The Program SIMU: A Model Solution Program

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<Contents>

I. Introduction

Program SIMU is a general purpose simulation program designed to compute the solution values of a system of M equations in M endogenous variables $(Y_1, Y_2, \ldots, Y_M)$ and N exogenous variables $(X_1, X_2, \ldots, X_N)$. The original program was written by Morris Norman. First modifications to the University of Texas version were made by James T. Peach and James L. Weatherby, Jr. (November 1974). Subsequent modifications have been made by Kwang-Ha Kang (February 1981 and June 1983).

Modifications were done for the following reasons:

(1) The old version could not handle an equation with a nonlinear term which combines lagged exogenous or endogenous variables and current endogenous variables (for example, $\log(Y_t + aX_t + bY_{t-1} + cY_{t-2})$, where Y stands for an endogenous variable, X stands for an exogenous variable, and t denotes the time period);

(2) To increase the capacity(number of endogenous and exogenous variables

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and the number of variables graphed) of the program;

(3) To allow for greater flexibility in entering input data; and

(4) To clarify the input specifications.

Simulations may be either one period or dynamic. A one period simulation bases the solution to the model on actual or hypothetical values of exogenous and lagged endogenous variables. A dynamic simulation bases the solution on actual or hypothetical exogenous variables and solution values of endogenous variables for periods greater than two.

The program uses a simple iterative technique to produce a solution to the system of equations to any desired degree of accuracy.

II. The Solution Procedure

The program solves the system of equation by simple iterative technique which is best described by example. Suppose the model to be solved can be described as follows:

$$Y_1=a_0+a_1X_1+a_2Y_3 \tag{1}$$

$$Y_2=a_3+a_4Y_1+a_5Y_3+a_6X_2 \tag{2}$$

$$Y_3=a_7+a_8Y_2+a_9X_3 \tag{3}$$

where the Y's are the endogenous variables of the system and the X's are the exogenous variables of the system.

To solve the system, the program requires that values be supplied for the coefficients and for the exogenous variables, along with initial estimates of the values of the Y's. The latter might be zeros, or preliminary guesses, or the values of the Y's in the previous time period, or some other convenient values.

The first step of the program is to solve equation (1) for Y_1 in terms of the X's and the initial value of Y_3. This calculated value of Y_1 then replaces the initial value of Y_1 in the right hand side of the system. The program then proceeds to equation (2), which it solves for Y_2, using the new value of Y_1 together with X_2 and the initial value of Y_3. The new value of Y_2 is then substituted throughout the right hand side to replace the initial value. The program then obtains a new value of Y_3 in a similar manner, and replaces the old value of Y_3 throughout the right hand side.

The program then compares the calculated values of the endogenous variables (the Y's) with the corresponding initial values of the endogenous variables. If none of the Y's have changed by more than a prespecified small amount, the system is considered solved, and the program prints out the results. If, however, one or more of the Y's have changed by more than the specified small amount, the program repeats this process, calculating another new value for each of the Y's and modifying the right hand side of the system accordingly. The process continues until no endogenous variable changes in value from one iteration to the next by more than the specified amount.

III. Model Specification: A Simple Example

Model specification for program SIMU involves the insertion of a series of FORTRAN arithmetic assignment statements into subroutines CONST and SOLVE.(1) Within subroutine CONST all pre-determined terms(2) are computed and stored. This subroutine is called only once for each solution. Subroutine SOLVE uses the values of the pre-determined terms stored by subroutine CONST and the computed values of all other terms to generate a solution for the model. This subroutine is called repetitively during the iteration process described in the preceding section.

The model specification technique will be described by an example based on the following macroeconomic model:

$$C_t = a_1 + a_2 Y_t + a_3 T_t \qquad (4)$$

$$I_t = a_4 + a_5 R_t + a_6 I_{t-1} \qquad (5)$$

$$R_t = a_7 + a_8 Y_t + a_9 M_t \qquad (6)$$

(1) For a more complete description of the program, see Appendix.

(2) Pre-determined term includes the exogenous variables and endogenous variables which are not changed by the current endogenous variables.

$$Y_t = C_t + I_t + G_t \tag{7}$$

where

C_t=personal consumption expenditures in period t

I_t=investment expenditures in period t

R_t=long term interest rate in period t

Y_t=national income in period t

T_t=taxes in period t

M_t=money supply in period t

G_t=government expenditures in period t

the endogenous variables are: C_t, I_t, R_t, and Y_t

the exogenous variables are: M_t, T_t, and G_t

predetermined variable is I_{t-1}.

