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Computer Exercises

User's Guide for Programs HIST

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These are preliminary lecture notes, intended only for distribution to participants

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**User's Guide for Program
HIST**

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I. COMMON NOTATIONS

The program is used in dialog mode. The user is asked a set of questions displayed on a computer monitor. The answers to these questions specify the set of parameters and the version of an algorithm. The dialogs are, as we hope, clear except abbreviations and a few details explained below.

Notes for the dialogs:

Symbols appearing in dialogs	Meaning
'2 r' or '1 i' or '3 a', etc.	enter <i>two real numbers</i> or <i>one integer number</i> or <i>three characters</i> , etc.
'q.'	<i>question</i>
'min'	<i>minimal</i>
'max'	<i>maximal</i>
'in ()'	<i>in parentheses</i>
'in []'	<i>in brackets</i>
'name'	<i>name of a file</i>
'go to N'	<i>continue with the question in line number N</i>
(**)	<i>the default program answer or the answer from the previous part of the dialog</i>
(* .DAT)	<i>the file name must have extension .DAT</i>

After the end of the dialog the execution starts.

The number of the line (first column in the tables with dialogs below) is not shown on the display. It is introduced for the present explanations only.

In a dialog only the lines with '?' and with '>' require an answer. The current answer is displayed in parentheses. Possible answers separated by slashes are listed in brackets. If you do not want to change the current answer, enter '/'. If several values have to be entered, they should be separated by commas or spaces.

Other common notations (if they are indicated) are:

n - such limitation or such job is not required ('no');

w - start the execution ('work');

e - terminate the job ('exit').

Expressions like (1-7), (1-19), etc. among possible answers mean: enter the number of the question for which you want to change the answer. The numbers of questions on the screen are followed by colon ':' (for example '5:'). If you have entered an impossible answer, the question is repeated and in some cases your error is explained on the screen.

'PROFILE' file. The answers to all questions are stored in a separate file, called here '**profile**'. The questions are rather numerous, since the programs are flexible and offer a wide variety of possibilities. At the same time, some variants of computations may differ only in few answers, while the rest remain the same. Profile is created in order to avoid the tedious repetition of identical answers. Usually the profile is displayed at the first part of the dialog. Default answers will be suggested if you do not use **profile**. Several versions of profile may exist, identified by different names. The name of **profile** should have the extension **.HIS**.

Optionally you can create a special output file with extension **.PRI**, which is called '**protocol**'. It contain your answers in dialog and some information the working session.

II. CATALOGS

The program operates on catalogs of earthquakes. Each earthquake in a catalog is described by a vector (T , LA , LO , DEP , mb , ms , ml , mp) where T is the origin time; LA and LO are latitude and longitude of the epicenter in degrees and decimals (Western longitude and Southern latitude are negative); DEP is the focal depth in kilometers; mb , ms , ml , mp are four magnitudes (0 usually corresponds to unknown value of magnitude).

The earthquakes in a catalog should be in ascending order by time.

In this guide some abbreviations (names of program mode, options, LA , LO , etc.) will be distinguished by upper-case letters but the dialog usually uses lower-case letters.

The format of catalog

The program operates on catalogs stored in standard **20 bytes binary format**.

The first 4 bytes of the first record contain an integer, which is the total number of records in the file (the number of earthquakes plus 1).

For all other records:

Positions in a record	Contents	Type
1-4	time of the earthquake in minutes A.D.	integer *4
5-6	latitude, degrees multiplied by 100	integer *2
7-8	longitude, degrees multiplied by 100	integer *2
9-10	depth, km	integer *2
11-12	magnitude mb multiplied by 100	integer *2
13-14	magnitude ms multiplied by 100	integer *2
15-16	magnitude ml multiplied by 100	integer *2
17-18	magnitude mp multiplied by 100	integer *2
19-20	macroseismic intensity (not used usually in this program)	integer *2

III. DESCRIPTION OF THE PROGRAM

Input is a catalog in **20 bytes format**.

