



# YCCE Earthquake Data Analyzer

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**Abstract:** This paper introduces a software module which will convert the unformatted text file of earthquake data into an uniform format containing time, acceleration, velocity and displacement in transverse, longitudinal and vertical directions recorded at various earthquake stations during an earthquake. The paper contains methodology adopted in converting the raw data into useful data. The paper also presents the graphical representation of available and converted data.

**Keywords:** Earthquake: Series of vibrations induced in the earth's crust by the abrupt rupture and rebound of rocks, Earthquake data file: The data file created at earthquake station containing various parameters, Earthquake data analyzer: Earthquake data analyzer is a tool to format Earthquake data file and to analyze parameters of earthquake, GUI: Graphical User Interface

## I. INTRODUCTION

Earthquakes are one of the most destructive of natural hazards and to reduce the risk, it is important to analyze the data of previous earthquakes. Large data of earthquake occurred at various stations is available .That data is saved in files which contains Acceleration, velocity and displacement of respective directions i.e. longitudinal, transverse and vertical. It is very tedious for an earthquake engineer to bring the file in readable and understandable format for analyzing it. So, our objective is to bring this data into proper format by sorting it on the basis of various parameters (e.g. Acceleration, Velocity, and Displacement) in three directions (Longitudinal, Vertical, and Transverse).

According to the earthquake experts we interacted, they are using Microsoft Office Excel for analyzing the data in the file. But before analyzing they used to take lot of efforts to bring the data in proper format. So, Representation of this data in MS-Excel file was our first aim. The earthquake data information and related parameters are analyzed by earthquake engineers, geophysicist and structural engineers in different manner. We came across some common methodologies they used like creating graph, crating idealized graphs, analyzing frequency and finding time at which P and S waves started. So, we have developed an application that can open the available data file and perform those operations on it. We have data of four earthquakes at India-Burma Border stations, we applied data mining technology with clustering that can suitably arrange this data and can be used for predicting values of some parameters as desired by experts. This technique will help all concern with earthquake data in determining parameters of interest such as location of focus, epicenter and properties of earth crust with ease.

## II. METHODOLOGY

As mentioned in introduction the data file contain information about earthquake, along with it also contains other information about location of earthquake station peak acceleration, peak velocity, peak displacement, initial velocity, initial displacement. Information about specific

earthquake is stored in form of data points after every 0.020 sec. i.e. acceleration, velocity, displacement at particular time instance. As we can see in Fig 1 a sample of the data file is shown.

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N.E. INDIA EARTHQUAKE, MAY 06, 1995
BAIGAO Lat & Lon25 24 N 92 52 E Comp: S28W
Accelerogram Bandpass filtered between .550-.700 and 25.00-27.00 hz.
Initial Velocity = -0.6200E-03 m/s Initial Displacement = 0.2700 mm
