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Exercises on

Analysis of Earthquake Catalogs

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Exercises on Analysis of Earthquake Catalogs

I. WRITTEN EXERCISES

1.1 SEPARATION OF THE CATALOG INTO MAIN SHOCKS AND AFTERSHOCKS

Definition of aftershocks

Consider two earthquakes: one with the origin time t_1 and magnitude M_1, and another with the origin time t_2, and magnitude M_2. The second earthquake is an aftershock of the first one if the following conditions are satisfied:

$0 \leq t_2 - t_1 \leq T(M_1)$

$M_2 \leq M_1$

$r \leq R(M_1)$, where r is the distance between their epicenters.

$h \leq H(M_1)$, where h is the difference between the depths of the sources.

Here $T(M_1)$, $R(M_1)$, $H(M_1)$ are empirical functions.

The algorithm of separation of main shocks and aftershocks

The first earthquake in the catalog has to be counted as a main shock. Its aftershocks are identified and excluded from the catalog. The first remaining earthquake is the second main shock, etc.

Exercise 1: Separate the catalog in Table 1 into main shocks and aftershocks. Use the following empirical functions:

$T(M_1) = 2$ years, $R(M_1) = 100$ km, $H(M_1) = 10$ km.

Note: Different main shocks may have a common aftershock. The algorithm described above may indicate different main shocks to the same aftershock. The computer program assigns such aftershock to the strongest main shock. If these main shocks have equal magnitudes - the aftershock is assigned to the latest main shock.

TABLE 1

#	Date	φ^o	λ^o	M
1	1970.1.1	60	124.3	6.1
2	1970.1.3	60	124.0	5.9
3	1970.1.4	60	124.3	3.2
4	1970.1.4	60	125.3	6.2
5	1970.1.5	60	117.4	3.6
6	1970.1.6	60	124.9	6.0
7	1970.1.7	60	123.9	4.0
8	1970.1.7	60	125.0	4.8
9	1970.1.8	60	125.2	5.7
10	1970.1.9	60	125.8	6.6
11	1970.1.9	60	116.8	7.4
12	1970.1.10	60	124.3	4.5
13	1971.4.18	60	123.9	6.1
14	1971.6.20	60	124.2	4.2
15	1972.6.25	60	117.0	7.3
16	1972.7.28	60	116.9	6.5
17	1973.2.12	60	117.2	6.1
18	1973.2.13	60	119.9	6.3
19	1973.2.13	60	116.5	7.0
20	1973.2.14	60	119.4	6.0
21	1973.2.15	60	116.9	6.3
22	1974.8.11	60	124.3	3.1

All the earthquakes are normal (h_i = 33 km).
Let us remind you that 1° of the Earth meridian is equal to 40 000 km / 360 = 111.11 km, by definition.

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1.2 THE COUNT OF AFTERSHOCKS

Consider the main shocks with $M_0 - a_2 \le M \le M_0 - a_1$. For each main shock $b(e)$ is the number of its aftershocks with $M \ge M_0 - a_3$ during the first e days.

A strong earthquake (with $M \ge M_0$, and which is not an aftershock of the stronger one) terminates the count of function $b(e)$, but not the identification of main shocks and aftershocks. In other words, it may happen that $t_i \le t_j \le t_i + e$, where t_j is the moment of a strong earthquake and t_i is the moment of a main shock under consideration. In this case the count is terminated just before t_j.

Exercise 2: Count $b(e)$ for each main shock in Table 1. (The main shocks and aftershocks were identified in previous ***Exercise 1***). Use e = 2 days, M_0 = 7, a_1= 0.1, a_2 = 1 and a_3 = 3.5.

1.3 BURST OF AFTERSHOCKS

This is a distraction from our major purpose, but it is useful for research in earthquake prediction. Let us diagnose an approach of a strong earthquake by the premonitory seismicity pattern called "**burst of aftershocks**" or "**pattern B**". The occurrence of this pattern starts a period of alarm, so called **Time of Increased Probability** of a strong earthquake or **TIP**.

We diagnose the occurrence of **pattern B**, when for some main shock $b(e) \geq B$, and assume that the duration of a **TIP** equals to 3 years.

To choose the threshold B one may use the histogram of values of b. B should be chosen near a minimum of the histogram; otherwise the diagnosis of pattern B will not be stable due to possible uncertainties in the choice of B.

Another condition on B: the number of **patterns B** should not be too small (preferably not less than the number of strong earthquakes) nor too large (to have the **TIP**s not more than about 1/3 of all time).

Exercise 3: Given is the catalog of strong and main shocks with values of $b(e)$ (Table 2). Make the histogram of the values of $b(e)$ and choose the value of $\boldsymbol{B}$. The histogram has to be made with a grouping interval equal to 2.

TABLE 2

Date	φ°	λ°	Depth	M	b
1962.07.30	-3.40	143.70	33	6.88	2
1963.08.14	-3.40	135.40	33	6.99	0
1964.01.01	-3.20	139.70	33	6.88	0
1968.10.23	-3.33	143.25	12	6.80	3
1970.10.31	-4.93	145.47	42	7.00	16
1970.11.08	-3.44	135.63	33	6.80	5
1971.01.10	-3.13	139.70	33	8.10	(strong shock)
1976.06.25	-4.60	149.09	33	7.10	19
1976.10.29	-4.52	139.92	33	7.20	4
1979.09.12	-1.68	136.04	5	7.90	(strong shock)
1980.07.16	-4.46	143.52	84	7.10	0

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1.4 DETERMINATION OF MAGNITUDE THRESHOLDS

Let m_1, m_2, and m_3 be three values of lower magnitude thresholds. Each value is selected from the condition: $N(m_i) = c_i$. Here $i = 1$, 2, and 3; $N(m_i)$ is the number of main shocks with $M \geq m_i$ within all the time considered; c_i is a numerical parameter. (In the description of algorithms the average annual number of main shocks (a) is used instead of N.)

Exercise 4: Using the catalog of main shocks (Table 3) make a two-dimensional distribution of the number of earthquakes for the period from 1967.05.25.15:00 through 1980.05.25.15:00 with a 1 year step and for magnitudes $4.9 \leq M < 6.7$ with a 0.1 step. Present the result in the table below:

Time*	Magnitude																		Sum in a line
	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	
1965.05.25	1			1															2
1966.05.25								1							1				2
1967.05.25																			
1968.05.25																			
1969.05.25																			
1970.05.25																			
1971.05.25																			
1972.05.25																			
1973.05.25																			
1974.05.25																			
1975.05.25																			
1976.05.25																			
1977.05.25																			
1978.05.25																			
1979.05.25																			
Sum in a column																			

*The time indicated in a line corresponds to the beginning of 1 year time interval.

TABLE 3

Year	month	date	hour	minute	φ°	λ°	Depth	M	b
1965	9	25	17	43	34.70	-116.50	10	5.20	4
1965	10	17	9	45	33.97	-116.77	17	4.90	6
1966	6	28	4	26	35.90	-120.53	18	5.60	17
1966	8	7	17	36	31.80	-114.50	0	6.30	0
1967	9	21	0	1	31.42	-115.95	1	5.20	1
1968	4	9	2	28	33.18	-116.12	11	6.40	57
1968	7	5	0	45	34.12	-119.70	5	5.20	10
1969	3	20	8	16	31.40	-114.00	0	5.20	0
1969	3	20	8	17	31.30	-114.20	0	5.70	12
1969	3	23	11	32	31.40	-115.00	0	5.20	0
1969	6	10	3	41	31.62	-116.20	2	5.00	0
1969	10	3	13	10	37.62	-118.92	2	4.90	0
1969	10	22	22	51	34.57	-121.62	10	5.40	17
1969	10	24	8	29	33.28	-119.18	10	5.10	10
1969	11	5	17	54	34.60	-121.43	10	5.60	8
1970	1	19	7	16	31.48	-115.97	10	4.90	0
1970	9	12	14	30	34.27	-117.53	8	5.40	8
1971	2	9	14	0	34.40	-118.40	8	6.40	210
1971	9	30	22	46	33.03	-115.82	8	5.10	9
1973	2	21	14	45	34.05	-119.03	8	5.90	9
1973	10	16	14	53	31.60	-115.82	8	4.90	3
1975	6	1	1	38	34.50	-116.48	4	5.20	8
1975	7	17	18	24	31.92	-115.77	17	5.00	6
1976	12	7	12	59	31.97	-114.77	8	5.00	0
1978	5	5	21	3	32.20	-115.30	6	5.20	4
1978	8	13	22	54	34.33	-119.68	12	5.10	19
1978	10	4	16	42	37.50	-118.67	5	5.80	55
1979	1	1	23	14	33.93	-118.67	11	5.00	18
1979	3	15	20	17	34.30	-116.43	2	4.90	1
1979	3	15	21	7	34.32	-116.43	2	5.20	28
1979	10	15	23	16	32.60	-115.32	12	6.60	359
1980	2	25	10	47	33.50	-116.50	13	5.50	6
1980	5	25	16	33	37.60	-118.62	3	6.40	80
1980	5	25	19	44	37.55	-118.78	6	6.50	288

Exercise 5: Using the result of previous ***Exercise 4***, find the values m_1, m_2, and m_3 from the following conditions:

within period 1965.05.25.15:00 - 1980.05.25.15:00
32 main shocks had $M \geq m_1$,
12 main shocks had $M \geq m_2$,
4 main shocks had $M \geq m_3$.

In other words, find m_1, m_2, and m_3 for $c_1 = 32$, $c_2 = 12$ and, $c_3 = 4$. Calculate also the average annual number of main shocks (a) for obtained m_1, m_2, and m_3.

Exercise 6: Using the result of ***Exercise 5***, find distributions of the number of main shocks with $M \geq 4.9$, $M \geq 5.3$, and $M \geq 6.2$ separately within the period from 1967.05.25.15:00 through 1980.05.25.15:00 with a 1 year step.
Present the result in the table below:

Time	Magnitude		
	$M \geq 4.9$	$M \geq 5.3$	$M \geq 6.2$
1965.05.25	2		
1966.05.25	2	2	1
1967.05.25			
1968.05.25			
1969.05.25			
1970.05.25			
1971.05.25			
1972.05.25			
1973.05.25			
1974.05.25			
1975.05.25			
1976.05.25			
1977.05.25			
1978.05.25			
1979.05.25			

1.5 FUNCTIONS

In ***Exercises 7*** and ***8*** the time step is 1 year, $m_1 = 4.9$, $m_2 = 5.3$, $m_3 = 6.2$, and $M_0 = 6.4$. The functions have to be calculated at the moment t' = 1980.05.25.15:00 for the catalog of the main shocks from Table 3. The results of ***Exercise 6*** in Section 1.4 are useful for these calculations. The functions and their definitions are listed in Table 4.

Exercise 7: Using definitions from Table 4 calculate N1(t'), N3(t'), SIGMA(t') (use also Table 5), G(t'), q(t') (take $a_2 = 1.4$), Q(t'), V(t'), K(t'), L(t') (assume $l_2 = 58$, $t' - t_0 = 48$ years, and get l_1 from Table 3), Smax(t') (use the result of ***Exercise 6*** from Section 1.4), Bmax(t') (the number of aftershocks $b(e)$ is given in the b column of Table 3).

