163888E-08
5	-0.	5	-0.	5	-0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 2

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.5531523E-06	0	3.9217144E-06	0	2.5051678E-06	0	-0.
1	3.8299629E-06	1	4.2456253E-06	1	2.5922120E-06	1	4.6227361E-07
2	3.8083220E-06	2	5.1867665E-06	2	2.7480295E-06	2	9.6791124E-07
3	3.0023695E-06	3	6.7489901E-06	3	2.4837876E-06	3	1.0482541E-06
4	2.2232606E-06	4	8.3085808E-06	4	1.3696118E-06	4	5.4264979E-07
5	1.9516525E-06	5	8.9231787E-06	5	5.8845133E-07	5	2.3011362E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 2

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	2.5051678E-06	0	0.45038494	0	0.70505501	0	6.28318530
1	2.6331084E-06	1	0.42638434	1	0.68750231	1	0.17647653
2	2.9135062E-06	2	0.42973579	2	0.76503671	2	0.33865125
3	2.6959297E-06	3	0.35868583	3	0.89793403	3	0.39935958

4	1.4731956E-06	4	0.11749073	4	0.66262840	4	0.37723227
5	5.8845133E-07	5	0.01988378	5	0.30151440	5	0.00000004

RECOLORED SPECTRUM OF SERIES 1 AND 2 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.5531523E-06	0	3.9217144E-06	0	2.1554333E-06
1	3.8299629E-06	1	4.2456253E-06	1	2.4353572E-06
2	3.8083220E-06	2	5.1867665E-06	2	2.9578273E-06
3	3.0023695E-06	3	6.7489901E-06	3	4.3282229E-06
4	2.2232606E-06	4	8.3085808E-06	4	7.3323995E-06
5	1.9516525E-06	5	8.9231787E-06	5	8.7457521E-06

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	3.1232636E-06	0	2.9256769E-06	0	1.0682291E-06	0	1.0682291E-06
1	5.8159718E-07	1	7.3859374E-07	1	-6.7343746E-07	1	3.6406247E-07
2	-4.1840276E-07	2	-2.0473955E-07	2	-6.6510411E-07	2	-1.2760417E-07
3	-5.4340273E-07	3	-2.8182289E-07	3	-7.0260411E-07	3	-3.5937498E-08
4	-5.0173606E-07	4	-3.6932290E-07	4	-5.5260414E-07	4	-6.9843743E-07
5	-2.1006943E-07	5	-2.9557291E-07	5	-1.5677084E-07	5	1.6822917E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 3

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	3.1232636E-06	0	2.9256769E-06	0	1.0682291E-06	0	1.0682291E-06
1	4.6993052E-07	1	5.9678373E-07	1	-5.4413747E-07	1	2.9416247E-07
2	-1.7740277E-07	2	-8.6809570E-08	2	-2.8200415E-07	2	-5.4104167E-08
3	-6.9555551E-08	3	-3.6073331E-08	3	-8.9933329E-08	3	-4.5999998E-09
4	-8.0277773E-09	4	-5.9091665E-09	4	-8.8416665E-09	4	-1.1174999E-08
5	-0.	5	-0.	5	-0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.5531523E-06	0	3.8616600E-06	0	3.6759576E-07	0	-0.
1	3.8299629E-06	1	3.8694975E-06	1	8.0753807E-07	1	-7.8927140E-07
2	3.8083220E-06	2	3.4896860E-06	2	1.3331934E-06	2	-8.8328830E-07
3	3.0023695E-06	3	2.6352851E-06	3	1.3347283E-06	3	-6.1093756E-07
4	2.2232606E-06	4	1.8936759E-06	4	1.1535813E-06	4	-3.5852789E-07

I		I		I		I	
5	1.9516525E-06	5	1.6188185E-06	5	1.0566124E-06	5	-1.8793219E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	3.6759576E-07	0	0.00984811	0	0.10345623	0	6.28318530
1	1.1291887E-06	1	0.08603673	1	0.29483018	1	5.50922608
2	1.5992507E-06	2	0.19244786	2	0.41993579	2	5.69804800
3	1.4679048E-06	3	0.27233535	3	0.48891543	3	5.85392648
4	1.2080101E-06	4	0.34661323	4	0.54335067	4	5.98185796
5	1.0566124E-06	5	0.35337087	5	0.54139371	5	6.28318524

RECOLORED SPECTRUM OF SERIES 1 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.5531523E-06	0	3.8616600E-06	0	3.8236299E-06
1	3.8299629E-06	1	3.8694975E-06	1	3.5365785E-06
2	3.8083220E-06	2	3.4896860E-06	2	2.8181034E-06
3	3.0023695E-06	3	2.6352851E-06	3	1.9176037E-06
4	2.2232606E-06	4	1.8936759E-06	4	1.2373028E-06
5	1.9516525E-06	5	1.6188185E-06	5	1.0467752E-06

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	3.1232636E-06	0	3.4341664E-06	0	1.0916666E-06	0	1.0916666E-06
1	5.8159718E-07	1	1.1083333E-06	1	8.3333327E-07	1	-2.0833330E-07
2	-4.1840276E-07	2	2.7208333E-07	2	8.3333327E-07	2	5.9999996E-07
3	-5.4340273E-07	3	3.7041664E-07	3	7.1249995E-07	3	1.5833333E-07
4	-5.0173606E-07	4	-1.1108332E-06	4	-3.9583332E-07	4	-2.4583328E-07
5	-2.1006943E-07	5	-1.2291666E-06	5	-1.3041666E-06	5	4.6249998E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 4

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	3.1232636E-06	0	3.4341664E-06	0	1.0916666E-06	0	1.0916666E-06
1	4.6993052E-07	1	8.9553328E-07	1	6.7333328E-07	1	-1.6833331E-07
2	-1.7740277E-07	2	1.1536333E-07	2	3.5333332E-07	2	2.5439999E-07
3	-6.9555551E-08	3	4.7413331E-08	3	9.1199996E-08	3	2.0266667E-08
4	-8.0277773E-09	4	-1.7773332E-08	4	-6.3333333E-09	4	-3.9333326E-09
5	-0.	5	-0.	5	-0.	5	0.

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 3

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	6.1824821E-06	0	2.9256769E-06	0	1.6113019E-06	0	1.6113019E-06
1	-1.2540972E-06	1	5.9678373E-07	1	-4.2045454E-07	1	-3.8779789E-07
2	1.2913597E-07	2	-8.6809570E-08	2	1.7651208E-07	2	-1.0350457E-07
3	3.7311114E-09	3	-3.6073331E-08	3	-2.7780000E-08	3	7.4459993E-08
4	-9.1536105E-09	4	-5.9091665E-09	4	-2.1232499E-08	4	-5.8058331E-09
5	-0.	5	-0.	5	-0.	5	-0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.9217144E-06	0	3.8616600E-06	0	8.9569863E-07	0	-0.
1	4.2456253E-06	1	3.8694975E-06	1	9.8742204E-07	1	1.4081297E-07
2	5.1867665E-06	2	3.4896860E-06	2	1.2563536E-06	2	2.0829812E-07
3	6.7489901E-06	3	2.6352851E-06	3	1.8314109E-06	3	-1.5022443E-07
4	8.3085808E-06	4	1.8936759E-06	4	2.3240517E-06	4	-3.7367519E-07
5	8.9231787E-06	5	1.6188185E-06	5	2.4188434E-06	5	-2.6274581E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	8.9569863E-07	0	0.05297534	0	0.22839466	0	6.28318530
1	9.9741193E-07	1	0.06055540	1	0.23492698	1	0.14165158
2	1.2735040E-06	2	0.08960197	2	0.24552946	2	0.16430119
3	1.8375617E-06	3	0.18985301	3	0.27227210	3	6.20134187
4	2.3539009E-06	4	0.35216310	4	0.28330962	4	6.12376362
5	2.4188434E-06	5	0.40503985	5	0.27107418	5	6.28318524

