

PROBABILISTIC SEISMIC HAZARD ANALYSIS (Example 4.5 For Source 1)

Minimum Magnitude : $m_0 = 4.0$
 Maximum Magnitude : $m_u = 7.3$
 Frequency-Magnitude Relationship : $a = 4.4$
 $b = 1.0$

A. Divide the seismic source zone into a set of subsonic zone

Subzone	1	2	3	4	5	6	7	8	9	10
R_i (km)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
$f(R_{mid})$	0.342	0.128	0.074	0.070	0.067	0.065	0.064	0.063	0.063	0.062

B. Calculate the occurrence rate of earthquakes with magnitude larger than the minimum magnitude m_0

$$v(m > 4.0) = N(m > 4.0) = 10^{(4.4 - 1.00 \cdot m_0)} = 2.51189$$

C. Probability Density Function

$$f_M(m) = k \cdot \beta \cdot e^{-(\beta(m_{mid} - m_0))}$$

$$k = (1 - e^{-(\beta(m_u - m_0))})^{-1}$$

m	4	4.33	4.33	4.66	4.66	4.99	4.99	5.32	5.32	5.65	5.65	5.98	5.98	6.31	6.31	6.64	6.64	6.97	6.97	7.3
m_{mid}	4.165		4.495		4.825		5.155		5.485		5.815		6.145		6.475		6.805		7.135	
$f(m_{mid})$	1.575554412		0.736942165		0.344693748		0.161225379		0.075410775		0.03527227		0.01649808		0.00771673		0.0036094		0.001688	
$f(m_{mid})$	0.519932956		0.243190915		0.113748937		0.053204375		0.024885556		0.01163985		0.005444366		0.00254652		0.0011911		0.000557	

D. Acceleration Attenuation Function

$$\ln \text{PHA (gals)} = 6.74 + 0.859 m - 1.80 \ln(R + 25)$$

R (km)	m									
	4.165	4.495	4.825	5.155	5.485	5.815	6.145	6.475	6.805	7.135
27.04	3.204112223	3.487582223	3.771052223	4.054522223	4.337992223	4.62146222	4.904932223	5.18840222	5.4718722	5.755342
33.68	2.987956884	3.271426884	3.554896884	3.838366884	4.121836884	4.40530688	4.688776884	4.97224688	5.2557169	5.539187
40.32	2.794998117	3.078468117	3.361938117	3.645408117	3.928878117	4.21234812	4.495818117	4.77928812	5.0627581	5.346228
46.96	2.620736264	2.904206264	3.187676264	3.471146264	3.754616264	4.03808626	4.321556264	4.60502626	4.8884963	5.171966
53.6	2.461865941	2.745335941	3.028805941	3.312275941	3.595745941	3.87921594	4.162685941	4.44615594	4.7296259	5.013096
60.24	2.315887547	2.599357547	2.882827547	3.166297547	3.449767547	3.73323755	4.016707547	4.30017755	4.5836475	4.867118
66.88	2.18086492	2.46433492	2.74780492	3.03127492	3.31474492	3.59821492	3.88168492	4.16515492	4.4486249	4.732095
73.52	2.055267768	2.338737768	2.622207768	2.905677768	3.189147768	3.47261777	3.756087768	4.03955777	4.3230278	4.606498
80.16	1.9378656	2.2213356	2.5048056	2.7882756	3.0717456	3.3552156	3.6386856	3.9221556	4.2056256	4.489096
86.8	1.827654191	2.111124191	2.394594191	2.678064191	2.961534191	3.24500419	3.528474191	3.81194419	4.0954142	4.378884

For several target peak acceleration levels the corresponding standard normal variable is:

$$Z = (\ln \text{Acceleration} - \ln \text{PHA}) / 0.57$$

Acceleration	4.165									
(gals)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
9.81	-1.6153	-1.2361	-0.8975	-0.5918	-0.3131	-0.057	0.17989	0.40024	0.6062	0.79956
196.20	3.64039	4.01961	4.35813	4.66386	4.94258	5.19868	5.43556	5.65591	5.86188	6.05523
294.30	4.35173	4.73095	5.06948	5.3752	5.65392	5.91002	6.1469	6.36725	6.57322	6.76657
392.40	4.85644	5.23566	5.57418	5.8799	6.15862	6.41473	6.65161	6.87195	7.07792	7.27128
490.50	5.24792	5.62714	5.96566	6.27138	6.5501	6.80621	7.04309	7.26343	7.4694	7.66276
588.60	5.56778	5.947	6.28552	6.59125	6.86997	7.12607	7.36295	7.5833	7.78927	7.98262
686.70	5.83822	6.21744	6.55596	6.86169	7.14041	7.39651	7.63339	7.85374	8.05971	8.25306
784.80	6.07249	6.45171	6.79023	7.09595	7.37467	7.63077	7.86766	8.088	8.29397	8.48732