Exercise 8: Use the following list of strong earthquakes:

1971.02.09.14:00 $M = 6.4$,
1976.11.26.11:19 $M = 6.8$,
1979.10.15.23:16 $M = 6.6$.

Find all the long-range aftershocks in the catalog (Table 3) in the time interval ((t' - 3 years), t') and calculate MI(t').

TABLE 4

Name of function in computer dialog (program **FUNC**)	Definition
N1(t)	The number of main shocks with magnitude $M \geq m_2$, which occurred from (t - 6 years) to t.
N3(t)	The number of main shocks with magnitude $M \geq m_2$, which occurred from (t - 10 years) to (t - 7 years).
SIGMA(t)	SIGMA(t) = $\Sigma 10^{\beta(M_i - \alpha)}$ The main shocks with $m_1 \leq M_i \leq M_0 - 0.1$ and the origin time (t - 3 years) $\leq t_i \leq t$ are included in summation; $\alpha = 4.5$, $\beta = 1.00$.
G(t)	G(t) = 1 - P, where P is the ratio of the number of the main shocks with $M_i \geq m_2$ to the number of the main shocks with $M_i \geq m_1$. Only the main shocks with the origin time t_i, which satisfies the condition (t - 3 years) $\leq t_i \leq t$, are considered.
q(t)	$q(t) = \sum_{j=1}^{6} \max\{0, \text{ENTIRE}(A - n_j)\}$, where $A = 6a_2$, a_2 is the average annual number of main shocks with $M \geq m_2$ in the catalog, n_j is the number of main shocks with $M_i \geq m_2$ and origin time (t - (8 + j) years) $\leq t_i \leq$ (t - (2 + j) years).
Q(t)	$Q(t) = \sum_{j=2}^{j^*} \lvert n_j - n_{j-1} \rvert$, where n_j is the number of main shocks with $M_i \geq m_1$ and (t - j years) $\leq t_i <$ (t - (j - 1) years); j^* is the first number j for which: $n_j > n_{j-1}$ and $n_j > n_{j+1}$ (if there are no such n_j for j = 2, 3, ..., 15 then j = 15).
V(t)	$V(t) = \sum_{j=2}^{7} \lvert n_j - n_{j-1} \rvert$, where n_j is the same as in definition of Q(t).
K(t)	K(t) = $K_1 - K_2$, where K_j is the number of main shocks with $M_i \geq m_2$ and origin time (t - 2j years) $\leq t_i \leq$ (t - 2(j - 1) years).

TABLE 4 (continuation)

Name of function in computer dialog (program **FUNC**)	Definition
L(t)	$L(t) = l_1 - \frac{l_2(t - t_0)}{t - t_0 - 6\,\text{years}}$, where t_0 is the beginning of the catalog, l_1 is the number of main shocks with $M_i \geq m_2$ between t_0 and t, l_2 is the similar number for the period between t_0 and (t - 6 years),
Smax(t)	Smax(t) = max{S_1/N_1, S_2/N_2, S_3/N_3}, where S_j is calculated by the same formula as SIGMA(t) for the events with the origin time (t - j years) $\leq t_i \leq$ (t - (j - 1) years), and N_j is the number of terms in the sum.
Bmax(t)	The maximal number of aftershocks for the main shocks with $M_i \geq m_1$ and origin time within ((t - 3 years), t). Aftershocks are counted for the first 2 days (e = 2 days) after the main shock.
Ml(t)	The maximal magnitude of the long-range aftershocks in the region under consideration within the time interval from (t - 3 years) to t. A long-range aftershock is a main shock with $M_i \geq m_1$, which follows a strong ($M \geq M_0$) main shock in the region or in its neighborhood within 1 year.

Notes: 1) The addition or subtraction of a year in the program does not change the month, day, and hour.

2) Almost all functions are defined here with the same values of numerical parameters as in the original design of the algorithms. These values may be changed in applications with an adequate attention to the danger of data-fitting. We would recommend to assume B and corresponding values of β in accordance with preferred magnitude-energy relation $\lg E = A + BM$.

TABLE 5 Function $10^{\beta(M-\alpha)}$ for $\alpha = 4.5$ and $\beta = 1.00$

M	$10^{\beta(M-\alpha)}$	M	$10^{\beta(M-\alpha)}$	M	$10^{\beta(M-\alpha)}$	M	$10^{\beta(M-\alpha)}$
4.5	1.00	5.0	3.16	5.5	10.00	6.0	31.62
4.6	1.26	5.1	3.98	5.6	12.59	6.1	39.81
4.7	1.58	5.2	5.01	5.7	15.85	6.2	50.12
4.8	2.00	5.3	6.31	5.8	19.95	6.3	63.10
4.9	2.51	5.4	7.94	5.9	25.12	6.4	79.43

II. ANSWERS FOR WRITTEN EXERCISES

Exercises 1, 2:

Main shocks	Aftershocks	$b(e)$
1	2, 3	1
4	6, 7, 8, 9, 13	1
5		weak
10	12, 14	0
11		strong
15	16, 17, 19, 21	strong
18	20	1
22		weak

Exercise 3: Any number between 6 and 15.

Exercise 4:

Time*	Magnitude																		Sum in a line
	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	
1965.05.25	1			1															2
1966.05.25								1							1				2
1967.05.25				1												1			2
1968.05.25				3					1										4
1969.05.25	2	1	1			1		1											6
1970.05.25						1										1			2
1971.05.25			1																1
1972.05.25											1								1
1973.05.25	1																		1
1974.05.25																			0
1975.05.25		1		1															2
1976.05.25		1																	1
1977.05.25				1															1
1978.05.25	1	1	1	1						1									5
1979.05.25							1											1	2
Sum in a column	5	4	3	8	0	2	1	2	1	1	1	0	0	0	1	2	0	1	32

Exercise 5: $m_1 = 4.9$, $m_2 = 5.3 \div 5.4$, $m_3 = 6.0 \div 6.3$,
$a_1 = 2.1$, $a_2 = 0.8$, $a_3 = 0.27$

Exercise 6:

Time	Magnitude		
	$M \geq 4.9$	$M \geq 5.3$	$M \geq 6.2$
1965.05.25	2		
1966.05.25	2	2	1
1967.05.25	2	1	1
1968.05.25	4	1	
1969.05.25	6	2	
1970.05.25	2	2	1
1971.05.25	1		
1972.05.25	1	1	
1973.05.25	1		
1974.05.25			
1975.05.25	2		
1976.05.25	1		
1977.05.25	1		
1978.05.25	5	1	
1979.05.25	2	2	1

Exercise 7: N1(t') = 3, N3(t') = 3, SIGMA(t') = 49.62,
G(t') = 0.625, q(t') = 18, Q(t') = 3,
V(t') = 11, K(t') = 3, L(t') = -5.29,
Smax(t') = 10.00, Bmax(t') = 359

Exercise 8: There is only one long-range aftershock:
1980.02.25 $M = 5.5$.

Ml(t') = 5.5

III. COMPUTER EXERCISES WITH THE PROGRAMS EDCAT, CATAL, HIST, AND AFT

EXERCISE 1

Task: To check the catalog which has format 41 bytes to find
double records, unreasonable values of records parameters
and disturbance of time order of records.
Program to use: **EDCAT**.
Input files: profile - no,
file with input catalog - EX1.DAT (format - 41).
Input data: mode of work - reorganize,
transformation of magnitude - off,
type - on, print - on,
standard ranges to define double records and
unreasonable values of records parameters,
do not create file with output catalog and output
profile.

EXERCISE 2

Task: To compare two catalogs which have format 41 bytes to find
in each of them records which have no doubles in another
catalog.
Program to use: **CATAL.**
Input files: profile - no,
file with the first input catalog - EX2F.DAT,
file with the second input catalog - EX2S.DAT
(format of both catalogs - 41).
Input data: mode of work - d(unequiv.),
start from the 1st record in the both catalogs,
time from 1900 1 1 0 0 to 1990 1 1 0 0,
no limitations on magnitude, depth and area,
type - on, print - on,
standard ranges to define double records,
do not create file with output catalog,
create output profile with name EX2.CAT.

EXERCISE 3

Task: To create the subcatalog of earthquakes with magnitude
M ≥ 6.4 selected from the catalog of Southern California
earthquakes which has format 20 bytes.
Program to use: **CATAL.**
Input files: profile - no,
file with the input catalog - SCALIF28.DAT
(format - 20).
Input data: mode of work - Select,
start from the 1st record,
time from 1900 1 1 0 0 to 1990 1 1 0 0,
use common magnitude which equals to maximum of mb,
ms, mp and ml (transformation coefficients for all of
them are equal to 1. and 0.),
limitations on common magnitude - from 6.4 to 9.0,
no limitations on depth and area,
type - on, print - on,
do not create file with output catalog,
create output profile with name EX3.CAT.

EXERCISE 4

Task: To make for the catalog of Southern California earthquakes
the distribution of the number of epicenters on the map for
the time period 1932-1990. In other words to make the
two-dimensional histogram with the longitude as a horizontal
axis and the latitude as a vertical axis and with calculation
the number of epicenters. Note that as the vertical axis is
directed downwards, it is natural to indicate its boundaries
from the maximum latitude to the minimum latitude and
negative value of shift.
Program to use: **HIST.**
Input files: profile - no,
file with the input catalog - SCALIF28.DAT.
Input data: start from the 1st record,
time from 1932 1 1 0 0 to 1990 1 1 0 0,
use common magnitude which equals to maximum of mb, ms,
mp and ml (transformation coefficients for all of them
are equal to 1. and 0., value for blank magnitude is 0.),
no limitations on magnitude and depth,
limitations on area - rectangle with latitude from 30.
to 40. and longitude from -124. to -111.,
horizontal axis - longitude from -124. to -111. with
interval 2. and shift 2.,
vertical axis - latitude from 40. to 30. with
interval 0.5 and shift -0.5,
count the number of earthquakes (nu),
type - on, print - on,
count sums for lines and columns on the printout,
create output profile with name EX4.HIS.

EXERCISE 5

Task: To make for the catalog of Southern California earthquakes
the distribution of the maximum value of common
magnitude on the map for the time period 1932-1990.
Program to use: **HIST**.
Input files: profile - EX4.HIS (created in Exercise 4),
file with the input catalog - SCALIF28.DAT.
Input data: start from the 1st record,
time from 1932 1 1 0 0 to 1990 1 1 0 0,
use common magnitude which equals to maximum of mb, ms,
mp and ml (transformation coefficients for all of them
are equal to 1. and 0., value for blank magnitude is 0.),
no limitations on magnitude and depth,
limitations on area - rectangle with latitude from 30.
to 40. and longitude from -124. to -111.,
horizontal axis - longitude from -124. to -111. with
interval 2. and shift 2.,
vertical axis - latitude from 40. to 30. with
interval 0.5 and shift -0.5,
count the maximum value of common magnitude (mc),
type - on, print - on,
do not count sums for lines and columns on the printout,
create output profile with name EX5.HIS.