Coding for Subroutine CONST

The "C" array is used to store the calculated values of all pre-determined terms in each equation. For the model described above, the following FORTRAN statements are required:

```
C(1)=A(1)+A(3)*E(K,2)
C(2)=A(4)+A(6)*X(L1,2)
C(3)=A(7)+A(9)*E(K,1)
C(4)=E(K,3).
```

The term $E(K,2)$ refers to the current period value of the second exogenous variable. The term $X(L1,2)$ refers to the previous period value of the second endogenous variable. Throughout subroutines CONST and SOLVE, the subscript K refers to the current time period and the subscripts $L1, L2, \cdots, L19$ refer to lagged values starting with $L1$ representing a lag of one period, $L2$ representing a lag of two periods, etc. (the A array contains the value of the fixed coefficients, while an AC array is used for variable coefficients[3]).

The FORTRAN statements described above (or similar statements for your

(3) See page 37 for use of A array or AC array.

particular model) should be inserted within subroutine CONST immediately following the card which looks like:

C***ENTER USER STATEMENTS HERE***.

Coding for Subroutine SOLVE

The "Y" array is used during the iteration process to store the computed solution values of the model. During the first iteration, the "Z" array will contain the "initial guess" of the solution vector (usually lagged values of the endogenous variable).

After the first iteration the "Z" array will contain the previously computed "solution" values. For the model described above the following FORTRAN statements are required:

$Y(1)=C(1)+A(2)*Z(4)$

$Y(2)=C(2)+A(5)*Z(3)$

$Y(3)=C(3)+A(8)*Z(4)$

$Y(4)=C(4)+Z(1)+Z(2)$.

These statements should be inserted immediately after the following card in subroutine SOLVE:

C***ENTER USER STATEMENTS HERE***.

IV. Description of Data Files

Two data files are required during execution of program SIMU. The first file contains data for all of the endogenous variables over the sample period.[4] The second file contains data for all of the exogenous variables over the sample period as well as the forecasting or simulation period.

Input is read in an user provided format using the FORTRAN read statement, "READ*, $(X(K,I),\ I=1,N)$," where K denotes the time period, and N denotes the number of variables to be read per time period. Each time this

(4) In case of pure forecasting and if there are no lags, you must provide some values for the endogenous variables at least one time period before the first forecast period.

READ is executed, the computer reads the input cards until it has found N numbers. It begins looking for these numbers at the beginning of the card following the last card that was read by an earlier READ statement. Once the computer finds N numbers, it considers the READ accomplished, even if there are more numbers on the card currently being read. Any data remaining on a card after the Nth number is ignored, because subsequent execution of READ will cause the computer to start looking for numbers on the next card. Thus, you can enter the data one number per card, or several numbers per card, as long as you ensure that you start a new card for every $X(K, 1)$. That is, yon must start a new card at least every new time period, but you may start new cards more often than that if you have to.

V. The Specification File

The specification cards required by program SIMU specify which program options are to be utilized, the values of the coefficients of the model and starting and ending dates for the simulation. A description of each specification card (in order of appearance) follows. The names of the parameters described for each card are identical to the names of the variables representing these parameters in the program. For an example of the specification cards properly filled out, see Appendix.

Card 1: Always Required.

FORMAT: (10I5)

Parameters: NED, NEX, NL, NC, MAX, NOT

NED=Number of endogenous variables($\leq$200)

NEX=Number of exogenous variables($\leq$200)

NL=Length of maximum lag($0\leq$NL$\leq$19)

NC=Number of fixed coefficients($\leq$500)

MAX=Maximum number of iterations to be performed

NOT=Equal to 0 to perform the standard convergence criteria test of .01 on all elements of the solution vector.

Equal to 1 to read a user provided vector of convergence criteria, one element for each element in the solution vector.

Card 2: Required only if NOT=1

FORMAT: (8F10.5)

Parameters: (TEST(I), I=1, NED)

Cards 3 & 4: Always Required. These cards provide labels for both endogenous (card 3) and exogenous (card 4) variables. Therefore, there will always be a minimum of two label cards, but there may be more given your model.

