iclicker 2: using binomial
p=prob bad = .001 = 1000/1000000
n=5
5 << 1000000 so ignore that it's selection w/o replacement

prob(k bad of 5) = (5 choose k) p^k q^(5-k)
prob(0 bad) = 1 .999^5 = .995
prob(1 bad) = (5 choose 1) p^1 q^4 = 5 * .001 * .996 = very small
prob(1 bad) is much less than prob(0 bad) so ignore it.
prob(0 or 1 bad) = .995

approximation I used: (1-e)^n approx = 1-ne if ne<<1

.999^10 = .990 approx

(1-e)^n = 1 -ne + (n choose 2)e^2 - ...

Try the same question using Poisson.

The event is the number of bad widgets.
p = .001

Prob(k bad) = p^k e^(-p) / k!
Prob(0 bad) = 1 * (1-p) * 1 = .999
Prob(1 bad) = .001 * .999 * 1 = .000999 << .999

p here is lambda in wikipedia or alpha in the text.

Poisson good when there are many possible events, but prob of any one
is very small, so expected number is reasonable.
e.g. radioactive decay.

Perhaps there are 10^24 atoms. Prob of any one decaying is 10^-20.
Expected number of decays is 10,000.

book 3.51 a

WANT $(a+b+c)^n$

KNOW $(a+b)^n = \sum_{k=0}^{n} \binom{n}{k} a^k b^{n-k}$

pw/

$a+b+c = (a+b)+c$

$(a+b+c)^n = ((a+b)+c)^n$

$= \sum_{k=0}^{n} \binom{n}{k} (a+b)^k c^{n-k}$

$= \sum_{i=0}^{k} \binom{k}{i} a^i b^{k-i}$

$= \sum_{k=0}^{n} \sum_{i=0}^{k} \binom{n}{k}\binom{k}{i} a^i b^{k-i} c^{n-k}$

$\frac{n!}{k!(n-k)!} \frac{k!}{i!(k-i)!}$

$\frac{n!}{(n-k)!\, i!\, (k-i)!}$

$$(a+b+c)^n = \sum_{k=0}^{n} \sum_{i=0}^{k} \frac{n!}{(n-k)!\, i!\, (k-i)!} a^i b^{k-i} c^{n-k}$$

Let $j = k - i$

$i = k - j$

$$\sum_{k=0}^{n} \sum_{j=0}^{k} \frac{n!}{(n-k)!}$$

q 3.91 on page 139.

Poisson mean λ

$$P(K) = \frac{\lambda^k e^{-\lambda}}{K!}$$

$$P(K|YES) = \frac{\lambda_1^k}{K!} e^{-\lambda_1}$$

$$P(K|NO) = \frac{\lambda_0^k}{K!} e^{-\lambda_0}$$

$$P(YES) = p$$

$$P(k) = P(K|YES)\, P(YES) + P(K|NO)\, P(NO)$$

$$= \frac{\lambda_1^k}{K!} e^{-\lambda_1} p + \frac{\lambda_0^k}{K!} e^{-\lambda_0} q$$

$$P(YES|k)\, P(K) = P(YES + K)$$

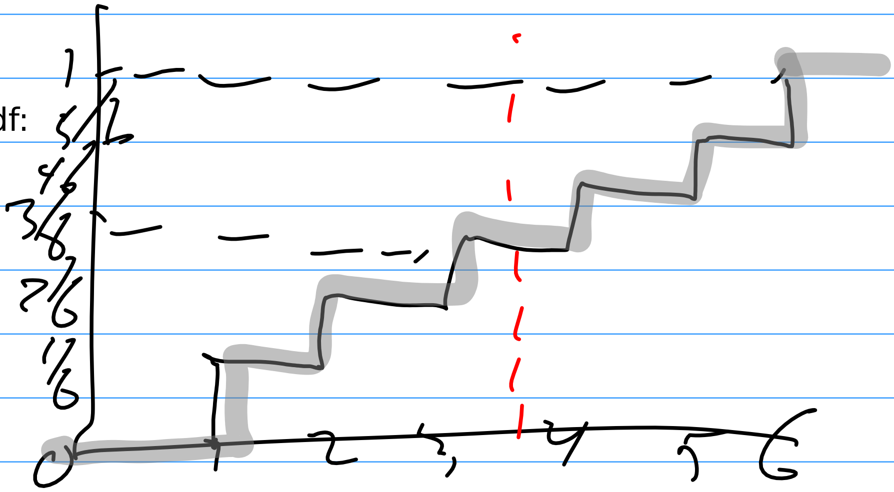
$$P(YES \mid K) = \frac{\frac{\lambda_1^K}{K!} e^{-\lambda_1} p}{\frac{\lambda_1^K}{K!} e^{-\lambda_1} p + \frac{\lambda_0^K}{K!} e^{-\lambda_0} q}$$

$$= \frac{\left(\frac{\lambda_1}{\lambda_0}\right)^K e^{-\lambda_1} p}{\left(\frac{\lambda_1}{\lambda_0}\right)^K e^{-\lambda_1} p + e^{-\lambda_0} q}$$

$$= \frac{\left(\frac{\lambda_1}{\lambda_0}\right)^K e^{\lambda_0 - \lambda_1} p}{\left(\frac{\lambda_1}{\lambda_0}\right)^K e^{\lambda_0 - \lambda_1} p + q}$$

page 6

for die cdf:



P(DIE AT MOST 3½) = 1/2

P(... 1) = 1/6

P(... 100) = 1