EXERCISE 6

Task: To make for the catalog of Southern California earthquakes
the two-dimensional histogram for the time period
1932-1988 with the common magnitude as a horizontal axis and
the time as a vertical axis and with calculation the number of
earthquakes.
Program to use: **HIST.**
Input files: profile - EX5.HIS (created in Exercise 5),
file with the input catalog - SCALIF28.DAT.
Input data: start from the 1st record,
time from 1932 1 1 0 0 to 1988 1 1 0 0,
use common magnitude which equals to maximum of mb, ms,
mp and ml (transformation coefficients for all of them
are equal to 1. and 0., value for blank magnitude is 0.),
no limitations on magnitude and depth,
limitations on area - rectangle with latitude from 30.
to 40. and longitude from -124. to -111.,
horizontal axis - common magnitude from 2. to 8. with
interval 1. and shift 1.,
vertical axis - time from 1932 1 1 0 to 1988 1 1 0
with interval 2 years and shift 2 years,
count the number of earthquakes (nu),
type - on, print - on,
count sums for lines and columns on the printout,
create output profile with name EX6.HIS.

EXERCISE 7

Task: To make for the catalog of Southern California earthquakes
the two-dimensional histogram for the time period
1932-1988 with the common magnitude as a horizontal axis and
the time as a vertical axis and with accumulating along the
horizontal axis calculation the number of earthquakes.
Program to use: **HIST.**
Input files: profile - EX6.HIS (created in Exercise 6),
file with the input catalog - SCALIF28.DAT.
Input data: start from the 1st record,
time from 1932 1 1 0 0 to 1988 1 1 0 0,
use common magnitude which equals to maximum of mb, ms,
mp and ml (transformation coefficients for all of them
are equal to 1. and 0., value for blank magnitude is 0.),
no limitations on magnitude and depth,
limitations on area - rectangle with latitude from 30.
to 40. and longitude from -124. to -111.,
horizontal axis - common magnitude from 2. to 8. with
interval 0. (accumulation) and shift 1.,
vertical axis - time from 1932 1 1 0 to 1988 1 1 0
with interval 2 years and shift 2 years,
count the number of earthquakes (nu),
type - on, print - on,
count sums only for columns on the printout,
create output profile with name EX7.HIS.

EXERCISE 8

Task: To create the catalog of main shocks with statistics
of aftershocks for the catalog of Southern California
earthquakes.
Program to use: **AFT.**
Input files: profile - no,
file with the input catalog - SCALIF28.DAT.
Input data: start from the 1st record,
time from 1932 1 1 0 0 to 1988 1 1 0 0,
use common magnitude which equals to maximum of mb, ms,
mp and ml (transformation coefficients for all of them
are equal to 1. and 0.),
no limitations on magnitude and area,
depth from -10 to 100,
coefficients c, d, f for calculation of SIGMA -
1., 0.77, 4.5,
threshold magnitude for strong shocks - 9.,
limitations for selection of aftershocks are the
same for the whole main shocks magnitude interval:
for magnitude - absolute from 0. to the
magnitude of the main shock,
for depth - no limitations,
for distance - absolute 50.,
identification time for selection of aftershocks is
different for 7 subintervals of main shock magnitude
covering magnitudes from 0. to 9., the function b(e)
is calculated for two time intervals e=T1 and e=T2:

magnitude subinterval	identification time	T1	T2
from 0.00 to 2.79	11 days	2 days	11 days
from 2.79 to 3.40	23 days	2 days	23 days
from 3.40 to 4.00	46 days	2 days	46 days
from 4.00 to 4.40	91 days	2 days	91 days
from 4.40 to 5.40	182 days	2 days	182 days
from 5.40 to 6.40	1 year	2 days	1 year
from 6.40 to 9.00	2 years	2 days	2 years

type - on, print - on, type SIGMA - off,
minimum number of aftershocks to type and print a
main shock - 15.
Create output catalog of main shocks in file with
name MAIN.DAT,
create output profile with name MAIN.AFT.

EXERCISE 9

Task: To make for the catalog of Southern California main shocks (the result of Exercise 8) the two-dimensional histogram for the time period 1932-1988 with the number of aftershocks as a horizontal axis and the time as a vertical axis and with calculation the number of earthquakes. Use segmentation for the horizontal axis. Note that records of a main shocks catalog contain the number of aftershocks divided by 100 in the ms position so the number of aftershocks can be obtained as common magnitude if it is defined to be equal to ms*100.

Program to use: **HIST.**

Input files: profile - no,
file with the input catalog - MAIN.DAT (created in Exercise 8).

Input data: start from the 1st record,
time from 1932 1 1 0 0 to 1988 1 1 0 0,
use common magnitude which equals to maximum of mb, ms, mp and ml (transformation coefficients for ms are equal 100. and 0., all other transformations coefficients are equal to 0., value for blank magnitude is 0.),
no limitations on depth and area,
limitations on common magnitude - from 0. to 400.,
horizontal axis - common magnitude
with segmentation: from 0. to 5.,
from 6. to 10.,
from 11. to 15.,
from 16. to 20.,
from 21. to 25.,
from 26. to 30.,
from 31. to 40.,
from 41. to 50.,
from 51. to 100.,
from 101. to 200.,
from 201. to 400.,
vertical axis - time from 1932 1 1 0 to 1988 1 1 0
with interval 1 year and shift 1 year,
count the number of earthquakes (nu),
type - on, print - on,
count sums for lines and columns on the printout,
create output profile with name EX9.HIS.

EXERCISE 10

Task: To select the subcatalog for the first region of the Southern California from the catalog of Southern California main shocks (the result of Exercise 8).
Program to use: **CATAL.**
Input files: profile - no,
file with the input catalog - MAIN.DAT
(format - 20, created in Exercise 8).
Input data: mode of work - Select,
start from the 1st record,
time from 1932 1 1 0 0 to 1988 1 1 0 0,
use magnitude mb,
limitations on magnitude mb - from 4.5 to 9.0,
no limitations on depth,
area is limited by the polygon with 11 vertices
(latitude,longitude): (31.25, -114.), (32., -114.),
(34., -115.), (36., -116.), (38., -117.), (38., -119),
(37., -120.4), (35.5, -123.), (33.75, -121.5),
(31.25, -119), (31.25, -116.25),
type - on, print - off, protocol - on,
create output subcatalog in format 20 in file with
name REG1.DAT,
create output profile with name REG1.CAT.

EXERCISE 11

Task: To create the subcatalog of earthquakes with magnitude mb $\geq$ 4.9 and time from 25.09.1965 to 26.05.1980 selected from the catalog of main shocks of the first region of the Southern California which has format 20 bytes. Compare the result of this exercise with Table 3 of Section 1.4 of the written exercises.
Program to use: **CATAL.**
Input files: profile - no,
file with the input catalog - REG1.DAT
(format - 20, created in Exercise 10).
Input data: mode of work - Select,
start from the 1st record,
time from 1965 9 25 0 0 to 1980 5 26 0 0,
use magnitude mb,
limitations on magnitude - from 4.9 to 9.0,
no limitations on depth and area,
type - on, print - on,
create output catalog in format 20 in file with
name EX11.DAT,
create output profile with name EX11.CAT.

EXERCISE 12

Task: To make for the subcatalog selected in Exercise 11 the two-dimensional histogram with the magnitude mb as a horizontal axis and the time as a vertical axis and with calculation the number of earthquakes. Compare the result of this exercise with the answer to Exercise 4 of Section 1.4 of the written exercises.

Program to use: **HIST.**

Input files: profile - no,
file with the input catalog - EX11.DAT (created in Exercise 11).

Input data: start from the 1st record,
time from 1965 5 25 15 0 to 1980 5 25 15 0,
use magnitude mb,
limitations on magnitude - from 4.9 to 6.7,
no limitations on depth and area,
horizontal axis - magnitude mb from 4.9 to 6.7 with interval 0.1 and shift 0.1,
vertical axis - time from 1965 5 25 15 to 1980 5 25 15 with interval 1 year and shift 1 year,
count the number of earthquakes (nu),
type - on, print - on,
count sums for lines and columns on the printout,
create output profile with name EX12.HIS.

EXERCISE 13

Task: To make for the subcatalog selected in Exercise 11 the two-dimensional histogram with the magnitude mb as a horizontal axis and the time as a vertical axis and with calculation the number of earthquakes. Use segmentation for the horizontal axis. Compare the result of this exercise with the answer to Exercise 5 of Section 1.4 of the written exercises.

Program to use: **HIST.**

Input files: profile - EX12.HIS (created in Exercise 12),
file with the input catalog - EX11.DAT (created in Exercise 11).

Input data: start from the 1st record,
time from 1965 5 25 15 0 to 1980 5 25 15 0,
use magnitude mb,
limitations on magnitude - from 4.9 to 6.7,
no limitations on depth and area,
horizontal axis - magnitude mb
with segmentation: from 4.9 to 6.7,
from 5.3 to 6.7,
from 6.2 to 6.7,
vertical axis - time from 1965 5 25 15 to 1980 5 25 15 with interval 1 year and shift 1 year,
count the number of earthquakes (nu),
type - on, print - on,
count sums only for columns on the printout,
create output profile with name EX13.HIS.

EXERCISE 14

Task: To calculate values of functions on seismic flow using the catalog of main shocks of the first region of the Southern California (file REG1.DAT created in Exercise 10) and the catalog of enough strong earthquakes of California (file CAL6.DAT). Compare the values of functions obtained for the object 1805 with the answers to Exercises 7 and 8 of Section 1.5 of the written exercises.

Program to use: **FUNC.**

Input files: profile - no,
common name of files with regional catalogs of main shocks - REG.DAT.

Output profile: EX14.PAT.

Input data: list of regions: 1,
time from 1932 5 25 16 33 to 1984 1 1 1 0,
skipping to 1938 5 25 16,
learning to 1984 1 1 0,
threshold magnitude for strong shocks - 6.4,
dates of objects are set by step from 1938 5 25 16 to 1984 1 1 1 with step 1 year,
list of functions to calculate:

#	name	time	magnitude
1	N1	6	m2
3	K	2	m2
4	G	3	m2
5	SIGMA	3	m1
6	Smax	3	m1
9	N3	3	m2
10	L	6	m2
11	q	6	m2
12	M1	3	m1
13	Bmax	3	--
14	Q	1	m1
15	V	6	m1
21	SIGTH	3	m1

(see definitions of functions in the user's guide to the program FUNC).

Maximum magnitude for calculation of SIGMA - 6.3,
coefficients for calculation of SIGMA and SIGTH:
C=1., D=1., F=4.5,
maximum magnitude for calculation of Smax - 6.3,
coefficients for calculation of Smax: C=1., D=1., F=4.5,
file with catalog for selection of long range aftershocks - CAL6.DAT,
threshold magnitude for long range aftershocks - 6.4,
magnitude thresholds: m1=4.9, m2=5.3, m3=6.2,
type - on, print - on, type all objects.

EXERCISE 15

Task: To calculate values of functions on seismic flow using the catalog of main shocks of the first region of the Southern California (file REG1.DAT created in Exercise 10) and the catalog of enough strong earthquakes of California (file CAL6.DAT). Dates of objects have to be set by list according to the input profile REGL1.PAT.

Program to use: **FUNC.**

Input files: profile - REGL1.PAT,
common name of files with regional catalogs of main shocks - REG.DAT.

Output profile: EX15.PAT.

