Steps to calculate hazard using USGS hazard codes:

(Step 1) Run agridPC.exe – need input file (e.g., turkeyagrid1.in)

turkeyagrid1.in

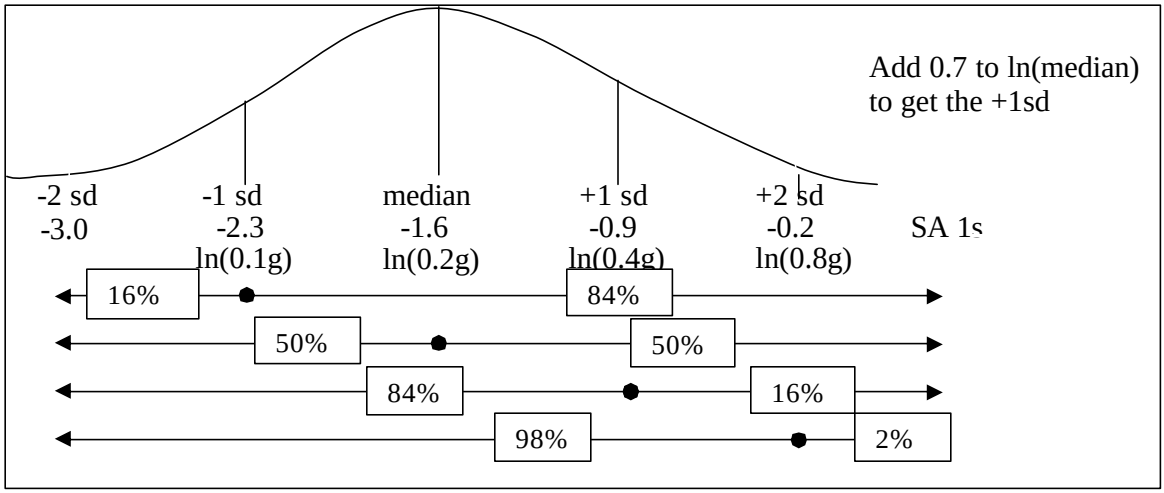
```
39.2 41.5 .1   (for grid: latitude minimum, latitude maximum, latitude step)
26.6 31.0 .1   (for grid: longitude minimum, longitude maximum, longitude step)
.1 .1          (step in lat, step in lon for source cell)
1              (number of magnitude catagories)
5.0 1901       (minimum magnitude and min year of completeness)
2001           (end year of catalog)
musgs100.cc    (name of declustered catalog)
5.0 0.1 0.8    (minimum magnitude, step in magnitude, b-value)
50.            (smoothing correlation distance, in km)
turkeyagridz1  (name of output file)
---------------------------------
```

PSHA hypothetical problem (these relations are not correct so please do not use these in a real engineering application!!)

You have been given the task to evaluate the hazard for a long period structure and you will use 1 s spectral acceleration to define your design spectra. The site is located 20 km from a segment of a fault that ruptures in a Mw 7.0 earthquake every 250 years. Consider the following information.

a. You study the strong ground shaking from global earthquakes and use the find that the median ground motion for a M7 earthquake at 20 km is 0.2g SA(1s), ln(0.2)=-1.6. The distribution is lognormal.
b. You also note that the attenuation relation gives a standard deviation of a factor of two in pga, i.e., median + 1 standard deviation is 0.4 g and +2 standard deviations is 0.8 g for 1s SA.
c. You have a statistics book with a table that describes the standard normal distribution (see figure below). This table and figures indicate that for the median value there is 50% of the weight on both the left and right side of the distribution, for the -1 standard deviation there is 16% on the left side of the distribution and 84% on the right side, for the +1 standard deviation value 84% of the weight on the left side and 16% is on the right side of the distribution, for 2 standard deviations 98% of the distribution is on the left side and 2% is on the right side, and for 3 standard

deviations 99.9% is on the left side and 0.1% is on the right side of the distribution. There is 100% probability that you will exceed 0 g.



1. What is the median deterministic pga?

2. What is the mean+1standard deviation pga?

3. Calculate the annual rate of exceedance for ground motions of
   Ground motions: 0g, 0.1g 0.2g 0.4g, 0.8g,
   Rate of exceedance fault 1:

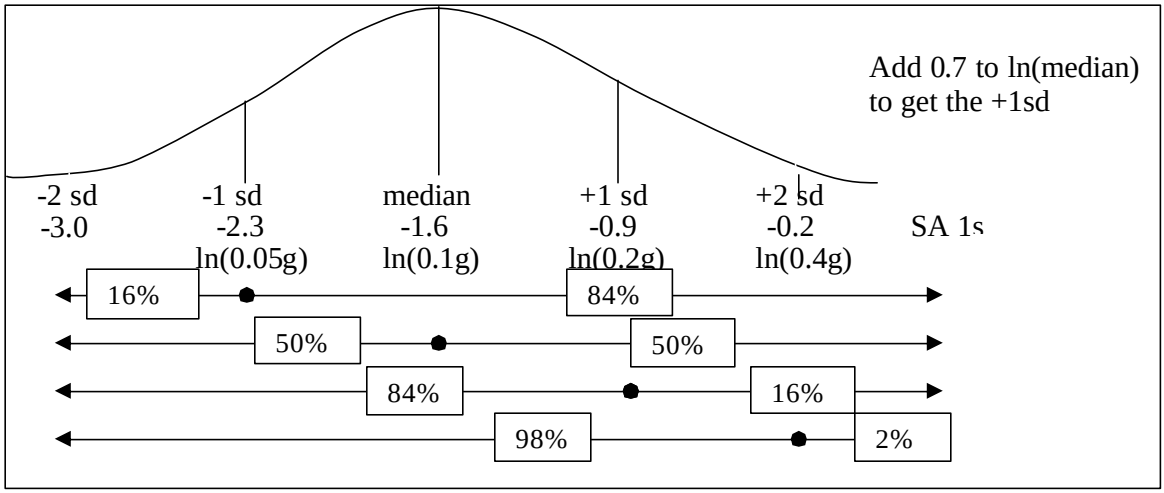
   Remember that the Rate of exceedance of a ground motion is the rate of the earthquake multiplied by the probability that the ground motion will exceed the given level (0g, 0.2g, etc).
   Rate = rate of earthquake X P(x>x')

