

Technical Report No. 46
ODE: NUMERICAL ANALYSIS
FOR ORDINARY DIFFERENTIAL EQUATIONS

L. J. Bledsoe
Colorado State University

GRASSLANDS BIOME
U. S. International Biological Program

January 1970

Program ODE

INTRODUCTION

ODE (Ordinary Differential Equation) is a general purpose routine for solving sets of ordinary differential equations. The equations may be of any complexity so long as they can be reduced to a first-order form and the derivatives of the dependent variables can be calculated in a subroutine given the present vector of system variables plus time and any other independent variables. The program requires that the user write one or more subroutines to evaluate these derivatives. The subroutine to find the derivatives should be called DER. Other subroutines which must be provided by the user to perform various options include INPUT, INIT, PL1, and DEBUG. These are described below.

The output of ODE consists of a list of the values for the dependent variables at various time points specified by the input data cards. In addition, the values of the derivatives of the variables and of various functions associated with the set of equations may be optionally printed out. Plotted output can be provided through the use of user coded subroutine PL1. ODE provides the user with an option of solving the differential equations numerically using either a fifth-order Runge-Kutta procedure with an automatic error determination algorithm or a first-order Euler method. One of the two methods is selected by an input option card. The less accurate but very fast Euler method is intended to be used during the debugging stages of the program and the more accurate but slower Runge-Kutta procedure is intended for production runs. Subroutine INPUT is designed to read in constant parameters associated with the set of differential equations. Subroutine INIT is designed also to read in parameters associated with the differential equations. However, INIT is designed to be used for

parameters which the user might decide to modify between simulation runs. The parameters read in by subroutine INPUT would be constant for all of a series of simulations. Thus subroutine INPUT reads in data which is used for the first and all subsequent simulations. However, in order to avoid duplication of a large number of constant data points, subroutine INIT is called to read in modifications of the equation coefficients for subsequent simulations. The purpose of using both INIT and INPUT for coefficient input is to make sensitivity analysis easier. The user has the option of calling subroutine PL1 at each iteration of each simulation to provide plotted output and also subroutine DEBUG. Reference to the following subroutine format and the example at the end of this section should clarify the use of these subroutines.

SUBROUTINE FORMAT

INPUT

Subroutine INPUT has one parameter, NP, which is read in on the parameter card by the main program described below. Subroutine INPUT should contain an input statement which reads values of parameters into variables and array locations in a labeled common block. For purposes of later reference, assume that this common block has been called L1. The parameters which are read in by input should be those that will be constant throughout a series of simulations.

INIT

Subroutine INIT should also contain input statements reading data values into locations of a common block. Assume this block is labeled L2. Parameters read by INIT should be those which the user desires to change during each of a sequence of simulation runs.

DER

Subroutine DER has three arguments - T, V, VP. V and VP should each be dimensioned 10. T and V are input parameters for subroutine DER. The subroutine must be FORTRAN coded to calculate the values of T and V and place the derivatives in their respective components of FP and then return to the main program. In general, a number of constant parameters will also be required for this calculation. These are the parameters read in by subroutines INPUT and INIT; DER should contain common blocks L1 and L2 in order to communicate with the parameter values read in. DER may also make use of any other user provided subroutines and functions which are desirable for efficient programming and debugging.

PL1

This subroutine is called at each iteration of a simulation and should be coded by the user to call plotting routines if plotted output is desired. At this time no standard plotting routine has been provided.

DEBUG

This subroutine should be user coded and, if the option is selected, will be called at each iteration step and should print out the values of various functions which the user wishes to check out for program debugging.

PURPOSE AND EXAMPLES

ODE can be used to simulate any situation where a physical or biological mechanism has been described by a set of ordinary differential equations. For example, the linear compartment model as described by Bledsoe and Van Dyne (1969). The program is designed so as to enable easy and rapid sensitivity analysis in terms of the parameters of the model. The enclosed

example is a four-compartment linear constant coefficient compartment model, and several runs provide a partial sensitivity analysis in terms of two of the elements of the coefficient matrix.

DATA FORMAT

<u>Column</u>	<u>Variable</u>	<u>Description</u>	<u>Format</u>
Card #1			
1- 5	NCOM	Number of equations to be solved.	I5
6-10	NP	Number of parameters. This value passed to INPUT as argument. May be omitted.	I5
11-15	NT	Number of times for which printed output is desired.	I5
16-25	T1	First time point for which output is desired.	F10.0
26-35	TDEL	Time increment between output steps.	F10.0
36-45	ACC	Accuracy desired in solution of DE's. Not used if subroutine EULER is used for solving equations. .01 specifies 1% accuracy.	F10.0
46-55	DEL	Fraction to multiply by TDEL to determine the number of iterations which the DE solving subroutine will take between output steps. .01 means 100 iterations.	F10.0
56-60	ITER	Maximum number of times that KUTTA will half or double the integration time step in attempting to provide the requested accuracy, not used by EULER.	I5
Card #2			
1-10	DB	"DEBUG" if subroutine DEBUG is to be called at each output step; else blank (left justify).	A10
11-20	DESOLV	"EULER" if this subroutine is to be used for the numerical integration, else "KUTTA" (left justify).	A10
21-30	PLOT	"PLOT" if plotted output is desired and subroutine PL1 has been provided (left justify).	A10

DATA FORMAT (Continued)

<u>Column</u>	<u>Variable</u>	<u>Description</u>	<u>Format</u>
Card #3			
1-10	V	Initial values of system dependent variables. Extend to second card if necessary.	8F10.0
11-20			
"			

Cards #4

Insert those cards read in by subroutine INPUT at this point.

Cards #5

Insert those cards read in by subroutine INIT at this point.

Cards #6

If another simulation run is desired, put a negative number (e.g., -1) in columns 1-5 of one card.

Cards #7

Same as #3 - Initial values for this simulation.

Cards #8

Insert those cards read in by INIT at this point.

----- Repeat cards 6 through 8 for each additional simulation desired.

Last Card

All blank.

```

PROGRAM GDE (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
DIMENSION V(10),VP(10),ID(8),FC(8)
COMMON/L1/P(100)
EXTERNAL DER
D=DATE(X) & TT=TIME(X)
READ (5,1300) ID
1 READ(5,1300) FC
  DECODE (5,100,FC) M1
  IF (M1 ) 2,11,4
4 DECODE (80,100,FC) NCOM,NP,NT,T1,TDEL,ACC,DEL,ITER
  READ (5,1300) DB,DEFSOLV,PLOT
2 WRITE (6,200) ID,D,T1,T1,TDEL,NT
  IF (PLOT.EQ.10RPL0T ) CALL PL1(0.,0.,0.)
  WRITE (5,210) NCOM,NP,ACC,DEL,ITER
  READ (5,300) (V(I),I=1,NCOM)
300 FORMAT(8F10.0)
  IF (N1 .LT.0) GO TO 3
  CALL INPUT (NP)
3 T=T1-TDEL
  CALL IN11
  WRITE (6,600)
  DO 20 I=1,NT
    T=T+TDEL & T2=T+TDEL
    WRITE (5,800) T, (V(J),J=1,NCOM)
    IF (PLOT.EQ.10RPL0T ) CALL PL2(T3,NCOM,V)
    IF (DB.EQ.10RDEB0G ) GO TO 8
    CALL DER(T,V,VP) & CALL ALGY(T,V) & CALL DEBUG(T,V,VP)
    WRITE (5,900) (VP(J),J=1,NCOM)
4 IF (DEFSOLV.EQ.10HEUL0R ) 5,6
5 CALL EULER(T,T2,V,NCOM,DEL) & GO TO 7
6 CALL KUTTA(T,T2,V,NCOM,DEL,ACC,ITER,DER)
7 CALL ALGY(T2,V)
20 WRITE (6,1100)
  GO TO 1
11 STOP
100 FORMAT(3I5,4F10.0,15)
200 FORMAT(*IDE SOLUTION*/* *8A10/A10* TIME*A10//
  1* TIME STARTS AT *F10.3*, INCREMENTS BY *F10.5* FOR *15* STEPS*/)
210 FORMAT(* *15* EQUATIONS, *15* CONSTANTS*/* KUTTA PARAMETERS ARE *
  12F10.2,15)
600 FORMAT(//* TIME, VARIABLE VALUES*)
800 FORMAT(* *F10.2,10F10.4/(11X,10F10.4))
900 FORMAT(* DERIVATIVE*10F10.4/(11X,10F10.4))
1100 FORMAT(//)
1300 FORMAT(8A10)
  END

```

```

SUBROUTINE INPUT(NP)
COMMON/L1/F(5,5)
WRITE (5,100)
DO 10 I=1,4
05 READ (5,300) (F(I,J),J=1,4)
10 WRITE (5,200) (F(I,J),J=1,4)
100 FORMAT(* COEFFICIENT MATRIX*)
200 FORMAT(* *4G12.5)
300 FORMAT(4F10.0)
RETURN
END

```

SUBROUTINE INIT FORTRAN EXTENDED VERSION 2.0

03/14/70

```

SUBROUTINE INIT
COMMON/L1/F(5,5)
READ (5,100) N
WRITE (6,400) N
05 IF (N.EQ.0) GO TO 1
DO 10 K=1,N
READ (5,200) I,J,X
WRITE (6,300) I,J,X
10 F(I+J)=X
1 RETURN
100 FORMAT(I5)
200 FORMAT(2I5,F10.0)
300 FORMAT(1H,2I5,G12.5)
400 FORMAT(*MODIFY COEFFICIENT MATRIX, *I5,* VALUES*)
15 RETURN
END