RECOLORED SPECTRUM OF SERIES 2 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.9217144E-06	0	3.8616600E-06	0	3.6570872E-06
1	4.2456253E-06	1	3.8694975E-06	1	3.6351785E-06
2	5.1867665E-06	2	3.4896860E-06	2	3.1770033E-06
3	6.7489901E-06	3	2.6352851E-06	3	2.1349683E-06
4	8.3085808E-06	4	1.8936759E-06	4	1.2267931E-06
5	8.9231787E-06	5	1.6188185E-06	5	9.6313249E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.1824821E-06	0	3.4341664E-06	0	1.8249999E-06	0	1.8249999E-06
1	-1.5521006E-06	1	1.1083333E-06	1	1.8004165E-06	1	-1.3583329E-07
2	3.0456596E-07	2	2.7208333E-07	2	3.2999999E-07	2	1.0645832E-06
3	2.9149307E-08	3	3.7041664E-07	3	7.1666661E-08	3	-1.3416666E-07
4	-5.7210065E-07	4	-1.1108332E-06	4	-1.4733333E-06	4	-1.3679165E-06
5	-1.7166839E-06	5	-1.2291666E-06	5	-1.5012499E-06	5	-2.9083331E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 4

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	6.1824821E-06	0	3.4341664E-06	0	1.8249999E-06	0	1.8249999E-06
1	-1.2540972E-06	1	8.9553328E-07	1	1.4547366E-06	1	-1.0975330E-07
2	1.2913597E-07	2	1.1536333E-07	2	1.3992000E-07	2	4.5138330E-07
3	3.7311114E-09	3	4.7413331E-08	3	9.1733328E-09	3	-1.7173332E-08
4	-9.1536105E-09	4	-1.7773332E-08	4	-2.3573333E-08	4	-2.1886665E-08
5	-0.	5	-0.	5	-0.	5	-0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.9217144E-06	0	5.5152395E-06	0	3.7078264E-06	0	-0.
1	4.2456253E-06	1	4.9539228E-06	1	3.1350870E-06	1	6.4743060E-07
2	5.1867665E-06	2	3.7132736E-06	2	1.7546724E-06	2	1.2909626E-06
3	6.7489901E-06	3	2.7597664E-06	3	9.1048272E-07	3	1.6539015E-06
4	8.3085808E-06	4	2.1145225E-06	4	9.5391412E-07	4	1.2418518E-06
5	8.9231787E-06	5	1.7434531E-06	5	1.0338599E-06	5	6.9017737E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	3.7078263E-06	0	0.63562129	0	0.94546057	0	6.28318530
1	3.2012398E-06	1	0.48724290	1	0.75400902	1	0.20364843
2	2.1784076E-06	2	0.24639088	2	0.41999337	2	0.63430465
3	1.8879536E-06	3	0.19136897	3	0.27973868	3	1.06756468
4	1.5659336E-06	4	0.13957497	4	0.18847185	4	0.91578732
5	1.0338599E-06	5	0.06870581	5	0.11586229	5	0.00000006

RECOLORED SPECTRUM OF SERIES 2 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.9217144E-06	0	5.5152395E-06	0	2.0096358E-06
1	4.2456253E-06	1	4.9539228E-06	1	2.5401590E-06
2	5.1867665E-06	2	3.7132736E-06	2	2.7983568E-06
3	6.7489901E-06	3	2.7597664E-06	3	2.2316327E-06
4	8.3085808E-06	4	2.1145225E-06	4	1.8193881E-06
5	8.9231787E-06	5	1.7434531E-06	5	1.6236677E-06

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.

0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 3 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	2.9256769E-06	0	3.4341664E-06	0	1.0587499E-06	0	1.0587499E-06
1	7.3859374E-07	1	1.1083333E-06	1	6.8416661E-07	1	-6.2083313E-08
2	-2.0473955E-07	2	2.7208333E-07	2	-3.2999998E-07	2	7.9458327E-07
3	-2.8182289E-07	3	3.7041664E-07	3	3.3291664E-07	3	-5.0916665E-07
4	-3.6932290E-07	4	-1.1108332E-06	4	4.9374997E-07	4	-1.2608332E-06
5	-2.9557291E-07	5	-1.2291666E-06	5	8.7499950E-09	5	-1.0541666E-06

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 3 AND 4

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	2.9256769E-06	0	3.4341664E-06	0	1.0587499E-06	0	1.0587499E-06
1	5.9678373E-07	1	8.9553328E-07	1	5.5280662E-07	1	-5.0163317E-08
2	-8.6809570E-08	2	1.1536333E-07	2	-1.3991999E-07	2	3.3690331E-07
3	-3.6073331E-08	3	4.7413331E-08	3	4.2613331E-08	3	-6.5173332E-08
4	-5.9091665E-09	4	-1.7773332E-08	4	7.8999997E-09	4	-2.0173333E-08
5	-0.	5	-0.	5	0.	5	-0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 3 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	3.8616600E-06	0	5.5152395E-06	0	1.7235432E-06	0	0.
1	3.8694975E-06	1	4.9539228E-06	1	1.5431688E-06	1	1.9943224E-08
2	3.4896860E-06	2	3.7132736E-06	2	1.0691711E-06	2	2.0313404E-07
3	2.6352851E-06	3	2.7597664E-06	3	7.2201764E-07	3	8.1707205E-07
4	1.8936759E-06	4	2.1145225E-06	4	7.1593205E-07	4	8.9391285E-07
5	1.6188185E-06	5	1.7434531E-06	5	7.6337659E-07	5	5.4649742E-14

CROSS SPECTRAL ESTIMATES OF SERIES 3 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	1.7235432E-06	0	0.13947807	0	0.44632183	0	0.
1	1.5432976E-06	1	0.12424976	1	0.39883671	1	0.01292283
2	1.0882970E-06	2	0.09140112	2	0.31186099	2	0.18775430
3	1.0903743E-06	3	0.16347499	3	0.41375954	3	0.84707996
4	1.1452680E-06	4	0.32756412	4	0.60478567	4	0.89550872
5	7.6337659E-07	5	0.20647584	5	0.47156403	5	0.00000007

RECOLORED SPECTRUM OF SERIES 3 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	3.8616600E-06	0	5.5152395E-06	0	4.7459844E-06
1	3.8694975E-06	1	4.9539228E-06	1	4.3383990E-06

2	3.4896860E-06	2	3.7132736E-06	2	3.3738762E-06
3	2.6352851E-06	3	2.7597664E-06	3	2.3086136E-06
4	1.8936759E-06	4	2.1145225E-06	4	1.4218808E-06
5	1.6188185E-06	5	1.7434531E-06	5	1.3834721E-06

MULTIPLE CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	TIMESERIES 1	I	TIMESERIES 2	I	TIMESERIES 3	I	TIMESERIES 4	I	TIMESERIES
0	0.45363576	0	0.72683620	0	0.15617822	0	0.67374569		
1	0.50667653	1	0.66305266	1	0.24167839	1	0.52926789		
2	0.59782810	2	0.59751318	2	0.37055860	2	0.28017768		
3	0.53682660	3	0.52219089	3	0.43460175	3	0.26376975		
4	0.43586674	4	0.41965257	4	0.59628256	4	0.38012698		
5	0.56207681	5	0.50395292	5	0.66501886	5	0.37140989		