FORMAT: (10A8)

Card 5: Always Required. This card provides the values of the fixed coefficients.

FORMAT: (8F10.5)

Parameters: (A(J), J=1, NC)

Card 6: Always Required

FORMAT: (10I5)

Parameters: NI, NJ

NI =0 if no variable coefficients

=length of simulation period if one or more coefficients are variables ($\leq$100)

NJ =Number of variable coefficients ($\leq$50)

Card 7: Required only if NI$\neq$0

FORMAT: (8F10.5)

Parameters: ((AC(I,J), J=1, NJ), I=1, NI)

Card 8: Always Required. This control card provides an appropriate date on output.

FORMAT: (2A4)

Parameter: DAY

Card 9: Always Required. This card provides appropriate title on output and can be any alpha numeric description.

FORMAT: (20A4)

Parameter: Title

Card 10: Always Required

FORMAT: (10I5)

Parameters: N1, N3, N4, N5, N6, N7, ERROR

N1 =0 for Dynamic Simulation
1 for one period simulation (forecast)

N3 =Number of summary tables. Normally equal to 1.

N4 =1 to print actual values of endogenous variables with dynamic simulation
=0 otherwise

N5 =Number of iterations before testing for convergence
=(1 for residual check)
Set N5=0 if N7=1.

N6 =Number of variables to be graphed (≤ 50)

N7 =1 to print iteration values
=0 normally

ERROR =0 normal
=1 to print mean absolute percentage errors

Card 11: Required only if N6≠0. This is the location vector for the variables to be graphed.

FORMAT: (10I5)

Parameters: (LOC(J), J=1, N6)

Card 12: Always required

FORMAT: (3(I5, I2))

Parameters: JY1, JQ1, IDS1, IDS2, JY2, JQ2

JY1 =starting year for data

JQ1 =starting quarter for data

IDS1=starting year for analysis
IDS2=starting quarter for analysis
JY2 =ending year for analysis
JQ2 =ending quarter for analysis

Notes: If JQ1=IDS2=JQ2=0, a yearly model is assumed.

Caution: You must be careful to choose IDS1, IDS2, JY2, JQ2. For example, if you want to analyse a model with time period 1960I—1975III, then IDS1=1959, IDS2=4, JY2=1975, JQ2=4. Therefore, IDS1, IDS2 actually denote the time period just one before the analysis starting. JY2, JQ2 denote the time period just one after the analysis ending.

Card 13: Always required. This card contains the user provided format specification for data file.

FORMAT: (7A10)

Parameters: (IFORM(J), J=1,7)

VI. Program Execution

Since model specification for program SIMU requires modifications to only two subroutines (CONST and SOLVE) a considerable amount of compilation time may be saved by compiling only these two subroutines and using a previously compiled version of the main program and all other subroutines. This procedure will be assumed in the following instructions.

First, user needs to modify the subroutines CONST and SOLVE. Second, user may calls a "control card macro" which direct the computer to (1) read and compile the user supplied subroutines CONST and SOLVE, (2) attach the compiled version of these subroutines to a previously compiled version of the rest of program SIMU, (3) read the data and control cards from user's input file, and (4) execute the program.[5]

(5) For detailed information about using the program SIMU, contact Kwang-Ha Kang, Department of Economics, Seoul National University.

VII. Some Modifications to the Simple Example

1. Failure of Model to Converge

Although the iterative procedure used by the program to obtain a solution seems to work reasonably well for most models, the method does not guarantee a solution. If no solution is reached within a reasonable number of iterations, the program stops and prints out its last result. In this case, two steps can be taken that may facilitate a solution:

(1) The equations of the model can be reordered, moving some of the more volatile relationships to the end of the iterative cycle. In this way the program calculates values for those Y's that are least sensitive to initial conditions before it gets to the more sensitive Y's.

(2) If the iteration process appears to be exploding—that is diverging from, rather than converging toward a solution—two or more of the equations can be altered by moving the Y's on the left over to the right, and replacing them with Y's moved from right to left. This must still leave the system in the form shown above. The force of this change can be understood in terms of a simple price determination model, consisting of a supply and a demand function. To fit the program, the model must be written in a form like

$P=S(Q, X_1)$ as the supply, and

$Q=D(P, X_2)$ as the demand.