Input data: list of regions: 1,
time from 1932 1 1 0 0 to 1984 1 1 1 0,
skipping to 1938 1 1 1,
learning to 1984 1 1 0,
threshold magnitude for strong shocks - 6.4,
dates of objects are set by list according to the input profile REGL1.PAT (see printout for this exercise), calculate " Standard CN" set of functions:

#	name	time	magnitude
2	N2	3	m3
3	K	2	m2
4	G	3	m2
5	SIGMA	3	m1
6	Smax	3	m1
8	Zmax	3	m1
9	N3	3	m2
11	q	6	m2
13	Bmax	3	--
21	SIGTH	3	m1

maximum magnitude for calculation of SIGMA - 6.3,
coefficients for calculation of SIGMA and SIGTH:
C=1., D=1., F=4.5,
maximum magnitude for calculation of Smax - 6.3,
coefficients for calculation of Smax: C=1., D=1., F=4.5,
maximum magnitude for calculation of Zmax - 6.3,
coefficients for calculation of Zmax: C=1., D=0.5, F=4.5,
magnitude thresholds: m1=4.9, m2=5.3, m3=6.2,
type - on, print - on, type all objects.

EXERCISE 16

Task: To calculate values of functions on seismic flow using the catalog of main shocks of the first region of the Southern California (file LREG1.DAT) and the catalog of enough strong earthquakes of California (file CAL6.DAT). Dates of objects have to be set with time step 2 months.

Program to use: **FUNC.**

Input files: profile - REGL1.PAT,
common name of files with regional catalogs of main shocks - LREG.DAT.

Output profile: EX16.PAT.

Input data: list of regions: 1,
time from 1932 1 1 0 0 to 1991 1 1 0 0,
skipping to 1938 1 1 1,
learning to 1984 1 1 0,
threshold magnitude for strong shocks - 6.4,
dates of objects are set by step from 1938 1 1 0
to 1990 1 1 0 with step 2 months,
calculate " Standard CN" set of functions:

#	name	time	magnitude
2	N2	3	m3
3	K	2	m2
4	G	3	m2
5	SIGMA	3	m1
6	Smax	3	m1
8	Zmax	3	m1
9	N3	3	m2
11	q	6	m2
13	Bmax	3	--
21	SIGTH	3	m1

maximum magnitude for calculation of SIGMA - 6.3,
coefficients for calculation of SIGMA and SIGTH:
C=1., D=1., F=4.5,
maximum magnitude for calculation of Smax - 6.3,
coefficients for calculation of Smax: C=1., D=1.,
F=4.5,
maximum magnitude for calculation of Zmax - 6.3,
coefficients for calculation of Zmax: C=1., D=0.5,
F=4.5,
definition of magnitudes m1, m2, m3, by using the
average annual numbers of events: a1=3., a2=1.4,
a3=0.4,
type - on, print - off, protocol - on, type all
objects.

LIST OF PROGRAMS WITH THEIR FUNCTIONS AND INPUT AND OUTPUT FILES

NAME OF PROGRAM	MAIN FUNCTIONS	NAMES OF INPUT FILES		NAMES OF OUTPUT FILES	
		PROFILE	files with information	for other programs	for printer
EDCAT	Reformatting and testing of catalogs	*.EDC	*.DAT file with a catalog	*.DAT file with a catalog	EDC.PRI
CATAL	Selection of subcatalogs	*.CAT	*.DAT files with catalogs	*.DAT files with subcatalogs	CAT.PRI
HIST	Construction of histograms	*.HIS	*.DAT file with a catalog	—	HIS.PRI
AFT	Selection of aftershocks and creation of a catalog of main shocks	*.AFT	*.DAT file with a catalog	*.DAT file with a catalog of main shocks	AFT.PRI
FUNC	Calculation of values of functions on an earthquake flow	*.PAT	*.DAT files with catalogs of main shocks	*.PAT file with values of functions	PRO.PRI FUN.PRI

IV. RESULTING PRINTOUTS FOR COMPUTER EXERCISES

Exercise 1

Mode of work - reorganize
Input catalogue from file ex1.dat; its format - 4
File with output catalogue is not created
Transformation of magnitude is not made
Selection of double records is made with following thresholds for
differences between values of parameters of double records:
for time 1 minutes 0 seconds; for depth 1.00 km;
for latitude 0.01 degrees; for longitude 0.01 degrees;
for magnitudes mb, ms, ml, mp: 0.01, 0.01, 0.01, 0.01;
double records are deleted by dialog
Ranges of expected values for parameters:
year [1900,2011]; depth(km) [-10,999];
latitude(degrees) [-90.00, 90.00];
longitude(degrees) [-180.00,180.00];
magnitudes from input catalogue:
mb [0.00,9.00]; ms [0.00,9.00];
ml [0.00,9.00]; mp [0.00,9.00];
Profile has not been created

UNREASONABLE value of MONTH in record number 4

	year	mo	d	h	mi	s	lat	long	dep	mb	ms	ml	mp	in
4.	1940	15	19	4	36	0	32.73	-115.50	0	6.70	0.20	0.00	0.00	0

the following records are DOUBLE RECORDS:

	year	mo	d	h	mi	s	lat	long	dep	mb	ms	ml	mp	in
8.	1956	2	9	14	32	0	31.75	-115.92	0	6.80	0.46	0.00	0.00	0
9.	1956	2	9	14	33	0	31.74	-115.91	0	6.81	0.45	0.00	0.00	0

TIME ORDER is not valid for record number 12

	year	mo	d	h	mi	s	lat	long	dep	mb	ms	ml	mp	in
11.	1979	10	15	23	16	0	32.60	-115.32	12	6.60	3.59	0.00	0.00	0
12.	1971	2	9	14	0	0	34.40	-118.40	8	6.40	0.45	0.00	0.00	0

19 records have been read;

Records in input catalogue have:
time from 30.12.1934 13 h 52 m to 1.12.1987 1 h 1 m;
latitude from 31.74 degrees to 37.60 degrees;
longitude from -120.25 degrees to -114.75 degrees;
depth from 0 km to 12 km;
magnitudes:
mb - from 6.40 to 7.70; ms - from 0.00 to 3.59;
ml - from 0.00 to 0.00; mp - from 0.00 to 0.00;

Exercise 2 (CAT.PRI)

```
        You selected mode - d
First  Input catalog          ex2f.dat - format41
Second Input catalog          ex2s.dat - format41
1: You start in first  input   catalog from     1 event
                in second input catalog from     1 event
Time(yr,mo,d,hr,mi) from 1900  1  1  0  to 1990  1  1  0
2: You choose magnitude mb
3: Min,max magnitude :   0.00,   9.00
     depth :    -10,    999
4: No limit on area
5: Type output - y;  print  output - y
6: No output catalog
7: dMin -   1, dH -  1, dLa - 0.01, dLo - 0.01, dM - 0.01
8: Output profile - ex2.cat
```

unique records from catalogues ex2f.dat and ex2s.dat

	year	mo	d	h	mi	s	lat	long	dep	mb	ms	ml	mp	in
1.	*1934	12	30	13	52	0	32.25	-115.50	0	6.50	0.06	0.00	0.00	0
13.	1983	6	2	23	42	0	36.23	-120.50	9	4.50	0.00	0.00	0.00	0

Exercise 3 (CAT.PRI)

```
        You selected mode - s
Input catalog       scalif28.dat - format20
Catalog has  19668 events
1: You start in  input catalog from      1 event
Time(yr,mo,d,hr,mi) from 1900  1  1  0  to 1990  1  1  0
2: Blank magnitude -  0.00
Coeff.for magn.
mb-  1.00,  0.00,ms-  1.00,  0.00,ml-  1.00,  0.00,mp-  1.00,  0.00
Priority -max
3: Min,max magnitude :   6.40,   9.00
                depth :    -10,    999
4: No limit on area
5: Type output - y;  print  output - y
6: No output catalog
7: Question is not used with this mode
8: Output profile - ex3.cat
```

printout of subcatalogue selected from file scalif28.dat

	year	mo	d	h	mi	s	lat	long	dep	mb	ms	ml	mp	in
156.	1932	12	21	6	10	0	38.73	-117.82	0	0.00	0.00	0.00	7.20	0
494.	1934	1	30	20	17	0	38.33	-118.50	0	0.00	0.00	0.00	6.60	0
684.	1934	12	30	13	52	0	32.25	-115.50	0	0.00	0.00	0.00	6.50	0
691.	1934	12	31	18	45	0	32.00	-114.75	0	0.00	0.00	0.00	7.10	0
1959.	1940	5	19	4	36	0	32.73	-115.50	0	0.00	0.00	0.00	6.70	0
2605.	1942	10	21	16	22	0	32.97	-116.00	0	0.00	0.00	0.00	6.50	0
4241.	1948	12	4	23	43	0	33.93	-116.38	0	0.00	0.00	0.00	6.50	0
5356.	1952	7	21	11	52	0	35.00	-119.02	0	0.00	0.00	0.00	7.70	0
5363.	1952	7	21	12	5	0	35.00	-119.00	0	0.00	0.00	0.00	6.40	0
7032.	1956	2	9	14	32	0	31.75	-115.92	0	0.00	0.00	0.00	6.80	0
7086.	1956	2	15	1	20	0	31.50	-115.50	0	0.00	0.00	0.00	6.40	0
9882.	1968	4	9	2	28	0	33.18	-116.12	11	0.00	0.00	0.00	6.40	0
11030.	1971	2	9	14	0	0	34.40	-118.40	8	0.00	0.00	0.00	6.40	0
14643.	1979	10	15	23	16	0	32.60	-115.32	12	0.00	0.00	0.00	6.60	0
15404.	1980	5	25	16	33	0	37.60	-118.82	3	0.00	0.00	0.00	6.40	0
15486.	1980	5	25	19	44	0	37.55	-118.78	6	0.00	0.00	0.00	6.50	0

subcatalogue contains 16 records

Exercise 4

(HIS.PRI)

1: Select from number - 1
Input catalog - scalif28.dat has 19668 events
from 1932yr, 1m, 1d, 0h, 0m to 1990 1 1 0 0
2: Blank magnitude - 0.00
Coeff. for magn.
mb - 1.00, 0.00,ms- 1.00, 0.00,ml- 1.00, 0.00,mp- 1.00, 0.00
Priority - max
3: Min,max magnitude: 0.00, 9.00
depth: -10.00, 999.00
4: Rectangle:
La from 30.00 to 40.00
Lo from -124.00 to -111.00
5: Parameters for axis :lo,la,no
6: Horizontal axis
Longitude
From -124.00 to -111.00
Interval 2.000 and shift 2.000
Accumulation - n
7: Vertical axis -
Latitude
From 40.00 to 30.00
Interval 0.500 and shift -0.500
Accumulation - n
8: List
No variable
9: Count - nu
10: Type-y; print-y; str-y; col-y
11: Name of output profile - ex4.his