4. Approximate the 10% in 50 year pga for this site?
   Hint: Remember that P=1-exp(-rate*time). You want to know the annual rate of exceedance. Using the Poisson equation we can solve for rate:
   Rate= –(ln(1-P)/time)
   For this problem P=0.1, time=50years

5. Would the 10% in 50 year pga increase, decrease, or stay the same if the earthquake were found to have a recurrence of 100 years instead of 250 years?

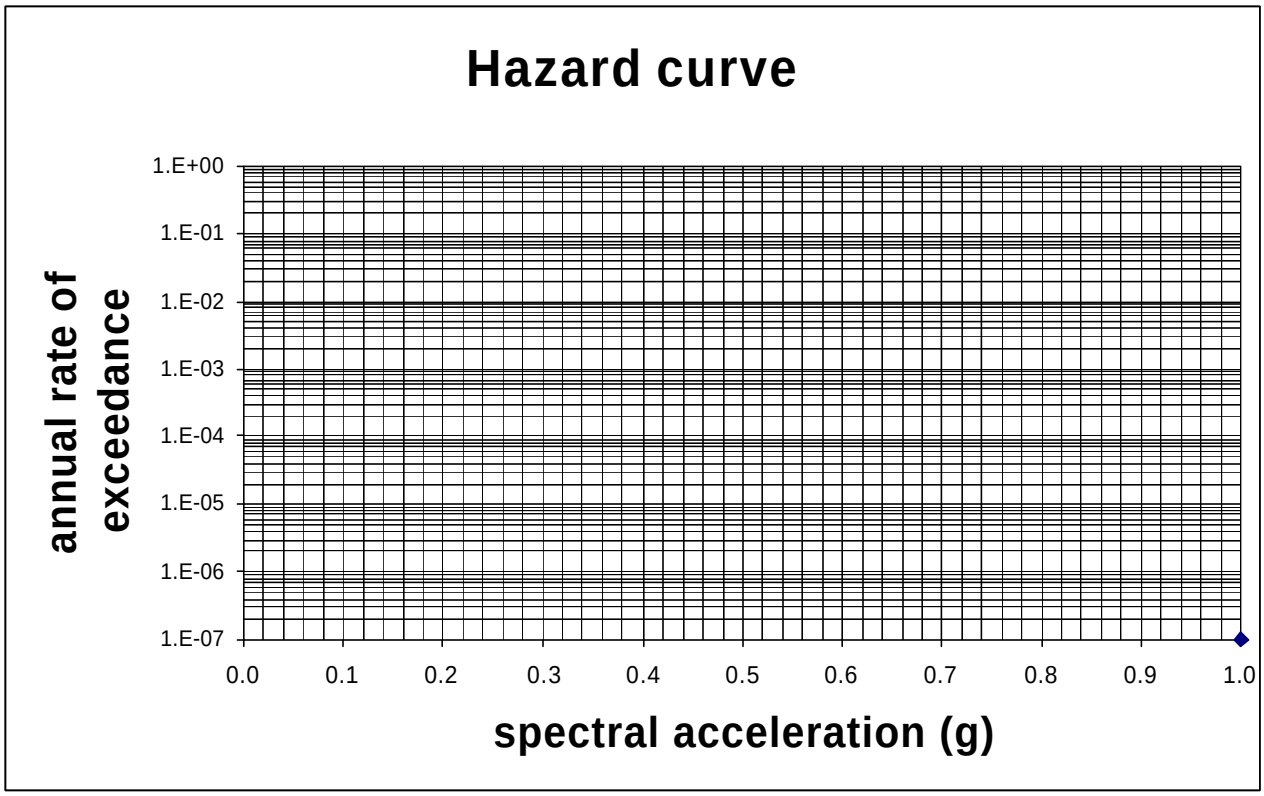
6. Now you have discovered a new fault located 10 km from your site. This one is much smaller in length and has M 6.5 earthquakes very 100 years. The median ground motion for a M 6.5 at 10 km is 0.1, the -1 standard deviation is 0.05 g, the +1 standard deviation is 0.2 and the +2 standard deviation is 0.4 g for 1s SA. Calculate the annual rate of exceedance for ground motions of
   SA 1s Ground motions: 0g, 0.1g 0.2g, 0.4g, 0.8g,
   Rate of exceedance fault 2:

7. What is the total annual rate of exceedance for ground motions
   SA 1s Ground motions: 0g, 0.1g 0.2g, 0.4g, 0.8g,
   Rate of exceedance fault 1:
   Rate of exceedance fault 2:
   Total rate of exceedance:



8. Which fault contributed most at 0g, 0.1g, 0.2g, 4g ground motions?

9. Plot the final hazard curve.


Hazard curve
annual rate of exceedance
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
spectral acceleration (g)