The solution the program is seeking is the intersection of the two curves. The iteration starts with a quantity and finds a price on the supply schedule; with this price it finds a quantity on the demand; with this quantity it finds a price on the supply, and so on. This generates a cobweb around the equilibrium solution, but the cobweb pattern may explode away from the solution, rather than converge toward it. In this case, the solution can be obtained by reversing the direction of movement around the cobweb by interchanging the position of P and Q in the two equations. The model

$$Q=S^{*}(P, X_1)$$
$$P=D^{*}(Q, X_2)$$

is formally equivalent to the first, but may produce a convergent iteration.

(3) In some cases a relaxation of the convergence criteria on some or all equations of the model may be required. If this becomes necessary, refer to the description of card 1 (parameter NOT).

2. Model Verification

The user should carefully examine the coding of the model, the specification card file (including coefficients), and the data files as a first check to insure the accuracy of the model solution. A simple test, however, can be performed to insure that the model, the coefficients and the data have been properly specified. "Properly specified" in this case should be understood as consistent with the estimation of the model.

This check-out procedure is actually a "residual" check against the results of the estimation program. Many estimation programs (Program ECON, for example) provide the user the option of printing out either (or both) "predicted" values and residuals (actual-predicted). A one period simulation run throughout the sample period should produce identical (or nearly identical) predicted values. To perform this test, Card 10 parameter N5 should be set to 1.

Appendix: A Sample Execution of Program SIMU

The following sample execution of program SIMU is based on the simple macroeconomic model presented in section III. In this example the model will be simulated over twenty time periods (quarters) within the sample period. The printout contains a complete listing of the input and data required to run program SIMU for this example, and the resulting output from program SIMU.

SPECIFICATION FILE EXAMPLE

```
     4        3      1         9    100      1
0.1          0.1            0.1          0.1
C            I          R            Y
M           T          G
23.539      0.6122         -0.1667    -2.1423    1.8117    0.9113    0.5661    0.0048
0.0066
   0       0
12/15/80
MACRO MODEL EXAMPLE
      0       1       1       2       1       0       1
      1
 1947    4  1948  2  1953    2
(4F9.3)
```

DATA FILE FOR ENDOGENOUS VARIABLES

```
158.9        23.1        2.537        225.0
162.5        23.2        2.573        232.7
166.5        24.4        2.777        235.5
169.1        26.1        2.847        242.6
172.8        26.1        2.767        248.9
175.7        27.1        2.830        257.4
176.6        28.2        2.823        262.0
175.4        26.6        2.707        260.8
176.8        25.7        2.707        263.9
176.2        24.3        2.630        263.5
178.8        23.8        2.597        265.0
181.7        24.4        2.577        275.0
```

185.8	26.7	2.610	274.0
199.4	29.8	2.633	288.0
197.0	30.7	2.670	290.8
207.5	31.0	2.700	309.1
202.9	31.8	2.900	312.7
205.4	32.4	2.887	323.7
209.2	32.0	2.953	332.6
210.4	32.3	2.957	333.4
214.6	32.7	2.933	341.3
216.7	29.6	2.947	339.3