Output is a histogram $A(P1, P2, P3)$. Here $P1$, $P2$, $P3$ are some parameters of an earthquake. A is one of the characteristics of an earthquake flow.

The histogram is made for the subcatalog, which may be specified by space, time and magnitude limitations: the certain rectangle of (LA , LO) plane, the intervals of focal depth, origin time, and magnitude.

NB: Rectangle on (LA , LO) plane should not cross 180° meridian.

The histogram is represented by a sequence of two-dimensional tables. Each table corresponds to a certain interval of the values of $P3$. Each column corresponds to a certain interval of $P1$ (horizontal axis). Each line corresponds to a certain interval of $P2$ (vertical axis).

The following parameters can be considered as $P1, P2, P3$:

Parameter	Code for entering	
Time - year, month, day, hour	ti	are forbidden to be used for horizontal axis $P1$
Days of month (1-31)	dm	
Hours (0-23)	hr	
Days of year (1-365)	dy	
Latitude	la	MC , or MB , or ML , or MS , or MP
Longitude	lo	
Depth	de	
Magnitude		

Common magnitude **MC** can be calculated by one of the three ways:

- a) **MC** is the maximal value among **MB**, **MS**, **ML**, **MP**. Here **MB**, ... , **MP** may be recalculated from input magnitudes mb, \dots, mp as:

$$\mathbf{MB} = mb * ab + bb$$

.....

$$\mathbf{MP} = mp * ap + bp$$

Coefficients ab, bb, \dots, ap, bp have to be entered.

- b) **MC** is the minimal value among **MB**, ... , **MP**.

- c) According to priority in the following sense:

Suppose you choose the priority: **MB**, **MP**, **ML**, **MS**. Then

MC = **MB** if **MB** is not 0,

MC = **MP** if **MB** = 0 and **MP** is not 0,

MC = **ML** if **MB** = **MP** = 0 and **ML** is not 0,

MC = **MS** if **MB** = **MP** = **ML** = 0 and **MS** is not 0.

If priority **MB**, **MB**, **MB**, **MB** is indicated then the program deals only with input magnitude mb .

The same is for **MS**, **ML**, **MP**.

In all cases, if **MB** = **MP** = **ML** = **MS** = 0 a value named 'blank' can be assigned to **MC**.

The cells of tables are filled with the observed values of $A(P1, P2, P3)$.

The following characteristics can be chosen as A :

Characteristic	Code for entering
Number of earthquakes	nu
Weighted sum of earthquakes (Sigma)	sg
Average weight of an earthquake	sn
Variation of magnitude	vm
Average magnitude	av
Maximal depth	de
Maximal magnitude	MC , mb , ms , ml , mp

sg - $E [c * 10^{*(d(M(i)-f))}]$ is the sum of weights. Summation is carried over all earthquakes in a cell. Here M is selected magnitude (**MC** or **mb**, ...) and c, d, f are coefficients, which should be entered; 10^{*x} is 10 in power x .

sn - $sg / (N^{*g})$, where N is the number of earthquakes in a cell and g is the coefficient, which should be entered.

vm - $E \sum M(i+1) - M(i)$ is the sum of magnitude jumps in a cell. Here $M(i)$ is magnitude of earthquake with number i from a cell.

av - $[E M(i)]/N$ is an average value of magnitude in a cell.

For each parameter P intervals of discretization (i.e. in the definition of cells) may be specified in two ways: **segmentation** - **n** (no segmentation) and **segmentation** - **y** (set of segments).

Segmentation - n

Denote BI and EI to be the minimal and maximal values of P , L to be the length of an interval, and S to be the shift. The program generates the following division of the values of P :

$$1) BI \leq P < BI + L$$

$$2) BI + S \leq P < BI + S + L$$

$$\dots\dots\dots$$

$$k) BI + (k - 1) * S \leq P \leq EI \leq BI + (k - 1) * S + L$$

Here k is the number of intervals. Each interval except the last one does not include its right end. For la , lo , de , mc , ... , mp one can also define a division with decreasing values of P . In this case, BI and EI have to be maximal and minimal values of P , and shift S has to be negative.