-124.00		-120.00		-116.00		-112.00		
40.00	.	.	.	.	.	.	.	0
	.	.	.	.	.	.	.	0
39.00	.	1	12	7	.	.	.	20
	.	3	195	8	3	.	.	209
38.00	.	25	1559	34	13	.	.	1631
	.	35	1033	143	18	.	.	1229
37.00	.	483	33	59	27	.	.	602
	1	751	128	178	12	.	.	1070
36.00	.	296	520	574	28	.	.	1418
	.	43	1327	169	.	.	.	1539
35.00	.	216	374	436	16	3	.	1045
	.	50	1080	1473	150	3	.	2756
34.00	.	33	806	1141	159	1	.	2140
	.	1	124	1241	703	.	.	2069
33.00	.	.	91	305	1307	1	.	1704
	.	1	22	237	728	6	.	994
32.00	.	.	3	296	561	6	1	867
	.	.	4	37	272	22	.	335
31.00	.	.	.	3	21	16	.	40

	.	.	.	.	.	.	0
30.00	.	.	.	.	.	.	0

	1	7	6	4		
	9	3	3	0		
	3	1	4	1	5	
1	8	1	1	8	8	1

19668 events

Exercise 5 (HIS.PRI)

1: Select from number - 1
Input catalog - scalif28.dat has 19668 events
from 1932yr, 1m, 1d, 0h, 0m to 1990 1 1 0 0
2: Blank magnitude - 0.00
Coeff. for magn.
mb - 1.00, 0.00,ms- 1.00, 0.00,ml- 1.00, 0.00,mp- 1.00, 0.00
Priority - max
3: Min,max magnitude: 0.00, 9.00
depth: -10.00, 999.00
4: Rectangle:
La from 30.00 to 40.00
Lo from -124.00 to -111.00
5: Parameters for axis :lo,la,no
6: Horizontal axis
Longitude
From -124.00 to -111.00
Interval 2.000 and shift 2.000
Accumulation - n
7: Vertical axis -
Latitude
From 40.00 to 30.00
Interval 0.500 and shift -0.500
Accumulation - n
8: - List -
No variable
9: Count - mc
10: Type-y; print-y; str-n; col-n
11: Name of output profile - ex5.his

	-124.00		-120.00		-116.00		-112.00	
40.00	.	.	.	.	.	.	.	
	.	.	.	.	.	.	.	
39.00	.	4.5	6.2	7.2	.	.	.	
	.	4.9	6.6	5.5	4.5	.	.	
38.00	.	4.6	6.5	4.9	4.7	.	.	
	.	5.8	6.3	5.6	4.4	.	.	
37.00	.	5.6	4.4	4.4	5.0	.	.	
	4.1	6.3	4.7	4.7	4.9	.	.	
36.00	.	6.0	6.3	5.4	5.0	.	.	
	.	4.3	6.1	4.7	.	.	.	
35.00	.	5.6	7.7	6.2	5.6	4.2	.	
	.	4.9	6.4	5.5	5.9	3.1	.	
34.00	.	5.4	5.5	6.5	5.0	3.4	.	

	.	4.0	5.1	6.4	5.7	.	.
33.00	.	.	5.9	5.1	6.7	3.3	.
	.	3.0	5.3	5.7	6.5	3.1	.
32.00	.	.	4.0	5.8	7.1	4.7	4.4
	.	.	4.9	5.7	6.4	5.3	.
31.00	.	.	.	5.2	6.0	6.0	.
	.	.	.	.	.	.	.
30.00	.	.	.	.	.	.	.

19668 events

Exercise 6 (HIS.PRI)

1: Select from number - 1
Input catalog - scalif28.dat has 19668 events
from 1932yr, 1m, 1d, 0h, 0m to 1988 1 1 0 0
2: Blank magnitude - 0.00
Coeff. for magn.
mb - 1.00, 0.00,ms- 1.00, 0.00,ml- 1.00, 0.00,mp- 1.00, 0.00
Priority - max
3: Min,max magnitude: 0.00, 9.00
depth: -10.00, 999.00
4: Rectangle:
La from 30.00 to 40.00
Lo from -124.00 to -111.00
5: Parameters for axis :mc,ti,no
6: Horizontal axis
Common magnitude
From 2.00 to 8.00
Interval 1.000 and shift 1.000
Accumulation - n
7: Vertical axis -
Year,month,day,hour
From 1932, 1, 1, 0 to 1988, 1, 1, 0
Interval - 2, 0, 0, 0
Shift - 2, 0, 0, 0
Accumulation - n
8: - List -
No variable
9: Count - nu
10: Type-y; print-y; str-y; col-y
11: Name of output profile - ex6.his

	2.00		4.00		6.00			8.00
32 1 1 0	5	294	163	14	1	1	.	478
	.	418	114	11	4	1	.	548
36 1 1 0	.	335	78	4	1	.	.	418
	.	326	103	13	.	.	.	442
40 1 1 0	.	349	152	20	4	.	.	525
	.	330	126	11	1	.	.	468
44 1 1 0	44	257	52	8	.	.	.	361
	135	523	97	18	2	.	.	775
48 1 1 0	122	513	70	7	1	.	.	713
	94	350	62	7	.	.	.	513
52 1 1 0	173	557	222	20	4	1	.	977
	143	505	118	20	3	.	.	789
56 1 1 0	74	303	164	27	5	.	.	573
	62	306	104	6	1	.	.	479
60 1 1 0	73	316	68	9	.	.	.	466
	84	346	70	7	.	.	.	507
64 1 1 0	77	261	76	7	.	.	.	421
	71	250	49	4	1	.	.	375
68 1 1 0	166	571	103	44	1	.	.	885
	191	654	79	6	1	.	.	931
72 1 1 0	153	372	43	3	.	.	.	571
	293	489	55	3	.	.	.	840
76 1 1 0	293	422	43	2	.	.	.	760
	477	834	83	10	1	.	.	1405
80 1 1 0	663	1357	131	13	4	.	.	2168
	458	843	96	12	1	.	.	1410
84 1 1 0	280	528	59	2	1	.	.	870
	.	.	.	.	.	.	.	0
88 1 1 0	.	.	.	.	.	.	.	0
		1						
	4	2	2					
	1	6	5	3				
	3	0	8	0	3			
	1	9	0	8	7	3	0	

19668 events

Exercise 7 (HIS.PRI)

1: Select from number - 1
Input catalog - scalif28.dat has 19668 events
from 1932yr, 1m, 1d, 0h, 0m to 1988 1 1 0 0
2: Blank magnitude - 0.00
Coeff. for magn.
mb - 1.00, 0.00,ms- 1.00, 0.00,ml- 1.00, 0.00,mp- 1.00, 0.00
Priority - max
3: Min,max magnitude: 0.00, 9.00
depth: -10.00, 999.00
4: Rectangle:
La from 30.00 to 40.00
Lo from -124.00 to -111.00
5: Parameters for axis :mc,ti,no
6: Horizontal axis
Common magnitude
From 2.00 to 8.00
Interval 0.000 and shift 1.000
Accumulation - y
7: Vertical axis -
Year,month,day,hour
From 1932, 1, 1, 0 to 1988, 1, 1, 0
Interval - 2, 0, 0, 0
Shift - 2, 0, 0, 0
Accumulation - n
8: - List -
No variable
9: Count - nu
10: Type-y; print-y; str-n; col-y
11: Name of output profile - ex7.his

	2.00		4.00		6.00		8.00
32110	478	473	179	16	2	1	.
	548	548	130	16	5	1	.
36110	418	418	83	5	1	.	.
	442	442	116	13	.	.	.
40110	525	525	176	24	4	.	.
	468	468	138	12	1	.	.
44110	361	317	60	8	.	.	.
	775	640	117	20	2	.	.
48110	713	591	78	8	1	.	.
	513	419	69	7	.	.	.
52110	977	804	247	25	5	1	.
	789	646	141	23	3	.	.
56110	573	499	196	32	5	.	.
	479	417	111	7	1	.	.
60110	466	393	77	9	.	.	.
	507	423	77	7	.	.	.
64110	421	344	83	7	.	.	.
	375	304	54	5	1	.	.
68110	885	719	148	45	1	.	.
	931	740	86	7	1	.	.
72110	571	418	46	3	.	.	.
	840	547	58	3	.	.	.
76110	760	467	45	2	.	.	.
	1405	928	94	11	1	.	.
80110	2168	1505	148	17	4	.	.
	1410	952	109	13	1	.	.
84110	870	590	62	3	1	.	.
		.	.	.	.	.	.
88110	.	.	.	.	.	.	.
	1	1					
	9	5	2				
	6	5	9	3			
	6	3	2	4	4		
	8	7	8	8	0	3	0

19668 events

Exercise 8 (AFT.PRI)

Printout of Aftershocks
Input catalog scalif28.dat - format20
Catalog has 19668 events
1: You start in input catalog from 1 event
Time(yr,mo,d,hr,mi) from 1932 1 1 0 to 1988 1 1 0
2: Blank magnitude - 0.00
Coeff.for magn.
mb- 1.00, 0.00,ms- 1.00, 0.00,ml- 1.00, 0.00,mp- 1.00, 0.00
Priority -max
3: Min,max magnitude : 0.00, 9.00
depth : -10, 100
4: No limit on area
5: Coeff.c,d,f - 1.00, 0.77, 4.50
6: Magnitude of strong shock : 9.00
7: Magnitude of main shock - from 0.00 to 9.00
8: Limits for selection of aftershocks:

9: Interval		10: Magnitude	11: Depth	12: Distance
0.00	2.79	0.00		50.00
2.79	3.40	0.00		50.00
3.40	4.00	0.00		50.00
4.00	4.40	0.00		50.00
4.40	5.40	0.00		50.00
5.40	6.40	0.00		50.00
6.40	9.00	0.00		50.00
		Mono Abs	No Abs	Mono

13: Intervals of time for selection of aftershocks

Interval		Time			Time1			Time2			Time3			Time4			Time5		
0.00	2.79	0	11	0	0	2	0	0	11	0	0	0	0	0	0	0	0	0	0
2.79	3.40	0	23	0	0	2	0	0	23	0	0	0	0	0	0	0	0	0	0
3.40	4.00	0	46	0	0	2	0	0	46	0	0	0	0	0	0	0	0	0	0
4.00	4.40	0	91	0	0	2	0	0	91	0	0	0	0	0	0	0	0	0	0
4.40	5.40	0	182	0	0	2	0	0	182	0	0	0	0	0	0	0	0	0	0
5.40	6.40	1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
6.40	9.00	2	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0