DATA FILE FOR EXOGENOUS VARIABLES

111.633	57.9	43.0
112.600	57.7	47.0
113.100	60.7	44.6
113.067	61.5	47.4
112.133	60.8	50.0
112.233	60.5	54.6
111.800	60.7	57.2
111.200	59.5	58.8
111.367	57.7	61.4
111.033	58.3	63.0
111.033	57.4	62.4
112.033	62.6	68.9
113.667	67.4	61.5
114.933	74.5	58.8
115.933	79.3	63.1
117.133	88.6	70.6
118.200	85.6	78.0
119.700	85.2	85.9
121.900	89.8	91.4
123.500	90.5	90.7
124.533	91.1	94.0
125.800	92.4	93.0

```
SUBROUTINE CONST
COMMON DATE(100,2),X(40,200),E(40,200),A(500),AC(100,50),TITLE(20)
1      ,Y(200),B(50),C(200),XNOR(100),LABX(200),LABE(200),K,N1,NED
```

```
2            , NEX, MAX, NT, K1, DAY(2), N3, NCOL, N2, N4, N5, N7, ID, ID1, M, MIN
3            /LLL/L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L14, L15, L16
4            , L17, L18, L19, L20
5            /GRAP/GRA(100, 20), LOC(10), N6, NO, NL, LD1(100), LD2(100)
 DIMENSION Z(200), LO(20)
 EQUIVALENCE(LO, L1, L)
 EQUIVALENCE(Y, Z)
 IN1=1
 IF(N1. EQ. 0) IN1=21
 DO 2 LAG=1, NL
 LO(LAG)=MOD(K+19-LAG, 20)+IN1
 *** ENTER USER CODE HERE ***
 C(1)=A(1)+A(3)*E(K, 2)
 C(2)=A(4)+A(6)*X(L1, 2)
 C(3)=A(7)+A(9)*E(K, 1)
 RETURN
 END
 SUBROUTINE SOLVE
 COMMON DATE(100, 2), X(40, 200), E(40, 200), A(500), AC(100, 50), TITLE(20)
1            , Y(200), B(50), C(200), XNOR(100), LABX(200), LABE(200), K, N1, NED
2            , NEX, MAX, NT, K1, DAY(2), N3, NCOL, N2, N4, N5, N7, ID, ID1, M, MIN
3            /LLL/L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L14, L15, L16
4            , L17, L18, L19, L20
5            /GRAP/GRA(100, 20), LOC(10), N6, NO, NL, LD1(100), LD2(100)
 DIMENSION Z(200), LO(20)
 EQUIVALENCE(LO, L1, L)
 EQUIVALENCE(Y, Z)
 REAL LRGNP, LRATIO
 IN1=1
 IF(N1. EQ. 0) IN1=21
 DO 2 LAG=1, NL
 LO(LAG)=MOD(K+19-LAG, 20)+IN1
 NT=NT+1
 *** ENTER USER CODE HERE ***
 Y(1)=C(1)+A(2)*Z(4)
 Y(2)=C(2)+A(5)*Z(3)
 Y(3)=C(3)+A(8)*Z(4)
 Y(4)=Z(1)+Z(2)+E(K, 3)
```

```
RETURN
END
```

RESULTING OUTPUT

```
                  *** PROGRAM SIMU ***
1        CONTROL CARD SUMMARY
0    THERE ARE    4 ENDOGENOUS VARIABLES
0    THERE ARE    3 EXOGENOUS VARIABLES
0    THE MAXIMUM NUMBER OF LAGS=  1
0    THERE ARE    9 COEFFICIENTS IN THE SYSTEM
0    THE MAXIMUM NUMBER OF  ITERATIONS=100
0    USER SPECIFIED CONVERGENCE CRITERIA
0          .10000        .10000        .10000        .10000
0    THE ENDOGENOUS VARIABLES ARE:
0             C             I           R           Y
0    THE EXOGENOUS VARIABLES ARE:
0             M             T           G
0    REGRESSION COEFFICIENTS
        23.5390   .6122   -.1667   -2.1423   1.8117   .9113   0.5661   0.0048
          .0066
0    THERE ARE    0 VARIABLE COEFFICIENTS
0    DYNAMIC SIMULATION REQUESTED
0       1 SUMMARY TABLES REQUESTED
0       2 ITERATIONS BEFORE CONVERGENCE CHECK BEGINS
0       1 VARIABLES ARE TO BE GRAPHED
1    DYNANIC SIMULATION ON 6/15/2
 MACRO MODEL EXAMPLE
0ACTUAL VALUES FOR EXOGENOUS VARIABLES
-                 1            2             3
                  M            T             G
1948 3        113.06700     61.50000      47.40000
1948 4        112.13300     60.80000      50.00000
1949 1        112.23300     60.50000      54.60000
1949 2        111.80000     60.70000      57.20000
1949 3        111.20000     59.50000      58.80000
1949 4        111.36700     57.70000      61.40000
1950 1        111.03300     58.30000      63.00000
1950 2        111.03300     57.40000      62.40000
1950 3        112.03300     62.60000      68.90000
```

1950 4	113.66700	67.40000	61.50000
1951 1	114.93300	74.50000	58.80000
1951 2	115.93300	79.30000	63.10000
1951 3	117.13300	88.60000	70.60000
1951 4	118.20000	85.60000	78.00000
1952 1	119.70000	85.20000	85.90000
1952 2	121.90000	89.80000	91.40000
1952 3	123.50000	90.50000	90.70000
1952 4	124.53300	91.10000	94.00000
1953 1	125.80000	92.40000	93.00000