PARTIAL CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	REAL PART	I	IMAG PART	I	COH.SQ(I)	I	PHASE(I)
			TIMESERIES 1 AND 2				
0	0.48912906	0	-0.	0	0.23924723	0	6.28318530
1	0.57582258	1	0.10529221	1	0.34265810	1	0.18085723
2	0.58710238	2	0.31668609	2	0.44497928	2	0.49467266
3	0.40871058	3	0.41169898	3	0.33654039	3	0.78904069
4	-0.03950186	4	0.30283752	4	0.09327096	4	1.70050316
5	-0.40614685	5	0.00000001	5	0.16495526	5	3.14159259
			TIMESERIES 1 AND 3				
0	-0.07007401	0	-0.	0	0.00491036	0	3.14159265
1	0.10147758	1	-0.35144027	1	0.13380796	1	4.99349087
2	0.27638756	2	-0.46257909	2	0.29036950	2	5.25096273
3	0.28556044	3	-0.39944049	3	0.24109747	3	5.33304578
4	0.37714583	4	-0.22507267	4	0.19289659	4	5.74513763
5	0.58154027	5	-0.00000001	5	0.33818908	5	6.28318524
			TIMESERIES 1 AND 4				
0	-0.00743497	0	-0.	0	0.00005528	0	3.14159265
1	-0.10444432	1	0.06293020	1	0.01486883	1	2.59931937
2	-0.07011148	2	0.02234309	2	0.00541483	2	2.83308804
3	0.09602565	3	0.02693810	3	0.00994658	3	0.27350033
4	0.25195289	4	0.05886634	4	0.06694550	4	0.22952298
5	0.45455302	5	-0.00000000	5	0.20661844	5	6.28318524
			TIMESERIES 2 AND 3				
0	-0.07074080	0	-0.	0	0.00500426	0	3.14159265
1	-0.01914486	1	0.19964918	1	0.04022632	1	1.66639656
2	0.10553591	2	0.34709017	2	0.13160941	2	1.27561976
3	0.27349520	3	0.21671489	3	0.12176497	3	0.67008348
4	0.50157864	4	-0.00550269	4	0.25161140	4	6.27221495
5	0.68355296	5	-0.00000000	5	0.46724464	5	6.28318524

TIMESERIES 2 AND 4

0	0.69086478	0	-0.	0	0.47729414	0	6.28318530
1	0.58396358	1	0.06616437	1	0.34539118	1	0.11282108
2	0.29131349	2	0.17949040	2	0.11708035	2	0.55220394
3	0.03227222	3	0.28566524	3	0.08264612	3	1.45830108
4	-0.04149522	4	0.17373270	4	0.03190490	4	1.80524914
5	0.15254551	5	0.00000000	5	0.02327013	5	0.00000004

TIMESERIES 3 AND 4

0	0.32206202	0	0.	0	0.10372394	0	0.
1	0.27364490	1	0.02221793	1	0.07537517	1	0.08101486
2	0.19660021	2	0.01524005	2	0.03688389	2	0.07736330
3	0.18656701	3	0.09214745	3	0.04329840	3	0.45876437
4	0.21153485	4	0.21363648	4	0.09038754	4	0.79034112
5	0.01560556	5	0.00000001	5	0.00024353	5	0.00000099

NRSERS	NRDATA	NRFICS	NRLAGS
4	24	3	5

FILTER COEFFICIENTS

-0.33333333 0.66666666 -0.33333333

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

FILTERED SERIES NO 1

-0.00099999	0.00066666	0.00000000	-0.00133333	0.00033333	-0.
-0.	0.00099999	0.	-0.00200000	0.00099999	0.00166667
-0.00200000	0.00166667	-0.00099999	0.	-0.00133333	0.00233333
-0.00066666	-0.00066666	0.	0.00033333		

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

FILTERED SERIES NO 2

0.00099999	-0.00099999	0.00096666	-0.00076666	0.00060000	-0.00080000
0.00076666	-0.00213333	0.00546666	-0.00786667	0.00480000	0.00096666
-0.00150000	0.	0.00106666	-0.00183333	0.00009999	0.00020000
0.00066666	0.00006666	-0.00070000	0.00040000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 2

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2757115E-06	0	6.0587409E-06	0	9.7722667E-07	0	9.7722667E-07
1	-6.3842968E-07	1	-4.4277726E-06	1	1.1570242E-08	1	-6.1166199E-07
2	-1.3842973E-07	2	1.6032872E-06	2	-7.8438923E-07	2	-6.7580344E-07
3	1.3429750E-07	3	-2.1236912E-07	3	4.8530756E-07	3	1.4105600E-06

I		I		I		I	
4	1.6460054E-07	4	4.7975201E-07	4	1.7571164E-07	4	-1.2667125E-06
5	-3.8590445E-07	5	-1.2931266E-06	5	-6.2580343E-07	5	7.2924693E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 2

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	1.2757115E-06	0	6.0587409E-06	0	9.7722667E-07	0	9.7722667E-07
1	-5.1585118E-07	1	-3.5776402E-06	1	9.3487552E-09	1	-4.9422288E-07
2	-5.8694206E-08	2	6.7979379E-07	2	-3.3258104E-07	2	-2.8654066E-07
3	1.7190081E-08	3	-2.7183248E-08	3	6.2119369E-08	3	1.8055168E-07
4	2.6336086E-09	4	7.6760324E-09	4	2.8113864E-09	4	-2.0267400E-08
5	-0.	5	-0.	5	-0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 2

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.6626811E-07	0	2.2403358E-07	0	9.8445880E-08	0	-0.
1	3.8988640E-07	1	6.9451307E-07	1	3.3276885E-07	1	1.5313452E-07
2	1.0256806E-06	2	2.7964356E-06	2	1.1265530E-06	2	4.9952675E-07
3	1.7189360E-06	3	7.1306750E-06	3	1.8188718E-06	3	5.9754893E-07
4	2.0804639E-06	4	1.2238399E-05	4	1.2672906E-06	4	2.1357780E-07
5	2.1609124E-06	5	1.4643327E-05	5	5.8285200E-07	5	3.9703135E-15

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 2

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	9.8445880E-08	0	0.26017947	0	0.59209118	0	6.28318530
1	3.6631310E-07	1	0.49554877	1	0.93953803	1	0.43128965
2	1.2323346E-06	2	0.52946875	2	1.20147987	2	0.41736156
3	1.9145127E-06	3	0.29903786	3	1.11377777	3	0.31741884
4	1.2851619E-06	4	0.06486805	4	0.61772851	4	0.16696209
5	5.8285199E-07	5	0.01073593	5	0.26972495	5	0.00000000

RECOLORED SPECTRUM OF SERIES 1 AND 2 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	7.3982052E 34
1	2.4050917E-05	1	4.2842419E-05	1	2.1611910E-05
2	4.8334806E-06	2	1.3178095E-05	2	6.2007056E-06
3	2.2571047E-06	3	9.3631641E-06	3	6.5632235E-06
4	1.4303998E-06	4	8.4143752E-06	4	7.8685509E-06
5	1.2155133E-06	5	8.2368720E-06	5	8.1484413E-06

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

FILTERED SERIES NO 1

-0.00099999	0.00066666	0.00000000	-0.00133333	0.00033333	-0.
-0.	0.00099999	0.	-0.00200000	0.00099999	0.00166667
-0.00200000	0.00166667	-0.00099999	0.	-0.00133333	0.00233333

-0.00066666	-0.00066666	0.	0.00033333		

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

FILTERED SERIES NO 3

-0.00049999	0.00113333	-0.00153333	-0.00043333	0.00106666	0.00043333
-0.00073333	-0.00030000	0.00203333	-0.00306667	0.00143333	0.00013333
-0.00013333	0.00103333	-0.00130000	-0.00020000	0.00033333	0.00066666
-0.00143333	0.00023333	0.00096666	0.00020000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2757115E-06	0	1.2769167E-06	0	6.7936172E-07	0	6.7936172E-07
1	-6.3842968E-07	1	-6.7010322E-07	1	-6.1003206E-07	1	-1.6154726E-07
2	-1.3842973E-07	2	-1.2909319E-07	2	1.0410926E-07	2	-2.6811292E-07
3	1.3429750E-07	3	2.5787645E-07	3	2.1320015E-07	3	4.5814961E-07
4	1.6460054E-07	4	-6.6012389E-08	4	-1.0043617E-07	4	-4.3174925E-07
5	-3.8590445E-07	5	-1.5052789E-08	5	-2.7518362E-07	5	1.0915977E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 3