14: Type output - y; print output - y
15: Type Sigma - n
16: Min number of aftershocks for type,print- 15
17: Output catalog - main.dat; format :20
18: Output profile - main.aft

printout of catalogue of main shocks selected from file scalif28.dat

	year	mo	d	d.y	lat	long	dep	mag	b1	sigma	b2	sigma
189.	1933	3	11	70	33.62	-117.97	0	6.30	132	9.89e+001	244	1.43e+002
1283.	1937	3	25	84	33.40	-116.25	10	6.00	19	4.43e+000	57	9.94e+000
1959.	1940	5	19	140	32.73	-115.50	0	6.70	20	2.98e+001	55	3.94e+001
2255.	1941	7	1	182	34.37	-119.58	0	5.90	30	7.15e+000	73	1.53e+001
3273.	1946	3	15	74	35.72	-118.05	22	6.30	32	2.46e+001	192	6.37e+001
3669.	1947	4	10	100	34.98	-116.55	0	6.20	63	1.92e+001	161	3.52e+001
3825.	1947	7	24	205	34.02	-116.50	0	5.50	33	1.87e+001	105	2.94e+001
4241.	1948	12	4	339	33.93	-116.38	0	6.50	31	9.30e+000	146	2.49e+001
4415.	1949	5	2	122	34.02	-115.68	0	5.90	35	6.07e+000	124	2.21e+001
4653.	1949	11	4	308	32.20	-116.55	0	5.70	29	6.80e+000	50	1.17e+001
4839.	1950	7	27	208	33.12	-115.57	0	4.80	21	8.89e+000	21	8.89e+000
5356.	1952	7	21	203	35.00	-119.02	0	7.70	64	1.03e+002	409	2.49e+002
5431.	1952	7	23	205	35.37	-118.58	0	6.10	24	2.13e+001	200	9.66e+001
6321.	1954	3	19	78	33.28	-116.18	0	6.20	75	2.71e+001	123	3.67e+001
6675.	1954	11	12	316	31.50	-116.00	0	6.30	19	2.52e+001	33	3.63e+001
6977.	1955	12	17	351	33.00	-115.50	0	5.40	23	4.95e+000	27	5.47e+000
7032.	1956	2	9	40	31.75	-115.92	0	6.80	46	1.21e+002	142	2.98e+002
7428.	1957	4	25	115	33.20	-115.80	0	5.20	19	7.24e+000	26	1.09e+001
7672.	1958	7	14	195	34.33	-119.48	16	4.70	16	1.78e+000	21	2.69e+000
9301.	1965	6	16	167	33.05	-115.62	0	4.40	16	3.43e+000	32	6.58e+000
9530.	1966	6	28	179	35.90	-120.53	18	5.60	17	6.59e+000	40	1.01e+001
9882.	1968	4	9	100	33.18	-116.12	11	6.40	57	1.68e+001	212	4.96e+001
10322.	1969	3	21	80	31.20	-114.20	0	5.80	44	1.12e+002	55	1.36e+002
10575.	1969	10	22	295	34.57	-121.62	10	5.40	17	3.02e+000	26	5.30e+000
11030.	1971	2	9	40	34.40	-118.40	8	6.40	210	8.41e+001	408	1.12e+002
12359.	1974	7	30	211	34.62	-116.33	8	4.40	17	2.28e+000	32	3.36e+000
12565.	1975	1	23	23	32.95	-115.48	4	4.80	59	7.69e+000	118	1.36e+001
13426.	1976	11	4	309	33.12	-115.58	5	4.20	22	4.37e+000	22	4.37e+000
13449.	1976	11	4	309	33.12	-115.58	5	4.40	20	1.97e+000	42	3.99e+000
13873.	1978	3	11	70	32.40	-115.13	6	4.80	18	4.10e+000	39	6.44e+000
14041.	1978	8	13	225	34.33	-119.68	12	5.10	19	1.55e+000	30	2.63e+000
14092.	1978	10	4	277	37.50	-118.67	5	5.80	55	1.39e+001	125	2.56e+001
14252.	1979	1	1	1	33.93	-118.67	11	5.00	18	2.01e+000	31	3.30e+000
14361.	1979	3	15	74	34.32	-116.43	2	5.20	28	5.84e+000	91	1.68e+001
14643.	1979	10	15	288	32.60	-115.32	12	6.60	359	6.47e+001	494	8.10e+001
14893.	1979	10	16	289	33.00	-115.57	8	4.00	23	2.18e+000	25	2.35e+000
15404.	1980	5	25	146	37.60	-118.82	3	6.40	80	3.24e+001	90	3.47e+001
15486.	1980	5	25	146	37.55	-118.78	6	6.50	288	8.62e+0011	198	2.24e+002
16475.	1980	9	7	251	37.98	-118.40	5	5.70	30	9.31e+000	114	2.35e+001
16953.	1981	4	25	115	33.10	-115.62	4	4.10	20	2.52e+000	20	2.52e+000
16979.	1981	4	26	116	33.08	-115.62	3	5.70	34	3.84e+000	59	6.20e+000
17662.	1982	10	1	274	35.73	-117.75	8	4.90	23	4.64e+000	99	1.21e+001
17869.	1983	1	7	7	37.65	-118.92	5	5.70	88	1.84e+001	227	4.14e+001
18119.	1983	5	2	122	36.23	-120.25	9	6.30	146	3.44e+001	425	9.95e+001
19228.	1984	11	23	328	37.47	-118.58	6	6.20	105	1.87e+001	226	4.46e+001

catalogue of main shocks contains 5540 records,
it has been written in file main.dat

Exercise 9 (HIS.PRI)

1: Select from number - 1
Input catalog - main.dat has 5540 events
from 1932yr, 1m, 1d, 0h, 0m to 1988 1 1 0 0
2: Blank magnitude - 0.00
Coeff. for magn.
mb - 0.00, 0.00,ms-100.00, 0.00,ml- 0.00, 0.00,mp- 0.00, 0.00
Priority - max
3: Min,max magnitude: 0.00, 400.00
depth: -10.00, 999.00
4: No area limit
5: Parameters for axis :mc,ti,no
6: Horizontal axis
Common magnitude

Segment 1 -	0.00,	5.00
Segment 2 -	6.00,	10.00
Segment 3 -	11.00,	15.00
Segment 4 -	16.00,	20.00
Segment 5 -	21.00,	25.00
Segment 6 -	26.00,	30.00
Segment 7 -	31.00,	40.00
Segment 8 -	41.00,	50.00
Segment 9 -	51.00,	100.00
Segment 10 -	101.00,	200.00
Segment 11 -	201.00,	400.00

7: Vertical axis
Year,month,day,hour
From 1932, 1, 1, 0 to 1988, 1, 1, 0
Interval - 1, 0, 0, 0
Shift - 1, 0, 0, 0
Accumulation - n
8: List
No variable
9: Count - nu
10: Type-y; print-y; str-y; col-y
11: Name of output profile - ex9.his

	0.00 5.00		11.00 15.00		21.00 25.00		31.00 40.00		51.00 100.00		201.00 400.00		
		6.00 10.00		16.00 20.00		26.00 30.00		41.00 50.00		101.00 200.00			
32 1 1 0	81	2	.	.	.	.	.	.	.	.	.		83
	48	.	.	.	.	.	.	.	.	1	.		49
34 1 1 0	84	2	.	.	.	.	.	.	.	.	.		86
	82	.	2	.	.	.	.	.	.	.	.		84
36 1 1 0	74	.	.	.	.	.	.	.	.	.	.		74
	81	.	.	1	.	.	.	.	.	.	.		82
38 1 1 0	78	1	.	.	.	.	.	.	.	.	.		79
	85	.	.	.	.	.	.	.	.	.	.		85
40 1 1 0	61	1	.	1	.	.	.	.	.	.	.		63
	76	.	.	.	.	1	.	.	.	.	.		77
42 1 1 0	74	.	1	.	.	.	.	.	.	.	.		75
	72	.	.	.	.	.	.	.	.	.	.		72
44 1 1 0	74	.	.	.	.	.	.	.	.	.	.		74
	71	.	.	.	.	.	.	.	.	.	.		71
46 1 1 0	92	.	.	.	.	.	1	.	.	.	.		93
	83	.	.	.	.	.	1	.	1	.	.		85
48 1 1 0	114	.	.	.	.	.	1	.	.	.	.		115
	96	.	.	.	.	1	1	.	.	.	.		98
50 1 1 0	106	1	2	.	1	.	.	.	.	.	.		110
	93	.	.	.	.	.	.	.	.	.	.		93
52 1 1 0	99	1	1	.	1	.	.	.	1	.	.		103
	107	1	.	.	.	.	.	.	.	.	.		108
54 1 1 0	89	1	.	1	.	.	.	.	1	.	.		92
	92	.	.	.	1	.	.	.	.	.	.		93
56 1 1 0	90	.	1	.	.	.	.	1	.	.	.		92
	89	.	.	1	.	.	.	.	.	.	.		90
58 1 1 0	92	.	1	1	.	.	.	.	.	.	.		94
	92	1	.	.	.	.	.	.	.	.	.		93
60 1 1 0	106	.	.	.	.	.	.	.	.	.	.		106
	102	1	.	.	.	.	.	.	.	.	.		103
62 1 1 0	95	.	1	.	.	.	.	.	.	.	.		96
	103	1	.	.	.	.	.	.	.	.	.		104
64 1 1 0	97	.	.	.	.	.	.	.	.	.	.		97
	82	2	.	1	.	.	.	.	.	.	.		85
66 1 1 0	84	.	.	1	.	.	.	.	.	.	.		85
	100	1	.	.	.	.	.	.	.	.	.		101
68 1 1 0	105	3	1	.	.	.	.	.	1	.	.		110
	143	3	1	1	.	.	.	1	.	.	.		149
70 1 1 0	138	1	.	.	.	.	.	.	.	.	.		139
	132	1	.	.	.	.	.	.	.	.	1		134
72 1 1 0	111	1	.	.	.	.	.	.	.	.	.		112
	142	1	.	.	.	.	.	.	.	.	.		143
74 1 1 0	138	.	.	1	.	.	.	.	.	.	.		139
	154	2	.	.	.	.	.	.	1	.	.		157
76 1 1 0	141	.	.	1	1	.	.	.	.	.	.		143
	116	2	.	.	.	.	.	.	.	.	.		118
78 1 1 0	154	1	.	2	.	.	.	.	1	.	.		158
	134	3	1	1	1	1	.	.	.	.	1		142
80 1 1 0	102	1	.	.	.	1	.	.	1	.	1		106
	112	.	1	1	.	.	1	.	.	.	.		115
82 1 1 0	131	3	.	.	1	.	.	.	.	.	.		135
	128	.	.	.	.	.	.	.	1	1	.		130
84 1 1 0	150	2	.	.	.	.	.	.	.	1	.		153
	66	.	1	.	.	.	.	.	.	.	.		67
86 1 1 0	.	.	.	.	.	.	.	.	.	.	.		0
	.	.	.	.	.	.	.	.	.	.	.		0
88 1 1 0	.	.	.	.	.	.	.	.	.	.	.		0
	5												
	4												
	4	4	1	1									
	1	0	4	4	6	4	5	2	8	3	3		

5540 events

Exercise 10 (CAT.PRI)

```
You selected mode - s
Input catalog          main.dat - format20
Catalog has  5540 events
1:  Blank  Caption
You start in  input catalog from      1 event
Time(yr,mo,d,hr,mi) from 1932  1  1  0  to 1988  1  1  0
2: You choose magnitude mb
3: Min,max magnitude :   4.50,   9.00
      depth :    -10,    999
4: Coordinate of the pol.(p ):
31.250 -La.;-114.000 -Lo.; N= 1
32.000 -La.;-114.000 -Lo.; N= 2
34.000 -La.;-115.000 -Lo.; N= 3
36.000 -La.;-116.000 -Lo.; N= 4
38.000 -La.;-117.000 -Lo.; N= 5
38.000 -La.;-119.000 -Lo.; N= 6
37.000 -La.;-120.400 -Lo.; N= 7
35.500 -La.;-123.000 -Lo.; N= 8
33.750 -La.;-121.500 -Lo.; N= 9
31.250 -La.;-119.000 -Lo.; N=10
31.250 -La.;-116.250 -Lo.; N=11

5: Type output - y;  print  output - n;  print profile - y
6: Output catalog - reg1.dat; format :20
7: Question is not used with this mode
8: Output profile - reg1.cat
```

