By the given statement, if the nationwide rate holds true, then the number of develop influenza in a class with 15 students followed bionomial distribution $B(15, 0.2)$.

4.9 Thus the probability of obtaining at least 6 cases in the class is $P(X \geq 6)$ where

$$P(X \geq 6) = 1 - P(X \leq 5) = 1 - \sum_{k=0}^{5} \binom{15}{k} (0.2)^k (0.8)^{15-k} = 6.1051 \times 10^{-2}.$$

However, there were 6 out of 15 students in this class develop influenza. We can see that $\frac{6}{15} = 0.4 >> 6.1051 \times 10^{-2}$. Therefore, there is evidence of an excessive number of cases in the class.

4.10 The expected number of students in the class who will develop influenza is

$$E(X) = 15 \times 0.2 = 3.$$

4.36 Generally, the probability that a hypertensive know he/she has high blood pressure and are being treated appropriately and are complying with this treatment is $(0.5)^3 = 0.125$. Thus we have $X \sim B(10, 0.125)$. Since

$$P(X \geq 5) = 1 - P(X \leq 4) = 1 - \sum_{k=0}^{4} \binom{10}{k} (0.125)^k (0.875)^{10-k} = 4.4545 \times 10^{-3}.$$

Thus the probability that among 10 true hypertensive at least 50% are being treated appropriately and are complying with this treatment is $4.4545 \times 10^{-3}$.

4.37 Since the probability that one hypertensive know he/she has high blood pressure is 0.5, thus we have the number $X$ of 10 hypertensives know they have high blood pressure follows $B(10, 0.5)$, and the probability that at least 7 of the 10 hypertensives know they have high blood pressure is

$$P(X \geq 7) = \sum_{k=7}^{10} \binom{10}{k} (0.125)^k (0.875)^{10-k} = 0.17188.$$

4.38 If the preceding 50% rates were each reduced to 40%, then the probability that a hypertensive is being treated appropriately and is complying with the treatment became $(0.6)^3 = 0.216$. Suppose the morality rate for untreated hypertensives be $m$ and then for treated hypertensives will be $0.8m$. Then, the overall morality rate before and after education are $(1 - 0.125)m + (0.125)(0.8)m = 0.975m$ and $(1 - 0.216)m + (0.216)(0.8)m = 0.9568m$ respectively. Therefore, the morality rate would decrease by the education program became

$$1 - \frac{0.9568m}{0.975m} = 1.8667 \times 10^{-2} \approx 1.87.$$
Let $X \sim B(20, 0.05)$ and $Y|X \sim B(20 - X, 0.2)$, then

$$P(X = k) = \binom{20}{k} (0.05)^k (0.95)^{20-k}, \text{ for } k = 0, 1, \ldots, 20;$$

$$P(Y = j|X = k) = \binom{20 - k}{j} (0.05)^j (0.95)^{20-j-k}, \text{ for } k + j = 0, 1, \ldots, 20.$$

4.57 The probability that 3 or more rats will die in the first 4 hours is

$$P(X \geq 3) = 1 - P(X \leq 2)$$

$$= 1 - \sum_{k=0}^{2} \binom{20}{k} (0.05)^k (0.95)^{20-k}$$

$$= 7.5484 \times 10^{-2}.$$

4.58 Suppose two rats die in the first 4 hours, then the probability that 2 or fewer rats will die in the next 4 hours is

$$P(Y \leq 2|X = 2) = \sum_{k=0}^{2} \binom{18}{k} (0.1)^k (0.9)^{18-k} = 0.7338.$$

