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The following FORTRAN program, *pdemagcomp.f*, is based on a code for computing *mb* magnitude in the PDE bulletin of the USGS/NEIC. The original author is unknown. The program incorporates a procedure, *mbmag*, that has been used for decades to compute *mb* magnitude for the USGS/NEIC. It is included to provide the source code for *mbmag* and to show how *mbmag* is used. Program *pdemagcomp.f* was written by James W. Dewey, USGS/NEIC, for a limited research objective.

### **pdemagcomp.f.**

- c program pdemagcomp.f
- c calculates a Gutenberg-Richter *mb*, given epicentral distance,
- c event focal depth, amplitude in nanometers and period in seconds
- c requires 'qfile', the table of Gutenberg-Richter Q values

```
common q(108,17)
character*1 mbflg
real mb
```

```
open(unit = 23, status = 'old', file = 'qfile')
read (23,32,end = 33) ((q(i,j),j=1,17),i=1,108)
32 format(17(x,f4.2))
33 continue
```

```
type *, 'enter event focal depth, f5.1'
read *, depth
type *, 'enter station epicentral distance, degrees, f6.2'
read *, delta
type *, 'enter amplitude in nanometers, f7.1'
read *, amp
type *, 'enter period in seconds, f3,1'
read *, t
type *, 'enter P-wave travel-time residual in seconds, f5.1'
read *, res
call mbmag(t,amp,mbflg,mb,depth,delta,res)
type *, 'mb = ', mb, 'mbflag = ', mbflg
stop
end
```

```
subroutine mbmag(t,amp,mbflg,mb,depth,delta,res)
```

- c explanation of parameters (J. Dewey, 3/31/99)
- c t = P-wave period
- c amp = amplitude in nanometers
- c mbflg = 'n' -- computed magnitude not reported for this station
- c = 'R' or 'r' -- computed magnitude reported for this station,
- c but not used to compute average event magnitude
- c mb = short-period P-wave magnitude
- c depth = focal depth in km
- c delta = epicentral distance in degrees

```

c  q = magnitude calibration function for Gutenberg-Richter mb. tabulated
c    from 2 to 109 degrees, at depths of 0,25,50,75,100,150,....,650,700 km.
c  res = travel-time residual, in seconds, of P-wave with which
c    this magnitude is associated

    common q(108,17)
    character*1 mbflg
    real mb

c
    mb=0.
    if(t.lt.1.or.t.gt.9.) go to 11
    if(amp.eq.0.) go to 11
    if(delta.lt.5..or.delta.gt.109.) go to 11
c  if(delta.lt.5..and.depth.ne.0.) go to 11
    if(abs(res).gt.10..or.depth.gt.700.) go to 11
c
    do 7 k=1,17
    if(k.gt.5) go to 6
    dep=(k-1)*25
    if(depth.ge.dep) go to 7
    s1=(depth+25.0-dep)*0.04
    go to 8
    6 dep=(k-3)*50
    if(depth.gt.dep) go to 7
    s1=(depth+50.0-dep)*0.02
    go to 8
    7 continue
    k=17
    s1=0.0
    8 do 9 j=1,108
    del=j+1
    if(delta.ge.del) go to 9
    s2=delta+1.0-del
    go to 10
    9 continue
    j=108
    s2=0.0
    10 q1=q(j-1,k-1)+s1*(q(j-1,k)-q(j-1,k-1))
    q2=q(j,k-1) +s1*(q(j,k) -q(j,k-1))
    qval=q1+s2*(q2-q1)
    mb=alog10(amp*.001/t)+qval !change amp to microns for use with q tables
c  if((t.gt.3..or.(delta.lt.15..and.depth.lt.100.)).and.