Acceleration	4.495									
(gals)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
9.81	-2.1126	-1.7334	-1.3949	-1.0891	-0.8104	-0.5543	-0.3174	-0.0971	0.10889	0.30224
196.20	3.14307	3.52229	3.86082	4.16654	4.44526	4.70136	4.93824	5.15859	5.36456	5.55791
294.30	3.85442	4.23364	4.57216	4.87788	5.1566	5.41271	5.64959	5.86993	6.0759	6.26926
392.40	4.35912	4.73834	5.07687	5.38259	5.66131	5.91741	6.15429	6.37464	6.58061	6.77396
490.50	4.7506	5.12982	5.46835	5.77407	6.05279	6.30889	6.54577	6.76612	6.97209	7.16544
588.60	5.07046	5.44968	5.78821	6.09393	6.37265	6.62875	6.86563	7.08598	7.29195	7.4853
686.70	5.3409	5.72012	6.05865	6.36437	6.64309	6.89919	7.13607	7.35642	7.56239	7.75574
784.80	5.57517	5.95439	6.29291	6.59864	6.87736	7.13346	7.37034	7.59069	7.79665	7.99001

Acceleration	4.825									
(gals)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
9.81	-2.6099	-2.2307	-1.8922	-1.5864	-1.3077	-1.0516	-0.8147	-0.5944	-0.3884	-0.1951
196.20	2.64576	3.02498	3.3635	3.66923	3.94794	4.20405	4.44093	4.66128	4.86724	5.0606
294.30	3.3571	3.73632	4.07484	4.38057	4.65929	4.91539	5.15227	5.37262	5.57859	5.77194
392.40	3.86181	4.24103	4.57955	4.88527	5.16399	5.4201	5.65698	5.87732	6.08329	6.27664
490.50	4.25329	4.63251	4.97103	5.27675	5.55547	5.81157	6.04846	6.2688	6.47477	6.66812
588.60	4.57315	4.95237	5.29089	5.59662	5.87533	6.13144	6.36832	6.58867	6.79463	6.98799
686.70	4.84359	5.22281	5.56133	5.86705	6.14577	6.40188	6.63876	6.8591	7.06507	7.25843
784.80	5.07785	5.45707	5.7956	6.10132	6.38004	6.63614	6.87302	7.09337	7.29934	7.49269

Acceleration	5.155									
(gals)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
9.81	-3.1072	-2.728	-2.3895	-2.0838	-1.805	-1.5489	-1.3121	-1.0917	-0.8857	-0.6924
196.20	2.14844	2.52766	2.86619	3.17191	3.45063	3.70673	3.94361	4.16396	4.36993	4.56328
294.30	2.85978	3.239	3.57753	3.88325	4.16197	4.41807	4.65496	4.8753	5.08127	5.27462
392.40	3.36449	3.74371	4.08223	4.38796	4.66668	4.92278	5.15966	5.38001	5.58598	5.77933
490.50	3.75597	4.13519	4.47371	4.77944	5.05816	5.31426	5.55114	5.77149	5.97746	6.17081
588.60	4.07583	4.45505	4.79358	5.0993	5.37802	5.63412	5.871	6.09135	6.29732	6.49067
686.70	4.34627	4.72549	5.06402	5.36974	5.64846	5.90456	6.14144	6.36179	6.56776	6.76111

(gals)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
9.81	-5.5938	-5.2146	-4.8761	-4.5703	-4.2916	-4.0355	-3.7986	-3.5783	-3.3723	-3.179
196.20	-0.3381	0.04108	0.37961	0.68533	0.96405	1.22015	1.45703	1.67738	1.88335	2.0767
294.30	0.37321	0.75243	1.09095	1.39667	1.67539	1.93149	2.16838	2.38872	2.59469	2.78804
392.40	0.87791	1.25713	1.59566	1.90138	2.1801	2.4362	2.67308	2.89343	3.0994	3.29275
490.50	1.26939	1.64861	1.98714	2.29286	2.57158	2.82768	3.06456	3.28491	3.49088	3.68423
588.60	1.58925	1.96847	2.307	2.61272	2.89144	3.14754	3.38442	3.60477	3.81074	4.00409
686.70	1.85969	2.23891	2.57744	2.88316	3.16188	3.41798	3.65486	3.87521	4.08118	4.27453
784.80	2.09396	2.47318	2.8117	3.11743	3.39615	3.65225	3.88913	4.10948	4.31544	4.5088

Acceleration	7.135									
(gals)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
9.81	-6.0911	-5.7119	-5.3734	-5.0677	-4.7889	-4.5328	-4.296	-4.0756	-3.8696	-3.6763
196.20	-0.8355	-0.4562	-0.1177	0.18801	0.46673	0.72284	0.95972	1.18006	1.38603	1.57939
294.30	-0.1241	0.25511	0.59363	0.89936	1.17808	1.43418	1.67106	1.89141	2.09738	2.29073
392.40	0.3806	0.75982	1.09834	1.40406	1.68278	1.93888	2.17577	2.39611	2.60208	2.79543
490.50	0.77208	1.1513	1.48982	1.79554	2.07426	2.33036	2.56725	2.78759	2.99356	3.18691
588.60	1.09194	1.47116	1.80968	2.1154	2.39412	2.65023	2.88711	3.10745	3.31342	3.50678
686.70	1.36238	1.7416	2.08012	2.38584	2.66456	2.92067	3.15755	3.37789	3.58386	3.77722
784.80	1.59664	1.97586	2.31439	2.62011	2.89883	3.15493	3.39181	3.61216	3.81813	4.01148