4.59 The probability that 0 rats die in the first 4 hours is

$$P(X = 0) = (0.95)^{20};$$

the probability that 0 rats die in the next 4 hours given no rat die in first 4 hours is

$$P(Y = 0|X = 0) = (0.9)^{20}.$$

Therefore, the probability that 0 rats die in the 8 hours is

$$(0.95)^{20}(0.9)^{20} = 4.3584 \times 10^{-2}.$$

4.60 Similar as (4.59), the probability that 1 rats die in the first 4 hours and 0 rats die in the next 4 hours is

$$P(X = 1)P(Y = 0|X = 1) = \binom{20}{1} (0.05)(0.95)^{19}(0.9)^{19};$$

and the probability that 0 rats die in the first 4 hours and 1 rats die in the next 4 hours is

$$P(X = 0)P(Y = 1|X = 0) = (0.95)^{20} \binom{20}{1} (0.1)(0.9)^{19}.$$

Then the probability that 1 rat will die in the 8 hours period is

$$\binom{20}{1} (0.05)(0.95)^{19}(0.9)^{19} + (0.95)^{20} \binom{20}{1} (0.1)(0.9)^{19} = 0.14783.$$
4.61 Similar as (4.59), the probability that 2 rats die in the first 4 hours and 0 rats die in the next 4 hours is

\[ P(X = 2)P(Y = 0|X = 2) = \binom{20}{2}(0.05)^2(0.95)^{18}(0.9)^{18}; \]

and the probability that 1 rats die in the first 4 hours and 1 rats die in the next 4 hours is

\[ P(X = 1)P(Y = 1|X = 1) = \binom{20}{1}(0.05)^1(0.95)^{19}\binom{19}{1}(0.1)^1(0.9)^{18}; \]

and the probability that 0 rats die in the first 4 hours and 2 rats die in the next 4 hours is

\[ P(X = 0)P(Y = 2|X = 0) = (0.95)^{20}\binom{20}{2}(0.1)^2(0.9)^{18}; \]

Then the probability that 2 rat will die in the 8 hours period is 0.23817.

4.62 The probability that \( a \) rats die in the first 4 hours and \( b \) rats die in the next 4 hours is

\[ P(X = a)P(Y = b|X = a) = \binom{20}{a}(0.05)^a(0.95)^{20-a}\binom{20-a-b}{b}(0.1)^b(0.9)^{20-a-b}; \]

where \( 0 \leq a + b \leq 20 \). Then the required formula is

\[
\sum_{a=0}^{x} P(X = a)P(Y = b|X = a). 
\]

\[
\begin{array}{c|c|c|c}
 x & \text{Prob} & x & \text{Prob} \\
 0 & 0.04358 & 6 & 0.04019 \\
 1 & 0.14783 & 7 & 0.01363 \\
 2 & 0.23817 & 8 & 0.00376 \\
 3 & 0.24234 & 9 & 0.00085 \\
 4 & 0.17467 & 10 & 0.00016 \\
 5 & 0.09479 & & \\
\end{array}
\]

Let \( X \sim B(5, 0.4) \), then

4.69 The probability that exactly 3 of 5 light users are HIV positive is

\[ P(X = 3) = \binom{5}{3}(0.4)^3(0.6)^2 = 0.2034. \]
4.70 The probability that at least 3 of 5 light users are HIV positive is

\[ P(X \geq 3) = \sum_{k=3}^{5} \binom{5}{k} (0.4)^k (0.6)^{5-k} = 0.31744. \]

4.73 Let \( X \sim B(200, 0.0067) \), then the probability that exactly 2 will become blind over a 1-year period in a group of 200 IDDM 30- to 39-year-old men is

\[ P(X = 2) = \binom{200}{2} (0.0067)^2 (0.9933)^{198} = 0.23601. \]

4.74 Let \( Y \sim B(200, 0.0074) \), then the probability that at least 2 will become blind over a 1-year period in a group of 200 IDDM 30- to 39-year-old women is

\[
\begin{align*}
P(Y \geq 2) &= 1 - P(Y \leq 1) \\
&= 1 - \sum_{k=0}^{1} \binom{200}{k} (0.0074)^k (0.9926)^{200-k} \\
&= 0.43606.
\end{align*}
\]

4.75 Since the probability that a 30-year-old male IDDM patient will not become blind over the next 10 years is \((0.9933)^{10} = 0.93498\), thus the required probability is equal to \(1 - 0.93498 = 0.06502\).