c  1 mbflg.ne.'R') mbflg='r'
    if((t.gt.3..or.delta.lt.15.).and.mbflg.ne.'R') mbflg='r'
    return
c
    11 mbflg='n'
    return
    end
=

```

The following Q-table is used at the USGS/NEIC to compute the short-period body-wave magnitude *mb* that is published in the PDE bulletin of the USGS/NEIC. For distances from 5° to 109°, it represents a "digitized" version of Figure 5 of B. Gutenberg and C.F. Richter, 1956, "Magnitude and Energy of Earthquakes", *Annali di Geofisica*, v. IX, n. 1, p. 1-15. The original figure is reproduced as Figure VIII-6 in Richter, C.F., 1958, *Elementary Seismology*, Freeman, San Francisco, 768 p. The origin of the Q values at distance less than 5° is not documented. The USGS/NEIC does not compute *mb* for all distance ranges represented in the table.

dist	h0	h25	h50	h75	h100	h150	h200	h250	h300	h350	h400	h450	h500	h550	h600	h650	h700
2	5.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	5.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	6.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	6.4	6.3	6	6	6	6	5.9	5.7	5.8	5.7	5.7	5.8	5.8	5.8	5.7	5.7	5.7
6	6.5	6.5	6.2	6.1	6	6	6	6.7	5.7	5.7	5.8	5.9	5.8	5.8	5.8	5.7	5.7
7	7	6.8	6.5	6.4	6.3	6.2	6	5.8	5.7	5.8	5.9	5.9	5.9	5.9	5.8	5.7	5.7
8	7	7	6.6	6.5	6.4	6.4	6	5.8	5.8	5.9	6	6.1	6	5.9	5.8	5.8	5.7
9	7.2	7	6.8	6.8	6.6	6.4	6.1	5.8	5.8	6	6.1	6.1	6.1	6	5.9	5.8	5.7
10	7.3	7.1	6.9	6.8	6.7	6.4	6.1	5.9	5.9	6.1	6.2	6.2	6.2	6.1	5.8	5.8	5.7
11	7.2	7	6.9	6.7	6.6	6.4	6.2	5.9	6	6.2	6.2	6.2	6.2	6.1	5.9	5.8	5.8
12	7.1	7	6.8	6.7	6.5	6.3	6.2	6	6	6.2	6.2	6.2	6.2	6.2	6	5.8	5.8
13	7	6.9	6.7	6.5	6.4	6.2	6.2	6	6.1	6.2	6.2	6.2	6.3	6.2	6	5.9	5.8
14	6.6	6.5	6.5	6.1	6	6.1	6.2	6.1	6.1	6.2	6.2	6.3	6.3	6.2	6.1	5.9	5.8
15	6.3	6.1	6	6	6	6.1	6.2	6.2	6.1	6.1	6.2	6.3	6.4	6.3	6.1	5.9	5.8
16	5.9	5.9	5.9	5.9	6	6.1	6.2	6.2	6.2	6.1	6.2	6.3	6.4	6.3	6.2	6	5.9
17	5.9	5.9	5.9	6	6	6.1	6.2	6.2	6.2	6.1	6.1	6.3	6.4	6.4	6.2	6.1	5.9
18	5.9	5.9	5.9	6	6	6.1	6.2	6.3	6.2	6.1	6.1	6.3	6.4	6.4	6.3	6.1	6
19	6	6	6	6	6.1	6.1	6.3	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.3	6.1	6
20	6.1	6.1	6.1	6.1	6.1	6.2	6.3	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.2	6
21	6.1	6.2	6.1	6.1	6.1	6.2	6.3	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.2	6