So the probability that the PHA is greater than every target PHA is:
 From a Normal Distribution function we have:

$$P(y>Y) = 1 - P(Z^* < Z)$$

0.94687503

Acceleration	4.165									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	0.94688	0.89178	0.81528	0.72301	0.6229	0.52272	0.42862	0.34449	0.27219	0.21198
0.20	0.00014	2.9E-05	6.6E-06	1.6E-06	3.9E-07	1E-07	2.7E-08	7.8E-09	2.3E-09	7E-10
0.30	6.8E-06	1.1E-06	2E-07	3.8E-08	7.8E-09	1.7E-09	4E-10	9.6E-11	2.5E-11	6.6E-12
0.40	6E-07	8.2E-08	1.2E-08	2.1E-09	3.7E-10	7.1E-11	1.4E-11	3.2E-12	7.3E-13	1.8E-13
0.50	7.7E-08	9.2E-09	1.2E-09	1.8E-10	2.9E-11	5E-12	9.4E-13	1.9E-13	4E-14	9.1E-15
0.60	1.3E-08	1.4E-09	1.6E-10	2.2E-11	3.2E-12	5.2E-13	9E-14	1.7E-14	3.3E-15	0
0.70	2.6E-09	2.5E-10	2.8E-11	3.4E-12	4.7E-13	7E-14	1.1E-14	2E-15	0	0
0.80	6.3E-10	5.5E-11	5.6E-12	6.4E-13	8.2E-14	1.2E-14	1.8E-15	0	0	0

-1.615

Acceleration	4.495									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	0.98268	0.95849	0.91847	0.86195	0.79115	0.71032	0.62454	0.53867	0.45665	0.38123
0.20	0.00084	0.00021	5.7E-05	1.5E-05	4.4E-06	1.3E-06	3.9E-07	1.2E-07	4.1E-08	1.4E-08
0.30	5.8E-05	1.1E-05	2.4E-06	5.4E-07	1.3E-07	3.1E-08	8E-09	2.2E-09	6.2E-10	1.8E-10

0.40	6.5E-06	1.1E-06	1.9E-07	3.7E-08	7.5E-09	1.6E-09	3.8E-10	9.2E-11	2.3E-11	6.3E-12
0.50	1E-06	1.5E-07	2.3E-08	3.9E-09	7.1E-10	1.4E-10	3E-11	6.6E-12	1.6E-12	3.9E-13
0.60	2E-07	2.5E-08	3.6E-09	5.5E-10	9.3E-11	1.7E-11	3.3E-12	6.9E-13	1.5E-13	3.6E-14
0.70	4.6E-08	5.3E-09	6.9E-10	9.8E-11	1.5E-11	2.6E-12	4.8E-13	9.4E-14	2E-14	4.4E-15
0.80	1.2E-08	1.3E-09	1.6E-10	2.1E-11	3E-12	4.9E-13	8.5E-14	1.6E-14	3.2E-15	0

Acceleration	4.825									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	0.99547	0.98715	0.97077	0.94368	0.90452	0.85351	0.79239	0.72388	0.65115	0.57733
0.20	0.00408	0.00124	0.00038	0.00012	3.9E-05	1.3E-05	4.5E-06	1.6E-06	5.7E-07	2.1E-07
0.30	0.00039	9.3E-05	2.3E-05	5.9E-06	1.6E-06	4.4E-07	1.3E-07	3.9E-08	1.2E-08	3.9E-09
0.40	5.6E-05	1.1E-05	2.3E-06	5.2E-07	1.2E-07	3E-08	7.7E-09	2.1E-09	5.9E-10	1.7E-10
0.50	1.1E-05	1.8E-06	3.3E-07	6.6E-08	1.4E-08	3.1E-09	7.3E-10	1.8E-10	4.7E-11	1.3E-11
0.60	2.4E-06	3.7E-07	6.1E-08	1.1E-08	2.1E-09	4.4E-10	9.6E-11	2.2E-11	5.4E-12	1.4E-12
0.70	6.4E-07	8.8E-08	1.3E-08	2.2E-09	4E-10	7.7E-11	1.6E-11	3.5E-12	8E-13	2E-13
0.80	1.9E-07	2.4E-08	3.4E-09	5.3E-10	8.9E-11	1.6E-11	3.1E-12	6.5E-13	1.4E-13	3.4E-14