0ACTUAL VALUES FOR ENDOGENOUS VARIABLES

—	1	2	3	4
	C	I	R	Y
1948 3	169.10000	26.10000	2.84700	242.60000
1948 4	172.80000	26.10000	2.76700	248.90000
1949 1	175.70000	27.10000	2.83000	257.40000
1949 2	176.60000	28.20000	2.82300	262.00000
1949 3	175.40000	26.60000	2.70700	260.80000
1949 4	176.80000	25.70000	2.70700	263.90000
1950 1	176.20000	24.30000	2.63000	263.50000
1950 2	178.80000	23.80000	2.59700	265.00000
1950 3	181.70000	24.40000	2.57700	275.00000
1950 4	185.80000	26.70000	2.61000	274.00000
1951 1	199.40000	29.80000	2.63300	288.00000
1951 2	197.00000	30.70000	2.67000	290.80000
1951 3	207.50000	31.00000	2.70000	309.10000
1951 4	202.90000	31.80000	2.90000	312.70000
1952 1	205.40000	32.40000	2.88700	323.70000
1952 2	209.20000	32.00000	2.95300	332.60000
1952 3	210.40000	32.30000	2.95700	333.40000
1952 4	214.60000	32.70000	2.93300	341.30000
1953 1	216.70000	29.60000	2.94700	339.30000

0SOLUTION VALUES FOR ENDOGENOUS VARIABLES BEGIN TO 1948 4

—	1	2	3	4
	C	I	R	Y
1948 3	169.10000	26.10000	2.84700	242.60000
1948 4	154.67019	26.01660	2.41379	230.68679
1949 1	162.14109	26.04748	2.47263	242.78857

1949 2	166.26894	26.12938	2.50240	249.59832
1949 3	169.52225	26.24053	2.52238	254.56278
1949 4	174.63089	26.41177	2.56118	262.44266
1950 1	176.97398	26.59663	2.57814	266.57061
1950 2	176.64990	26.75819	2.57442	265.80808
1950 3	185.12030	27.04986	2.65423	281.07017
1950 4	171.80645	27.15973	2.56690	260.46617
1951 1	164.54707	27.18875	2.52762	250.53582
1951 2	169.43787	27.30781	2.57884	259.84569
1951 3	177.70123	27.57012	2.66370	275.87135
1951 4	191.38940	28.00946	2.77414	297.39886
1952 1	205.01253	28.62046	2.89034	319.53299
1952 2	212.55017	29.31916	2.96997	333.26932
1952 3	212.38359	29.97607	2.98014	333.05966
1952 4	218.23637	30.66993	3.03363	342.90629
1953 1	217.07382	31.30373	3.03457	341.37755

1

DYNAMIC SIMULATION ON 6/15/2

MACRO MODEL EXAMPLE

MEAN ABSOLUTE PERCENTAGE ERRORS BASED ON 18. PERIODS

1	C	5.32
2	I	7.34
3	R	4.30
4	Y	3.96

1

MACRO MODEL EXAMPLE

ACTUAL	SOLUTION	RESIDUALS	
C+	C*		
172.80000	154.67019	18.12981	1948 4
175.70000	162.14109	13.55891	1949 1
176.60000	166.26894	10.33106	1949 2
175.40000	169.52225	5.87775	1949 3
176.80000	174.63089	2.16911	1949 4
176.20000	176.97398	−.77398	1950 1
178.80000	176.64990	2.15010	1950 2
181.70000	185.12030	−3.42030	1950 3
185.80000	171.80645	13.99355	1950 4
199.40000	164.54707	34.85293	1951 1

197.00000	169.43787	27.56213	1951 2
207.50000	177.70123	29.79877	1951 3
202.90000	191.38940	11.51060	1951 4
205.40000	205.01253	.38747	1952 1
209.20000	212.55017	−3.35017	1952 2
210.40000	212.38359	−1.98359	1952 3
214.60000	218.23637	−3.63637	1952 4
216.70000	217.07382	−.37382	1953 1

RANGE 154.67 TO 221.66