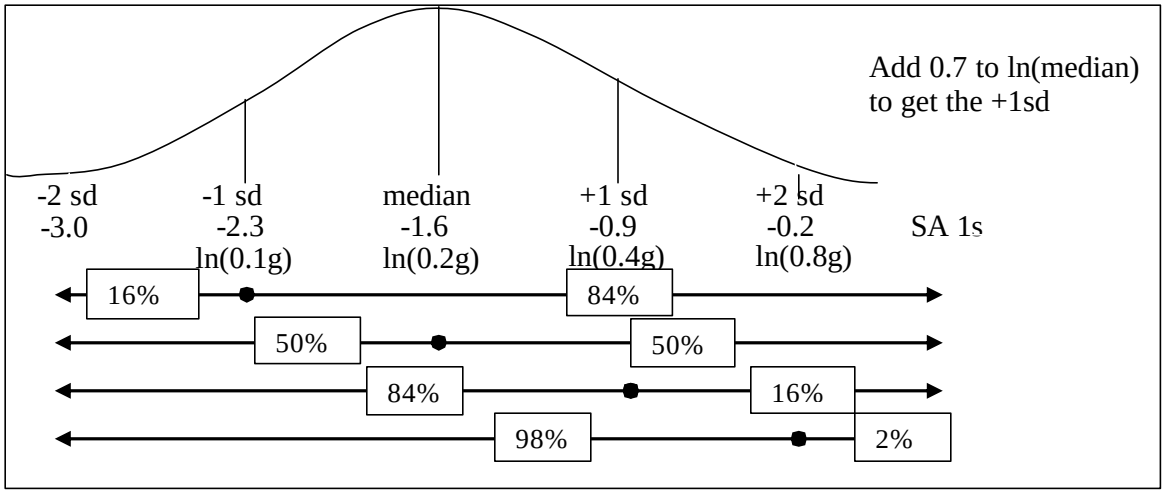
PSHA hypothetical problem (these relations are not correct so please do not use these in a real engineering application!!)

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:

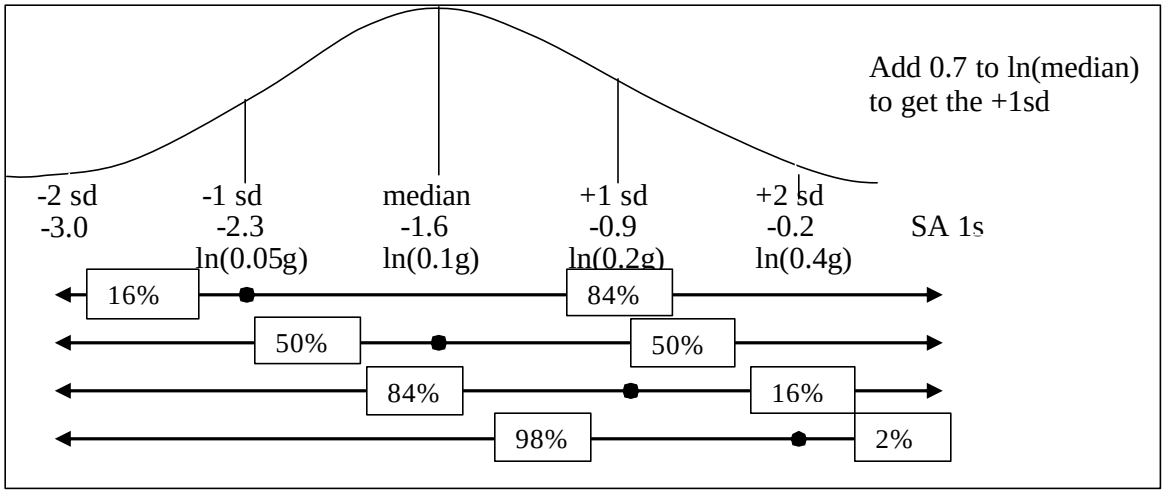
   Remember that the Rate of exceedance of a ground motion is the rate of the earthquake multiplied by the probability that the ground motion will exceed the given level (0g, 0.2g, etc).
   Rate = rate of earthquake X P(x>x')

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.