```

SUBROUTINE DER FORTRAN EXTENDED VERSION 2.0

03/14/70

```

SUBROUTINE DER(T,V,VP)
COMMON/L1/F(5,5)
DIMENSION V(10),VP(10)
DO 10 I=1,4
05 VP(I)=0.
DO 10 J=1,4
10 VP(I)=VP(I)+F(I,J)*V(J)
VP(I)=VP(I)+F1(T)
RETURN
10 END

```

FUNCTION F1 FORTRAN EXTENDED VERSION 2.0

03/14/70

```

FUNCTION F1(T)
F1=Sin(3.14159*T)**2
RETURN
END

```

```
05      SUBROUTINE DEGRN(T,V,VP)
          DIMENSION V(10),VP(10)
          A=F1(T)
          *RIIE (6*100) *
          100 FORMAT(* DRIVING FUNCTION*,F10.3)
          RETURN
          END
```

SUBROUTINE EULER FORTRAN EXTENDED VERSION 2.0

03/14/70

```
05      SUBROUTINE EULER (XL,XU,V,N,DEL)
          DIMENSION V(10),VP(10)
          DT=(XU-XL)*DEL
          T=XL
          ND=1./DEL+.0001
          DO 20 K=1,ND
              T=T+DT
              CALL DEH (T,V,VP)
              10 20 V(1)=V(1)+DT*VP(1)
          RETURN
          END
```

SUBROUTINE ALGY FORTRAN EXTENDED VERSION 2.0

03/14/70

```
      SUBROUTINE ALGY(T,V)
          DIMENSION V(10)
          RETURN
          END
```

SUBROUTINE PL1 FORTRAN EXTENDED VERSION 2.0

03/14/70

```
05      SUBROUTINE PL1(T,N,V)
          DIMENSION V(10)
          ENTRY PL2
          RETURN
          END
```

INPUT DECK FOR SAMPLE RUN OF ODE

```

SAMPLE 4 VARIABLE LINEAR SYSTEM -- SIN**2 DRIVING -- SENS ANALYSIS, F(1,3)
      4      0 1000.      1.      .01      .01      20
DEBUG      EULER
100.      0.      0.      0.
-.65      0.      .2      0.
.5      -.1      0.      0.
.15      .1      -.25      0.
0.      0.      .05      0.
      0
      -1
100.      0.      0.      0.
      2
      1      3 .4
      3      3 -.45
      -1
100.      0.      0.      0.
      2
      1      3 .8
      3      3 -.85
      -1
100.      0.      0.      0.
      2
      1      3 1.
      3      3 -1.05
  
```

DE SOLUTION

EXAMPLE 4 VARIABLE LINEAR SYSTEM -- SIN**2 DRIVING -- SENS ANALYSIS: F(1+3)
 03/14/70 TIME*00.41.04.

TIME STARTS AT 0.000, INCREMENTS BY 1.00000 FOR 100 STEPS

4 EQUATIONS, 0 CONSTANTS
 KUTTA PARAMETERS ARE .01000 .01000 20
 COEFFICIENT MATRIX
 -.65000 0. .20000 0.
 .50000 -.10000 0. 0.
 .15000 .10000 -.25000 0.
 0. 0. .50000E-01 0.

MODIFY COEFFICIENT MATRIX: 0 VALUES

TIME, VARIABLE VALUES

TIME	DRIVING FUNCTION	DERIVATIVE	1	2	3
0.00	100.0000	0.0000	0.0000	0.0000	0.0000
0.00	0.000	0.0000	15.0000	0.0000	0.0000

1.00	53.4651	35.1756	11.5443	.3120
DRIVING FUNCTION	.000			
DERIVATIVE	-32.4454	23.2105	8.6517	.5772

2.00	30.5054	51.1414	18.2817	1.0705
DRIVING FUNCTION	.000			
DERIVATIVE	-16.1728	10.1391	5.1197	.9141

3.00	19.3005	57.7960	22.3109	2.0926
DRIVING FUNCTION	.000			
DERIVATIVE	-8.0831	3.8706	3.0970	1.1155

4.00	13.9194	60.0402	24.7666	3.2738
DRIVING FUNCTION	.000			
DERIVATIVE	-4.0943	.9557	1.9003	1.2383

5.00	11.3901	60.2745	26.2759	4.5525
DRIVING FUNCTION	.000			
DERIVATIVE	-2.1521	-.3294	1.1676	1.3138

6.00	10.2534	57.6502	27.1994	5.8910
DRIVING FUNCTION	.000			
DERIVATIVE	-1.2248	-.8389	.7038	1.3600

7.00	9.7616	53.7204	27.7444	7.2655
DRIVING FUNCTION	.000			
DERIVATIVE	-.7901	-.9921	.4010	1.3872

8.00	9.5643	57.7349	28.0398	8.6609
DRIVING FUNCTION	.000			
DERIVATIVE	-.6088	-.9913	.1952	1.4020

9.00	9.4907	56.7702	28.1666	10.0665
------	--------	---------	---------	---------

DERIVATIVE	- .5356	- .9323	.0596	1.4003
------------	---------	---------	-------	--------

10.00	9.4610	55.8804	28.1772	11.4754
DRIVING FUNCTION	.000			
DERIVATIVE	- .5143	- .8581	- .0365	1.4089

11.00	9.4403	55.0701	28.1069	12.8827
DRIVING FUNCTION	.000			
DERIVATIVE	- .5148	- .7869	- .1037	1.4053

12.00	9.4143	54.3207	27.9799	14.2850
DRIVING FUNCTION	.000			
DERIVATIVE	- .5233	- .7249	- .1508	1.3990

13.00	9.3787	53.6261	27.8133	15.6800
DRIVING FUNCTION	.000			
DERIVATIVE	- .5335	- .6735	- .1837	1.3907

14.00	9.3332	52.9820	27.6190	17.0658
DRIVING FUNCTION	.000			
DERIVATIVE	- .5428	- .6316	- .2066	1.3810

15.00	9.2792	52.3737	27.4057	18.4415
DRIVING FUNCTION	.000			
DERIVATIVE	- .5503	- .5978	- .2222	1.3703

16.00	9.2185	51.7959	27.1795	19.8061
DRIVING FUNCTION	.000			
DERIVATIVE	- .5582	- .5703	- .2325	1.3590

17.00	9.1529	51.2430	26.9449	21.1592
DRIVING FUNCTION	.000			
DERIVATIVE	- .5604	- .5479	- .2390	1.3472

18.00	9.0836	50.7106	26.7053	22.5004
DRIVING FUNCTION	.000			
DERIVATIVE	- .5633	- .5272	- .2427	1.3353

19.00	9.0120	50.1953	26.4631	23.8295
DRIVING FUNCTION	.000			
DERIVATIVE	- .5652	- .5135	- .2444	1.3232

20.00	8.9389	49.6946	26.2198	25.1465
DRIVING FUNCTION	.000			
DERIVATIVE	- .5683	- .5000	- .2447	1.3110

21.00	8.8650	49.2005	25.9770	26.4515
DRIVING FUNCTION	.000			
DERIVATIVE	- .5688	- .4882	- .2438	1.2988

22.00	8.7906	48.7221	25.7353	27.7443
DRIVING FUNCTION	.000			
DERIVATIVE	- .5689	- .4775	- .2422	1.2868

23.00	8.7166	46.2629	25.4955	29.0250
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5667	-.4660	-.2401	1.2748

24.00	8.6428	47.8053	25.2581	30.2936
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5662	-.4591	-.2376	1.2629

25.00	8.5696	47.3503	25.0233	31.5508
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5656	-.4508	-.2348	1.2512

26.00	8.4971	46.9153	24.7915	32.7961
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5648	-.4430	-.2318	1.2396

27.00	8.4254	46.4820	24.5627	34.0299
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5640	-.4355	-.2287	1.2281

28.00	8.3546	46.0500	24.3370	35.2524
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5631	-.4283	-.2255	1.2169

29.00	8.2847	45.6371	24.1146	36.4636
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5621	-.4214	-.2222	1.2057

30.00	8.2157	45.2221	23.8954	37.6638
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5611	-.4146	-.2190	1.1948

31.00	8.1478	44.8196	23.6795	38.8531
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5602	-.4081	-.2157	1.1840

32.00	8.0808	44.4207	23.4668	40.0317
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5592	-.4017	-.2125	1.1733

33.00	8.0148	44.0261	23.2573	41.1998
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5582	-.3954	-.2093	1.1629

34.00	7.9498	43.6417	23.0510	42.3574
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5572	-.3892	-.2061	1.1526

35.00	7.8858	43.2614	22.8479	43.5048
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5562	-.3832	-.2030	1.1424

