A horizontal quarter-circle source (internal radius 20 km, external radius 40 km, centered at XYZ=0,0,0) generates earthquakes of magnitude recurrence described by a truncated exponential model ($NMmin = 2$, b-value=1, Mmin=4, Mmax=6.4). Use the Sadigh et al. 1997 GMM (strike-slip) to compute the seismic hazard deaggregation curve for Sa(T=0.001) and a return period of 475 years. Set the rupture area model to null.

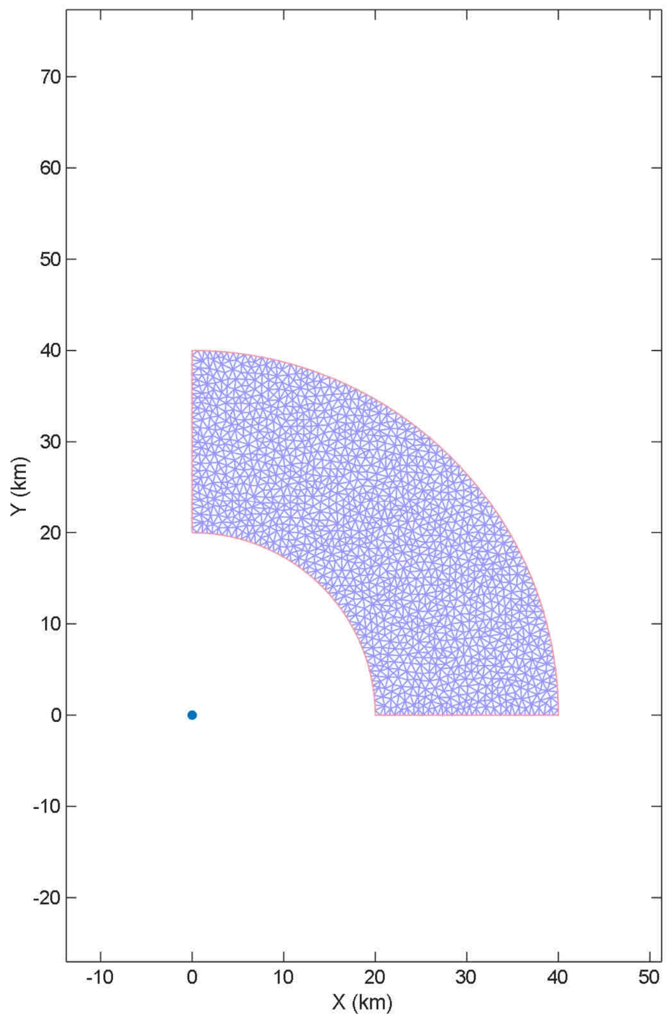


Figure 1 – Area source geometry and source discretization

Evaluating Sadigh et al 1997 at T=0.001s leads to

$$\ln Sa(0.001) = -1.274 + 1.1M - 2.1\ln(r + \exp(-0.48451 + 0.5240M))$$

$$\sigma \quad = 1.39 - 0.14M = 0.41$$

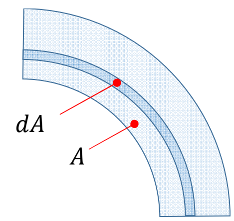
The probability term $P(Sa > y|m = 7, r)$ is

$$P(Sa > y|m, r) = 1 - \Phi\left(\frac{\log(y) - [-1.274 + 1.1M - 2.1\ln(r + \exp(-0.48451 + 0.5240M))]}{1.39 - 0.14M}\right)$$

And the probability density functions for distance and magnitude are

$$f_R(r) = \frac{1}{A}\frac{dA}{dr} = \frac{\frac{\pi}{2}r}{\pi(40^2 - 20^2)/4} = \frac{r}{600}$$