Acceleration	5.155									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	0.99906	0.99681	0.99156	0.98141	0.96447	0.9393	0.90525	0.86252	0.81212	0.75565
0.20	0.01584	0.00574	0.00208	0.00076	0.00028	0.0001	4E-05	1.6E-05	6.2E-06	2.5E-06
0.30	0.00212	0.0006	0.00017	5.2E-05	1.6E-05	5E-06	1.6E-06	5.4E-07	1.9E-07	6.7E-08
0.40	0.00038	9.1E-05	2.2E-05	5.7E-06	1.5E-06	4.3E-07	1.2E-07	3.7E-08	1.2E-08	3.7E-09
0.50	8.6E-05	1.8E-05	3.8E-06	8.8E-07	2.1E-07	5.4E-08	1.4E-08	3.9E-09	1.1E-09	3.4E-10
0.60	2.3E-05	4.2E-06	8.2E-07	1.7E-07	3.8E-08	8.8E-09	2.2E-09	5.6E-10	1.5E-10	4.3E-11
0.70	6.9E-06	1.1E-06	2.1E-07	3.9E-08	8.1E-09	1.8E-09	4.1E-10	1E-10	2.6E-11	6.8E-12
0.80	2.3E-06	3.5E-07	5.8E-08	1E-08	2E-09	4.2E-10	9.1E-11	2.1E-11	5.2E-12	1.3E-12

Acceleration	5.485									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	0.99984	0.99937	0.99805	0.99508	0.98934	0.97963	0.9648	0.94397	0.91668	0.88292
0.20	0.04936	0.02116	0.00892	0.00374	0.00157	0.00067	0.00028	0.00012	5.4E-05	2.4E-05
0.30	0.00908	0.00306	0.00103	0.00035	0.00012	4.4E-05	1.6E-05	6E-06	2.3E-06	8.9E-07
0.40	0.00207	0.00058	0.00017	5E-05	1.5E-05	4.8E-06	1.6E-06	5.2E-07	1.8E-07	6.4E-08
0.50	0.00056	0.00014	3.5E-05	9.3E-06	2.5E-06	7.3E-07	2.2E-07	6.7E-08	2.1E-08	7E-09
0.60	0.00017	3.8E-05	8.7E-06	2.1E-06	5.3E-07	1.4E-07	3.9E-08	1.1E-08	3.3E-09	1E-09
0.70	5.9E-05	1.2E-05	2.5E-06	5.5E-07	1.3E-07	3.2E-08	8.3E-09	2.3E-09	6.4E-10	1.9E-10
0.80	2.2E-05	4.1E-06	7.9E-07	1.6E-07	3.6E-08	8.4E-09	2.1E-09	5.3E-10	1.4E-10	4.1E-11

Acceleration	5.815									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	0.99998	0.9999	0.99964	0.99896	0.99744	0.99451	0.98946	0.98153	0.96997	0.9542
0.20	0.12429	0.06263	0.03063	0.01473	0.00702	0.00334	0.00159	0.00076	0.00037	0.00018
0.30	0.03108	0.0124	0.0049	0.00193	0.00077	0.00031	0.00013	5.2E-05	2.2E-05	9.3E-06
0.40	0.0089	0.00299	0.00101	0.00035	0.00012	4.3E-05	1.6E-05	5.8E-06	2.2E-06	8.6E-07
0.50	0.00288	0.00084	0.00025	7.7E-05	2.4E-05	7.8E-06	2.6E-06	8.9E-07	3.1E-07	1.1E-07
0.60	0.00103	0.00027	7.3E-05	2E-05	5.8E-06	1.7E-06	5.4E-07	1.7E-07	5.7E-08	1.9E-08

0.70	0.0004	9.5E-05	2.4E-05	6.1E-06	1.6E-06	4.6E-07	1.3E-07	4E-08	1.3E-08	4E-09
0.80	0.00017	3.7E-05	8.4E-06	2E-06	5.1E-07	1.3E-07	3.7E-08	1.1E-08	3.2E-09	9.8E-10

Acceleration	6.145									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	1	0.99999	0.99995	0.99983	0.99951	0.99882	0.99748	0.99511	0.99129	0.98553
0.20	0.25575	0.15017	0.08468	0.04648	0.02508	0.01339	0.00711	0.00377	0.002	0.00107
0.30	0.08568	0.04031	0.01851	0.00839	0.00379	0.00172	0.00078	0.00036	0.00017	7.8E-05
0.40	0.03057	0.01217	0.00479	0.00189	0.00075	0.0003	0.00012	5.1E-05	2.1E-05	9E-06
0.50	0.01179	0.00411	0.00143	0.00051	0.00018	6.6E-05	2.5E-05	9.4E-06	3.6E-06	1.4E-06
0.60	0.00488	0.00152	0.00048	0.00015	5.1E-05	1.7E-05	6E-06	2.1E-06	7.7E-07	2.9E-07
0.70	0.00216	0.00061	0.00018	5.3E-05	1.6E-05	5.1E-06	1.7E-06	5.6E-07	1.9E-07	6.9E-08
0.80	0.00101	0.00026	7.1E-05	2E-05	5.6E-06	1.7E-06	5.2E-07	1.7E-07	5.5E-08	1.9E-08