36.00	7.8228	42.0611	22.0411	44.0422
DRIVING FUNCTION		.000		
DERIVATIVE	-.5552	-.3773	-.1999	1.1324

37.00	7.7608	42.5186	22.4511	45.7696
DRIVING FUNCTION		.000		
DERIVATIVE	-.5543	-.3715	-.1968	1.1226

38.00	7.6996	42.1559	22.2572	46.8672
DRIVING FUNCTION		.000		
DERIVATIVE	-.5533	-.3658	-.1938	1.1129

39.00	7.6395	41.7959	22.0664	47.9953
DRIVING FUNCTION		.000		
DERIVATIVE	-.5524	-.3601	-.1908	1.1033

40.00	7.5803	41.4474	21.8785	49.0938
DRIVING FUNCTION		.000		
DERIVATIVE	-.5515	-.3546	-.1878	1.0939

41.00	7.5219	41.1015	21.6935	50.1831
DRIVING FUNCTION		.000		
DERIVATIVE	-.5506	-.3492	-.1849	1.0847

42.00	7.4645	40.7609	21.5114	51.2631
DRIVING FUNCTION		.000		
DERIVATIVE	-.5497	-.3438	-.1821	1.0756

43.00	7.4080	40.4255	21.3322	52.3342
DRIVING FUNCTION		.000		
DERIVATIVE	-.5488	-.3386	-.1793	1.0666

44.00	7.3524	40.0956	21.1557	53.3963
DRIVING FUNCTION		.000		
DERIVATIVE	-.5479	-.3334	-.1765	1.0578

45.00	7.2976	39.7707	20.9820	54.4497
DRIVING FUNCTION		.000		
DERIVATIVE	-.5470	-.3283	-.1738	1.0491

46.00	7.2437	39.4509	20.8110	55.4945
DRIVING FUNCTION		.000		
DERIVATIVE	-.5462	-.3232	-.1711	1.0405

47.00	7.1906	39.1351	20.6426	56.5307
DRIVING FUNCTION		.000		
DERIVATIVE	-.5454	-.3183	-.1685	1.0321

48.00	7.1383	38.8201	20.4769	57.5587
DRIVING FUNCTION		.000		
DERIVATIVE	-.5445	-.3134	-.1659	1.0238

DRIVING FUNCTION	•000			
DERIVATIVE	-.5437	-.3086	-.1633	1.0157

50.00	7.0303	38.2206	20.1531	59.5900
DRIVING FUNCTION	•000			
DERIVATIVE	-.5429	-.3039	-.1608	1.0077

51.00	6.9804	37.9250	19.9950	60.5936
DRIVING FUNCTION	•000			
DERIVATIVE	-.5422	-.2993	-.1583	.9998

52.00	6.9373	37.6339	19.8394	61.5894
DRIVING FUNCTION	•000			
DERIVATIVE	-.5414	-.2947	-.1559	.9920

53.00	6.8890	37.3474	19.6862	62.5775
DRIVING FUNCTION	•000			
DERIVATIVE	-.5406	-.2902	-.1535	.9843

54.00	6.8415	37.0603	19.5353	63.5579
DRIVING FUNCTION	•000			
DERIVATIVE	-.5399	-.2858	-.1511	.9768

55.00	6.7947	36.7876	19.3868	64.5309
DRIVING FUNCTION	•000			
DERIVATIVE	-.5392	-.2814	-.1488	.9693

56.00	6.7486	36.5142	19.2407	65.4965
DRIVING FUNCTION	•000			
DERIVATIVE	-.5384	-.2771	-.1465	.9620

57.00	6.7032	36.2451	19.0968	66.4549
DRIVING FUNCTION	•000			
DERIVATIVE	-.5377	-.2729	-.1442	.9548

58.00	6.6585	35.9802	18.9551	67.4061
DRIVING FUNCTION	•000			
DERIVATIVE	-.5370	-.2688	-.1420	.9478

59.00	6.6146	35.7195	18.8157	68.3503
DRIVING FUNCTION	•000			
DERIVATIVE	-.5363	-.2647	-.1398	.9408

60.00	6.5713	35.4627	18.6784	69.2876
DRIVING FUNCTION	•000			
DERIVATIVE	-.5356	-.2606	-.1376	.9339

61.00	6.5287	35.2100	18.5433	70.2181
DRIVING FUNCTION	•000			
DERIVATIVE	-.5350	-.2567	-.1355	.9272

62.00	6.4867	34.9612	18.4102	71.1419
-------	--------	---------	---------	---------

DERIVATIVE -5343 -2528 -1334 .9205

63.00 6.4454 34.7153 18.2793 72.0590
DRIVING FUNCTION .000
DERIVATIVE -5337 -2459 -1314 .9140

64.00 6.4048 34.4752 18.1503 72.9697
DRIVING FUNCTION .000
DERIVATIVE -5330 -2451 -1293 .9075

65.00 6.3648 34.2379 18.0234 73.8740
DRIVING FUNCTION .000
DERIVATIVE -5324 -2414 -1274 .9012

66.00 6.3254 34.0042 17.8985 74.7720
DRIVING FUNCTION .000
DERIVATIVE -5318 -2377 -1254 .8949

67.00 6.2866 33.7742 17.7755 75.6637
DRIVING FUNCTION .000
DERIVATIVE -5312 -2341 -1235 .8888

68.00 6.2484 33.5478 17.6544 76.5494
DRIVING FUNCTION .000
DERIVATIVE -5306 -2306 -1216 .8827

69.00 6.2108 33.3249 17.5352 77.4291
DRIVING FUNCTION .000
DERIVATIVE -5300 -2271 -1197 .8768

70.00 6.1738 33.1055 17.4179 78.3028
DRIVING FUNCTION .000
DERIVATIVE -5294 -2236 -1178 .8709

71.00 6.1374 32.8895 17.3024 79.1708
DRIVING FUNCTION .000
DERIVATIVE -5288 -2202 -1160 .8651

72.00 6.1016 32.6768 17.1887 80.0330
DRIVING FUNCTION .000
DERIVATIVE -5283 -2169 -1142 .8594

73.00 6.0663 32.4675 17.0767 80.8895
DRIVING FUNCTION .000
DERIVATIVE -5277 -2136 -1125 .8538

74.00 6.0315 32.2614 16.9665 81.7405
DRIVING FUNCTION .000
DERIVATIVE -5272 -2104 -1108 .8483

75.00 5.9973 32.0586 16.8581 82.5861
DRIVING FUNCTION .000
DERIVATIVE -5266 -2072 -1091 .8429

76.00	5.9636	31.8589	16.7513	83.4262
DRIVING FUNCTION		.000		
DERIVATIVE	-.5261	-.2041	-.1074	.8376

77.00	5.9305	31.6623	16.6461	84.2611
DRIVING FUNCTION		.000		
DERIVATIVE	-.5256	-.2010	-.1057	.8323

78.00	5.8979	31.4688	16.5427	85.0907
DRIVING FUNCTION		.000		
DERIVATIVE	-.5251	-.1979	-.1041	.8271

79.00	5.8657	31.2783	16.4408	85.9152
DRIVING FUNCTION		.000		
DERIVATIVE	-.5246	-.1950	-.1025	.8220

80.00	5.8341	31.0907	16.3405	86.7347
DRIVING FUNCTION		.000		
DERIVATIVE	-.5241	-.1920	-.1009	.8170

81.00	5.8030	30.9061	16.2418	87.5492
DRIVING FUNCTION		.000		
DERIVATIVE	-.5236	-.1891	-.0994	.8121

82.00	5.7724	30.7243	16.1446	88.3588
DRIVING FUNCTION		.000		
DERIVATIVE	-.5231	-.1863	-.0979	.8072

83.00	5.7422	30.5454	16.0489	89.1635
DRIVING FUNCTION		.000		
DERIVATIVE	-.5226	-.1834	-.0964	.8024

84.00	5.7125	30.3693	15.9547	89.9635
DRIVING FUNCTION		.000		
DERIVATIVE	-.5222	-.1807	-.0949	.7977

85.00	5.6833	30.1959	15.8620	90.7589
DRIVING FUNCTION		.000		
DERIVATIVE	-.5217	-.1780	-.0934	.7931

86.00	5.6545	30.0252	15.7707	91.5496
DRIVING FUNCTION		.000		
DERIVATIVE	-.5213	-.1753	-.0920	.7885

87.00	5.6261	29.8572	15.6809	92.3358
DRIVING FUNCTION		.000		
DERIVATIVE	-.5208	-.1726	-.0906	.7840

88.00	5.5983	29.6918	15.5924	93.1176
DRIVING FUNCTION		.000		
DERIVATIVE	-.5204	-.1700	-.0892	.7796

89.00	5.5708	29.5289	15.5054	93.8950
DRIVING FUNCTION		.000		
DERIVATIVE	-.5200	-.1675	-.0878	.7753

90.00	5.5438	29.3686	15.4196	94.6680
DRIVING FUNCTION		.000		
DERIVATIVE	-.5195	-.1650	-.0865	.7710

91.00	5.5172	29.2108	15.3353	95.4368
DRIVING FUNCTION		.000		
DERIVATIVE	-.5191	-.1625	-.0852	.7668

92.00	5.4910	29.0555	15.2522	96.2014
DRIVING FUNCTION		.000		
DERIVATIVE	-.5187	-.1601	-.0839	.7626

93.00	5.4652	28.9025	15.1704	96.9619
DRIVING FUNCTION		.000		
DERIVATIVE	-.5183	-.1577	-.0826	.7585

94.00	5.4398	28.7520	15.0899	97.7183
DRIVING FUNCTION		.000		
DERIVATIVE	-.5179	-.1553	-.0813	.7545

95.00	5.4148	28.6038	15.0107	98.4707
DRIVING FUNCTION		.000		
DERIVATIVE	-.5175	-.1530	-.0801	.7505

96.00	5.3902	28.4579	14.9326	99.2193
DRIVING FUNCTION		.000		
DERIVATIVE	-.5171	-.1507	-.0788	.7466

97.00	5.3660	28.3143	14.8558	99.9639
DRIVING FUNCTION		.000		
DERIVATIVE	-.5167	-.1484	-.0776	.7428

98.00	5.3422	28.1729	14.7802	100.7047
DRIVING FUNCTION		.000		
DERIVATIVE	-.5164	-.1462	-.0764	.7390

99.00	5.3187	28.0337	14.7058	101.4418
DRIVING FUNCTION		.000		
DERIVATIVE	-.5160	-.1440	-.0753	.7353

DE SOLUTION
 EXAMPLE 4 VARIABLE LINEAR SYSTEM -- SIN**2 DRIVING -- SENS ANALYSIS, F(1,3)
 03/14/70 TIME#00.41.09.

