2.3

$$P_B(x; n, p) = \binom{n}{x} p^x (1-p)^{n-x}$$

x	P_B
0	1/64
1	6/64
2	15/64
3	20/64
4	15/64
5	6/64
6	1/64

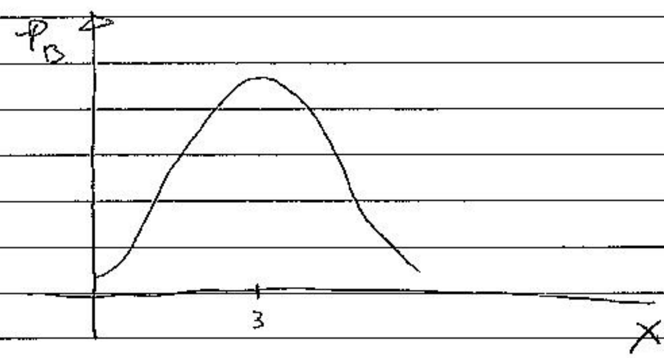
w/ $p = 1/2$

NOTE SYMMETRY OF P_B's

$$\boxed{\mu = Np = 3}$$

$$\sigma^2 = Npq = 3/2 \Rightarrow \boxed{\sigma = 1.22}$$

ROUGH SKETCH

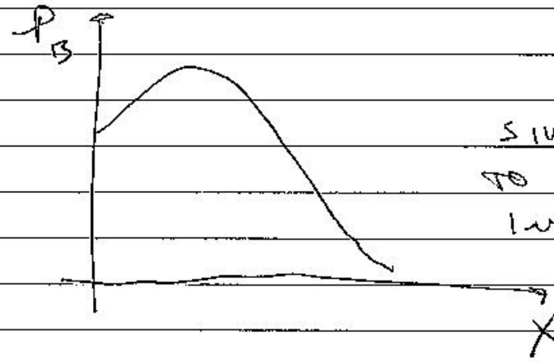


2.3 w/ $p = 1/6$

X	P_B
0	0.335
1	0.402
2	0.201
3	0.054
4	0.008
5	0.0006
6	2.1 -5

$\mu = Np = 1$

$\sigma = (5/6)^{1/2} = 0.913$



SIMILAR TO FIG 2.2 IN TEXT

TEC

2.7

$$\sigma^2 = \sum_{x=0}^{N} \left[(x-\mu)^2 \frac{N!}{x!\,(N-x)!} p^x q^{N-x} \right]$$

$$= \sum_{x=0}^{N} x^2 \frac{N!}{x!\,(N-x)!} p^x q^{N-x} \qquad (1)$$

$$- \sum_{x=0}^{N} 2\mu x \frac{N!}{x!\,(N-x)!} p^x q^{N-x} \qquad (2)$$

$$+ \mu^2 \sum_{x=0}^{N} \frac{N!}{x!\,(N-x)!} p^x q^{N-x} \qquad (3)$$

$$\boxed{(3) = \mu^2}, \text{ since } \sum_{x=0}^{N} \frac{N!}{x!\,(N-x)!} p^x q^{N-x} = 1$$

$$(2) = -2\mu \sum_{x=0}^{N} \frac{x}{x!} \frac{N!}{(N-x)!} p^x q^{N-x}$$

$$= -2\mu \sum_{x=1}^{N} \frac{1}{(x-1)!} \frac{N(N-1)!}{(N-x)!} p\, p^{x-1} q^{N-x}$$

$$= -2\mu N p \sum_{x=1}^{N} \frac{1}{(x-1)!} \frac{(N-1)!}{(N-x)!} p^{x-1} q^{N-x}$$