22	6.2	6.2	6.2	6.2	6.1	6.2	6.3	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.3	6.1
23	6.3	6.3	6.2	6.2	6.1	6.2	6.4	6.3	6.2	6.1	6.2	6.3	6.4	6.4	6.4	6.3	6.1
24	6.4	6.3	6.3	6.2	6.2	6.3	6.4	6.3	6.2	6.1	6.2	6.3	6.3	6.4	6.4	6.4	6.1
25	6.5	6.4	6.3	6.2	6.2	6.3	6.4	6.3	6.2	6.1	6.2	6.3	6.3	6.4	6.4	6.4	6.2
26	6.5	6.4	6.3	6.3	6.3	6.4	6.5	6.4	6.2	6.1	6.2	6.2	6.3	6.4	6.4	6.4	6.2
27	6.5	6.4	6.4	6.3	6.3	6.4	6.5	6.4	6.2	6.1	6.2	6.2	6.3	6.4	6.4	6.4	6.3
28	6.6	6.5	6.4	6.4	6.4	6.5	6.5	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.3
29	6.6	6.5	6.4	6.4	6.4	6.5	6.5	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.3
30	6.6	6.6	6.5	6.5	6.5	6.5	6.5	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.3
31	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.3
32	6.7	6.7	6.6	6.6	6.5	6.6	6.4	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.4
33	6.7	6.7	6.6	6.6	6.6	6.5	6.4	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.4
34	6.7	6.7	6.7	6.7	6.6	6.5	6.4	6.4	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.4	6.3
35	6.6	6.7	6.7	6.7	6.7	6.5	6.4	6.3	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.3	6.3
36	6.6	6.7	6.7	6.7	6.7	6.5	6.4	6.3	6.3	6.1	6.1	6.2	6.3	6.4	6.4	6.3	6.3
37	6.5	6.6	6.7	6.7	6.7	6.5	6.4	6.3	6.2	6.1	6.1	6.2	6.3	6.4	6.4	6.3	6.3
38	6.5	6.6	6.7	6.7	6.7	6.5	6.4	6.3	6.2	6.1	6.1	6.2	6.3	6.4	6.3	6.3	6.3
39	6.4	6.5	6.6	6.7	6.6	6.5	6.4	6.3	6.1	6	6.1	6.2	6.3	6.4	6.3	6.3	6.3
40	6.4	6.5	6.6	6.7	6.6	6.5	6.3	6.2	6.1	6	6.1	6.2	6.3	6.4	6.3	6.2	6.3
41	6.5	6.5	6.5	6.6	6.6	6.4	6.3	6.2	6	6	6.1	6.2	6.3	6.3	6.3	6.2	6.3
42	6.5	6.5	6.5	6.6	6.6	6.4	6.3	6.2	6	6	6.1	6.2	6.3	6.3	6.3	6.2	6.3
43	6.5	6.5	6.5	6.6	6.6	6.4	6.3	6.1	6	6	6.1	6.2	6.3	6.3	6.3	6.2	6.3
44	6.6	6.6	6.5	6.6	6.6	6.4	6.3	6.1	6.1	6	6.1	6.2	6.3	6.3	6.3	6.2	6.2
45	6.7	6.7	6.6	6.6	6.6	6.4	6.2	6.1	6.1	6	6.1	6.2	6.3	6.3	6.3	6.2	6.2
46	6.8	6.7	6.7	6.7	6.6	6.4	6.2	6.1	6.1	6	6.1	6.2	6.3	6.3	6.3	6.2	6.2
47	6.9	6.8	6.7	6.7	6.6	6.4	6.2	6.1	6.1	6	6.1	6.2	6.3	6.3	6.3	6.2	6.2
48	6.9	6.8	6.8	6.7	6.6	6.5	6.2	6.1	6.1	6	6.1	6.2	6.2	6.3	6.3	6.2	6.2
49	6.8	6.8	6.8	6.8	6.7	6.5	6.2	6.2	6.1	6.1	6.1	6.2	6.2	6.3	6.3	6.2	6.2
50	6.7	6.8	6.8	6.8	6.8	6.5	6.3	6.2	6.1	6.1	6.1	6.1	6.2	6.3	6.3	6.1	6.1

dist	h0	h25	h50	h75	h100	h150	h200	h250	h300	h350	h400	h450	h500	h550	h600	h650	h700
51	6.7	6.7	6.8	6.8	6.8	6.5	6.3	6.2	6.2	6.1	6.1	6.1	6.2	6.2	6.2	6.1	6.1