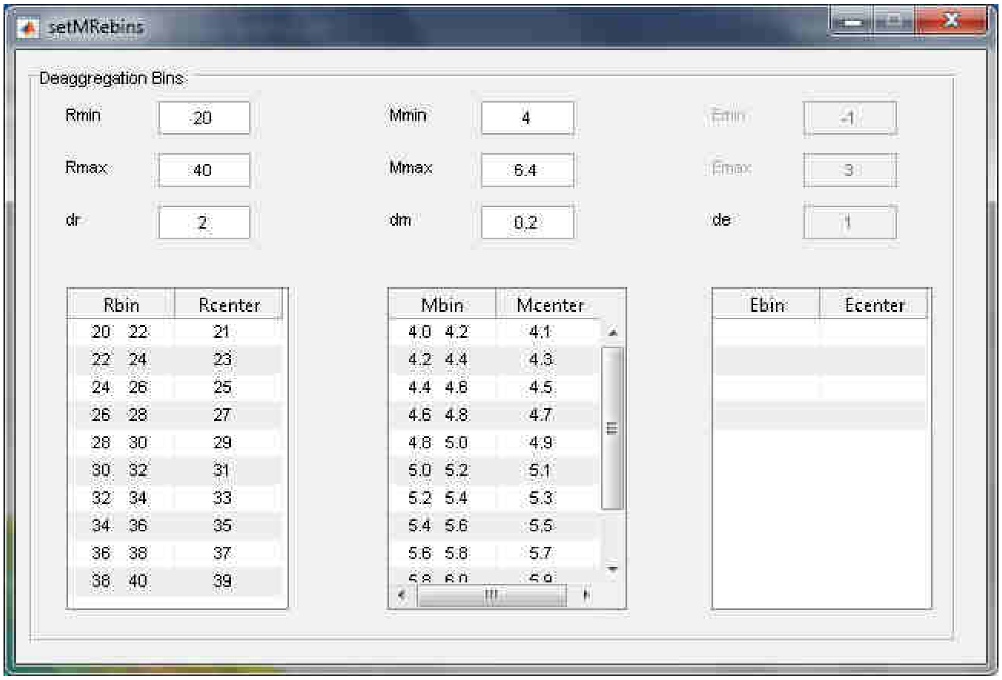
$$f_M(m) = \frac{\beta\, exp\left(-\beta(m - M_{min})\right)}{1 - exp\left(-\beta(M_{max} - M_{min})\right)}$$

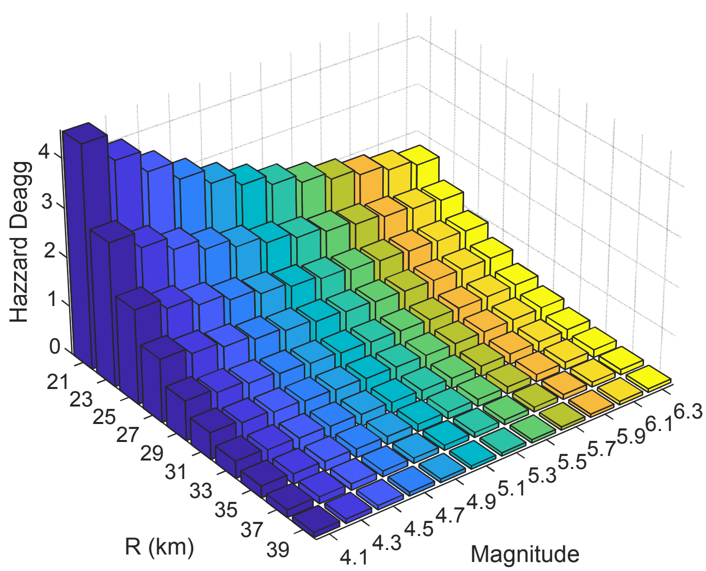


The Sa level associated with a 475 year return period is $y = 0.251549690490885g$. Then, hazard deaggregation for the i-th distance bin and the j-th magnitude bin is given by

$$Deagg = \frac{\int_{ri_1}^{ri_2}\int_{mj_1}^{mj_2} P(Sa > y|m, r) f_M(m) f_R(r)\, dmdr}{1/475}$$

$$Deagg = 475\int_{ri_1}^{ri_2}\int_{mj_1}^{mj_2} P(Sa > y|m, r)\frac{\beta\, exp\left(-\beta(m - M_{min})\right)}{1 - exp\left(-\beta(M_{max} - M_{min})\right)}\frac{r}{600}\, dmdr$$


setMRebins
Deaggregation Bins
Rmin 20
Rmax 40
dr 2
Mmin 4
Mmax 6.4
dm 0.2
Emin -1
Emax 3
de 1
Rbin Rcenter
20 22 21
22 24 23
24 26 25
26 28 27
28 30 29
30 32 31
32 34 33
34 36 35
36 38 37
38 40 39
Mbin Mcenter
4.0 4.2 4.1
4.2 4.4 4.3
4.4 4.6 4.5
4.6 4.8 4.7
4.8 5.0 4.9
5.0 5.2 5.1
5.2 5.4 5.3
5.4 5.6 5.5
5.6 5.8 5.7
Ebin Ecenter


Hazzard Deagg
0
1
2
3
4
R (km)
21 23 25 27 29 31 33 35 37 39
Magnitude
4.1 4.3 4.5 4.7 4.9 5.1 5.3 5.5 5.7 5.9 6.1 6.3