Exercise 11 (CAT.PRI)

You selected mode - s
Input catalog reg1.dat - format20
Catalog has 340 events
1: You start in input catalog from 1 event
Time(yr,mo,d,hr,mi) from 1965 9 25 0 to 1980 5 26 0
2: You choose magnitude mb
3: Min,max magnitude : 4.90, 9.00
depth : -10, 999
4: No limit on area
5: Type output - y; print output - y
6: Output catalog - ex11.dat; format :20
7: Question is not used with this mode
8: Output profile - ex11.cat
printout of subcatalogue selected from file reg1.dat

	year	mo	d	h	mi	s	lat	long	dep	mb	ms	ml	mp	in
250.	1965	9	25	17	43	0	34.70	-116.50	10	5.20	0.04	0.00	0.00	0
251.	1965	10	17	9	45	0	33.97	-116.77	17	4.90	0.06	0.00	0.00	0
255.	1966	6	28	4	26	0	35.90	-120.53	18	5.60	0.17	0.00	0.00	0
256.	1966	8	7	17	36	0	31.80	-114.50	0	6.30	0.00	0.00	0.00	0
260.	1967	9	21	0	1	0	31.42	-115.95	1	5.20	0.01	0.00	0.00	0
261.	1968	4	9	2	28	0	33.18	-116.12	11	6.40	0.57	0.00	0.00	0
263.	1968	7	5	0	45	0	34.12	-119.70	5	5.20	0.10	0.00	0.00	0
265.	1969	3	20	8	16	0	31.40	-114.00	0	5.20	0.00	0.00	0.00	0
266.	1969	3	20	8	17	0	31.30	-114.20	0	5.70	0.12	0.00	0.00	0
267.	1969	3	23	11	32	0	31.40	-115.00	0	5.20	0.00	0.00	0.00	0
268.	1969	6	10	3	41	0	31.62	-116.20	2	5.00	0.00	0.00	0.00	0
269.	1969	10	3	13	10	0	37.62	-118.92	2	4.90	0.00	0.00	0.00	0
270.	1969	10	22	22	51	0	34.57	-121.62	10	5.40	0.17	0.00	0.00	0
271.	1969	10	24	8	29	0	33.28	-119.18	10	5.10	0.10	0.00	0.00	0
273.	1969	11	5	17	54	0	34.60	-121.43	10	5.60	0.08	0.00	0.00	0
274.	1970	1	19	7	16	0	31.48	-115.97	10	4.90	0.00	0.00	0.00	0
275.	1970	9	12	14	30	0	34.27	-117.53	8	5.40	0.08	0.00	0.00	0
276.	1971	2	9	14	0	0	34.40	-118.40	8	6.40	2.10	0.00	0.00	0
277.	1971	9	30	22	46	0	33.03	-115.82	8	5.10	0.09	0.00	0.00	0
280.	1973	2	21	14	45	0	34.05	-119.03	8	5.90	0.09	0.00	0.00	0
283.	1973	10	16	14	53	0	31.60	-115.82	8	4.90	0.03	0.00	0.00	0
292.	1975	6	1	1	38	0	34.50	-116.48	4	5.20	0.08	0.00	0.00	0
293.	1975	7	17	18	24	0	31.92	-115.77	17	5.00	0.06	0.00	0.00	0
299.	1976	12	7	12	59	0	31.97	-114.77	8	5.00	0.00	0.00	0.00	0
302.	1978	5	5	21	3	0	32.20	-115.30	6	5.20	0.04	0.00	0.00	0
303.	1978	8	13	22	54	0	34.33	-119.68	12	5.10	0.19	0.00	0.00	0
304.	1978	10	4	16	42	0	37.50	-118.67	5	5.80	0.55	0.00	0.00	0
305.	1979	1	1	23	14	0	33.93	-118.67	11	5.00	0.18	0.00	0.00	0
306.	1979	3	15	20	17	0	34.30	-116.43	2	4.90	0.01	0.00	0.00	0
307.	1979	3	15	21	7	0	34.32	-116.43	2	5.20	0.28	0.00	0.00	0
310.	1979	10	15	23	16	0	32.60	-115.32	12	6.60	3.59	0.00	0.00	0
312.	1980	2	25	10	47	0	33.50	-116.50	13	5.50	0.06	0.00	0.00	0
314.	1980	5	25	16	33	0	37.60	-118.82	3	6.40	0.80	0.00	0.00	0
315.	1980	5	25	19	44	0	37.55	-118.78	6	6.50	2.88	0.00	0.00	0

subcatalogue contains 34 records, it has been written in file ex11.dat

Exercise 12 (HIS.PRI)

1: Select from number - 1
Input catalog - ex11.dat has 34 events
from 1965yr, 5m,25d,15h, 0m to 1980 5 25 15 0
2: You have chosen magnitude mb
3: Min,max magnitude: 4.90, 6.70
depth: -10.00, 999.00
4: No area limit
5: Parameters for axis :mb,ti,no
6: Horizontal axis
Magn mb
From 4.90 to 6.70
Interval 0.100 and shift 0.100
Accumulation - n
7: Vertical axis
Year,month,day,hour
From 1965, 5,25,15 to 1980, 5,25,15
Interval - 1, 0, 0, 0
Shift - 1, 0, 0, 0
Accumulation - n
8: List
No variable
9: Count - nu
10: Type-y; print-y; str-y; col-y
11: Name of output profile - ex12.his

	4.90	5.10	5.30	5.50	5.70	5.90	6.10	6.30	6.50	6.70	
65 52515	1	.	1	.	.	.	.	.	.	.	2
	.	.	.	.	1	.	.	1	.	.	2
67 52515	.	.	1	.	.	.	.	.	1	.	2
	.	.	3	.	1	.	.	.	.	.	4
69 52515	2	1	1	.	.	1	.	.	.	.	6
	.	.	.	1	.	.	.	.	1	.	2
71 52515	.	.	1	.	.	.	.	.	.	.	1
	.	.	.	.	.	1	.	.	.	.	1
73 52515	1	.	.	.	.	.	.	.	.	.	1
	.	.	.	.	.	.	.	.	.	.	0
75 52515	.	1	.	1	.	.	.	.	.	.	2
	.	1	.	.	.	.	.	.	.	.	1
77 52515	.	.	.	1	.	.	.	.	.	.	1
	1	1	1	1	.	1	.	.	.	.	5
79 52515	.	.	.	.	1	.	.	.	1	.	2
	.	.	.	.	.	.	.	.	.	.	0
	5	4	3	8	0	2	1	2	1	1	1	0	0	0	1	2	0	1	0	

32 events

Exercise 13 (HIS.PRI)

```
1: Select from number -    1
Input catalog - ex11.dat          has    34 events
from 1965yr, 5m,25d,15h, 0m  to 1980  5 25 15  0
2: You have chosen magnitude mb
3: Min,max magnitude:   4.90,   9.00
      depth: -10.00, 999.00
4: No area limit
5: Parameters for axis :mb,ti,no
6:  Horizontal axis
          Magn  mb
Segment  1 -   4.90,   6.70
Segment  2 -   5.30,   6.70
Segment  3 -   6.20,   6.70
7:  Vertical axis
   Year,month,day,hour
From 1965,  5,25,15 to 1980,  5,25,15
Interval -    1,  0, 0, 0
Shift -    1, 0,  0, 0
Accumulation - n
8: List
      No variable
9: Count - nu
10: Type-y; print-y; str-n; col-y
11: Name of output profile - ex13.his
```

	4.90		6.20
	6.70		6.70
		5.30	
		6.70	
65-52515	2	.	.
	2	2	1
67-52515	2	1	1
	4	1	.
69-52515	6	2	.
	2	2	1
71-52515	1	.	.
	1	1	.
73-52515	1	.	.
	.	.	.
75-52515	2	.	.
	1	.	.
77-52515	1	.	.
	5	1	.
79-52515	2	2	1
	.	.	.
	3	1	
	2	2	4

32 events

Exercise 14

File PRO.PRI

FUNC - calculation of functions on earthquake flow
COMMON CONSTANTS
Title: Exercise 14.
Common name of subcatalogs: reg.dat
Time from 1932. 5.25.16.33 to 1984. 1. 1. 1. 0
Skipping to 1938. 5.25.16
Learning to 1984. 1. 1. 0
List of regions: 1
DATES OF OBJECTS
from 1938. 5.25.16 to 1984. 1. 1. 1
with step 1 y 0 m 0 d
LIST OF FUNCTIONS

#	Function	Time	Magnitude	Delta
1	N1	6	m2	--
3	K	2	m2	--
4	G	3	m2	--
5	SIGMA	3	m1	--
6	Smax	3	m1	--
9	N3	3	m2	--
10	L	6	m2	--
11	q	6	m2	--
12	Ml	3	m1	--
13	Bmax	3	--	--
14	Q	1	m1	--
15	V	6	m1	--
21	SIGTH	3	m1	--

COEFFICIENTS C, D, F AND MAXIMUM MAGNITUDE
For function SIGMA: 1.00, 1.00, 4.50, 6.30
For functions Smax and S1max: 1.00, 1.00, 4.50, 6.30
For function SIGTH: 1.00, 1.00, 4.50, --
FOR FUNCTION Ml (LONG-RANGE AFTERSHOCKS)
Catalog of main shocks: cal6.dat
Threshold magnitude for main shocks: 6.40
MAGNITUDE THRESHOLDS
(Directly defined)
For region m1 n1 m2 n2 m3 n3
1 4.90 147 5.30 72 6.20 19
OUTPUT PROFILE: ex14.pat