One can also define $L = 0$. In this case the program generates the following intervals :

$$1) BI \leq P \leq EI$$

$$2) BI + S \leq P \leq EI$$

$$\dots\dots\dots$$

$$k) BI + (k - 1) * S \leq P \leq EI$$

These intervals correspond to accumulation of A .

If $P3 = ti$ then L should not exceed S ($L \leq S$).

Segmentation - y

In this mode the intervals $[BI, EI]$, $[B2, E2]$, ... , $[Bk, Ek]$ are specified by indication of their ends and the program generates the following division of the values of P :

$$1) BI \leq P \leq EI \quad \text{segment 1}$$

$$2) B2 \leq P \leq E2 \quad \text{segment 2}$$

$$\dots\dots\dots$$

$$k) Bk \leq P \leq Ek \quad \text{segment } k$$

If $P3 = ti$ then intersection of segments is forbidden.

The number of columns (i.e. the number of intervals or segments) for horizontal axis should not exceed 14 for display, 21 for ordinary printout, and 41 for compressed printout

IV. DIALOG IN PROGRAM HIST

# of line	Questions	Answers and comments
1	Profile?(pro.his) [y/n/name(*.his)]>	y - use input profile named in (). n - use default answers name - enter the name of the input profile. Name has to be with extension .HIS .
2	Name of input catalog? (**)[y/name(*.dat)]>	y - use the catalog named in () as input catalog. name - enter the name of the catalog you want. Name has to be with extension .DAT .
3	1:your caption?(**)>	text - enter the title for printout (not more than 30 symbols).
4	Earthquake to start?(**)>	1 i - start from earthquake with this number in input catalog.
5	Beginning yr,mon,day,hr,min? (**,**,**,**,**)>	5 i - year, month, day, hour, minute - beginning of subcatalog.
6	End yr,mon,day,hr,min? (**,**,**,**,**)>	5 i - year, month, day, hour, minute - end of subcatalog.
7	2:Common magnitude?(**) [y/n/1-11]>	y - common magnitude with transformation of <i>mb</i> , ... , <i>mp</i> . Go to q.8. n - go to q.14.
8	Blank magnitude?(**)>	1 r - value of blank magnitude.

Now all the parameters for processing of common magnitude from profile are displayed.

9	Revise magnitude?(n)[y/n]>	y - go to q.10. n - go to q.15.
10	Recalculate magnitude?(n)[y/n]>	y - go to q.11. n - go to q.12.
11	Enter values a,b for <i>mb</i> ?(**)> <i>ms</i> ?(**)> <i>ml</i> ?(**)> <i>mp</i> ?(**)>	2 r - enter coefficients <i>ab</i> , <i>bb</i> in MB = <i>mb</i> * <i>ab</i> + <i>bb</i> <i>as</i> , <i>bs</i> in MS = <i>ms</i> * <i>as</i> + <i>bs</i> <i>al</i> , <i>bl</i> in ML = <i>ml</i> * <i>al</i> + <i>bl</i> <i>ap</i> , <i>bp</i> in MP = <i>mp</i> * <i>ap</i> + <i>bp</i>
12	Max,min or priority?(**)[ma/mi/pr]>	mi - MC is minimum of MB , ... , MP . Go to q.15. ma - MC is maximum. Go to q.15. pr - go to q.13.
13	Priority?(**,**,**,**)>	Enter the order of priority for <i>mb</i> , <i>ms</i> , <i>ml</i> , <i>mp</i> . Go to q.15.
14	Magnitude: <i>mb</i> (1), <i>ms</i> (2), <i>ml</i> (3), <i>mp</i> (4)? (**)[1/./4]>	i - number of magnitude, which will be used.
15	3:Min,max magnitude?(**,**)>	2 r - minimum and maximum magnitude in the subcatalog.
16	Min,max depth?(**,**)>	2 i - minimum and maximum depth in the subcatalog.