Acceleration	6.475									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	1	1	0.99999	0.99998	0.99993	0.9998	0.99952	0.99897	0.99798	0.99634
0.20	0.43676	0.29515	0.19026	0.11847	0.07196	0.04295	0.02533	0.01483	0.00864	0.00503
0.30	0.19201	0.1057	0.05611	0.02911	0.0149	0.00757	0.00384	0.00195	0.00099	0.00051
0.40	0.08453	0.03968	0.01818	0.00823	0.00371	0.00168	0.00076	0.00035	0.00016	7.5E-05
0.50	0.03864	0.01594	0.00649	0.00263	0.00107	0.00044	0.00018	7.8E-05	3.3E-05	1.4E-05
0.60	0.01846	0.00684	0.00252	0.00094	0.00035	0.00013	5.2E-05	2E-05	8.2E-06	3.4E-06
0.70	0.00921	0.00311	0.00105	0.00036	0.00013	4.5E-05	1.6E-05	6.1E-06	2.3E-06	9.1E-07
0.80	0.00478	0.00149	0.00047	0.00015	4.9E-05	1.7E-05	5.8E-06	2E-06	7.4E-07	2.8E-07

Acceleration	6.805									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	1	1	1	1	0.99999	0.99997	0.99993	0.99983	0.99963	0.99926
0.20	0.63237	0.48361	0.35212	0.24657	0.16751	0.1112	0.07255	0.04673	0.02983	0.01891
0.30	0.3545	0.2259	0.13765	0.08126	0.04693	0.02671	0.01507	0.00845	0.00473	0.00265
0.40	0.19	0.10435	0.05528	0.02863	0.01463	0.00742	0.00376	0.00191	0.00097	0.0005
0.50	0.10215	0.04961	0.02345	0.01093	0.00506	0.00234	0.00109	0.00051	0.00024	0.00011
0.60	0.056	0.02451	0.01053	0.00449	0.00192	0.00082	0.00036	0.00016	6.9E-05	3.1E-05
0.70	0.03146	0.01258	0.00498	0.00197	0.00078	0.00032	0.00013	5.3E-05	2.2E-05	9.6E-06
0.80	0.01813	0.0067	0.00246	0.00091	0.00034	0.00013	5E-05	2E-05	8E-06	3.3E-06

Acceleration	7.135									
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8
0.01	1	1	1	1	1	1	0.99999	0.99998	0.99995	0.99988
0.20	0.79827	0.67589	0.54685	0.42543	0.32034	0.23489	0.1686	0.11899	0.08287	0.05712
0.30	0.54939	0.39932	0.27638	0.18423	0.11938	0.07576	0.04735	0.02929	0.01798	0.01099
0.40	0.35175	0.22368	0.13603	0.08015	0.04621	0.02626	0.01479	0.00829	0.00463	0.00259
0.50	0.22003	0.12481	0.06814	0.03628	0.01903	0.00989	0.00513	0.00266	0.00138	0.00072
0.60	0.13743	0.07062	0.03517	0.0172	0.00833	0.00402	0.00194	0.00094	0.00046	0.00023
0.70	0.08654	0.04079	0.01876	0.00852	0.00385	0.00175	0.0008	0.00037	0.00017	7.9E-05
0.80	0.05517	0.02409	0.01032	0.0044	0.00187	0.0008	0.00035	0.00015	6.7E-05	3E-05

So, the annual rate of exceedance of a peak acceleration a by an earthquake of magnitude m at a distance R will be:

$$\lambda_a = v * P(y > Y) * F(R) * F(m)$$

Acceleration	4.165										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.42293	0.14908	0.07879	0.0661	0.05451	0.04437	0.03583	0.02834	0.0224	0.01716	9.20E-01
0.20	6.1E-05	4.9E-06	6.3E-07	1.4E-07	3.4E-08	8.5E-09	2.3E-09	6.4E-10	1.9E-10	5.7E-11	6.65E-05
0.30	3E-06	1.9E-07	1.9E-08	3.5E-09	6.9E-10	1.5E-10	3.3E-11	7.9E-12	2E-12	5.3E-13	3.23E-06
0.40	2.7E-07	1.4E-08	1.2E-09	1.9E-10	3.2E-11	6E-12	1.2E-12	2.6E-13	6E-14	1.4E-14	2.82E-07
0.50	3.4E-08	1.5E-09	1.2E-10	1.6E-11	2.5E-12	4.3E-13	7.9E-14	1.6E-14	3.3E-15	7.4E-16	3.60E-08
0.60	5.8E-09	2.3E-10	1.6E-11	2E-12	2.8E-13	4.4E-14	7.5E-15	1.4E-15	2.7E-16	0	6.01E-09
0.70	1.2E-09	4.2E-11	2.7E-12	3.1E-13	4.1E-14	5.9E-15	9.6E-16	1.6E-16	0	0	1.22E-09
0.80	2.8E-10	9.2E-12	5.4E-13	5.9E-14	7.2E-15	9.9E-16	1.5E-16	0	0	0	2.91E-10