SeismicHazard	Magnitude											
Distance(km)	**4.1**	**4.3**	**4.5**	**4.7**	**4.9**	**5.1**	**5.3**	**5.5**	**5.7**	**5.9**	**6.1**	**6.3**
21	4.57	4.03	3.58	3.21	2.90	2.64	2.43	2.25	2.09	1.96	1.84	1.72
23	2.98	2.64	2.36	2.13	1.95	1.79	1.67	1.56	1.48	1.41	1.36	1.30
25	1.91	1.70	1.53	1.39	1.28	1.19	1.12	1.06	1.02	0.99	0.96	0.95
27	1.26	1.13	1.02	0.93	0.86	0.80	0.76	0.73	0.71	0.70	0.69	0.70
29	0.82	0.73	0.66	0.61	0.56	0.53	0.50	0.49	0.48	0.47	0.48	0.49
31	0.54	0.48	0.44	0.40	0.37	0.35	0.34	0.33	0.33	0.33	0.33	0.34
33	0.36	0.32	0.29	0.27	0.25	0.24	0.23	0.22	0.22	0.22	0.23	0.24
35	0.23	0.21	0.19	0.17	0.16	0.15	0.15	0.14	0.14	0.15	0.15	0.16
37	0.16	0.14	0.13	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11
39	0.11	0.09	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.07	0.07	0.07

Benchmark	Magnitude											
Distance(km)	**4.1**	**4.3**	**4.5**	**4.7**	**4.9**	**5.1**	**5.3**	**5.5**	**5.7**	**5.9**	**6.1**	**6.3**
21	4.56	4.02	3.57	3.20	2.89	2.64	2.42	2.24	2.09	1.95	1.83	1.72
23	2.96	2.63	2.35	2.12	1.94	1.78	1.66	1.56	1.47	1.41	1.35	1.30
25	1.93	1.72	1.54	1.40	1.29	1.20	1.13	1.07	1.03	0.99	0.97	0.96
27	1.26	1.12	1.01	0.93	0.85	0.80	0.76	0.73	0.71	0.69	0.69	0.69
29	0.82	0.74	0.67	0.61	0.57	0.53	0.51	0.49	0.48	0.48	0.48	0.49
31	0.54	0.48	0.44	0.40	0.37	0.35	0.34	0.33	0.32	0.33	0.33	0.34
33	0.36	0.32	0.29	0.27	0.25	0.23	0.22	0.22	0.22	0.22	0.23	0.24
35	0.24	0.21	0.19	0.18	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.16
37	0.16	0.14	0.13	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11
39	0.11	0.09	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.07	0.07	0.07

Error(%)	Magnitude											
Distance(km)	**4.1**	**4.3**	**4.5**	**4.7**	**4.9**	**5.1**	**5.3**	**5.5**	**5.7**	**5.9**	**6.1**	**6.3**
21	0.19	0.19	0.20	0.20	0.20	0.20	0.21	0.21	0.22	0.23	0.24	0.26
23	0.45	0.45	0.45	0.45	0.45	0.46	0.46	0.47	0.48	0.49	0.50	0.52
25	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	0.77	0.77	0.75	0.74
27	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.62
29	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.53
31	0.28	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26
33	0.57	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
35	0.86	0.86	0.86	0.87	0.87	0.87	0.88	0.88	0.88	0.88	0.88	0.88
37	0.19	0.19	0.20	0.20	0.20	0.21	0.21	0.22	0.22	0.23	0.23	0.24
39	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07

```
NMmin   = 2;
Mmin    = 4;
Mmax    = 6.5;
b       = 1;
beta    = b*log(10);



rc = (21:2:39)';    NR = length(rc);
mc = 4.1:0.2:6.4;   NM = length(mc);

deagg = zeros(NR,NM);
haz = 1/475;
y475 = 0.251549690490885;
for i=1:NR
    r1 = rc(i)-1;
    r2 = rc(i)+1;
    r  = linspace(r1,r2,200);

    for j=1:NM
        m1 = mc(j)-0.1;
        m2 = mc(j)+0.1;
        m  = linspace(m1,m2,150);

        [rr,mm] = meshgrid(r,m);
        fM      = beta*exp(-beta*(mm-Mmin))./(1-exp(-beta*(Mmax-Mmin)));
        fR      = rr/600;

        C       = [-0.624 1.0 0.000 -2.100 1.29649 0.250 0.0];
        lny     = C(1)+C(2)*mm+C(4)*log(rr+exp(C(5)+C(6)*mm));
        C       = [1.39 0.14 0.38 7.21];
        sigma   = C(1)-C(2)*mm;

        xhat      = (log(y475)-lny)./sigma;
        P         = 1-normcdf(xhat);
        f         = NMmin*P.*fM.*fR;
        deagg(i,j)= trapz(r,trapz(m,f))/haz*100;
    end
end
```