Peak Acceleration = 0.55919 m/s/s at 2.360 sec
609 Acceleration data points (in m/s/s) at .020 sec
-0.393E+00 -.361E+00 -.114E+00 0.289E+00 0.307E+00 -.123E+00 -.377E+00 -.819E-01
0.457E+00 0.548E+00 0.238E+00 -.262E+00 -.507E+00 -.266E+00 0.615E-01 0.177E+00
0.154E+00 0.131E+00 0.130E+00 0.456E-01 -.851E-01 -.183E+00 -.293E+00 -.246E+00
0.630E-01 0.208E+00 0.101E+00 0.589E-01 0.372E-01 -.219E-01 -.807E-01 -.129E+00
-.949E-01 0.205E-01 0.672E-01 0.273E-01 -.331E-01 -.288E-01 0.984E-01 0.133E+00
0.129E-01 -.509E-01 0.343E-01 0.128E+00 0.631E-02 -.129E+00 -.145E+00 -.996E-01
-.329E-01 0.859E-01 0.109E+00 0.427E-01 0.478E-01 -.260E-01 -.182E+00 -.169E+00
0.445E-01 0.262E+00 0.179E+00 -.144E+00 -.280E+00 -.191E-01 0.248E+00 0.446E-01
-.315E+00 -.337E+00 -.394E-01 0.395E+00 0.379E+00 0.151E+00 -.594E-02 -.123E+00
-.162E+00 -.132E+00 -.158E+00 -.580E-01 0.169E+00 0.332E+00 0.198E+00 0.348E-01
Peak Velocity = -0.2215E-01 m/s at 2.340 sec
609 Velocity data points (in m/s) at .020 sec
-0.620E-03 -.828E-02 -.132E-01 -.115E-01 -.566E-02 -.393E-02 -.904E-02 -.137E-01
-.101E-01 -.180E-02 0.765E-02 0.747E-02 -.250E-03 -.797E-02 -.100E-01 -.760E-02
-.426E-02 -.140E-02 0.122E-02 0.300E-02 0.258E-02 0.200E-04 -.461E-02 -.988E-02
-.116E-01 -.875E-02 -.554E-02 -.381E-02 -.273E-02 -.245E-02 -.350E-02 -.542E-02
-.749E-02 -.806E-02 -.701E-02 -.589E-02 -.578E-02 -.622E-02 -.535E-02 -.286E-02
-.142E-02 -.165E-02 -.167E-02 0.110E-03 0.161E-02 0.530E-03 -.207E-02 -.436E-02
-.666E-02 -.486E-02 -.294E-02 -.135E-02 -.360E-03 -.700E-04 -.207E-02 -.550E-02
-.335E-02 -.352E-02 0.970E-03 0.141E-02 -.286E-02 -.585E-02 -.357E-02 -.640E-03
-.987E-02 -.136E-01 -.101E-01 -.234E-02 0.296E-02 0.439E-02 0.304E-02
Peak Displacement = 0.7400 mm at 2.060 sec
609 Displacement data points (in mm) at .020 sec
0.270E+00 0.270E+00 0.140E+00 -.400E-01 -.120E+00 -.150E+00 -.300E+00
-.470E+00 -.490E+00 -.380E+00 -.110E+00 0.700E-01 0.800E-01 0.000E+00 -.800E-01
-.100E+00 -.500E-01 0.500E-01 0.190E+00 0.280E+00 0.410E+00 0.470E+00 0.420E+00
0.290E+00 0.190E+00 0.150E+00 0.190E+00 0.240E+00 0.210E+00 0.210E+00
0.160E+00 0.800E-01 0.200E-01 -.300E-01 -.600E-01 -.100E+00 -.130E+00 -.130E+00
-.140E+00 -.110E+00 -.900E-01 -.400E-01 0.400E-01 0.120E+00 0.170E+00 0.160E+00
0.120E+00 0.800E-01 0.200E-01 0.300E-01 0.500E-01 0.900E-01 0.120E+00 0.800E-01
0.000E+00 -.700E-01 -.500E-01 0.300E-01 0.400E-01 -.100E-01 -.700E-01 -.700E-01
-.500E-01 -.150E+00 -.350E+00 -.560E+00 -.640E+00 -.590E+00 -.480E+00 -.350E+00
-.250E+00 -.220E+00 -.250E+00 -.330E+00 -.430E+00 -.470E+00 -.390E+00 -.240E+00
```

Fig.1 Data File From Earthquake Stations.

As we can see in figure firstly all data points of Acceleration are stored with the interval of 0.020 sec. followed by velocity data points acceleration and displacement data points. Data points are stored in exponential form i.e. "-.623E-03". Firstly we converted these data points into regular decimal point format i.e. "0.000623". To analyze data parameters of each direction is required i.e. Longitudinal, Transverse and Vertical. So, for analysis of one station we have to process three files (.l, .t and .v).



After preprocessing the data file, we used Net Beans for development of user interface in java swing. The facility of selecting the data file (Fig 2 and 3)(any one out of three with extensions .l, .t or .v) and getting the formatted output in swing tables is provided in GUI(Fig 4). Also additional details in the file can be viewed in the Details tab (Fig 5).

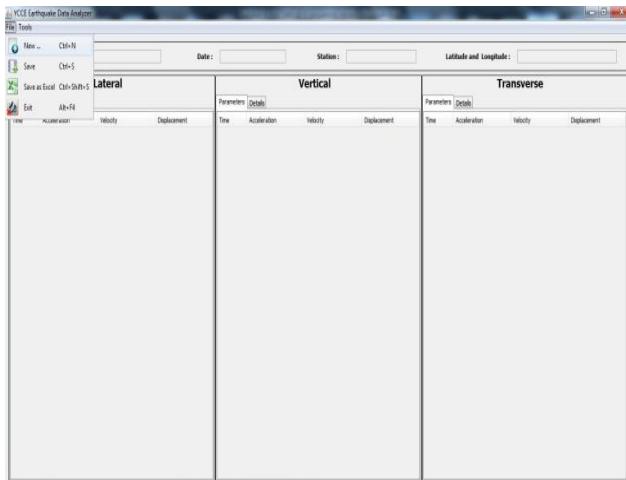


Fig 2 Using File Menu for opening a Data File.