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	1.2757115E-06	0	1.2769167E-06	0	6.7936172E-07	0	6.7936172E-07
1	-5.1585118E-07	1	-5.4144340E-07	1	-4.9290590E-07	1	-1.3053018E-07
2	-5.8694206E-08	2	-5.4735513E-08	2	4.4142330E-08	2	-1.1367988E-07
3	1.7190081E-08	3	3.3008186E-08	3	2.7289621E-08	3	5.8643153E-08
4	2.6336086E-09	4	-1.0561982E-09	4	-1.6069787E-09	4	-6.9079881E-09
5	-0.	5	-0.	5	-0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.6626811E-07	0	1.4846286E-07	0	6.3805903E-08	0	-0.
1	3.8988640E-07	1	3.4832323E-07	1	1.3383711E-07	1	-8.9604383E-08
2	1.0256806E-06	2	9.7678903E-07	2	4.7081407E-07	2	-2.3846662E-07
3	1.7189360E-06	3	1.7528666E-06	3	9.9516087E-07	3	-4.1393463E-07
4	2.0804639E-06	4	2.1412711E-06	4	1.1956872E-06	4	-3.9603177E-07
5	2.1609124E-06	5	2.1822036E-06	5	1.1388125E-06	5	-2.4385958E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	6.3805903E-08	0	0.16492821	0	0.38375311	0	6.28318530
1	1.6106309E-07	1	0.19101678	1	0.41310260	1	5.69322151
2	5.2777055E-07	2	0.27802085	2	0.51455642	2	5.81431860
3	1.0778159E-06	3	0.38554987	3	0.62702500	3	5.88900715
4	1.2595670E-06	4	0.35613175	4	0.60542604	4	5.96334076
5	1.1388125E-06	5	0.27502488	5	0.52700537	5	6.28318524

RECOLORED SPECTRUM OF SERIES 1 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	8.3507178E 34
1	2.4050917E-05	1	2.1487011E-05	1	1.7382631E-05
2	4.8334806E-06	2	4.6030808E-06	2	3.3233283E-06
3	2.2571047E-06	3	2.3016583E-06	3	1.4142542E-06
4	1.4303998E-06	4	1.4722072E-06	4	9.4790741E-07
5	1.2155133E-06	5	1.2274896E-06	5	8.8989940E-07

ORIGINAL SERIES NO 1

0.00399999	0.00099999	0.00099999	-0.00099999	-0.00300000	-0.00099999
-0.	0.00099999	0.00200000	-0.	-0.00200000	0.00200000
0.00300000	-0.00099999	0.00099999	-0.00200000	-0.00200000	-0.00200000
0.00200000	-0.00099999	-0.00200000	-0.00099999	-0.	-0.

FILTERED SERIES NO 1

-0.00099999	0.00066666	0.00000000	-0.00133333	0.00033333	-0.
-0.	0.00099999	0.	-0.00200000	0.00099999	0.00166667
-0.00200000	0.00166667	-0.00099999	0.	-0.00133333	0.00233333
-0.00066666	-0.00066666	0.	0.00033333		

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

FILTERED SERIES NO 4

-0.00110000	-0.00006666	0.00113333	-0.00043333	-0.00053333	0.00053333
0.00006666	-0.00189999	0.00226666	-0.00066666	-0.00086667	0.00143333
-0.00040000	0.00056666	-0.00049999	-0.00006666	-0.00143333	0.00153333
-0.00099999	-0.00030000	0.00246666	-0.00150000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2757115E-06	0	1.3543915E-06	0	4.7619370E-07	0	4.7619370E-07
1	-6.3842968E-07	1	-7.2601230E-07	1	-5.8149680E-08	1	-7.2229099E-07
2	-1.3842973E-07	2	-1.6995177E-07	2	-1.2835168E-07	2	4.9033509E-07
3	1.3429750E-07	3	5.1908855E-07	3	1.0700183E-07	3	-8.1496718E-09
4	1.6460054E-07	4	-3.5192145E-07	4	1.5750686E-07	4	-3.1976579E-07
5	-3.8590445E-07	5	-1.1035581E-07	5	-3.6623044E-07	5	3.4942603E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 1 AND 4

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	1.2757115E-06	0	1.3543915E-06	0	4.7619370E-07	0	4.7619370E-07
1	-5.1585118E-07	1	-5.8661793E-07	1	-4.6984941E-08	1	-5.8361111E-07
2	-5.8694206E-08	2	-7.2059552E-08	2	-5.4421112E-08	2	2.0790208E-07
3	1.7190081E-08	3	6.6443336E-08	3	1.3696235E-08	3	-1.0431580E-09

I		I		I		I	
4	2.6336086E-09	4	-5.6307433E-09	4	2.5201099E-09	4	-5.1162528E-09
5	-0.	5	-0.	5	-0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 1 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.6626811E-07	0	1.5866168E-07	0	9.1355567E-09	0	-0.
1	3.8988640E-07	1	3.2873493E-07	1	1.1649312E-08	1	8.4443299E-08
2	1.0256806E-06	2	9.9744881E-07	2	1.4612128E-07	2	3.4024590E-07
3	1.7189360E-06	3	1.9375636E-06	3	5.5632414E-07	3	6.6315051E-07
4	2.0804639E-06	4	2.3091988E-06	4	1.0397951E-06	4	5.7443458E-07
5	2.1609124E-06	5	2.2393599E-06	5	1.2450215E-06	5	3.3011108E-14

CROSS SPECTRAL ESTIMATES OF SERIES 1 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	9.1355566E-09	0	0.00316365	0	0.05494473	0	6.28318530
1	8.5243046E-08	1	0.05669359	1	0.21863560	1	1.43370736
2	3.7029542E-07	2	0.13402750	2	0.36102409	2	1.16515587
3	8.6560103E-07	3	0.22496754	3	0.50356791	3	0.87277542
4	1.1879179E-06	4	0.29373206	4	0.57098704	4	0.50472209
5	1.2450214E-06	5	0.32032631	5	0.57615545	5	0.00000002

RECOLORED SPECTRUM OF SERIES 1 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	9.9683633E 34
1	2.4050917E-05	1	2.0278667E-05	1	1.9128996E-05
2	4.8334806E-06	2	4.7004392E-06	2	4.0704511E-06
3	2.2571047E-06	3	2.5441807E-06	3	1.9718226E-06
4	1.4303998E-06	4	1.5876639E-06	4	1.1213161E-06
5	1.2155133E-06	5	1.2596400E-06	5	8.5614419E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

FILTERED SERIES NO 2

0.00099999	-0.00099999	0.00096666	-0.00076666	0.00060000	-0.00080000
0.00076666	-0.00213333	0.00546666	-0.00786667	0.00480000	0.00096666
-0.00150000	0.	0.00106666	-0.00183333	0.00009999	0.00020000
0.00066666	0.00006666	-0.00070000	0.00040000		

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00050000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

FILTERED SERIES NO 3

-0.00049999	0.00113333	-0.00153333	-0.00043333	0.00106666	0.00043333
-0.00073333	-0.00030000	0.00203333	-0.00306667	0.00143333	0.00013333
-0.00013333	0.00103333	-0.00130000	-0.00020000	0.00033333	0.00066666
-0.00143333	0.00023333	0.00096666	0.00020000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 3