Acceleration	4.495										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.2053	0.0749	0.0415	0.0369	0.0324	0.0282	0.0244	0.0207	0.0176	0.0144	4.96E-01
0.20	1.7E-04	1.7E-05	2.6E-06	6.6E-07	1.8E-07	5.1E-08	1.5E-08	4.8E-09	1.6E-09	5.2E-10	1.95E-04
0.30	1.2E-05	9.0E-07	1.1E-07	2.3E-08	5.1E-09	1.2E-09	3.1E-10	8.4E-11	2.4E-11	6.9E-12	1.32E-05
0.40	1.4E-06	8.4E-08	8.7E-09	1.6E-09	3.1E-10	6.5E-11	1.5E-11	3.5E-12	9.0E-13	2.4E-13	1.46E-06
0.50	2.1E-07	1.1E-08	1.0E-09	1.7E-10	2.9E-11	5.6E-12	1.2E-12	2.5E-13	6.0E-14	1.5E-14	2.24E-07
0.60	4.1E-08	2.0E-09	1.6E-10	2.4E-11	3.8E-12	6.7E-13	1.3E-13	2.7E-14	5.9E-15	1.3E-15	4.36E-08
0.70	9.7E-09	4.2E-10	3.1E-11	4.2E-12	6.3E-13	1.0E-13	1.9E-14	3.6E-15	7.6E-16	1.7E-16	1.01E-08
0.80	2.6E-09	1.0E-10	7.0E-12	8.9E-13	1.2E-13	1.9E-14	3.3E-15	6.1E-16	1.2E-16	0.0E+00	2.69E-09

Acceleration	4.825										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.09728	0.0361	0.02053	0.01887	0.01732	0.01585	0.01449	0.01303	0.01172	0.01023	2.55E-01
0.20	0.0004	4.5E-05	8.1E-06	2.4E-06	7.5E-07	2.4E-07	8.2E-08	2.8E-08	1E-08	3.7E-09	4.55E-04
0.30	3.8E-05	3.4E-06	4.9E-07	1.2E-07	3E-08	8.2E-09	2.4E-09	7E-10	2.2E-10	6.9E-11	4.25E-05
0.40	5.5E-06	4.1E-07	4.9E-08	1E-08	2.3E-09	5.5E-10	1.4E-10	3.8E-11	1.1E-11	3.1E-12	5.97E-06
0.50	1E-06	6.6E-08	7E-09	1.3E-09	2.7E-10	5.7E-11	1.3E-11	3.3E-12	8.5E-13	2.3E-13	1.10E-06
0.60	2.3E-07	1.3E-08	1.3E-09	2.2E-10	4E-11	8.1E-12	1.7E-12	4E-13	9.8E-14	2.5E-14	2.50E-07
0.70	6.2E-08	3.2E-09	2.8E-10	4.4E-11	7.6E-12	1.4E-12	2.9E-13	6.2E-14	1.4E-14	3.5E-15	6.59E-08
0.80	1.9E-08	8.9E-10	7.2E-11	1.1E-11	1.7E-12	3E-13	5.7E-14	1.2E-14	2.6E-15	6E-16	1.96E-08

Acceleration	5.155										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.04566	0.01705	0.00981	0.00918	0.00864	0.00816	0.00774	0.00726	0.00684	0.00626	1.27E-01
0.20	0.00072	9.8E-05	2.1E-05	7.1E-06	2.5E-06	9.1E-07	3.4E-07	1.3E-07	5.2E-08	2.1E-08	8.54E-04
0.30	9.7E-05	1E-05	1.7E-06	4.8E-07	1.4E-07	4.3E-08	1.4E-08	4.6E-09	1.6E-09	5.5E-10	1.10E-04
0.40	1.8E-05	1.6E-06	2.2E-07	5.4E-08	1.4E-08	3.7E-09	1.1E-09	3.1E-10	9.8E-11	3.1E-11	1.94E-05
0.50	3.9E-06	3E-07	3.8E-08	8.2E-09	1.9E-09	4.7E-10	1.2E-10	3.3E-11	9.5E-12	2.8E-12	4.30E-06
0.60	1E-06	7.2E-08	8.1E-09	1.6E-09	3.4E-10	7.6E-11	1.9E-11	4.7E-12	1.3E-12	3.5E-13	1.13E-06

0.70	3.2E-07	2E-08	2E-09	3.7E-10	7.2E-11	1.5E-11	3.5E-12	8.4E-13	2.2E-13	5.7E-14	3.39E-07
0.80	1.1E-07	6E-09	5.8E-10	9.8E-11	1.8E-11	3.6E-12	7.8E-13	1.8E-13	4.3E-14	1.1E-14	1.13E-07