File FUN.PRI

	N1	K	G	SIGMA	Smax	N3	L	q	Ml	Bmax	Q	V	SIGTH
1395	6	1	0.63	73	17.39	-	0	-	0	19	11	18	73
1405	9	4	0.55	63	6.42	-	6	-	0	20	1	17	221
1415	7	2	0.57	102	12.92	-	-1	-	600	20	3	14	260
1425	11	0	0.50	162	12.92	4	5	-	600	30	8	17	320
1435	11	1	0.50	137	12.92	3	5	-	600	30	7	23	237
1445	13	-2	0.36	118	12.31	4	8	-	600	30	8	22	218
1455	13	-1	0.29	42	10.00	1	7	-	550	11	10	18	142
1465	12	1	0.40	130	21.78	3	5	-	550	32	10	17	130
1475	13	0	0.54	180	21.78	5	6	3	0	63	11	16	180
1485	11	0	0.50	177	21.78	6	2	1	0	63	2	13	177
1495	13	1	0.42	133	14.24	8	4	1	590	63	3	7	233
1505	12	0	0.33	81	14.24	6	3	0	590	35	2	8	181
1515	13	-1	0.22	92	14.24	7	4	0	590	35	3	7	192
1525	12	0	0.29	79	15.07	5	3	0	570	29	1	8	79
1535	13	0	0.30	139	19.64	6	3	0	610	64	4	10	1724
1545	14	2	0.46	192	19.64	6	4	0	610	75	5	9	1777
1555	14	2	0.44	283	24.12	6	4	0	630	75	1	9	1867
1565	16	0	0.40	225	24.12	7	6	0	630	75	2	8	424
1575	13	-3	0.50	152	24.12	6	3	0	630	46	3	8	352
1585	12	-6	0.57	32	6.97	7	2	0	540	46	6	10	231
1595	10	-2	0.75	31	19.95	5	-1	0	500	19	7	8	31
1605	7	1	0.67	27	19.95	7	-4	0	0	16	8	8	27
1615	6	1	0.50	45	19.95	7	-5	0	0	16	9	8	45
1625	3	1	0.71	33	5.88	9	-8	0	0	5	1	8	33
1635	3	-2	0.78	38	5.88	9	-8	1	0	12	3	9	38
1645	4	-1	0.90	49	7.20	6	-7	3	0	12	3	6	49
1655	4	2	0.78	54	12.59	3	-6	8	0	12	3	8	54
1665	4	0	0.71	49	12.59	1	-6	13	0	6	4	8	49
1675	4	0	0.40	96	37.84	1	-6	17	0	17	4	7	96
1685	5	2	0.50	88	37.84	3	-5	21	0	57	4	5	168
1695	6	0	0.50	112	37.84	2	-3	24	570	57	6	7	191
1705	7	0	0.67	69	7.72	2	-2	26	570	57	8	8	148
1715	8	2	0.58	72	7.94	1	-1	24	570	210	4	9	151
1725	8	-1	0.56	45	7.94	2	-1	21	510	210	5	9	124
1735	7	-3	0.25	37	25.12	2	-2	18	510	210	5	9	116
1745	6	-1	0.67	32	25.12	3	-3	14	510	9	5	9	32
1755	5	-1	0.50	28	25.12	3	-4	10	0	59	6	8	28
1765	3	-1	1.00	11	4.09	4	-6	7	0	59	8	8	11
1775	1	0	1.00	11	4.09	4	-8	6	500	59	1	5	11
1785	1	0	1.00	16	5.01	5	-8	7	500	18	1	4	16
1795	1	1	0.86	43	6.92	4	-8	11	500	55	5	8	43
1805	3	3	0.63	50	10.00	3	-6	18	550	359	3	11	176
1815	8	6	0.33	116	23.84	1	0	25	610	359	6	13	421
1825	9	3	0.00	88	23.84	1	1	31	610	359	4	15	393
1835	12	-3	0.18	177	23.84	0	4	34	610	288	8	18	356

Exercise 15

File PRO.PRI

FUNC - calculation of functions on earthquake flow
COMMON CONSTANTS
Title: Exersise 15.
Common name of subcatalogs: reg.dat
Time from 1932. 1. 1. 0. 0 to 1984. 1. 1. 1. 0
Skipping to 1938. 1. 1. 1
Learning to 1984. 1. 1. 0
List of regions: 1

DATES OF OBJECTS:
1. 1938. 1. 1. 1
2. 1938. 5.19. 3
3. 1939. 5.19. 3
4. 1940. 5.19. 3
5. 1940.10.21.15
6. 1941.10.21.15
7. 1942.10.21.15
8. 1943. 1. 1. 1
9. 1944. 1. 1. 1
10. 1945. 1. 1. 1
11. 1946. 1. 1. 1
12. 1946.12. 4.22
13. 1947.12. 4.22
14. 1948.12. 4.22
15. 1949. 1. 1. 1
16. 1950. 1. 1. 1
17. 1950. 7.21.10
18. 1951. 7.21.10
19. 1952. 7.21.10
20. 1953. 1. 1. 1
21. 1954. 1. 1. 1
22. 1954. 2. 9.13
23. 1955. 2. 9.13
24. 1956. 2. 9.13
25. 1957. 1. 1. 1
26. 1958. 1. 1. 1
27. 1959. 1. 1. 1
28. 1960. 1. 1. 1
29. 1961. 1. 1. 1
30. 1962. 1. 1. 1
31. 1963. 1. 1. 1
32. 1964. 1. 1. 1
33. 1965. 1. 1. 1
34. 1966. 1. 1. 1
35. 1966. 4. 9. 1
36. 1967. 4. 9. 1
37. 1968. 4. 9. 1
38. 1969. 1. 1. 1
39. 1969. 2. 9.13
40. 1970. 2. 9.13
41. 1971. 2. 9.13
42. 1972. 1. 1. 1
43. 1973. 1. 1. 1
44. 1974. 1. 1. 1
45. 1975. 1. 1. 1
46. 1976. 1. 1. 1
47. 1977. 1. 1. 1
48. 1977.10.15.22
49. 1978.10.15.22
50. 1979.10.15.22
51. 1980. 5.25.15
52. 1981. 1. 1. 1
53. 1982. 1. 1. 1
54. 1983. 1. 1. 1
55. 1984. 1. 1. 1

LIST OF FUNCTIONS

#	Function	Time	Magnitude	Delta
2	N2	3	m3	--
3	K	2	m2	--
4	G	3	m2	--
5	SIGMA	3	m1	--
6	Smax	3	m1	--
8	Zmax	3	m1	--
9	N3	3	m2	--
11	q	6	m2	--
13	Bmax	3	--	--
21	SIGTH	3	m1	--

COEFFICIENTS C, D, F AND MAXIMUM MAGNITUDE
For function SIGMA: 1.00, 1.00, 4.50, 6.30
For functions Smax and S1max: 1.00, 1.00, 4.50, 6.30
For function Zmax: 1.00, 0.50, 4.50, 6.30
For function SIGTH: 1.00, 1.00, 4.50, --
MAGNITUDE THRESHOLDS
(Directly defined)

For region	m1	n1	m2	n2	m3	n3
1	4.90	147	5.30	72	6.20	19

OUTPUT PROFILE: ex15.pat

File FUN.PRI

	N2	K	G	SIGMA	Smax	Zmax	N3	q	Bmax	SIGTH
1381	0	-2	0.80	45	17.39	4.66	-	-	19	45
1385	0	-2	0.80	45	17.39	4.66	-	-	19	45
1395	0	1	0.63	73	17.39	4.66	-	-	19	73
1405	0	3	0.60	63	6.42	4.32	-	-	8	63
140o	1	2	0.62	70	8.04	4.25	-	-	20	228
141o	1	3	0.43	164	22.67	7.85	-	-	30	322
142o	1	1	0.50	148	22.67	7.85	4	-	30	307
1431	2	1	0.43	145	15.36	6.59	4	-	30	404
1441	1	-4	0.36	118	15.36	6.59	3	-	30	218
1451	1	-3	0.40	26	10.00	3.98	1	-	11	126
1461	0	0	0.38	61	10.00	4.58	3	-	5	61
146d	1	3	0.45	135	20.96	6.15	4	-	32	135
147d	2	0	0.53	194	20.96	6.15	5	1	63	194
148d	2	-2	0.50	158	20.96	6.15	8	0	63	158
1491	3	-1	0.45	158	20.96	6.15	8	1	63	258
1501	2	1	0.42	136	13.66	5.60	8	0	63	236
1507	1	1	0.33	81	14.24	5.19	6	0	35	181
1517	1	-1	0.22	92	14.24	5.19	6	0	35	192
1527	0	0	0.29	79	15.07	4.58	5	0	29	79
1531	1	0	0.30	139	19.64	6.23	5	0	64	1724
1541	1	0	0.45	137	19.64	6.23	5	0	64	1722
1542	1	1	0.50	142	19.64	6.23	5	0	64	1727
1552	3	2	0.40	278	33.14	9.19	7	0	75	1862
1562	2	1	0.43	225	33.14	9.19	6	0	75	225
1571	3	-3	0.43	215	26.19	8.92	7	0	75	414
1581	1	-6	0.63	37	6.48	4.01	7	0	46	236
1591	1	-2	0.60	31	19.95	4.47	7	0	46	230
1601	0	0	0.75	32	19.95	4.47	7	0	19	32
1611	0	-1	0.75	32	19.95	4.47	6	0	16	32
1621	0	1	0.71	33	5.20	3.59	9	0	5	33
1631	0	2	0.71	32	5.20	3.59	8	0	12	32
1641	0	-1	0.73	59	6.26	3.83	8	4	12	59
1651	0	0	0.78	54	7.88	3.83	3	8	12	54
1661	0	0	0.78	55	7.88	3.83	2	13	6	55
1664	0	0	0.71	49	12.59	3.81	1	13	6	49
1674	1	0	0.40	96	37.84	7.24	1	17	17	96
1684	1	1	0.60	88	37.84	7.24	3	21	17	88
1691	2	-1	0.40	86	37.84	7.24	2	25	57	165
1692	2	-1	0.40	86	37.84	7.24	2	24	57	165
1702	1	2	0.67	69	6.51	5.03	2	26	57	148
1712	1	3	0.58	72	7.94	5.03	1	25	57	151
1721	1	-2	0.58	70	7.01	5.05	2	21	210	150
1731	1	-3	0.50	14	5.23	2.77	2	18	210	94
1741	1	-1	0.50	32	13.82	4.16	3	15	210	111
1751	0	0	0.50	28	13.82	4.16	2	11	9	28
1761	0	-1	0.75	36	13.82	4.16	3	11	59	36
1771	0	-1	1.00	11	4.09	2.53	4	8	59	11
177o	0	0	1.00	11	4.09	2.53	5	8	59	11
178o	0	1	0.75	32	9.65	4.18	5	8	55	32
179o	0	1	0.86	43	9.65	4.18	4	14	55	43
1805	1	3	0.63	50	10.00	4.13	3	18	359	176
1811	3	5	0.42	105	21.89	6.47	2	23	359	411
1821	3	5	0.20	95	21.89	6.47	1	27	359	401
1831	2	-3	0.20	108	21.89	6.47	1	32	288	287
1841	1	-4	0.29	121	39.47	7.51	0	31	146	121

FUNC - calculation of functions on earthquake flow
COMMON CONSTANTS
Title: CALCULATION OF FUNCTIONS
Common name of subcatalogs: lreg.dat
Time from 1932. 1. 1. 0. 0 to 1991. 1. 1. 0. 0
Skipping to 1938. 1. 1. 1
Learning to 1984. 1. 1. 0
List of regions: 1
DATES OF OBJECTS
from 1938. 1. 1. 0 to 1990. 1. 1. 0
with step 0 y 2 m 0 d
LIST OF FUNCTIONS

#	Function	Time	Magnitude	Delta
2	N2	3	m3	--
3	K	2	m2	--
4	G	3	m2	--
5	SIGMA	3	m1	--
6	Smax	3	m1	--
8	Zmax	3	m1	--
9	N3	3	m2	--
11	q	6	m2	--
13	Bmax	3	--	--
21	SIGTH	3	m1	--

COEFFICIENTS C, D, F AND MAXIMUM MAGNITUDE
For function SIGMA: 1.00, 1.00, 4.50, 6.30
For functions Smax and S1max: 1.00, 1.00, 4.50, 6.30
For function Zmax: 1.00, 0.50, 4.50, 6.30
For function SIGTH: 1.00, 1.00, 4.50, --
MAGNITUDE THRESHOLDS
(Defined by annual numbers of events: 3.0, 1.4, 0.4)

For region	m1	n1	m2	n2	m3	n3
1	4.90	147	5.30	72	6.20	21

OUTPUT PROFILE: ex16.pat