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.0587409E-06	0	1.2769167E-06	0	1.7111797E-06	0	1.7111797E-06
1	-4.4277726E-06	1	-6.7010322E-07	1	-1.4697794E-06	1	-1.0687188E-06
2	1.6032872E-06	2	-1.2909319E-07	2	7.4042230E-07	2	5.4729087E-09
3	-2.1236912E-07	3	2.5787645E-07	3	7.8856755E-08	3	5.4653343E-07
4	4.7975201E-07	4	-6.6012389E-08	4	-5.8952705E-07	4	-2.3932504E-07
5	-1.2931266E-06	5	-1.5052789E-08	5	4.2961428E-07	5	-4.2892096E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 3

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	6.0587409E-06	0	1.2769167E-06	0	1.7111797E-06	0	1.7111797E-06
1	-3.5776402E-06	1	-5.4144340E-07	1	-1.1875817E-06	1	-8.6352481E-07
2	6.7979379E-07	2	-5.4735513E-08	2	3.1393906E-07	2	2.3205133E-09
3	-2.7183248E-08	3	3.3008186E-08	3	1.0093665E-08	3	6.9956281E-08
4	7.6760324E-09	4	-1.0561982E-09	4	-9.4324330E-09	4	-3.8292007E-09
5	-0.	5	-0.	5	0.	5	-0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 3

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	2.2403358E-07	0	1.4846286E-07	0	4.3121099E-08	0	0.
1	6.9451307E-07	1	3.4832323E-07	1	1.3552135E-07	1	4.5664742E-08
2	2.7964356E-06	2	9.7678903E-07	2	7.5263373E-07	2	-8.4516307E-08
3	7.1306750E-06	3	1.7528666E-06	3	2.1498107E-06	3	-4.6150385E-07
4	1.2238399E-05	4	2.1412711E-06	4	3.5037549E-06	4	-5.4048196E-07
5	1.4643327E-05	5	2.1822036E-06	5	3.9852341E-06	5	-3.4257866E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 3

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	4.3121098E-08	0	0.05590475	0	0.19247605	0	0.
1	1.4300806E-07	1	0.08453920	1	0.20591126	1	0.32500745
2	7.5736420E-07	2	0.20999257	2	0.27083198	2	6.17135966
3	2.1987887E-06	3	0.38680090	3	0.30835631	3	6.07172281
4	3.5451966E-06	4	0.47960573	4	0.28967813	4	6.13013375
5	3.9852341E-06	5	0.49701858	5	0.27215359	5	6.28318524

RECOLORED SPECTRUM OF SERIES 2 AND 3 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	9.4409523E 34
1	4.2842419E-05	1	2.1487011E-05	1	1.9670516E-05
2	1.3178095E-05	2	4.6030808E-06	2	3.6364680E-06
3	9.3631641E-06	3	2.3016583E-06	3	1.4113748E-06
4	8.4143752E-06	4	1.4722072E-06	4	7.6612814E-07
5	8.2368720E-06	5	1.2274896E-06	5	6.1740444E-07

ORIGINAL SERIES NO 2

-0.00040000	0.00089999	-0.00080000	0.00049999	-0.00110000	-0.00040000
-0.00150000	-0.00020000	-0.00120000	0.00420000	-0.00680000	0.00579999
0.00399999	-0.00070000	-0.00089999	-0.00110000	-0.00449999	-0.00240000
-0.00060000	0.00060000	-0.00020000	-0.00120000	-0.00009999	-0.00020000

FILTERED SERIES NO 2

0.00099999	-0.00099999	0.00096666	-0.00076666	0.00060000	-0.00080000
0.00076666	-0.00213333	0.00546666	-0.00786667	0.00480000	0.00096666
-0.00150000	0.	0.00106666	-0.00183333	0.00009999	0.00020000
0.00066666	0.00006666	-0.00070000	0.00040000		

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

FILTERED SERIES NO 4

-0.00110000	-0.00006666	0.00113333	-0.00043333	-0.00053333	0.00053333
0.00006666	-0.00189999	0.00226666	-0.00066666	-0.00086667	0.00143333
-0.00040000	0.00056666	-0.00049999	-0.00006666	-0.00143333	0.00153333
-0.00099999	-0.00030000	0.00246666	-0.00150000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	6.0587409E-06	0	1.3543915E-06	0	7.2584011E-07	0	7.2584011E-07
1	-4.4277726E-06	1	-7.2601230E-07	1	2.3280989E-07	1	-1.3822403E-06
2	1.6032872E-06	2	-1.6995177E-07	2	-6.4602838E-07	2	1.0694764E-06
3	-2.1236912E-07	3	5.1908855E-07	3	6.9164820E-07	3	-1.0062442E-07
4	4.7975201E-07	4	-3.5192145E-07	4	-4.0395770E-07	4	-5.9203848E-07
5	-1.2931266E-06	5	-1.1035581E-07	5	-1.2784665E-07	5	2.9488058E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 2 AND 4

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	6.0587409E-06	0	1.3543915E-06	0	7.2584011E-07	0	7.2584011E-07
1	-3.5776402E-06	1	-5.8661793E-07	1	1.8811039E-07	1	-1.1168502E-06
2	6.7979379E-07	2	-7.2059552E-08	2	-2.7391604E-07	2	4.5345802E-07
3	-2.7183248E-08	3	6.6443336E-08	3	8.8530972E-08	3	-1.2879927E-08
4	7.6760324E-09	4	-5.6307433E-09	4	-6.4633234E-09	4	-9.4726160E-09
5	-0.	5	-0.	5	-0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 2 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	2.2403358E-07	0	1.5866168E-07	0	3.6357404E-08	0	-0.
1	6.9451307E-07	1	3.2873493E-07	1	1.9470337E-08	1	1.7347904E-07
2	2.7964356E-06	2	9.9744881E-07	2	2.2746374E-07	2	7.5108165E-07
3	7.1306750E-06	3	1.9375636E-06	3	9.2386241E-07	3	1.6118851E-06

4	1.2238399E-05	4	2.3091988E-06	4	1.5689577E-06	4	1.5534891E-06
5	1.4643327E-05	5	2.2393599E-06	5	1.7425349E-06	5	9.4018874E-14

CROSS SPECTRAL ESTIMATES OF SERIES 2 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	3.6357404E-08	0	0.03718780	0	0.16228551	0	6.28318530
1	1.7456824E-07	1	0.13347632	1	0.25135343	1	1.45902951
2	7.8476964E-07	2	0.22079485	2	0.28063211	2	1.27672851
3	1.8578739E-06	3	0.24983072	3	0.26054670	3	1.05034858
4	2.2079304E-06	4	0.17249830	4	0.18041006	4	0.78044418
5	1.7425349E-06	5	0.09259750	5	0.11899856	5	0.00000005

RECOLORED SPECTRUM OF SERIES 2 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	9.6281219E 34
1	4.2842419E-05	1	2.0278667E-05	1	1.7571945E-05
2	1.3178095E-05	2	4.7004392E-06	2	3.6626064E-06
3	9.3631641E-06	3	2.5441807E-06	3	1.9085662E-06
4	8.4143752E-06	4	1.5876639E-06	4	1.3137946E-06
5	8.2368720E-06	5	1.2596400E-06	5	1.1430005E-06

ORIGINAL SERIES NO 3

0.00189999	0.00060000	0.00080000	-0.00240000	-0.00099999	0.00170000
0.00120000	-0.00060000	-0.00020000	0.00110000	-0.00370000	0.00070000
0.00080000	0.00049999	0.00060000	-0.00240000	-0.00150000	-0.
0.00049999	-0.00099999	0.00179999	0.00390000	0.00309999	0.00170000

FILTERED SERIES NO 3

-0.00049999	0.00113333	-0.00153333	-0.00043333	0.00106666	0.00043333
-0.00073333	-0.00030000	0.00203333	-0.00306667	0.00143333	0.00013333
-0.00013333	0.00103333	-0.00130000	-0.00020000	0.00033333	0.00066666
-0.00143333	0.00023333	0.00096666	0.00020000		