Acceleration	5.485										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.02137	0.008	0.00462	0.00435	0.00414	0.00398	0.00386	0.00372	0.00361	0.00342	6.11E-02
0.20	0.00106	0.00017	4.1E-05	1.6E-05	6.6E-06	2.7E-06	1.1E-06	4.8E-07	2.1E-07	9.3E-08	1.29E-03
0.30	0.00019	2.4E-05	4.8E-06	1.6E-06	5.2E-07	1.8E-07	6.4E-08	2.4E-08	9E-09	3.4E-09	2.26E-04
0.40	4.4E-05	4.7E-06	7.8E-07	2.2E-07	6.4E-08	2E-08	6.3E-09	2.1E-09	7.1E-10	2.5E-10	5.00E-05
0.50	1.2E-05	1.1E-06	1.6E-07	4.1E-08	1.1E-08	3E-09	8.7E-10	2.6E-10	8.4E-11	2.7E-11	1.33E-05
0.60	3.7E-06	3E-07	4E-08	9.2E-09	2.2E-09	5.7E-10	1.5E-10	4.4E-11	1.3E-11	4E-12	4.05E-06
0.70	1.3E-06	9.4E-08	1.1E-08	2.4E-09	5.4E-10	1.3E-10	3.3E-11	8.9E-12	2.5E-12	7.3E-13	1.38E-06
0.80	4.7E-07	3.2E-08	3.7E-09	7.2E-10	1.5E-10	3.4E-11	8.3E-12	2.1E-12	5.7E-13	1.6E-13	5.12E-07

Acceleration	5.815										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.01	0.00374	0.00216	0.00204	0.00195	0.00189	0.00185	0.00181	0.00179	0.00173	2.90E-02
0.20	0.00124	0.00023	6.6E-05	3E-05	1.4E-05	6.4E-06	3E-06	1.4E-06	6.8E-07	3.3E-07	1.60E-03
0.30	0.00031	4.6E-05	1.1E-05	4E-06	1.5E-06	5.9E-07	2.4E-07	9.6E-08	4E-08	1.7E-08	3.74E-04
0.40	8.9E-05	1.1E-05	2.2E-06	7.1E-07	2.4E-07	8.1E-08	2.9E-08	1.1E-08	4.1E-09	1.6E-09	1.03E-04
0.50	2.9E-05	3.2E-06	5.4E-07	1.6E-07	4.7E-08	1.5E-08	4.9E-09	1.6E-09	5.8E-10	2.1E-10	3.27E-05
0.60	1E-05	1E-06	1.6E-07	4.1E-08	1.1E-08	3.3E-09	1E-09	3.2E-10	1.1E-10	3.5E-11	1.15E-05
0.70	4E-06	3.6E-07	5.1E-08	1.2E-08	3.2E-09	8.7E-10	2.5E-10	7.4E-11	2.3E-11	7.3E-12	4.44E-06
0.80	1.7E-06	1.4E-07	1.8E-08	4.1E-09	1E-09	2.6E-10	6.9E-11	2E-11	5.8E-12	1.8E-12	1.84E-06

Acceleration	6.145										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.00468	0.00175	0.00101	0.00096	0.00092	0.00089	0.00087	0.00086	0.00085	0.00084	1.36E-02
0.20	0.0012	0.00026	8.6E-05	4.4E-05	2.3E-05	1.2E-05	6.2E-06	3.2E-06	1.7E-06	9E-07	1.64E-03
0.30	0.0004	7.1E-05	1.9E-05	8E-06	3.5E-06	1.5E-06	6.8E-07	3.1E-07	1.4E-07	6.6E-08	5.04E-04
0.40	0.00014	2.1E-05	4.9E-06	1.8E-06	6.9E-07	2.7E-07	1.1E-07	4.4E-08	1.8E-08	7.7E-09	1.72E-04
0.50	5.5E-05	7.2E-06	1.5E-06	4.8E-07	1.7E-07	5.9E-08	2.2E-08	8.1E-09	3.1E-09	1.2E-09	6.45E-05
0.60	2.3E-05	2.7E-06	4.9E-07	1.5E-07	4.7E-08	1.5E-08	5.2E-09	1.8E-09	6.7E-10	2.4E-10	2.62E-05
0.70	1E-05	1.1E-06	1.8E-07	5E-08	1.5E-08	4.5E-09	1.5E-09	4.8E-10	1.7E-10	5.8E-11	1.14E-05
0.80	4.7E-06	4.6E-07	7.1E-08	1.9E-08	5.2E-09	1.5E-09	4.6E-10	1.4E-10	4.7E-11	1.6E-11	5.26E-06