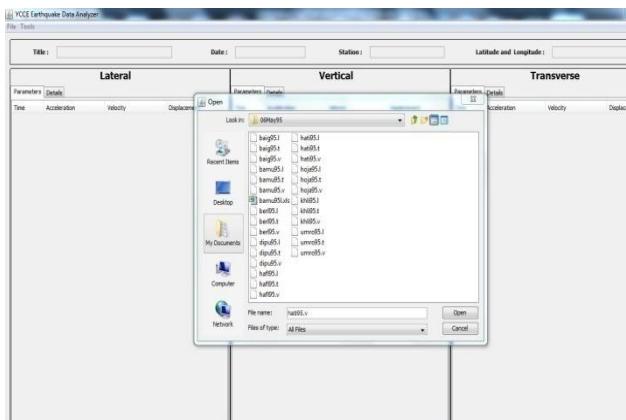


Fig 3 Browsing a Data File into Computer.

Title :		Date :	Station :	Latitude and Longitude :
		Lateral	Vertical	Transverse
Parameters [Details]		Time Acceleration Velocity Displacement	Time Acceleration Velocity Displacement	Time Acceleration Velocity Displacement
Time(sec.)	Acceleration(m/s <sup>2</sup> )	Velocity(m/s)	Displacement(mm)	
0.000	0.00000	-0.000420	0.000000	
0.040	0.05400	-0.000480	0.000000	
0.080	0.10800	-0.000540	0.000000	
0.120	0.16200	-0.000600	0.000000	
0.160	0.21600	-0.000660	0.000000	
0.200	0.27000	-0.000720	0.000000	
0.240	0.32400	-0.000780	0.000000	
0.280	0.37800	-0.000840	0.000000	
0.320	0.43200	-0.000900	0.000000	
0.360	0.48600	-0.000960	0.000000	
0.400	0.54000	-0.001020	0.000000	
0.440	0.59400	-0.001080	0.000000	
0.480	0.64800	-0.001140	0.000000	
0.520	0.70200	-0.001200	0.000000	
0.560	0.75600	-0.001260	0.000000	
0.600	0.81000	-0.001320	0.000000	
0.640	0.86400	-0.001380	0.000000	
0.680	0.91800	-0.001440	0.000000	
0.720	0.97200	-0.001500	0.000000	
0.760	1.02600	-0.001560	0.000000	
0.800	1.08000	-0.001620	0.000000	
0.840	1.13400	-0.001680	0.000000	
0.880	1.18800	-0.001740	0.000000	
0.920	1.24200	-0.001800	0.000000	
0.960	1.29600	-0.001860	0.000000	
1.000	1.35000	-0.001920	0.000000	
1.040	1.40400	-0.001980	0.000000	
1.080	1.45800	-0.002040	0.000000	
1.120	1.51200	-0.002100	0.000000	
1.160	1.56600	-0.002160	0.000000	
1.200	1.62000	-0.002220	0.000000	
1.240	1.67400	-0.002280	0.000000	
1.280	1.72800	-0.002340	0.000000	
1.320	1.78200	-0.002400	0.000000	
1.360	1.83600	-0.002460	0.000000	
1.400	1.89000	-0.002520	0.000000	
1.440	1.94400	-0.002580	0.000000	
1.480	1.99800	-0.002640	0.000000	
1.520	2.05200	-0.002700	0.000000	
1.560	2.10600	-0.002760	0.000000	
1.600	2.16000	-0.002820	0.000000	
1.640	2.21400	-0.002880	0.000000	
1.680	2.26800	-0.002940	0.000000	
1.720	2.32200	-0.003000	0.000000	
1.760	2.37600	-0.003060	0.000000	
1.800	2.43000	-0.003120	0.000000	
1.840	2.48400	-0.003180	0.000000	
1.880	2.53800	-0.003240	0.000000	
1.920	2.59200	-0.003300	0.000000	
1.960	2.64600	-0.003360	0.000000	
2.000	2.69900	-0.003420	0.000000	
2.040	2.75300	-0.003480	0.000000	
2.080	2.80700	-0.003540	0.000000	
2.120	2.86100	-0.003600	0.000000	
2.160	2.91500	-0.003660	0.000000	
2.200	2.96900	-0.003720	0.000000	
2.240	3.02300	-0.003780	0.000000	