ORIGINAL SERIES NO 4

0.00189999	-0.00040000	0.00060000	0.00179999	-0.00040000	-0.00130000
-0.00060000	-0.00150000	-0.00260000	0.00200000	-0.00020000	-0.00040000
0.00200000	0.00009999	-0.00060000	-0.00300000	-0.00390000	-0.00460000
-0.00099999	-0.00200000	-0.	0.00290000	-0.00160000	-0.00160000

FILTERED SERIES NO 4

-0.00110000	-0.00006666	0.00113333	-0.00043333	-0.00053333	0.00053333
0.00006666	-0.00189999	0.00226666	-0.00066666	-0.00086667	0.00143333
-0.00040000	0.00056666	-0.00049999	-0.00006666	-0.00143333	0.00153333
-0.00099999	-0.00030000	0.00246666	-0.00150000		

AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 3 AND 4

I	AUCVX(I)	I	AUCVY(I)	I	CRCVXY(I)	I	CRCVYX(I)
0	1.2769167E-06	0	1.3543915E-06	0	4.5480022E-07	0	4.5480022E-07
1	-6.7010322E-07	1	-7.2601230E-07	1	2.7318407E-07	1	-8.6686628E-07

2	-1.2909319E-07	2	-1.6995177E-07	2	-5.5474510E-07	2	6.9404260E-07
3	2.5787645E-07	3	5.1908855E-07	3	1.7212349E-07	3	-8.4391631E-08
4	-6.6012389E-08	4	-3.5192145E-07	4	1.6404268E-07	4	-2.3019968E-07
5	-1.5052789E-08	5	-1.1035581E-07	5	1.2780068E-08	5	1.5126490E-07

WEIGHTED AUTO AND CROSS COVARIANCE FUNCTIONS OF SERIES 3 AND 4

I	WACVX(I)	I	WACVY(I)	I	WCCVXY(I)	I	WCCVYX(I)
0	1.2769167E-06	0	1.3543915E-06	0	4.5480022E-07	0	4.5480022E-07
1	-5.4144340E-07	1	-5.8661793E-07	1	2.2073273E-07	1	-7.0042794E-07
2	-5.4735513E-08	2	-7.2059552E-08	2	-2.3571192E-07	2	2.9427407E-07
3	3.3008186E-08	3	6.6443336E-08	3	2.2031807E-08	3	-1.0802129E-08
4	-1.0561962E-09	4	-5.6307433E-09	4	2.6246829E-09	4	-3.6831950E-09
5	-0.	5	-0.	5	0.	5	0.

SPECTRUM AND CROSS SPECTRUM OF SERIES 3 AND 4

I	SPECX(I)	I	SPECY(I)	I	WCO(I)	I	WQUAD(I)
0	1.4846286E-07	0	1.5666168E-07	0	4.4338314E-08	0	0.
1	3.4832323E-07	1	3.2873493E-07	1	8.2356029E-08	1	7.2808146E-08
2	9.7678903E-07	2	9.9744881E-07	2	2.4937186E-07	2	5.3955331E-07
3	1.7528666E-06	3	1.9375636E-06	3	5.6400979E-07	3	1.1739997E-06
4	2.1412711E-06	4	2.3091988E-06	4	8.6545948E-07	4	1.0725350E-06
5	2.1822036E-06	5	2.2393599E-06	5	9.8126935E-07	5	6.3243983E-14

CROSS SPECTRAL ESTIMATES OF SERIES 3 AND 4

I	CRAMPL(I)	I	COH.SQ(I)	I	GAIN(I)	I	PHASE(I)
0	4.4338313E-08	0	0.08345810	0	0.29864920	0	0.
1	1.0992516E-07	1	0.10552756	1	0.31558377	1	0.72394157
2	5.9439389E-07	2	0.36262462	2	0.60851818	2	1.13785811
3	1.3024524E-06	3	0.49948094	3	0.74304139	3	1.12293723
4	1.3781696E-06	4	0.38412479	4	0.64362217	4	0.89184470
5	9.8126935E-07	5	0.19704130	5	0.44966900	5	0.00000006

RECOLORED SPECTRUM OF SERIES 3 AND 4 AND SPECTRAL ESTIMATES OF THE RESIDUALS

I	RSPECX(I)	I	RSPECY(I)	I	SPECRS(I)
0	1.0000000E 35	0	1.0000000E 35	0	9.1654190E 34
1	2.1487011E-05	1	2.0278667E-05	1	1.8138708E-05
2	4.6030808E-06	2	4.7004392E-06	2	2.9959442E-06
3	2.3016583E-06	3	2.5441807E-06	3	1.2734109E-06
4	1.4722072E-06	4	1.5876639E-06	4	9.7780285E-07
5	1.2274896E-06	5	1.2596400E-06	5	1.0114389E-06

MULTIPLE CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	TIMESERIES 1	I	TIMESERIES 2	I	TIMESERIES 3	I	TIMESERIES 4	I	TIMESERIES
0	0.36139277	0	0.28748653	0	0.23623050	0	0.12036850		
1	0.70954899	1	0.67683525	1	0.49350024	1	0.20045893		
2	0.70475503	2	0.68570871	2	0.59295568	2	0.42245751		
3	0.51982520	3	0.52447288	3	0.68373277	3	0.52011704		
4	0.47450529	4	0.54057553	4	0.70028231	4	0.43628062		

5	0.55031765	5	0.61457058	5	0.70331350	5	0.38203477

PARTIAL CORRELATION COEFFICIENT OF 4 TIMESERIES AT SUCCESSIVE FREQUENCY-POINTS

I	REAL PART	I	IMAG PART	I	COH.SQ(I)	I	PHASE(I)
			TIMESERIES 1 AND 2				
0	0.48116657	0	-0.	0	0.23152127	0	6.28318530
1	0.62884560	1	0.46238175	1	0.60924367	1	0.63401784
2	0.56171685	2	0.49690239	2	0.56243780	2	0.72424900
3	0.21084529	3	0.39958035	3	0.20412019	3	1.08526102
4	-0.27143580	4	0.20517807	4	0.11577544	4	2.49432680
5	-0.48328941	5	0.00000001	5	0.23356865	5	3.14159262
			TIMESERIES 1 AND 3				
0	0.36695082	0	-0.	0	0.13465291	0	6.28318530
1	0.29310056	1	-0.56638456	1	0.40669940	1	5.18993354
2	0.20491037	2	-0.51499081	2	0.30720379	2	5.09107620
3	0.24673374	3	-0.38245758	3	0.20715134	3	5.28533095
4	0.44064853	4	-0.21513210	4	0.24045295	4	5.82900840
5	0.57731808	5	-0.00000001	5	0.33329616	5	6.28318524
			TIMESERIES 1 AND 4				
0	-0.15085076	0	-0.	0	0.02275595	0	3.14159265
1	0.03499969	1	0.09654535	1	0.01054598	1	1.22301094
2	0.00435455	2	0.05801945	2	0.00338522	2	1.49588339
3	0.03291570	3	0.12219545	3	0.01601517	3	1.30767247
4	0.26514738	4	0.11378190	4	0.08324945	4	0.40536103
5	0.47984098	5	0.00000000	5	0.23024736	5	0.00000001
			TIMESERIES 2 AND 3				
0	-0.01967332	0	0.	0	0.00038704	0	3.14159265
1	0.18011656	1	0.49893863	1	0.28138173	1	1.22435623
2	0.27763939	2	0.32054661	2	0.17983376	2	0.85700440
3	0.43235909	3	0.04321660	3	0.18880206	3	0.09962443
4	0.65579263	4	-0.05633472	4	0.43323757	4	6.19749242
5	0.75628815	5	-0.00000000	5	0.57197176	5	6.28318524
			TIMESERIES 2 AND 4				
0	0.18860260	0	-0.	0	0.03557094	0	6.28318530
1	-0.07100283	1	0.14868488	1	0.02714860	1	2.01631421
2	-0.03760955	2	0.16845597	2	0.02979188	2	1.79045448
3	-0.08884319	3	0.12513245	3	0.02355124	3	2.18819770
4	0.01335084	4	0.09035940	4	0.00834306	4	1.42410499
5	0.22145426	5	0.00000000	5	0.04904199	5	0.00000002
			TIMESERIES 3 AND 4				
0	0.29002172	0	0.	0	0.08411259	0	0.
1	0.21513353	1	0.05417031	1	0.04921686	1	0.24667069
2	0.25522072	2	0.34051311	2	0.18108679	2	0.92760373
3	0.31406625	3	0.40121154	3	0.25960831	3	0.90663484
4	0.18492571	4	0.21219796	4	0.07922549	4	0.85396495
5	-0.03380486	5	0.00000001	5	0.00114276	5	3.14159241