17	4:Rectangle(not across 180)? (**)[y/n/1-11]>	y - go to q.18. n - no boundaries for latitude and longitude. Go to q.19.
18	Min,max La; min,max Lo? (**,**,**,**)>	4 r - boundary of rectangle.
19	5:Parameters for hor.,vert.,list axis? (**,**,**)[h/ti/mo/dm/hr/dy/ la/lo/de/mc/./mp/no]>	Specify <i>P1</i> , <i>P2</i> , <i>P3</i> . They may be: ti, mo, dm, hr, dy, la, lo, de, mc, mb, ms, ml, mp, no . Time (ti, mo, dm, hr, dy) is forbidden for <i>P1</i> . If no is specified for <i>P3</i> then there is one table only (<i>P3</i> is absent).
20	6:Horizontal axis ***	Full name *** of the parameter <i>P1</i> is displayed. Answer is not required.
21	Segmentation?(**)[y/n/1-11]>	y - divide a horizontal axes into segments. They will be specified in line 8. Go to next line. n - divide into equal intervals by <i>B1</i> , <i>E1</i> , <i>L</i> , <i>S</i> . Go to q.24.
22	*** 999/- no more segments***	Answer is not required.
23	Segment 1 ?(**,**)> Segment 2 ?(**,**)>	2 r - enter <i>B1</i> , <i>E1</i> . 2 r - enter <i>B2</i> , <i>E2</i> , etc. (<= 20 segments). 999/ - no more segments. Go to q.26.
24	Range?(**,**)>	2 r - enter <i>B1</i> , <i>E1</i> .
25	Interval(0-accum) and Shift?(**,**)>	2 r - enter length of interval <i>L</i> and shift <i>S</i> for a horizontal axis.
26	Any corrections?(n)[y/n/1-11]>	y - go to q.21. n - go to the next line.
27	7:Vertical axis ***	Full name *** of the parameter <i>P2</i> is displayed. Answer is not required.

Questions 21 - 26 will be repeated for parameters *P2*, *P3*.

If *P3* = **no** then questions about third axis are skipped.

If *P2* or *P3* is time (**ti**) the following questions are asked instead of 23 - 25:

	*** 0/- no more segments ***	Answer is not required.
	Segment 1 from(y,m,d,h)? (**,**,**,**)> to?(**,**,**,**)> Segment 2 from(y,m,d,h)? (**,**,**,**)> to?(**,**,**,**)>	4 i - beginning time for segment 1. 4 i - end time for segment 1. 4 i - beginning time for segment 2. 4 i - end time for segment 2.
	Interval(0-accum)?(**,**,**,**)>	4 i - length <i>L</i> of the time interval in years, months, days, hours.
	Shift?(**,**,**,**)>	4 i - length <i>S</i> of the shift.

28	9:Count?(**)[h/nu/sg/sn/vm/de/mc/ mb/./mp/1-11]>	Specify function <i>A</i> . If <i>A</i> is not sg, sn or vm then go to q.32.
29	Kind of magnitude?(**) [mc/mb/./mp/1-11]>	2 a - select magnitude. In case of vm go to q.32.
30	Coeff.c,d,f:sg=c(10**d(m-f))? (**,**,**)>	3 r - values of <i>c</i> , <i>d</i> , <i>f</i> . In case of sg go to q.32.

31	Coeff.g(sn=sg/(n**g))?(**)>	r - value of <i>g</i> for sn .
32	10:Type,print?(**)[y/n, y/n]>	y,y - display histogram and store it on the disk in the file HIS.PRI . y,n - display only. Go to q.34. n,y - store only in the file HIS.PRI . Answer n,n is forbidden.
33	Printout of sum for str,col?(**)[y/n,y/n]>	y,y - print sum of cell values for each string and column of histogram. y,n - only for strings. n,y - only for columns. n,n - no printout of sum.
34	11:Save profile?(**)[y/n/name(*.his)]>	y - store new profile the disk under the name in (). name - enter name for a new profile to store it on disk. Name has to be with extension .HIS .

Now new profile is displayed.

35	Any changes?(n)[y/n/1-11]>	y - go to q.1. n - execution starts.
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