2.280	3.07700	-0.003840	0.000000	
2.320	3.13100	-0.003900	0.000000	
2.360	3.18500	-0.003960	0.000000	
2.400	3.23900	-0.004020	0.000000	
2.440	3.29300	-0.004080	0.000000	
2.480	3.34700	-0.004140	0.000000	
2.520	3.39900	-0.004200	0.000000	
2.560	3.45200	-0.004260	0.000000	
2.600	3.50600	-0.004320	0.000000	
2.640	3.55900	-0.004380	0.000000	
2.680	3.61300	-0.004440	0.000000	
2.720	3.66600	-0.004500	0.000000	
2.760	3.71900	-0.004560	0.000000	
2.800	3.77300	-0.004620	0.000000	
2.840	3.82600	-0.004680	0.000000	
2.880	3.87900	-0.004740	0.000000	
2.920	3.93200	-0.004800	0.000000	
2.960	3.98500	-0.004860	0.000000	
3.000	4.03800	-0.004920	0.000000	
3.040	4.09100	-0.004980	0.000000	
3.080	4.14400	-0.005040	0.000000	
3.120	4.19700	-0.005100	0.000000	
3.160	4.25000	-0.005160	0.000000	
3.200	4.29300	-0.005220	0.000000	
3.240	4.34600	-0.005280	0.000000	
3.280	4.39900	-0.005340	0.000000	
3.320	4.45200	-0.005400	0.000000	
3.360	4.50500	-0.005460	0.000000	
3.400	4.55800	-0.005520	0.000000	
3.440	4.61100	-0.005580	0.000000	
3.480	4.66400	-0.005640	0.000000	
3.520	4.71700	-0.005700	0.000000	
3.560	4.77000	-0.005760	0.000000	
3.600	4.82300	-0.005820	0.000000	
3.640	4.87600	-0.005880	0.000000	
3.680	4.92900	-0.005940	0.000000	
3.720	4.98200	-0.006000	0.000000	
3.760	5.03500	-0.006060	0.000000	
3.800	5.08800	-0.006120	0.000000	
3.840	5.14100	-0.006180	0.000000	
3.880	5.19400	-0.006240	0.000000	
3.920	5.24700	-0.006300	0.000000	
3.960	5.29900	-0.006360	0.000000	
4.000	5.35200	-0.006420	0.000000	
4.040	5.39500	-0.006480	0.000000	
4.080	5.44800	-0.006540	0.000000	
4.120	5.49100	-0.006600	0.000000	
4.160	5.54400	-0.006660	0.000000	
4.200	5.59700	-0.006720	0.000000	
4.240	5.65000	-0.006780	0.000000	
4.280	5.70300	-0.006840	0.000000	
4.320	5.75600	-0.006900	0.000000	
4.360	5.80900	-0.006960	0.000000	
4.400	5.86200	-0.007020	0.000000	
4.440	5.91500	-0.007080	0.000000	
4.480	5.96800	-0.007140	0.000000	
4.520	6.02100	-0.007200	0.000000	
4.560	6.07400	-0.007260	0.000000	
4.600	6.12700	-0.007320	0.000000	
4.640	6.18000	-0.007380	0.000000	
4.680	6.23300	-0.007440	0.000000	
4.720	6.28600	-0.007500	0.000000	
4.760	6.33900	-0.007560	0.000000	
4.800	6.39200	-0.007620	0.000000	
4.840	6.44500	-0.007680	0.000000	
4.880	6.49800	-0.007740	0.000000	
4.920	6.55100	-0.007800	0.000000	
4.960	6.60400	-0.007860	0.000000	