Appendix

Subroutine PARCOR

This subroutine will perform the same computations as subroutine PARCOC without resorting to the complex-arithmetic facility of the IBM 7090. The second dimension of the matrices COVARS, A, B, CI, AXCI, AXCIXB and D has therefore been doubled in order to enable the storage of the real part of the complex numbers in the first and their imaginary part in the second half of the reserved locations. Furthermore, each statement involving complex arithmetic has been decomposed into one dealing with the real part of the complex numbers and the other with their imaginary part. For the rest, the two subroutines are the same.

Subroutine PARCOR is given on the next 5 pages. It contains 28 more cards than subroutine PARCOC since the latter contains 28 statements which involve complex-arithmetic operations.

```
      AXCIXB(1,1)=0.0
      AXCIXB(1,3)=0.0
      DO 11 I=1,NSM1
      AXCIXB(1,3)=AXCIXB(1,3)+AXCI(1,I)*B(I,3)+AXCI(1,I+5)*B(I,1)
   11 AXCIXB(1,1)=AXCIXB(1,1)+AXCI(1,I)*B(I,1)-AXCI(1,I+5)*B(I,3)
      CORELN(NRSERS,L,KK)=AXCIXB(1,1)/COVARS(1,1)
   12 DO 13 I=1,NRSERS
      COVARS(NSP1,I)=COVARS(1,I)
      COVARS(NSP1,I+7)=COVARS(1,I+7)
      COVARS(I,NSP1+7)=COVARS(I,8)
   13 COVARS(I,NSP1)=COVARS(I,1)
      COVARS(NSP1,NSP1)=COVARS(1,1)
      COVARS(NSP1,NSP1+7)=COVARS(1,8)
      DO 14 I=1,NRSERS
      DO 14 J=1,NRSERS
      COVARS(I,J+7)=COVARS(I+1,J+8)
   14 COVARS(I,J)=COVARS(I+1,J+1)
      L=L+1
      IF (L-NRSERS) 15,15,16
   16 L=1
   17 M=1
   18 DO 19 I=1,2
      DO 19 J=1,NSM2
      A(I,J)=COVARS(I,J+2)
      A(I,J+5)=COVARS(I,J+9)
      B(J,I+2)=COVARS(J+2,I+7)
   19 B(J,I)=COVARS(J+2,I)
      DO 20 I=1,NSM2
      DO 20 J=1,NSM2
      C(I,J+5)=COVARS(I+2,J+9)
   20 C(I,J)=COVARS(I+2,J+2)
      DO 21 I=1,NSM2
      II=I+NSM2
      DO 21 J=1,NSM2
      JJ=J+NSM2
      CC(I,J)=C(I,J)
      CC(I,JJ)=C(I,J+5)
      CC(II,J)=-C(I,J+5)
   21 CC(II,JJ)=C(I,J)
      CALL INVERT (NSM2X2,CC,SING)
      IF (SING) 23,23,22
   22 WRITE OUTPUT TAPE 6,7
      GO TO 34
   23 DO 24 I=1,NSM2
      DO 24 J=1,NSM2
      JJ=J+NSM2
      CI(I,J)=CC(I,J)
   24 CI(I,J+5)=CC(I,JJ)
      DO 25 I=1,2
      DO 25 K=1,NSM2
      AXCI(I,K)=0.0
      AXCI(I,K+5)=0.0
      DO 25 J=1,NSM2
      AXCI(I,K+5)=AXCI(I,K+5)+A(I,J)*CI(J,K+5)+A(I,J+5)*CI(J,K)
   25 AXCI(I,K)=AXCI(I,K)+A(I,J)*CI(J,K)-A(I,J+5)*CI(J,K+5)
      DO 26 I=1,2
      DO 26 K=1,2
      AXCIXB(I,K)=0.0
```

```
      AXCIXB(1,1)=0.0                                                   CCT 3270
      AXCIXB(1,3)=0.0                                                   CCT 3280
      DO 11 I=1,NSM1                                                    CCT 3290
      AXCIXB(1,3)=AXCIXB(1,3)+AXCI(1,I)*B(I,3)+AXCI(1,I+5)*B(I,1)      CCT 3300
   11 AXCIXB(1,1)=AXCIXB(1,1)+AXCI(1,I)*B(I,1)-AXCI(1,I+5)*B(I,3)      CCT 3310
      CORELN(NRSERS,L,KK)=AXCIXB(1,1)/COVARS(1,1)                       CCT 3320
   12 DO 13 I=1,NRSERS                                                  CCT 3330
      COVARS(NSP1,I)=COVARS(1,I)                                        CCT 3340
      COVARS(NSP1,I+7)=COVARS(1,I+7)                                    CCT 3350
      COVARS(I,NSP1+7)=COVARS(I,8)                                      CCT 3360
   13 COVARS(I,NSP1)=COVARS(I,1)                                        CCT 3370
      COVARS(NSP1,NSP1)=COVARS(1,1)                                     CCT 3380
      COVARS(NSP1,NSP1+7)=COVARS(1,8)                                   CCT 3390
      DO 14 I=1,NRSERS                                                  CCT 3400
      DO 14 J=1,NRSERS                                                  CCT 3410
      COVARS(I,J+7)=COVARS(I+1,J+8)                                     CCT 3420
   14 COVARS(I,J)=COVARS(I+1,J+1)                                       CCT 3430
      L=L+1                                                             CCT 3440
      IF (L-NRSERS) 15,15,16                                            CCT 3450
   16 L=1                                                               CCT 3460
   17 M=1                                                               CCT 3470
   18 DO 19 I=1,2                                                       CCT 3480
      DO 19 J=1,NSM2                                                    CCT 3490
      A(I,J)=COVARS(I,J+2)                                              CCT 3500
      A(I,J+5)=COVARS(I,J+9)                                            CCT 3510
      B(J,I+2)=COVARS(J+2,I+7)                                          CCT 3520
   19 B(J,I)=COVARS(J+2,I)                                              CCT 3530
      DO 20 I=1,NSM2                                                    CCT 3540
      DO 20 J=1,NSM2                                                    CCT 3550
      C(I,J+5)=COVARS(I+2,J+9)                                          CCT 3560
   20 C(I,J)=COVARS(I+2,J+2)                                            CCT 3570
      DO 21 I=1,NSM2                                                    CCT 3580
      II=I+NSM2                                                         CCT 3590
      DO 21 J=1,NSM2                                                    CCT 3600
      JJ=J+NSM2                                                         CCT 3610
      CC(I,J)=C(I,J)                                                    CCT 3620