TIME STARTS AT 0.000, INCREMENTS BY 1.00000 FOR 100 STEPS

4 EQUATIONS, 0 CONSTANTS
 KUTTA PARAMETERS ARE .01000 .01000 20

MODIFY COEFFICIENT MATRIX, 2 VALUES

1 3 .40000
 3 3 -.45000

TIME, VARIABLE VALUES

0.00	100.0000	0.0000	0.0000	0.0000
DRIVING FUNCTION		0.000		
DERIVATIVE		-65.0000	50.0000	15.0000

1.00	54.3529	35.3371	10.5165	.2935
DRIVING FUNCTION		.000		
DERIVATIVE		-31.1228	23.6428	6.9542

2.00	32.6542	52.0209	15.3699	.9550
DRIVING FUNCTION		.000		
DERIVATIVE		-15.0773	11.1250	3.1838

3.00	22.3038	59.8386	17.5724	1.7852
DRIVING FUNCTION		.000		
DERIVATIVE		-7.4685	5.1681	1.4218

4.00	17.3383	63.4324	18.5382	2.6910
DRIVING FUNCTION		.000		
DERIVATIVE		-3.8546	2.3259	.6018

5.00	14.9328	65.0084	18.9298	3.6291
DRIVING FUNCTION		.000		
DERIVATIVE		-2.1344	.9656	.2224

6.00	13.7473	65.6169	19.0565	4.5794
DRIVING FUNCTION		.000		
DERIVATIVE		-1.3131	.3119	.0483

7.00	13.1452	65.7597	19.0625	5.5326
DRIVING FUNCTION		.000		
DERIVATIVE		-.9194	-.0034	-.0304

8.00	12.8235	65.6776	19.0143	6.4846
DRIVING FUNCTION		.000		
DERIVATIVE		-.7295	-.1560	-.0652

9.00	12.6374	65.4865	18.9426	7.4335
DRIVING FUNCTION		.000		
DERIVATIVE		-.6373	-.2299	-.0799

10.00	12.5175	65.2428	18.8612	9.3785
DRIVING FUNCTION		.000		
DERIVATIVE	-.5919	-.2655	-.0856	.9431

11.00	12.4304	64.9739	18.7763	9.3194
DRIVING FUNCTION		.000		
DERIVATIVE	-.5693	-.2822	-.0874	.9388

12.00	12.3599	64.6935	18.6906	10.2560
DRIVING FUNCTION		.000		
DERIVATIVE	-.5577	-.2894	-.0874	.9345

13.00	12.2979	64.4086	18.6053	11.1883
DRIVING FUNCTION		.000		
DERIVATIVE	-.5515	-.2919	-.0868	.9303

14.00	12.2405	64.1224	18.5207	12.1164
DRIVING FUNCTION		.000		
DERIVATIVE	-.5481	-.2920	-.0860	.9260

15.00	12.1859	63.8369	18.4370	13.0402
DRIVING FUNCTION		.000		
DERIVATIVE	-.5460	-.2908	-.0851	.9218

16.00	12.1329	63.5530	18.3542	13.9599
DRIVING FUNCTION		.000		
DERIVATIVE	-.5447	-.2889	-.0841	.9177

17.00	12.0810	63.2712	18.2723	14.8755
DRIVING FUNCTION		.000		
DERIVATIVE	-.5437	-.2866	-.0833	.9136

18.00	12.0300	62.9917	18.1913	15.7870
DRIVING FUNCTION		.000		
DERIVATIVE	-.5430	-.2842	-.0824	.9096

19.00	11.9797	62.7147	18.1111	16.6945
DRIVING FUNCTION		.000		
DERIVATIVE	-.5423	-.2816	-.0816	.9056

20.00	11.9299	62.4403	18.0317	17.5980
DRIVING FUNCTION		.000		
DERIVATIVE	-.5418	-.2791	-.0808	.9014

21.00	11.8808	62.1685	17.9532	18.4976
DRIVING FUNCTION		.000		
DERIVATIVE	-.5412	-.2765	-.0800	.8977

22.00	11.8321	61.8993	17.8754	19.3932
DRIVING FUNCTION		.000		
DERIVATIVE	-.5407	-.2739	-.0792	.8938

DRIVING FUNCTION		•000		
DERIVATIVE	-.5402	-.2713	-.0784	.8899

24.00	11.7363	61.3686	17.7222	21.1729
DRIVING FUNCTION		•000		
DERIVATIVE	-.5397	-.2687	-.0777	.8861

25.00	11.6892	61.1071	17.6467	22.0570
DRIVING FUNCTION		•000		
DERIVATIVE	-.5393	-.2661	-.0769	.8823

26.00	11.6424	60.8432	17.5719	22.9374
DRIVING FUNCTION		•000		
DERIVATIVE	-.5388	-.2636	-.0762	.8786

27.00	11.5962	60.5918	17.4979	23.8141
DRIVING FUNCTION		•000		
DERIVATIVE	-.5384	-.2611	-.0755	.8749

28.00	11.5504	60.3379	17.4246	24.6871
DRIVING FUNCTION		•000		
DERIVATIVE	-.5379	-.2586	-.0747	.8712

29.00	11.5051	60.0805	17.3521	25.5564
DRIVING FUNCTION		•000		
DERIVATIVE	-.5375	-.2561	-.0740	.8676

30.00	11.4601	59.8375	17.2802	26.4221
DRIVING FUNCTION		•000		
DERIVATIVE	-.5370	-.2537	-.0733	.8640

31.00	11.4157	59.5910	17.2090	27.2843
DRIVING FUNCTION		•000		
DERIVATIVE	-.5366	-.2513	-.0726	.8605

32.00	11.3717	59.3469	17.1386	28.1429
DRIVING FUNCTION		•000		
DERIVATIVE	-.5361	-.2489	-.0719	.8569

33.00	11.3281	59.1051	17.0688	28.9980
DRIVING FUNCTION		•000		
DERIVATIVE	-.5357	-.2465	-.0712	.8534

34.00	11.2849	58.8658	16.9997	29.8497
DRIVING FUNCTION		•000		
DERIVATIVE	-.5353	-.2441	-.0706	.8500

35.00	11.2421	58.6297	16.9313	30.6978
DRIVING FUNCTION		•000		
DERIVATIVE	-.5349	-.2418	-.0699	.8466

36.00	11.1994	58.3940	16.8636	31.5426
-------	---------	---------	---------	---------