5.000	6.65700	-0.007920	0.000000	
5.040	6.71000	-0.007980	0.000000	
5.080	6.76300	-0.008040	0.000000	
5.120	6.81600	-0.008100	0.000000	
5.160	6.86900	-0.008160	0.000000	
5.200	6.92200	-0.008220	0.000000	
5.240	6.97500	-0.008280	0.000000	
5.280	7.02800	-0.008340	0.000000	
5.320	7.08100	-0.008400	0.000000	
5.360	7.13400	-0.008460	0.000000	
5.400	7.18700	-0.008520	0.000000	
5.440	7.24000	-0.008580	0.000000	
5.480	7.29300	-0.008640	0.000000	
5.520	7.34600	-0.008700	0.000000	
5.560	7.39900	-0.008760	0.000000	
5.600	7.45200	-0.008820	0.000000	
5.640	7.50500	-0.008880	0.000000	
5.680	7.55800	-0.008940	0.000000	
5.720	7.61100	-0.009000	0.000000	
5.760	7.66400	-0.009060	0.000000	
5.800	7.71700	-0.009120	0.000000	
5.840	7.77000	-0.009180	0.000000	
5.880	7.82300	-0.009240	0.000000	
5.920	7.87600	-0.009300	0.000000	
5.960	7.92900	-0.009360	0.000000	
6.000	7.98200	-0.009420	0.000000	
6.040	8.03500	-0.009480	0.000000	
6.080	8.08800	-0.009540	0.000000	
6.120	8.14100	-0.009600	0.000000	
6.160	8.19400	-0.009660	0.000000	
6.200	8.24700	-0.009720	0.000000	
6.240	8.29900	-0.009780	0.000000	
6.280	8.35200	-0.009840	0.000000	
6.320	8.40500	-0.009900	0.000000	
6.360	8.45800	-0.009960	0.000000	
6.400	8.51100	-0.010020	0.000000	
6.440	8.56400	-0.010080	0.000000	
6.480	8.61700	-0.010140	0.000000	
6.520	8.67000	-0.010200	0.000000	
6.560	8.72300	-0.010260	0.000000	
6.600	8.77600	-0.010320	0.000000	
6.640	8.82900	-0.010380	0.000000	
6.680	8.88200	-0.010440	0.000000	
6.720	8.93500	-0.010500	0.000000	
6.760	8.98800	-0.010560	0.000000	
6.800	9.04100	-0.010620	0.000000	
6.840	9.09400	-0.010680	0.000000	
6.880	9.14700	-0.010740	0.000000	
6.920	9.19900	-0.010800	0.000000	
6.960	9.25200	-0.010860	0.000000	
7.000	9.30500	-0.010920	0.000000	
7.040	9.35800	-0.010980	0.000000	
7.080	9.41100	-0.011040	0.000000	
7.120	9.46400	-0.011100	0.000000	
7.160	9.51700	-0.011160	0.000000	
7.200	9.57000	-0.011220	0.000000	
7.240				



Second type of graph that can be drawn from the tool is Idealized graph. As we can see in Fig 7 there are too many points in graph to be analyzed. So, just to ease the user only maximum and minimum points are used to draw a graph. In this case also we have to select a parameter to draw a graph. (Fig 8 and 9).

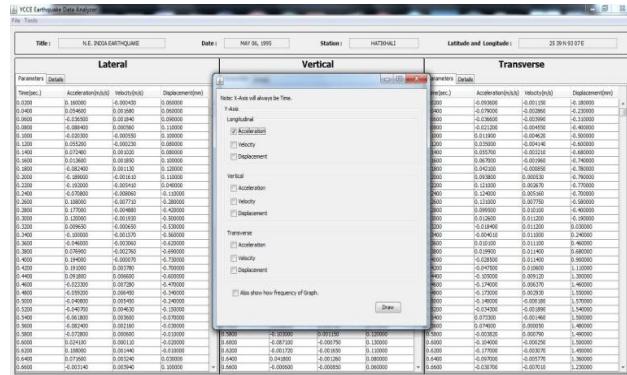


Fig. 8 Selecting a parameter to draw Graph.