      CC(I,JJ)=C(I,J+5)                                                 CCT 3630
      CC(II,J)=-C(I,J+5)                                                CCT 3640
   21 CC(II,JJ)=C(I,J)                                                  CCT 3650
      CALL INVERT (NSM2X2,CC,SING)                                      CCT 3660
      IF (SING) 23,23,22                                                CCT 3670
   22 WRITE OUTPUT TAPE 6,7                                             CCT 3680
      GO TO 34                                                          CCT 3690
   23 DO 24 I=1,NSM2                                                    CCT 3700
      DO 24 J=1,NSM2                                                    CCT 3710
      JJ=J+NSM2                                                         CCT 3720
      CI(I,J)=CC(I,J)                                                   CCT 3730
   24 CI(I,J+5)=CC(I,JJ)                                                CCT 3740
      DO 25 I=1,2                                                       CCT 3750
      DO 25 K=1,NSM2                                                    CCT 3760
      AXCI(I,K)=0.0                                                     CCT 3770
      AXCI(I,K+5)=0.0                                                   CCT 3780
      DO 25 J=1,NSM2                                                    CCT 3790
      AXCI(I,K+5)=AXCI(I,K+5)+A(I,J)*CI(J,K+5)+A(I,J+5)*CI(J,K)         CCT 3800
   25 AXCI(I,K)=AXCI(I,K)+A(I,J)*CI(J,K)-A(I,J+5)*CI(J,K+5)             CCT 3810
      DO 26 I=1,2                                                       CCT 3820
      DO 26 K=1,2                                                       CCT 3830
      AXCIXB(I,K)=0.0                                                   CCT 3840
```

```
      AXCIXB(I,K+2)=0.0
      DO 26 J=1,NSM2
      AXCIXB(I,K+2)=AXCIXB(I,K+2)+AXCI(I,J)*B(J,K+2)+AXCI(I,J+5)*B(J,K)
   26 AXCIXB(I,K)=AXCIXB(I,K)+AXCI(I,J)*B(J,K)-AXCI(I,J+5)*B(J,K+2)
      DO 27 I=1,2
      DO 27 J=1,2
      D(I,J+2)=COVARS(I,J+7)-AXCIXB(I,J+2)
   27 D(I,J)=COVARS(I,J)-AXCIXB(I,J)
      DIVISR=D(1,1)*D(2,2)
      IF (DIVISR) 28,28,29
   28 DIVISR =10.0**36
      GO TO 30
   29 DIVISR=SQRTF(DIVISR)
   30 CORELN(L,M,KK)=D(1,2)/DIVISR
      NRSRML=NRSERS-1
      LPM=L+M
      CORELN(NRSRML,LPM,KK)=D(1,4)/DIVISR
      ADDITN=PI
      IF (CORELN(L,M,KK)) 32,32,31
   31 ADDITN=ADDITN-SIGNF(PI,CORELN(NRSRML,LPM,KK))
   32 CORESP(L,M,KK)=ATANF(CORELN(NRSRML,LPM,KK)/CORELN(L,M,KK))+ADDITN
   33 CORESP(NRSRML,LPM,KK)=CORELN(L,M,KK)**2+CORELN(NRSRML,LPM,KK)**2
   34 DO 35 I=1,NRSERS
      COVARS(NSP1,I)=COVARS(2,I)
      COVARS(NSP1,I+7)=COVARS(2,I+7)
      COVARS(I,NSP1+7)=COVARS(I,9)
   35 COVARS(I,NSP1)=COVARS(I,2)
      COVARS(NSP1,NSP1)=COVARS(2,2)
      COVARS(NSP1,NSP1+7)=COVARS(2,9)
      DO 36 I=1,NSP1
      DO 36 J=2,NRSERS
      COVARS(I,J+7)=COVARS(I,J+8)
   36 COVARS(I,J)=COVARS(I,J+1)
      DO 37 I=2,NRSERS
      DO 37 J=1,NSP1
      COVARS(I,J+7)=COVARS(I+1,J+7)
   37 COVARS(I,J)=COVARS(I+1,J)
      M=M+1
      IF (M-NRSRML) 18,18,38
   38 DO 39 I=1,NRSERS
      COVARS(NSP1,I)=COVARS(1,I)
      COVARS(NSP1,I+7)=COVARS(1,I+7)
      COVARS(I,NSP1+7)=COVARS(I,8)
   39 COVARS(I,NSP1)=COVARS(I,1)
      COVARS(NSP1,NSP1)=COVARS(1,1)
      COVARS(NSP1,NSP1+7)=COVARS(1,8)
      DO 40 I=1,NRSERS
      DO 40 J=1,NRSERS
      COVARS(I,J+7)=COVARS(I+1,J+8)
   40 COVARS(I,J)=COVARS(I+1,J+1)
      M=M+1
      IF (M-NRSERS) 38,38,41
   41 L=L+1
      IF (L-NRSERS) 17,42,42
   42 KK=KK+1
      IF (KK-NRLSP1) 43,43,44
   44 WRITE OUTPUT TAPE 6,45,NRSERS
   45 FORMAT (/16X,37H MULTIPLE CORRELATION COEFFICIENT OF  I2,44H  TIME
```

```
     1SERIES AT SUCCESSIVE FREQUENCY-POINTS //)
      WRITE OUTPUT TAPE 6,46,(L,L=1,NRSERS)
   46 FORMAT (5(5X,1HI,6X,10HTIMESERIESI2))
      WRITE OUTPUT TAPE 6,47
   47 FORMAT (/1X)
      DO 48 K=1,NRLSP1
      KM1=K-1
   48 WRITE OUTPUT TAPE 6,49,(KM1,CORELN(NRSERS,L,K),L=1,NRSERS)
   49 FORMAT (5(I6,F18.8))
      WRITE OUTPUT TAPE 6,50,NRSERS
   50 FORMAT (/18X,36H PARTIAL CORRELATION COEFFICIENT OF  I3,45H   TIME
     1SERIES AT SUCCESSIVE FREQUENCY-POINTS //)
      WRITE OUTPUT TAPE 6,51
   51 FORMAT (11X,1HI,11X,9HREAL PART,7X,1HI,11X,9HIMAG PART,7X,1HI,11X,
     19HCOH.SQ(I),7X,1HI,12X,8HPHASE(I),4X)
   52 FORMAT (/50X,10HTIMESERIES I3,4H AND I3//)
      DO 53 L=1,NSM1
      NRSRML=NRSERS-L
      DO 53 M=1,NRSRML
      LPM=L+M
      WRITE OUTPUT TAPE 6,52,L,LPM
      DO 53 K=1,NRLSP1
      KM1=K-1
   53 WRITE OUTPUT TAPE 6,54,KM1,CORELN(L,M,K),KM1,CORELN(NRSRML,LPM,K),
     1KM1,CORESP(NRSRML,LPM,K),KM1,CORESP(L,M,K)
   54 FORMAT (4X,2(I8,F20.8),2(I8,F20.8))
      RETURN
      END
      SUBROUTINE INVERT (N,A,SING)
C     DOUBLE PIVOT PROGRAM FOR MATRIX INVERSION
      DIMENSION A(10,10),P(10,10),Q(10,10)
      THRES =1.0E-20
      SING=0.0
      NLESS1=N-1
      DO 3 I=1,N
      DO 3 J=1,N
      IF (I-J) 1,2,1
    1 P(I,J)=0.0
      Q(I,J)=0.0
      GO TO 3
    2 P(I,J)=1.0
      Q(I,J)=1.0
    3 CONTINUE
      DO 20 K=1,NLESS1
      BIGA=0.0
      KPLUS1=K+1
      DO 8 I=K,N
      DO 8 J=K,N
      IF (A(I,J)) 4,5,5
    4 ABSA=-A(I,J)
      GO TO 6
    5 ABSA=A(I,J)
    6 IF (BIGA-ABSA) 7,8,8
    7 BIGA=ABSA
      LARGJ=J
      LARGI=I
    8 CONTINUE
      IF (LARGJ-K) 25,12,9
```