DERIVATIVE	-.5345	-.2375	-.0642	.8436
------------	--------	--------	--------	-------

37.00	11.1579	58.1516	16.7965	32.3841
DRIVING FUNCTION	.000			
DERIVATIVE	-.5340	-.2372	-.0686	.8398

38.00	11.1164	57.9314	16.7300	33.2221
DRIVING FUNCTION	.000			
DERIVATIVE	-.5336	-.2350	-.0679	.8365

39.00	11.0753	57.7036	16.6643	34.0569
DRIVING FUNCTION	.000			
DERIVATIVE	-.5332	-.2327	-.0673	.8332

40.00	11.0346	57.4779	16.5991	34.8884
DRIVING FUNCTION	.000			
DERIVATIVE	-.5328	-.2305	-.0666	.8300

41.00	10.9943	57.2544	16.5346	35.7167
DRIVING FUNCTION	.000			
DERIVATIVE	-.5324	-.2283	-.0660	.8267

42.00	10.9544	57.0331	16.4708	36.5417
DRIVING FUNCTION	.000			
DERIVATIVE	-.5320	-.2261	-.0654	.8235

43.00	10.9149	56.8140	16.4075	37.3636
DRIVING FUNCTION	.000			
DERIVATIVE	-.5317	-.2240	-.0647	.8204

44.00	10.8757	56.5971	16.3449	38.1823
DRIVING FUNCTION	.000			
DERIVATIVE	-.5313	-.2218	-.0641	.8172

45.00	10.8370	56.3822	16.2829	38.9980
DRIVING FUNCTION	.000			
DERIVATIVE	-.5309	-.2197	-.0635	.8141

46.00	10.7986	56.1695	16.2215	39.8105
DRIVING FUNCTION	.000			
DERIVATIVE	-.5305	-.2176	-.0629	.8111

47.00	10.7606	55.9588	16.1607	40.6200
DRIVING FUNCTION	.000			
DERIVATIVE	-.5301	-.2156	-.0623	.8080

48.00	10.7230	55.7502	16.1004	41.4264
DRIVING FUNCTION	.000			
DERIVATIVE	-.5294	-.2135	-.0617	.8050

49.00	10.6857	55.5436	16.0408	42.2299
DRIVING FUNCTION	.000			
DERIVATIVE	-.5294	-.2115	-.0611	.8020

50.00	10.5489	53.3391	15.9818	43.0303
DRIVING FUNCTION		.000		
DERIVATIVE	-.5290	-.2095	-.0606	.7991

51.00	10.6123	55.1365	15.9233	43.8279
DRIVING FUNCTION		.000		
DERIVATIVE	-.5287	-.2075	-.0600	.7962

52.00	10.5762	54.9359	15.8654	44.6225
DRIVING FUNCTION		.000		
DERIVATIVE	-.5283	-.2055	-.0594	.7933

53.00	10.5403	54.7373	15.8081	45.4143
DRIVING FUNCTION		.000		
DERIVATIVE	-.5280	-.2036	-.0589	.7904

54.00	10.5049	54.5407	15.7513	46.2032
DRIVING FUNCTION		.000		
DERIVATIVE	-.5276	-.2016	-.0583	.7876

55.00	10.4697	54.3459	15.6951	46.9893
DRIVING FUNCTION		.000		
DERIVATIVE	-.5273	-.1997	-.0577	.7848

56.00	10.4350	54.1531	15.6394	47.7725
DRIVING FUNCTION		.000		
DERIVATIVE	-.5269	-.1978	-.0572	.7820

57.00	10.4005	53.9621	15.5843	48.5530
DRIVING FUNCTION		.000		
DERIVATIVE	-.5266	-.1950	-.0567	.7792

58.00	10.3664	53.7730	15.5298	49.3308
DRIVING FUNCTION		.000		
DERIVATIVE	-.5263	-.1941	-.0561	.7765

59.00	10.3327	53.5858	15.4757	50.1059
DRIVING FUNCTION		.000		
DERIVATIVE	-.5259	-.1923	-.0556	.7738

60.00	10.2992	53.4004	15.4222	50.8782
DRIVING FUNCTION		.000		
DERIVATIVE	-.5256	-.1904	-.0551	.7711

61.00	10.2661	53.2168	15.3692	51.6479
DRIVING FUNCTION		.000		
DERIVATIVE	-.5253	-.1886	-.0545	.7685

62.00	10.2333	53.0350	15.3167	52.4150
DRIVING FUNCTION		.000		
DERIVATIVE	-.5250	-.1866	-.0540	.7658

DRIVING FUNCTION		*000		
DERIVATIVE	-.5246	-.1851	-.0535	.7632

64.00	10.1687	52.6757	15.2133	53.9413
DRIVING FUNCTION		*000		
DERIVATIVE	-.5243	-.1833	-.0530	.7607

65.00	10.1369	52.5002	15.1624	54.7006
DRIVING FUNCTION		*000		
DERIVATIVE	-.5240	-.1816	-.0525	.7581

66.00	10.1053	52.3254	15.1119	55.4574
DRIVING FUNCTION		*000		
DERIVATIVE	-.5237	-.1799	-.0520	.7556

67.00	10.0741	52.1523	15.0619	56.2117
DRIVING FUNCTION		*000		
DERIVATIVE	-.5234	-.1782	-.0515	.7531

68.00	10.0432	51.9809	15.0125	56.9634
DRIVING FUNCTION		*000		
DERIVATIVE	-.5231	-.1765	-.0510	.7506

69.00	10.0126	51.8112	14.9635	57.7128
DRIVING FUNCTION		*000		
DERIVATIVE	-.5228	-.1748	-.0506	.7482

70.00	9.9823	51.6431	14.9150	58.4595
DRIVING FUNCTION		*000		
DERIVATIVE	-.5225	-.1732	-.0501	.7457

71.00	9.9523	51.4767	14.8669	59.2041
DRIVING FUNCTION		*000		
DERIVATIVE	-.5222	-.1715	-.0496	.7433

72.00	9.9226	51.3119	14.8194	59.9462
DRIVING FUNCTION		*000		
DERIVATIVE	-.5219	-.1699	-.0491	.7410

73.00	9.8931	51.1487	14.7723	60.6859
DRIVING FUNCTION		*000		
DERIVATIVE	-.5216	-.1683	-.0487	.7386

74.00	9.8640	50.9872	14.7256	61.4232
DRIVING FUNCTION		*000		
DERIVATIVE	-.5213	-.1667	-.0482	.7363

75.00	9.8351	50.8272	14.6795	62.1583
DRIVING FUNCTION		*000		
DERIVATIVE	-.5211	-.1651	-.0478	.7340

76.00	9.8066	50.6687	14.6337	62.8910
-------	--------	---------	---------	---------

DERIVATIVE - .5208 - .1636 - .0473 .7317

77.00 9.7703 50.5118 14.5884 63.6215
DRIVING FUNCTION .000
DERIVATIVE - .5205 - .1620 - .0469 .7294

78.00 9.7503 50.3555 14.5436 64.3497
DRIVING FUNCTION .000
DERIVATIVE - .5202 - .1605 - .0464 .7272

79.00 9.7225 50.2026 14.4992 65.0757
DRIVING FUNCTION .000
DERIVATIVE - .5200 - .1590 - .0460 .7250

80.00 9.6950 50.0503 14.4552 65.7995
DRIVING FUNCTION .000
DERIVATIVE - .5197 - .1575 - .0456 .7228

81.00 9.6678 49.8995 14.4117 66.5211
DRIVING FUNCTION .000
DERIVATIVE - .5194 - .1560 - .0451 .7206

82.00 9.6409 49.7501 14.3686 67.2405
DRIVING FUNCTION .000
DERIVATIVE - .5192 - .1546 - .0447 .7184

83.00 9.6142 49.6022 14.3259 67.9578
DRIVING FUNCTION .000
DERIVATIVE - .5189 - .1531 - .0443 .7163

84.00 9.5876 49.4557 14.2836 68.6729
DRIVING FUNCTION .000
DERIVATIVE - .5186 - .1517 - .0439 .7142

85.00 9.5616 49.3107 14.2417 69.3850
DRIVING FUNCTION .000
DERIVATIVE - .5184 - .1502 - .0435 .7121

86.00 9.5357 49.1671 14.2003 70.0969
DRIVING FUNCTION .000
DERIVATIVE - .5181 - .1486 - .0431 .7100

87.00 9.5101 49.0249 14.1592 70.8058
DRIVING FUNCTION .000
DERIVATIVE - .5179 - .1474 - .0427 .7080

88.00 9.4847 48.8841 14.1186 71.5127
DRIVING FUNCTION .000
DERIVATIVE - .5176 - .1461 - .0423 .7059

89.00 9.4596 48.7446 14.0783 72.2175
DRIVING FUNCTION .000
DERIVATIVE - .5174 - .1447 - .0419 .7039

DRIVING FUNCTION	•000			
DERIVATIVE	-5171	-1433	-0415	7019

91.00	9.4100	48.4698	13.9990	73.6212
DRIVING FUNCTION	•000			
DERIVATIVE	-5169	-1420	-0411	7000

92.00	9.3856	48.3344	13.9599	74.3201
DRIVING FUNCTION	•000			
DERIVATIVE	-5166	-1407	-0407	6980

93.00	9.3614	48.2003	13.9212	75.0170
DRIVING FUNCTION	•000			
DERIVATIVE	-5164	-1393	-0403	6961

94.00	9.3375	48.0676	13.8829	75.7121
DRIVING FUNCTION	•000			
DERIVATIVE	-5162	-1380	-0399	6941

95.00	9.3137	47.9361	13.8450	76.4052
DRIVING FUNCTION	•000			
DERIVATIVE	-5159	-1367	-0396	6922

96.00	9.2903	47.8060	13.8074	77.0964
DRIVING FUNCTION	•000			
DERIVATIVE	-5157	-1355	-0392	6904

97.00	9.2670	47.6771	13.7702	77.7858
DRIVING FUNCTION	•000			
DERIVATIVE	-5155	-1342	-0388	6885

98.00	9.2440	47.5494	13.7334	78.4733
DRIVING FUNCTION	•000			
DERIVATIVE	-5153	-1329	-0385	6867

99.00	9.2212	47.4230	13.6969	79.1589
DRIVING FUNCTION	•000			
DERIVATIVE	-5150	-1317	-0381	6848

DE SOLUTION
 EXAMPLE 4 VARIABLE LINEAR SYSTEM -- SIN**2 DRIVING -- SENS ANALYSIS; F(1,3)
 03/14/70 TIME=00.41.00.

TIME STARTS AT 0.000; INCREMENTS BY 1.00000 FOR 100 STEPS

4 EQUATIONS, 0 CONSTANTS
 KUTTA PARAMETERS ARE .01000 .01000 20

MODIFY COEFFICIENT MATRIX, 2 VALUES

1 3 .80000
 3 3 -.05000

TIME, VARIABLE VALUES

0.00 100.0000 0.0000 0.0000 0.0000
 DRIVING FUNCTION 0.000
 DERIVATIVE -05.0000 50.0000 15.0000 0.0000

1.00 55.8110 35.6176 8.8101 .2613
 DRIVING FUNCTION .000
 DERIVATIVE -29.2291 24.3437 4.4448 .4405

2.00 35.5802 63.3606 11.2745 .7765
 DRIVING FUNCTION .000
 DERIVATIVE -14.1128 12.4500 1.0910 .5637

3.00 25.7590 62.6000 11.7794 1.3566
 DRIVING FUNCTION .000
 DERIVATIVE -7.3199 6.6190 .1119 .5890

4.00 20.7272 67.5749 11.7482 1.9456
 DRIVING FUNCTION .000
 DERIVATIVE -4.0741 3.6057 -.1190 .5874

5.00 18.0446 70.3101 11.6156 2.5297
 DRIVING FUNCTION .000
 DERIVATIVE -2.4305 1.9913 -.1355 .5808

6.00 16.5712 71.8245 11.4969 3.1074
 DRIVING FUNCTION .000
 DERIVATIVE -1.5737 1.1032 -.1043 .5748

7.00 15.7445 72.6638 11.4118 3.6799
 DRIVING FUNCTION .000
 DERIVATIVE -1.1045 .6059 -.0726 .5706

8.00 15.2732 73.1201 11.3548 4.2489
 DRIVING FUNCTION .000
 DERIVATIVE -.8437 .3293 -.0483 .5677

9.00 15.0000 73.3600 11.3173 4.8155
 DRIVING FUNCTION .000
 DERIVATIVE -.6901 .1830 -.0329 .5659

DRIVING FUNCTION	.000			
DERIVATIVE	-.6131	.0719	-.0234	.5645

11.00	14.7455	73.5357	11.2742	5.9447
DRIVING FUNCTION	.000			
DERIVATIVE	-.5652	.0192	-.0177	.5637

12.00	14.6868	73.5444	11.2609	6.5079
DRIVING FUNCTION	.000			
DERIVATIVE	-.5377	-.0111	-.0143	.5630

13.00	14.6493	73.5299	11.2562	7.0706
DRIVING FUNCTION	.000			
DERIVATIVE	-.5219	-.0204	-.0123	.5625

14.00	14.6240	73.5021	11.2411	7.6328
DRIVING FUNCTION	.000			
DERIVATIVE	-.5127	-.0302	-.0111	.5621

15.00	14.6027	73.4668	11.2329	8.1946
DRIVING FUNCTION	.000			
DERIVATIVE	-.5074	-.0438	-.0104	.5616

16.00	14.5916	73.4272	11.2252	8.7559
DRIVING FUNCTION	.000			
DERIVATIVE	-.5044	-.0469	-.0100	.5613

17.00	14.5798	73.3853	11.2179	9.3169
DRIVING FUNCTION	.000			
DERIVATIVE	-.5026	-.0486	-.0097	.5609

18.00	14.5695	73.3422	11.2108	9.8775
DRIVING FUNCTION	.000			
DERIVATIVE	-.5015	-.0495	-.0096	.5605

19.00	14.5599	73.2984	11.2039	10.4378
DRIVING FUNCTION	.000			
DERIVATIVE	-.5009	-.0499	-.0094	.5602

20.00	14.5509	73.2544	11.1970	10.9977
DRIVING FUNCTION	.000			
DERIVATIVE	-.5005	-.0500	-.0094	.5598

21.00	14.5422	73.2103	11.1902	11.5573
DRIVING FUNCTION	.000			
DERIVATIVE	-.5003	-.0500	-.0093	.5595

22.00	14.5336	73.1664	11.1834	12.1166
DRIVING FUNCTION	.000			
DERIVATIVE	-.5001	-.0498	-.0093	.5592

23.00	14.5252	73.1225	11.1768	12.6755
-------	---------	---------	---------	---------

