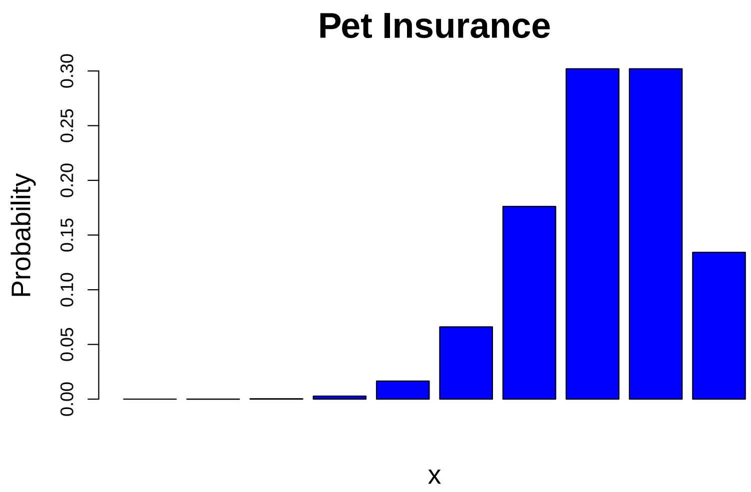
1. This is a binomial distribution with $n = 9$, $x = 6$ and $p = 0.8$.

   (a) $P(X = 6) = \binom{9}{6} 0.8^6 \cdot 0.2^3 \approx 0.1762$

   (b) $\sum_{x=6}^{9} \binom{9}{x} 0.8^x \cdot 0.2^{9-x} \approx 0.1762 + 0.3020 + 0.3020 + 0.1342 = 0.9144$

   $E(X) = \sum_{x=0}^{9} xf(x) = \sum_{x=0}^{9} x\binom{9}{x} 0.8^x \cdot 0.2^{9-x} = 7.2$ OR $E(X) = np = 9 \cdot 0.8 = 7.2$

```
barplot(height=y,xlab="x",ylab="Probability",main="Pet Insurance",col="blue",cex.lab=1.5,cex.main=2)
```



2. (a)

$$
\begin{aligned}
E(X) &= -2f(-2) + (-1)f(-1) + 0f(0) + 1f(1) + 2f(2) \\
&= -\frac{2}{4}(-2-1)^2 - \frac{1}{4}(-1-1)^2 + \frac{0}{4}(0-1)^2 + \frac{1}{4}(1-1)^2 + \frac{2}{4}(2-1)^2 \\
&= -\frac{18}{4} - \frac{4}{4} + \frac{0}{4} + \frac{0}{4} + \frac{2}{4} \\
&= -5
\end{aligned}
$$

   This is not in the range of x values, so it does not make sense. The reason is that the function is not a probability distribution. Although it is true that $f(x) \geq 0$ for all x, it is not true that the sum of all function values is 1.

   (b) Consider the current total of function values and divide the function by that number. That way, the sum of new function totals will be 1.

$$f(-2) = \frac{9}{4}, \qquad f(-1) = 1, \qquad f(0) = \frac{1}{4}, \qquad f(1) = 0, \qquad f(2) = \frac{1}{4}$$

$$\sum_{x=-2}^{2} f(x) = \frac{9}{4} + 1 + \frac{1}{4} + 0 + \frac{1}{4} = \frac{15}{4}$$

   So divide f by $\frac{15}{4}$, we'll call that new function g:

$$g(x) = \frac{f(x)}{15/4} = \frac{4}{15} \cdot \frac{1}{4}(x-1)^2 = \frac{1}{15}(x-1)^2$$

Now let's test that g is a probability distribution.

$$\sum_{x=-2}^{2} g(x) = \frac{9}{15} + 1 + \frac{1}{15} + 0 + \frac{1}{15} = \frac{15}{15} = 1$$

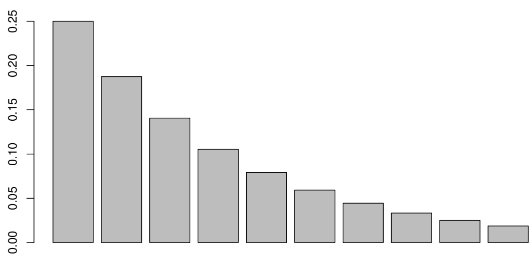
The expected value of g is

$$\begin{aligned}
E(X) &= -2g(-2) + (-1)g(-1) + 0g(0) + 1g(1) + 2g(2) \\
&= -\frac{2}{15}(-2-1)^2 - \frac{1}{15}(-1-1)^2 + \frac{0}{15}(0-1)^2 + \frac{1}{15}(1-1)^2 + \frac{2}{15}(2-1)^2 \\
&= -\frac{18}{15} - \frac{4}{15} + \frac{0}{15} + \frac{0}{15} + \frac{2}{15} \\
&= -\frac{4}{3}
\end{aligned}$$

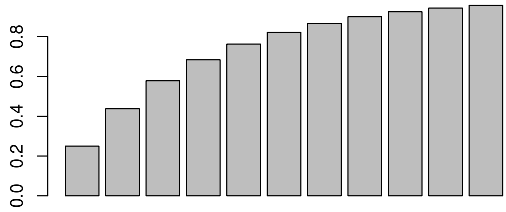
This number is between -2 and 2, and it's close to the -2 and the -1, which are the x values that yield the highest values of g, so this makes sense.

3. This is a geometric distribution with $p = 0.25$.

   (a)
```
x<-c(0:9)
(y<-c(dgeom(x,0.25)))
 [1]  0.2500000   0.18750000  0.14062500  0.10546875  0.07910156
 [6]  0.05932617  0.04449463  0.03337097  0.02502823  0.01877117
barplot(y)
```



   (b)
```
(Y<-cumsum(y))
 [1]  0.2500000  0.4375000  0.5781250  0.6835938  0.7626953
 [6]  0.8220215  0.8665161  0.8998871  0.9249153  0.9436865
barplot(Y)
```



(c) $\mu = \frac{1}{p} = \frac{1}{0.25} = 4$. If this happens, every 4 games you will bet a total of 4 dollars and win 3 dollars, for a net loss of one dollar. Don't play this game.

4. (a) $\mu = \lambda t = 0.2 \cdot 20 = 4$

   (b) $\sigma = \sqrt{\mu} = 2$

   (c) $P(X = 3) = \frac{4^3}{3!}e^{-4} \approx 0.1954$

   (d) $P(X \geq 3) = 1 - \left(\frac{4^0}{0!} + \frac{4^1}{1!} + \frac{4^2}{2!}\right) e^{-4} \approx 0.7619$

   (e) Binomial (Success: no errors on that slide; Failure: at least one error).

   (f) $\mu = np = 20 \cdot 0.8 = 16; \sigma = \sqrt{npq} = \sqrt{16(1 - 0.8)} = \sqrt{3.2} \approx 1.7889$

   (g) $P(X = 18) = \binom{20}{18}.8^{18}.2^2 \approx 0.1369$

   (h) $P(X \geq 18) = \binom{20}{18}.8^{18}.2^2 + \binom{20}{19}.8^{19}.2^1 + \binom{20}{20}.8^{20}.2^0 \approx 0.2061$