52	6.7	6.7	6.8	6.8	6.8	6.5	6.4	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.1	6.1
53	6.7	6.7	6.8	6.8	6.8	6.8	6.4	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6.2	6.1	6.1
54	6.8	6.8	6.8	6.8	6.8	6.6	6.4	6.3	6.2	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6
55	6.8	6.8	6.8	6.8	6.8	6.8	6.5	6.3	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6.1	6
56	6.8	6.8	6.8	6.8	6.8	6.7	6.5	6.3	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6	6
57	6.8	6.8	6.8	6.9	6.8	6.7	6.5	6.4	6.2	6.2	6.2	6.2	6.1	6.1	6	6	6
58	6.8	6.8	6.9	6.9	6.8	6.7	6.5	6.4	6.3	6.2	6.2	6.2	6.1	6.1	6	6	6
59	6.9	6.9	6.9	6.9	6.9	6.7	6.5	6.4	6.3	6.2	6.2	6.2	6.2	6.1	6	6	6
60	6.9	6.9	6.9	6.9	6.9	6.7	6.5	6.4	6.3	6.3	6.2	6.2	6.2	6.1	6	6	6
61	6.9	6.9	6.9	6.9	6.8	6.7	6.5	6.4	6.3	6.3	6.3	6.3	6.2	6.2	6.1	6	6
62	7	6.9	6.9	6.9	6.8	6.7	6.6	6.4	6.4	6.3	6.3	6.3	6.3	6.2	6.1	6.1	6
63	7	6.9	6.9	6.8	6.7	6.7	6.6	6.5	6.4	6.4	6.4	6.3	6.3	6.2	6.2	6.1	6
64	7	6.9	6.8	6.7	6.7	6.7	6.6	6.5	6.5	6.4	6.4	6.4	6.4	6.3	6.2	6.1	6.1
65	7	6.9	6.8	6.7	6.7	6.7	6.6	6.5	6.5	6.5	6.4	6.4	6.4	6.3	6.2	6.1	6.1
66	7	6.9	6.8	6.7	6.7	6.7	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.2	6.2	6.1
67	7	6.9	6.8	6.7	6.7	6.8	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.2	6.1
68	7	6.9	6.8	6.7	6.7	6.8	6.5	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.2
69	7	6.9	6.7	6.7	6.6	6.6	6.5	6.5	6.5	6.5	6.4	6.4	6.4	6.3	6.3	6.2	6.2
70	6.9	6.9	6.7	6.7	6.6	6.6	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.3	6.2	6.2
71	6.9	6.9	6.7	6.7	6.6	6.6	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.3	6.3	6.2
72	6.9	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.3	6.3	6.2
73	6.9	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.3	6.3	6.3
74	6.8	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.3	6.3	6.3	6.3
75	6.8	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.5	6.4	6.3	6.2	6.3	6.3	6.3
76	6.9	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.5	6.4	6.3	6.2	6.3	6.3	6.3
77	6.9	6.8	6.8	6.7	6.6	6.5	6.5	6.5	6.5	6.6	6.5	6.4	6.2	6.2	6.2	6.3	6.3
78	6.9	6.8	6.8	6.7	6.6	6.5	6.5	6.5	6.5	6.6	6.5	6.4	6.2	6.2	6.2	6.3	6.3
79	6.8	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.6	6.6	6.5	6.4	6.2	6.2	6.2	6.3	6.3
80	6.7	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.6	6.6	6.5	6.4	6.2	6.2	6.2	6.3	6.3