DERIVATIVE - .5000 - .0476 - .0092 .5588

24.00 14.5169 73.0789 11.1701 13.2341
DRIVING FUNCTION .000
DERIVATIVE - .4999 - .0494 - .0092 .5585

25.00 14.5007 73.0355 11.1635 13.7923
DRIVING FUNCTION .000
DERIVATIVE - .4998 - .0492 - .0091 .5582

26.00 14.5005 72.9923 11.1569 14.3502
DRIVING FUNCTION .000
DERIVATIVE - .4998 - .0490 - .0091 .5578

27.00 14.4924 72.9494 11.1504 14.9078
DRIVING FUNCTION .000
DERIVATIVE - .4997 - .0488 - .0090 .5575

28.00 14.4843 72.9067 11.1439 15.4651
DRIVING FUNCTION .000
DERIVATIVE - .4997 - .0485 - .0090 .5572

29.00 14.4763 72.8642 11.1375 16.0220
DRIVING FUNCTION .000
DERIVATIVE - .4996 - .0483 - .0090 .5569

30.00 14.4683 72.8220 11.1310 16.5787
DRIVING FUNCTION .000
DERIVATIVE - .4995 - .0480 - .0089 .5566

31.00 14.4604 72.7800 11.1247 17.1350
DRIVING FUNCTION .000
DERIVATIVE - .4995 - .0478 - .0089 .5562

32.00 14.4525 72.7382 11.1183 17.6910
DRIVING FUNCTION .000
DERIVATIVE - .4995 - .0476 - .0089 .5559

33.00 14.4447 72.6967 11.1120 18.2466
DRIVING FUNCTION .000
DERIVATIVE - .4994 - .0473 - .0088 .5556

34.00 14.4369 72.6554 11.1057 18.8029
DRIVING FUNCTION .000
DERIVATIVE - .4994 - .0471 - .0088 .5553

35.00 14.4291 72.6144 11.0995 19.3570
DRIVING FUNCTION .000
DERIVATIVE - .4994 - .0469 - .0088 .5550

36.00 14.4214 72.5735 11.0933 19.9117
DRIVING FUNCTION .000

37.00	14.4138	72.5330	11.0871	20.4662
DRIVING FUNCTION		.000		
DERIVATIVE	-.4993	-.0464	-.0087	.5544

38.00	14.4062	72.4926	11.0810	21.0203
DRIVING FUNCTION		.000		
DERIVATIVE	-.4992	-.0462	-.0087	.5540

39.00	14.3986	72.4525	11.0749	21.5741
DRIVING FUNCTION		.000		
DERIVATIVE	-.4992	-.0459	-.0086	.5537

40.00	14.3911	72.4125	11.0688	22.1276
DRIVING FUNCTION		.000		
DERIVATIVE	-.4991	-.0457	-.0086	.5534

41.00	14.3836	72.3729	11.0628	22.6808
DRIVING FUNCTION		.000		
DERIVATIVE	-.4991	-.0455	-.0085	.5531

42.00	14.3761	72.3334	11.0568	23.2337
DRIVING FUNCTION		.000		
DERIVATIVE	-.4991	-.0453	-.0085	.5528

43.00	14.3687	72.2942	11.0508	23.7863
DRIVING FUNCTION		.000		
DERIVATIVE	-.4990	-.0450	-.0085	.5525

44.00	14.3614	72.2552	11.0449	24.3386
DRIVING FUNCTION		.000		
DERIVATIVE	-.4990	-.0448	-.0084	.5522

45.00	14.3541	72.2164	11.0390	24.8906
DRIVING FUNCTION		.000		
DERIVATIVE	-.4989	-.0446	-.0084	.5520

46.00	14.3468	72.1776	11.0332	25.4423
DRIVING FUNCTION		.000		
DERIVATIVE	-.4989	-.0444	-.0084	.5517

47.00	14.3395	72.1394	11.0273	25.9937
DRIVING FUNCTION		.000		
DERIVATIVE	-.4988	-.0442	-.0083	.5514

48.00	14.3324	72.1013	11.0215	26.5448
DRIVING FUNCTION		.000		
DERIVATIVE	-.4988	-.0440	-.0084	.5511

49.00	14.3252	72.0634	11.0158	27.0957
DRIVING FUNCTION		.000		
DERIVATIVE	-.4988	-.0437	-.0083	.5508

50.00	14.3181	72.0257	11.0106	27.5462
DRIVING FUNCTION		.000		
DERIVATIVE	-.4987	-.0435	-.0082	.5505

51.00	14.3110	71.9882	11.0043	28.1965
DRIVING FUNCTION		.000		
DERIVATIVE	-.4987	-.0433	-.0082	.5502

52.00	14.3040	71.9509	10.9987	28.7465
DRIVING FUNCTION		.000		
DERIVATIVE	-.4986	-.0431	-.0082	.5499

53.00	14.2970	71.9138	10.9930	29.2962
DRIVING FUNCTION		.000		
DERIVATIVE	-.4986	-.0429	-.0082	.5497

54.00	14.2900	71.8769	10.9874	29.8456
DRIVING FUNCTION		.000		
DERIVATIVE	-.4986	-.0427	-.0081	.5494

55.00	14.2831	71.8403	10.9819	30.3948
DRIVING FUNCTION		.000		
DERIVATIVE	-.4985	-.0425	-.0081	.5491

56.00	14.2762	71.8038	10.9763	30.9436
DRIVING FUNCTION		.000		
DERIVATIVE	-.4985	-.0423	-.0081	.5488

57.00	14.2694	71.7676	10.9708	31.4922
DRIVING FUNCTION		.000		
DERIVATIVE	-.4985	-.0421	-.0080	.5485

58.00	14.2626	71.7316	10.9653	32.0405
DRIVING FUNCTION		.000		
DERIVATIVE	-.4984	-.0419	-.0080	.5483

59.00	14.2558	71.6957	10.9599	32.5886
DRIVING FUNCTION		.000		
DERIVATIVE	-.4984	-.0417	-.0080	.5480

60.00	14.2491	71.6601	10.9545	33.1363
DRIVING FUNCTION		.000		
DERIVATIVE	-.4983	-.0414	-.0079	.5477

61.00	14.2424	71.6247	10.9491	33.6838
DRIVING FUNCTION		.000		
DERIVATIVE	-.4983	-.0412	-.0079	.5475

62.00	14.2358	71.5894	10.9437	34.2311
DRIVING FUNCTION		.000		
DERIVATIVE	-.4983	-.0410	-.0079	.5472

63.00	14.2272	71.5544	10.9388	34.7700
DRIVING FUNCTION		.000		
DERIVATIVE	-.4982	-.0409	-.0078	.5469

64.00	14.2226	71.5196	10.9331	35.3247
DRIVING FUNCTION		.000		
DERIVATIVE	-.4982	-.0407	-.0078	.5467

65.00	14.2181	71.4849	10.9279	35.8711
DRIVING FUNCTION		.000		
DERIVATIVE	-.4982	-.0405	-.0078	.5464

66.00	14.2076	71.4505	10.9226	36.4173
DRIVING FUNCTION		.000		
DERIVATIVE	-.4981	-.0403	-.0078	.5461

67.00	14.2031	71.4163	10.9174	36.9632
DRIVING FUNCTION		.000		
DERIVATIVE	-.4981	-.0401	-.0077	.5459

68.00	14.1967	71.3822	10.9123	37.5089
DRIVING FUNCTION		.000		
DERIVATIVE	-.4980	-.0399	-.0077	.5456

69.00	14.1903	71.3483	10.9071	38.0543
DRIVING FUNCTION		.000		
DERIVATIVE	-.4980	-.0397	-.0077	.5454

70.00	14.1840	71.3147	10.9020	38.5994
DRIVING FUNCTION		.000		
DERIVATIVE	-.4980	-.0395	-.0076	.5451

71.00	14.1776	71.2812	10.8969	39.1443
DRIVING FUNCTION		.000		
DERIVATIVE	-.4979	-.0393	-.0076	.5448

72.00	14.1714	71.2479	10.8919	39.6889
DRIVING FUNCTION		.000		
DERIVATIVE	-.4979	-.0391	-.0076	.5446

73.00	14.1651	71.2148	10.8868	40.2333
DRIVING FUNCTION		.000		
DERIVATIVE	-.4979	-.0389	-.0075	.5443

74.00	14.1589	71.1819	10.8818	40.7774