Let $n = N-1$

$y = x-1$

#2.7

THEN

$$② = -2\mu Np \sum_{y=0}^{m} \frac{1}{y!} \frac{m!}{(m-y)!} p^{y} q^{m-y}$$

$$\boxed{② = -2\mu Np}$$

NOW, $$① = \sum_{x=0}^{N} \frac{x^2}{x!} \frac{N!}{(N-x)!} p^{x} q^{N-x}$$

$$= \sum_{x=1}^{N} \cancel{\frac{1}{x!}} \frac{x}{(x-1)!} \frac{N(N-1)!}{(N-x)!} p\, p^{x-1} q^{N-x}$$

$$= \sum_{x=1}^{N} \frac{x-1}{(x-1)!} \frac{N(N-1)!}{(N-x)!} p\, p^{x-1} q^{N-x} + \sum_{x=1}^{N} \frac{1}{(x-1)!} \frac{N(N-1)!}{(N-x)!} p\, p^{x-1} q^{N-x}$$

$$= \sum_{x=2}^{N} \frac{1}{(x-2)!} \frac{N(N-1)(N-2)!}{(N-x)!} p^2 p^{x-2} q^{N-x} + Ⓑ$$

$$= p^2 N(N-1) \sum_{x=2}^{N} \frac{(N-2)!}{(x-2)!\,(N-x)!} p^{x-2} q^{N-x} + Ⓑ$$

$$= p^2 N(N-1) \sum_{z=0}^{s} \frac{1}{z!} \frac{s!}{(s-z)!} p^{z} q^{s-z} + Ⓑ$$

w/ $z = x-2$, $s = N-2$

$$= p^2 N(N-1) + Ⓑ$$

#2.7

$$\text{1B} = \sum_{x=1}^{N} \frac{1}{(x-1)!} \frac{N(N-1)!}{(N-x)!} p\, p^{x-1} q^{N-x}$$

$$= Np \sum_{t=0}^{y} \frac{1}{t!} \frac{y!}{(y-t)!} p^{t} q^{y-t}$$

$$= Np$$

$$\Rightarrow \text{1} = p^2 N(N-1) + Np$$

COLLECTING TERMS,

$$\sigma^2 = \text{1} + \text{2} + \text{3}$$

$$= p^2N^2 - p^2N + Np - 2N^2p^2 + N^2p^2$$

$$= Np - p^2N$$

$$= Np(1-p)$$

$$\boxed{\sigma^2 = Npq}$$

2.13

a) $\text{Prob}(\geq 8 \text{ evts}) = 1 - e^{-\mu} \sum_{x=0}^{7} \mu^x / x!$

w/ $\mu = 2/\text{DAY}$

$\text{PROB}(\geq 8 \text{ evts}) = 0.001$

(I wrote a program to evaluate formula. MMA OK too)

b) Here, $\mu = 1.39 \; (-2) / 10 \text{ min.}$

$\text{PROB}(\geq 8 \text{ evts}) = 8.73 \times 10^{-17}$

BEVINGTON 2.14

BINOMIAL PROCESS

$N = N_R + N_L = 1000$ (FIXED NUMBER)

$P_R \simeq \frac{670}{1000} = 0.67$

$P_L \simeq \frac{330}{1000} = 0.33$

$\sigma = \sigma_R = \sigma_L$ BECAUSE N IS KNOWN PRECISELY.

$\sigma = \sqrt{Npq} = [10^3 * 0.67 * 0.33]^{1/2}$

$\boxed{\sigma = 14.9}$

b) $A = \frac{N_R - N_L}{N_R + N_L} = \frac{2N_R - N}{N} = \frac{2(670 \pm 14.9)}{10^3} - 1$

$\boxed{A_{EXPT} = 0.34 \pm 0.03}$

(c) $A = 0.400 = \frac{N_R - N_L}{1000} \Rightarrow N_R = 700$, $N_L = 300$

or $p = 0.7$, $q = 0.3$

$\sigma_R = \sqrt{Npq} = [10^3 (0.7)(0.3)]^{1/2}$

$\boxed{\sigma_R = 14.5}$ FOR part a.

BEVINGTON
2.14

(C) ~~THE σ_A~~

FOR A WE HAVE

$$A = \frac{2N_R - N}{N} = \frac{2(700 \pm 14.5)}{10^3} - 1$$

$$\Rightarrow A = 0.400 \pm 0.029$$

$$\boxed{\sigma_A = 0.029}$$

SEE NEXT PA