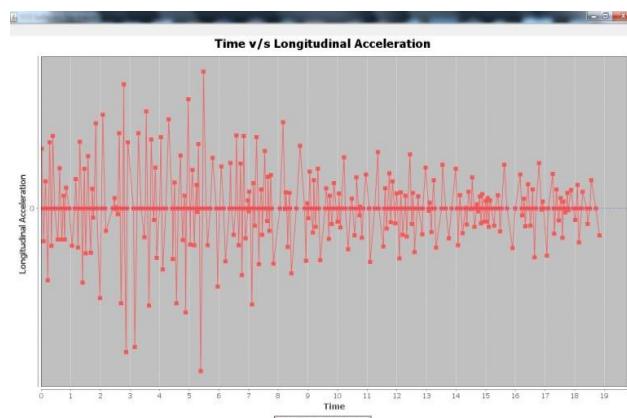


Fig. 9 Idealized Graph of selected parameter.

With the help of Jxl APIs, module for creation of Microsoft Excel file from available data is implemented. This MS-Excel file is very helpful to earthquake experts regarding further processing. Finding S-wave and P-wave has become easy (Fig 10a and 10b).

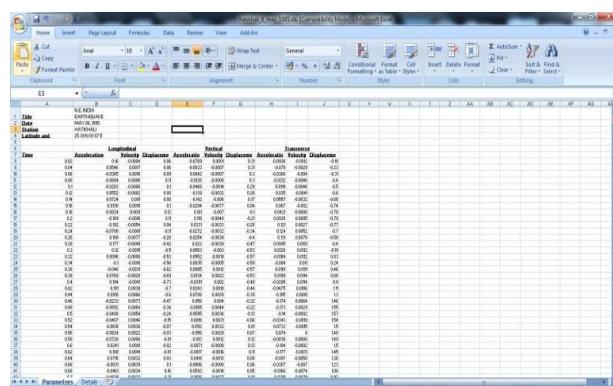


Fig.10a Excel File from the input data Files.

Earthquake.xls - [Compatibility Mode] - Microsoft Excel					
A1	B	C	D	E	F
1	Title	N.E. INDIA EARTHQUAKE			
2	Date	MAY 06, 1995	Station	HATIGALI	
3	Latitude and Longitude	23 39 59.91 E 87 27 37.8 N			
4	Time				
5	Longitudinal	Vertical	Transverse		
6	Time	Vertical	Transverse		
7	1	-0.09000	-0.00000		
8	2	-0.07000	-0.02000		
9	3	-0.05000	-0.04000		
10	4	-0.03000	-0.06000		
11	5	-0.01000	-0.08000		
12	6	0.01000	-0.10000		
13	7	0.03000	-0.12000		
14	8	0.05000	-0.14000		
15	9	0.07000	-0.16000		
16	10	0.09000	-0.18000		
17	11	0.11000	-0.20000		
18	12	0.13000	-0.22000		
19	13	0.15000	-0.24000		
20	14	0.17000	-0.26000		
21	15	0.19000	-0.28000		
22	16	0.21000	-0.30000		
23	17	0.23000	-0.32000		
24	18	0.25000	-0.34000		
25	19	0.27000	-0.36000		
26	20	0.29000	-0.38000		
27	21	0.31000	-0.40000		
28	22	0.33000	-0.42000		
29	23	0.35000	-0.44000		
30	24	0.37000	-0.46000		
31	25	0.39000	-0.48000		
32	26	0.41000	-0.50000		
33	27	0.43000	-0.52000		
34	28	0.45000	-0.54000		
35	29	0.47000	-0.56000		
36	30	0.49000	-0.58000		
37	31	0.51000	-0.60000		
38	32	0.53000	-0.62000		
39	33	0.55000	-0.64000		
40	34	0.57000	-0.66000		
41	35	0.59000	-0.68000		
42	36	0.61000	-0.70000		
43	37	0.63000	-0.72000		
44	38	0.65000	-0.74000		
45	39	0.67000	-0.76000		
46	40	0.69000	-0.78000		
47	41	0.71000	-0.80000		
48	42	0.73000	-0.82000		
49	43	0.75000	-0.84000		
50	44	0.77000	-0.86000		
51	45	0.79000	-0.88000		
52	46	0.81000	-0.90000		
53	47	0.83000	-0.92000		
54	48	0.85000	-0.94000		
55	49	0.87000	-0.96000		
56	50	0.89000	-0.98000		
57	51	0.91000	-1.00000		
58	52	0.93000	-1.02000		
59	53	0.95000	-1.04000		
60	54	0.97000	-1.06000		
61	55	0.99000	-1.08000		
62	56	1.01000	-1.10000		
63	57	1.03000	-1.12000		
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196	190	3.69000	-3.78000		

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