DRIVING FUNCTION		.000		
DERIVATIVE	-.4978	-.0387	-.0075	.5441

75.00	14.1527	71.1492	10.8768	41.3213
DRIVING FUNCTION		.000		
DERIVATIVE	-.4978	-.0386	-.0075	.5438

DRIVING FUNCTION	•000			
DERIVATIVE	-.4978	-.0384	-.0075	.5436

77.00	14.1405	71.0843	10.8670	42.4083
DRIVING FUNCTION	•000			
DERIVATIVE	-.4977	-.0382	-.0074	.5433

78.00	14.1344	71.0521	10.8621	42.9514
DRIVING FUNCTION	•000			
DERIVATIVE	-.4977	-.0380	-.0074	.5431

79.00	14.1284	71.0201	10.8572	43.4943
DRIVING FUNCTION	•000			
DERIVATIVE	-.4977	-.0378	-.0074	.5429

80.00	14.1224	70.9883	10.8524	44.0370
DRIVING FUNCTION	•000			
DERIVATIVE	-.4976	-.0376	-.0074	.5426

81.00	14.1164	70.9566	10.8476	44.5794
DRIVING FUNCTION	•000			
DERIVATIVE	-.4976	-.0375	-.0073	.5424

82.00	14.1105	70.9252	10.8428	45.1216
DRIVING FUNCTION	•000			
DERIVATIVE	-.4976	-.0373	-.0073	.5421

83.00	14.1046	70.8939	10.8381	45.6635
DRIVING FUNCTION	•000			
DERIVATIVE	-.4975	-.0371	-.0073	.5419

84.00	14.0987	70.8628	10.8333	46.2052
DRIVING FUNCTION	•000			
DERIVATIVE	-.4975	-.0369	-.0072	.5417

85.00	14.0929	70.8319	10.8286	46.7466
DRIVING FUNCTION	•000			
DERIVATIVE	-.4975	-.0368	-.0072	.5414

86.00	14.0871	70.8011	10.8240	47.2879
DRIVING FUNCTION	•000			
DERIVATIVE	-.4974	-.0366	-.0072	.5412

87.00	14.0813	70.7706	10.8193	47.8289
DRIVING FUNCTION	•000			
DERIVATIVE	-.4974	-.0364	-.0072	.5410

88.00	14.0756	70.7402	10.8147	48.3696
DRIVING FUNCTION	•000			
DERIVATIVE	-.4974	-.0362	-.0071	.5407

89.00	14.0699	70.7099	10.8101	48.9101
DRIVING FUNCTION	•000			

90.00	14.0642	70.6799	10.8055	40.4504
DRIVING FUNCTION		.000		
DERIVATIVE	-.4973	-.0359	-.0071	.5403

91.00	14.0586	70.6500	10.8010	40.9905
DRIVING FUNCTION		.000		
DERIVATIVE	-.4973	-.0357	-.0071	.5400

92.00	14.0530	70.6203	10.7965	50.5304
DRIVING FUNCTION		.000		
DERIVATIVE	-.4972	-.0355	-.0070	.5398

93.00	14.0474	70.5907	10.7920	51.0700
DRIVING FUNCTION		.000		
DERIVATIVE	-.4972	-.0354	-.0070	.5396

94.00	14.0418	70.5613	10.7875	51.6094
DRIVING FUNCTION		.000		
DERIVATIVE	-.4972	-.0352	-.0070	.5394

95.00	14.0363	70.5321	10.7831	52.1485
DRIVING FUNCTION		.000		
DERIVATIVE	-.4971	-.0350	-.0070	.5392

96.00	14.0308	70.5030	10.7787	52.6875
DRIVING FUNCTION		.000		
DERIVATIVE	-.4971	-.0349	-.0069	.5389

97.00	14.0254	70.4742	10.7743	53.2262
DRIVING FUNCTION		.000		
DERIVATIVE	-.4971	-.0347	-.0069	.5387

98.00	14.0200	70.4454	10.7699	53.7647
DRIVING FUNCTION		.000		
DERIVATIVE	-.4971	-.0346	-.0069	.5385

99.00	14.0146	70.4169	10.7656	54.3030
DRIVING FUNCTION		.000		
DERIVATIVE	-.4970	-.0344	-.0069	.5383

DE SOLUTION
 EXAMPLE 4 VARIABLE LINEAR SYSTEM -- SIN**2 DRIVING -- SENS ANALYSIS' F(1'3)
 03/14/70 TIME=00.41.00.

TIME STARTS AT 0.000, INCREMENTS BY 1.00000 FOR 100 STEPS

4 EQUATIONS, 0 CONSTANTS
 KUTTA PARAMETERS ARE .01000 .01000 20

MODIFY COEFFICIENT MATRIX, 2 VALUES

1 3 1.0000
 3 3 -1.0500

TIME, VARIABLE VALUES

0.00 100.0000 0.0000 0.0000 0.0000
 DRIVING FUNCTION 0.000
 DERIVATIVE -65.0000 50.0000 15.0000 0.0000

1.00 56.4116 35.7397 8.1015 .2472
 DRIVING FUNCTION .000
 DERIVATIVE -28.5601 24.6318 3.5292 .4051

2.00 36.5926 43.8747 9.8257 .7070
 DRIVING FUNCTION .000
 DERIVATIVE -13.9595 12.9008 .5594 .4913

3.00 26.7643 63.5585 9.9727 1.2045
 DRIVING FUNCTION .000
 DERIVATIVE -7.4241 7.0263 -.1009 .4986

4.00 21.5956 80.8689 9.8160 1.6995
 DRIVING FUNCTION .000
 DERIVATIVE -4.2212 3.9089 -.1786 .4908

5.00 18.7801 71.8755 9.6582 2.1861
 DRIVING FUNCTION .000
 DERIVATIVE -2.5408 2.2025 -.1366 .4829

6.00 17.2167 73.5677 9.5496 2.6660
 DRIVING FUNCTION .000
 DERIVATIVE -1.6413 1.2516 -.0878 .4775

7.00 16.3402 74.5350 9.4832 3.1416
 DRIVING FUNCTION .000
 DERIVATIVE -1.1379 .7106 -.0528 .4742

8.00 15.3408 75.0935 9.4450 3.6146
 DRIVING FUNCTION .000
 DERIVATIVE -.6559 .4191 -.0309 .4723

9.00 15.5692 75.4205 9.4241 4.0862
 DRIVING FUNCTION .000
 DERIVATIVE -.6459 .2425 -.0178 .4712

DRIVING FUNCTION		*.000		
DERIVATIVE	-.6056	.1451	-.0102	.4701

11.00	15.3270	75.7373	9.4082	5.0275
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5543	.0898	-.0059	.4704

12.00	15.2797	75.8159	9.4066	5.4977
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5252	.0503	-.0034	.4703

13.00	15.2548	75.8704	9.4069	5.9680
DRIVING FUNCTION		*.000		
DERIVATIVE	-.5007	.0403	-.0020	.4703

14.00	15.2424	75.9111	9.4082	6.4383
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4973	.0391	-.0012	.4704

15.00	15.2372	75.9439	9.4102	6.9086
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4940	.0242	-.0007	.4705

16.00	15.2302	75.9723	9.4125	7.3791
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4910	.0208	-.0005	.4706

17.00	15.2374	75.9900	9.4150	7.8497
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4893	.0189	-.0003	.4707

18.00	15.2399	76.0221	9.4176	8.3204
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4803	.0177	-.0003	.4709

19.00	15.2431	76.0454	9.4202	8.7913
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4878	.0170	-.0002	.4710

20.00	15.2468	76.0681	9.4229	9.2623
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4875	.0166	-.0002	.4711

21.00	15.2506	76.0904	9.4256	9.7334
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4873	.0163	-.0002	.4713