81	6.8	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.6	6.6	6.5	6.4	6.3	6.2	6.3	6.3	6.3
82	6.9	6.8	6.8	6.7	6.6	6.5	6.5	6.5	6.6	6.6	6.5	6.4	6.3	6.3	6.3	6.3	6.3
83	7	6.9	6.8	6.7	6.7	6.6	6.5	6.5	6.6	6.6	6.5	6.5	6.3	6.3	6.3	6.4	6.3
84	7	7	6.8	6.8	6.7	6.6	6.5	6.6	6.6	6.6	6.5	6.5	6.4	6.4	6.4	6.4	6.3
85	7	7	6.9	6.8	6.7	6.6	6.5	6.6	6.6	6.6	6.6	6.5	6.4	6.4	6.4	6.4	6.4
86	6.9	7	7	6.8	6.8	6.6	6.6	6.6	6.6	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.4
87	7	7	7	6.9	6.8	6.7	6.6	6.6	6.7	6.7	6.6	6.5	6.5	6.5	6.5	6.5	6.4
88	7.1	7.1	7	6.9	6.8	6.8	6.6	6.6	6.7	6.7	6.6	6.6	6.6	6.6	6.6	6.5	6.4
89	7	7.1	7.1	7	6.9	6.8	6.7	6.7	6.7	6.7	6.6	6.6	6.6	6.7	6.7	6.6	6.5
90	7	7	7.1	7	6.9	6.8	6.7	6.7	6.7	6.7	6.6	6.7	6.7	6.7	6.7	6.7	6.5
91	7.1	7.1	7.2	7.1	7	6.9	6.8	6.7	6.7	6.7	6.7	6.7	6.7	6.8	6.8	6.7	6.6
92	7.1	7.2	7.2	7.2	7.1	6.9	6.8	6.8	6.7	6.8	6.7	6.8	6.8	6.8	6.8	6.8	6.7
93	7.2	7.2	7.2	7.2	7.1	7	6.9	6.8	6.8	6.8	6.8	6.8	6.8	6.9	6.8	6.9	6.7
94	7.1	7.2	7.2	7.2	7.2	7	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	7	6.9	6.8
95	7.2	7.2	7.2	7.2	7.2	7.1	7	7	6.9	6.9	6.9	6.9	6.9	7	7	7	6.9
96	7.3	7.2	7.3	7.3	7.3	7.2	7.1	7	7	7	6.9	7	7	7	7	7	6.9
97	7.4	7.3	7.3	7.3	7.3	7.2	7.1	7.1	7	7	7	7	7.1	7.1	7.1	7	7
98	7.5	7.3	7.3	7.3	7.3	7.3	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7
99	7.5	7.3	7.3	7.3	7.4	7.3	7.2	7.2	7.2	7.1	7.1	7.2	7.2	7.2	7.2	7.1	7
100	7.3	7.3	7.3	7.4	7.4	7.3	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.1

dist	h0	h25	h50	h75	h100	h150	h200	h250	h300	h350	h400	h450	h500	h550	h600	h650	h700
101	7.4	7.3	7.4	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.2	7.1
102	7.4	7.4	7.4	7.5	7.5	7.5	7.4	7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.3	7.3	7.2
103	7.5	7.5	7.5	7.5	7.6	7.6	7.6	7.5	7.4	7.4	7.4	7.5	7.5	7.5	7.5	7.4	7.3
104	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.7	7.6	7.6	7.6	7.6	7.6	7.6	7.5	7.4	7.3
105	7.7	7.7	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.7	7.7	7.7	7.6	7.6	7.5	7.4
106	7.8	7.8	7.8	7.8	7.8	7.9	7.9	7.9	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.5	7.4
107	7.8	7.8	7.9	7.9	7.9	7.9	7.9	8	8	8	7.9	7.8	7.7	7.7	7.6	7.5	7.4
108	7.9	7.9	7.9	7.9	7.9	8	8	8	8	8	8	7.8	7.8	7.7	7.7	7.6	7.5
109	8	8	8	8	8	8	8	8	8	8	8	7.9	7.8	7.7	7.7	7.6	7.5