Acceleration	6.475										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.00219	0.00082	0.00047	0.00045	0.00043	0.00042	0.00041	0.0004	0.0004	0.0004	6.38E-03
0.20	0.00096	0.00024	9E-05	5.3E-05	3.1E-05	1.8E-05	1E-05	6E-06	3.5E-06	2E-06	1.41E-03
0.30	0.00042	8.7E-05	2.7E-05	1.3E-05	6.4E-06	3.1E-06	1.6E-06	7.9E-07	4E-07	2E-07	5.59E-04
0.40	0.00018	3.2E-05	8.6E-06	3.7E-06	1.6E-06	7E-07	3.1E-07	1.4E-07	6.5E-08	3E-08	2.33E-04
0.50	8.5E-05	1.3E-05	3.1E-06	1.2E-06	4.6E-07	1.8E-07	7.5E-08	3.1E-08	1.3E-08	5.7E-09	1.03E-04
0.60	4E-05	5.6E-06	1.2E-06	4.2E-07	1.5E-07	5.6E-08	2.1E-08	8.2E-09	3.3E-09	1.3E-09	4.78E-05
0.70	2E-05	2.5E-06	5E-07	1.6E-07	5.4E-08	1.9E-08	6.7E-09	2.5E-09	9.4E-10	3.6E-10	2.34E-05
0.80	1E-05	1.2E-06	2.2E-07	6.7E-08	2.1E-08	6.9E-09	2.4E-09	8.2E-10	3E-10	1.1E-10	1.20E-05

Acceleration	6.805										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.001	0.00038	0.00022	0.00021	0.0002	0.00019	0.00019	0.00019	0.00019	0.00019	2.99E-03
0.20	0.00065	0.00019	7.8E-05	5.2E-05	3.4E-05	2.2E-05	1.4E-05	8.8E-06	5.6E-06	3.5E-06	1.05E-03
0.30	0.00036	8.7E-05	3E-05	1.7E-05	9.4E-06	5.2E-06	2.9E-06	1.6E-06	8.9E-07	4.9E-07	5.17E-04
0.40	0.00019	4E-05	1.2E-05	6E-06	2.9E-06	1.4E-06	7.2E-07	3.6E-07	1.8E-07	9.2E-08	2.58E-04
0.50	0.0001	1.9E-05	5.2E-06	2.3E-06	1E-06	4.6E-07	2.1E-07	9.6E-08	4.5E-08	2.1E-08	1.33E-04
0.60	5.7E-05	9.4E-06	2.3E-06	9.4E-07	3.8E-07	1.6E-07	6.8E-08	2.9E-08	1.3E-08	5.8E-09	7.06E-05
0.70	3.2E-05	4.8E-06	1.1E-06	4.1E-07	1.6E-07	6.1E-08	2.5E-08	1E-08	4.2E-09	1.8E-09	3.88E-05
0.80	1.9E-05	2.6E-06	5.5E-07	1.9E-07	6.8E-08	2.5E-08	9.6E-09	3.7E-09	1.5E-09	6E-10	2.20E-05

Acceleration	7.135										
(g)	27.04	33.68	40.32	46.96	53.6	60.24	66.88	73.52	80.16	86.8	SUM
0.01	0.00048	0.00018	0.0001	9.8E-05	9.4E-05	9.1E-05	9E-05	8.8E-05	8.8E-05	8.7E-05	1.40E-03
0.20	0.00038	0.00012	5.7E-05	4.2E-05	3E-05	2.1E-05	1.5E-05	1E-05	7.3E-06	5E-06	6.91E-04
0.30	0.00026	7.2E-05	2.9E-05	1.8E-05	1.1E-05	6.9E-06	4.2E-06	2.6E-06	1.6E-06	9.5E-07	4.09E-04
0.40	0.00017	4E-05	1.4E-05	7.9E-06	4.3E-06	2.4E-06	1.3E-06	7.3E-07	4.1E-07	2.2E-07	2.40E-04
0.50	0.00011	2.2E-05	7.1E-06	3.6E-06	1.8E-06	9E-07	4.6E-07	2.3E-07	1.2E-07	6.2E-08	1.42E-04
0.60	6.6E-05	1.3E-05	3.6E-06	1.7E-06	7.8E-07	3.7E-07	1.7E-07	8.3E-08	4.1E-08	2E-08	8.52E-05
0.70	4.1E-05	7.3E-06	1.9E-06	8.3E-07	3.6E-07	1.6E-07	7.1E-08	3.2E-08	1.5E-08	6.9E-09	5.21E-05
0.80	2.6E-05	4.3E-06	1.1E-06	4.3E-07	1.8E-07	7.3E-08	3.1E-08	1.3E-08	5.9E-09	2.6E-09	3.25E-05

Now we can obtain the occurrence rate specified acceleration values when earthquakes occur in each subzone by summation the multiple of contribution of each magnitude range and its probability function $f(m_i)$

$$P_i(y>Y) = \sum P_j(y>Y)$$

a (g)	P _{1yr}
0.01	1.912315
0.2	0.009249
0.3	0.002757
0.4	0.001083
0.5	0.000493
0.6	0.000247
0.7	0.000132
0.8	0.000074