22.00	15.2546	76.1125	9.4282	10.2046
DRIVING FUNCTION		*.000		
DERIVATIVE	-.4873	.0161	-.0002	.4714

23.00	15.2587	76.1344	9.4309	10.6760
DRIVING FUNCTION		*.000		

24.00	15.2628	76.1502	9.4336	11.1475
DRIVING FUNCTION		.000		
DERIVATIVE	-.4872	.0158	-.0002	.4717

25.00	15.2668	76.1778	9.4362	11.6192
DRIVING FUNCTION		.000		
DERIVATIVE	-.4872	.0156	-.0002	.4718

26.00	15.2709	76.1993	9.4389	12.0910
DRIVING FUNCTION		.000		
DERIVATIVE	-.4872	.0155	-.0002	.4719

27.00	15.2750	76.2207	9.4415	12.5629
DRIVING FUNCTION		.000		
DERIVATIVE	-.4872	.0154	-.0003	.4721

28.00	15.2790	76.2419	9.4441	13.0349
DRIVING FUNCTION		.000		
DERIVATIVE	-.4873	.0153	-.0003	.4722

29.00	15.2831	76.2631	9.4467	13.5071
DRIVING FUNCTION		.000		
DERIVATIVE	-.4873	.0152	-.0003	.4723

30.00	15.2871	76.2842	9.4493	13.9794
DRIVING FUNCTION		.000		
DERIVATIVE	-.4873	.0151	-.0003	.4725

31.00	15.2911	76.3052	9.4519	14.4519
DRIVING FUNCTION		.000		
DERIVATIVE	-.4873	.0150	-.0003	.4726

32.00	15.2951	76.3261	9.4545	14.9244
DRIVING FUNCTION		.000		
DERIVATIVE	-.4873	.0149	-.0003	.4727

33.00	15.2990	76.3469	9.4570	15.3971
DRIVING FUNCTION		.000		
DERIVATIVE	-.4873	.0148	-.0003	.4729

34.00	15.3030	76.3675	9.4596	15.8699
DRIVING FUNCTION		.000		
DERIVATIVE	-.4874	.0147	-.0003	.4730

35.00	15.3069	76.3881	9.4621	16.3429
DRIVING FUNCTION		.000		
DERIVATIVE	-.4874	.0146	-.0004	.4731

36.00	15.3108	76.4086	9.4646	16.8160
DRIVING FUNCTION		.000		
		.0145	-.0004	.4732

37.00	15.3147	76.4296	9.4671	17.2892
DRIVING FUNCTION		.000		
DERIVATIVE	-.4874	.0144	-.0004	.4734

38.00	15.3186	76.4493	9.4696	17.7625
DRIVING FUNCTION		.000		
DERIVATIVE	-.4874	.0143	-.0004	.4735

39.00	15.3224	76.4695	9.4721	18.2359
DRIVING FUNCTION		.000		
DERIVATIVE	-.4875	.0142	-.0004	.4736

40.00	15.3262	76.4897	9.4746	18.7095
DRIVING FUNCTION		.000		
DERIVATIVE	-.4875	.0142	-.0004	.4737

41.00	15.3301	76.5097	9.4771	19.1832
DRIVING FUNCTION		.000		
DERIVATIVE	-.4875	.0141	-.0004	.4739

42.00	15.3339	76.5296	9.4795	19.6570
DRIVING FUNCTION		.000		
DERIVATIVE	-.4875	.0140	-.0004	.4740

43.00	15.3376	76.5494	9.4819	20.1310
DRIVING FUNCTION		.000		
DERIVATIVE	-.4875	.0139	-.0004	.4741

44.00	15.3414	76.5692	9.4844	20.6051
DRIVING FUNCTION		.000		
DERIVATIVE	-.4875	.0138	-.0005	.4742

45.00	15.3452	76.5888	9.4868	21.0792
DRIVING FUNCTION		.000		
DERIVATIVE	-.4876	.0137	-.0005	.4743

46.00	15.3489	76.6084	9.4892	21.5535
DRIVING FUNCTION		.000		
DERIVATIVE	-.4876	.0136	-.0005	.4745

47.00	15.3526	76.6279	9.4916	22.0280
DRIVING FUNCTION		.000		
DERIVATIVE	-.4876	.0135	-.0005	.4746

48.00	15.3563	76.6472	9.4940	22.5025
DRIVING FUNCTION		.000		
DERIVATIVE	-.4876	.0134	-.0005	.4747

49.00	15.3600	76.6665	9.4963	22.9772
DRIVING FUNCTION		.000		
DERIVATIVE	-.4876	.0133	-.0005	.4748

DRIVING FUNCTION		.000		
DERIVATIVE	-.4876	.0132	-.0005	.4749

51.00	15.3673	76.7048	9.5011	23.9269
DRIVING FUNCTION		.000		
DERIVATIVE	-.4877	.0132	-.0005	.4751

52.00	15.3709	76.7238	9.5034	24.4019
DRIVING FUNCTION		.000		
DERIVATIVE	-.4877	.0131	-.0005	.4752

53.00	15.3745	76.7428	9.5057	24.8770
DRIVING FUNCTION		.000		
DERIVATIVE	-.4877	.0130	-.0006	.4753

54.00	15.3781	76.7616	9.5080	25.3523
DRIVING FUNCTION		.000		
DERIVATIVE	-.4877	.0129	-.0006	.4754

55.00	15.3817	76.7804	9.5103	25.8276
DRIVING FUNCTION		.000		
DERIVATIVE	-.4877	.0128	-.0006	.4755

56.00	15.3852	76.7990	9.5126	26.3031
DRIVING FUNCTION		.000		
DERIVATIVE	-.4878	.0127	-.0006	.4756

57.00	15.3888	76.8176	9.5149	26.7787
DRIVING FUNCTION		.000		
DERIVATIVE	-.4878	.0126	-.0006	.4757

58.00	15.3923	76.8361	9.5172	27.2544
DRIVING FUNCTION		.000		
DERIVATIVE	-.4878	.0125	-.0006	.4759

59.00	15.3958	76.8545	9.5195	27.7303
DRIVING FUNCTION		.000		
DERIVATIVE	-.4878	.0125	-.0006	.4760

60.00	15.3993	76.8728	9.5217	28.2062
DRIVING FUNCTION		.000		
DERIVATIVE	-.4878	.0124	-.0006	.4761

61.00	15.4028	76.8910	9.5240	28.6823
DRIVING FUNCTION		.000		
DERIVATIVE	-.4878	.0123	-.0006	.4762

62.00	15.4062	76.9092	9.5262	29.1584
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0122	-.0007	.4763

63.00	15.4097	76.9272	9.5284	29.6347
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0121	-.0007	.4764

64.00	15.4151	76.9452	9.5395	30.1111
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0120	-.0007	.4765

65.00	15.4165	76.9631	9.5328	30.5876
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0119	-.0007	.4766

66.00	15.4199	76.9809	9.5350	31.0642
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0119	-.0007	.4768

67.00	15.4233	76.9967	9.5372	31.5409
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0118	-.0007	.4769

68.00	15.4267	77.0163	9.5394	32.0177
DRIVING FUNCTION		.000		
DERIVATIVE	-.4879	.0117	-.0007	.4770

69.00	15.4300	77.0339	9.5415	32.4946
DRIVING FUNCTION		.000		
DERIVATIVE	-.4880	.0116	-.0007	.4771

70.00	15.4333	77.0513	9.5437	32.9717
DRIVING FUNCTION		.000		
DERIVATIVE	-.4880	.0115	-.0007	.4772

71.00	15.4366	77.0667	9.5458	33.4488
DRIVING FUNCTION		.000		
DERIVATIVE	-.4880	.0115	-.0007	.4773

72.00	15.4400	77.0861	9.5480	33.9261
DRIVING FUNCTION		.000		
DERIVATIVE	-.4880	.0114	-.0008	.4774

73.00	15.4432	77.1033	9.5501	34.4034
DRIVING FUNCTION		.000		
DERIVATIVE	-.4880	.0113	-.0008	.4775

74.00	15.4465	77.1204	9.5522	34.8809
DRIVING FUNCTION		.000		
DERIVATIVE	-.4880	.0112	-.0008	.4776

75.00	15.4498	77.1375	9.5543	35.3585
DRIVING FUNCTION		.000		
DERIVATIVE	-.4881	.0111	-.0008	.4777

76.00	15.4530	77.1545	9.5564	35.8361
DRIVING FUNCTION		.000		
DERIVATIVE	-.4881	.0111	-.0008	.4778

DRIVING FUNCTION		.000		
DERIVATIVE	-.4861	.0110	-.0008	.4779

78.00	15.4594	77.1883	9.5605	36.7918
DRIVING FUNCTION		.000		
DERIVATIVE	-.4861	.0109	-.0008	.4780

79.00	15.4626	77.2050	9.5626	37.2698
DRIVING FUNCTION		.000		
DERIVATIVE	-.4861	.0108	-.0008	.4781

80.00	15.4658	77.2217	9.5646	37.7479
DRIVING FUNCTION		.000		
DERIVATIVE	-.4861	.0107	-.0008	.4782

81.00	15.4690	77.2383	9.5667	38.2261
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0107	-.0008	.4783

82.00	15.4721	77.2548	9.5687	38.7044
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0106	-.0009	.4784

83.00	15.4753	77.2713	9.5707	39.1828
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0105	-.0009	.4785

84.00	15.4784	77.2876	9.5728	39.6613
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0104	-.0009	.4786

85.00	15.4815	77.3039	9.5748	40.1398
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0104	-.0009	.4787

86.00	15.4846	77.3202	9.5768	40.6185
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0103	-.0009	.4788

87.00	15.4877	77.3363	9.5787	41.0973
DRIVING FUNCTION		.000		
DERIVATIVE	-.4862	.0102	-.0009	.4789

88.00	15.4907	77.3524	9.5807	41.5762
DRIVING FUNCTION		.000		
DERIVATIVE	-.4863	.0101	-.0009	.4790

89.00	15.4938	77.3684	9.5827	42.0552
DRIVING FUNCTION		.000		
DERIVATIVE	-.4863	.0101	-.0009	.4791

90.00	15.4968	77.3843	9.5846	42.5343
-------	---------	---------	--------	---------

DERIVATIVE -.4803 .0100 -.0009 .4792

91.00 15.4994 77.4001 9.5866 43.0135
DRIVING FUNCTION .000
DERIVATIVE -.4803 .0099 -.0009 .4793

92.00 15.5028 77.4159 9.5885 43.4928
DRIVING FUNCTION .000
DERIVATIVE -.4803 .0098 -.0009 .4794

93.00 15.5058 77.4315 9.5905 43.9722
DRIVING FUNCTION .000
DERIVATIVE -.4803 .0098 -.0010 .4795

94.00 15.5088 77.4472 9.5924 44.4517
DRIVING FUNCTION .000
DERIVATIVE -.4803 .0097 -.0010 .4796

95.00 15.5118 77.4627 9.5943 44.9312
DRIVING FUNCTION .000
DERIVATIVE -.4804 .0096 -.0010 .4797

96.00 15.5147 77.4782 9.5962 45.4109
DRIVING FUNCTION .000
DERIVATIVE -.4804 .0095 -.0010 .4798

97.00 15.5177 77.4936 9.5981 45.8907
DRIVING FUNCTION .000
DERIVATIVE -.4804 .0095 -.0010 .4799

98.00 15.5206 77.5090 9.6000 46.3705
DRIVING FUNCTION .000
DERIVATIVE -.4804 .0094 -.0010 .4800

99.00 15.5235 77.5242 9.6019 46.8505
DRIVING FUNCTION .000
DERIVATIVE -.4804 .0093 -.0010 .4801