Section 5.3: contd

Wednesday, May 22, 2013
11:52 AM

then x = number of events occurring in a period of time or space

μ = average number of such events expected to occur

and

$$P(x=k) = \frac{\mu^k e^{-\mu}}{k!} \quad \text{where } k = 0, 1, 2, \ldots$$

note: k has no maximum value
$\rightarrow$ unbounded

also

mean: μ

std dev: $\sigma = \sqrt{\mu}$

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example:

For a particular cement mix, the average number of cracks per concrete specimen is 2.5. Assume that this number of cracks obeys a Poisson distribution.

a) find the mean and standard deviation for the number of cracks per specimen.
b) what's the probability of having at least one crack in a randomly chosen specimen?

a) $\mu = 2.5$

$\sigma = \sqrt{\mu} = \sqrt{2.5} \approx 1.58 \approx 1.6$

b) $P(x \geq 1) = 1 - P(x=0)$

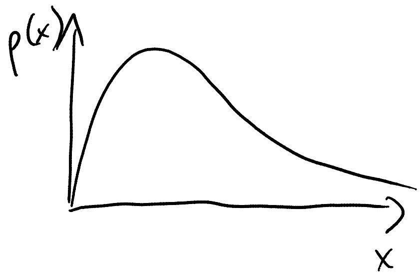
$$P(x=k) = \frac{\mu^k e^{-\mu}}{k!}$$

$$P(x=0) = \frac{(2.5)^0 e^{-2.5}}{0!} = 0.082085$$

$$P(x \geq 1) = 1 - 0.082085 = 0.917915 = 92\%$$

note: $\mu \pm 2\sigma$ = the interval from -0.7 to 5.7

and if you sum $\sum_{x=0}^{5} p(x) = 0.958$



Poisson distributions look like this

- unimodal + skewed to the right

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example:

In nuclear physics, the number of neutrons detected in a particular detector over a certain time period is a Poisson process. What average number of events should you measure so that your standard deviation is 1% of the mean?

$$\sigma = 0.01 \mu$$

$$\sqrt{\mu} = 0.01 \mu$$

$$1 = 0.01 \frac{\mu}{\mu^{1/2}}$$

$$1 = 0.01 \mu^{1/2}$$

$$1 = \frac{1}{100} \sqrt{\mu}$$

$$100 = \sqrt{\mu}$$

$$10000 = \mu$$