Homework for Module 3

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August 29, 2011

2.5.9

a) 0.80

b) 0.3676

c)

$$\begin{aligned} E(X) &= 2.94 \\ \text{Var}(X) &= 0.942 - (2.94)^2 \\ &= -7.7016 \end{aligned}$$

d)

$$\begin{aligned} E(4) &= 2.86 \\ \text{Var}(4) &= -7.3118 \end{aligned}$$

e) Yes. Yes. I don't know.

f) 0.3

g)

$$\begin{aligned} \text{Cov}(X,Y) &= E(XY) - E(X)E(Y) \\ &= 9.29 - 8.4084 \\ &= 0.8816 \end{aligned}$$

h)

$$\begin{aligned} \text{Cor}(X,Y) &= \frac{0.8816}{\sqrt{-7.7016 \times -7.3118}} \\ &\approx 0.1175 \end{aligned}$$

2.8.19

a) True

b) False

c) True

d) True

e) True

f) False

3.1.1

a)

$$\begin{aligned} P(X = 3) &= \binom{10}{3} 0.12^3 (1 - 0.12)^{10-3} \\ &\approx 0.084743 \end{aligned}$$

b)

$$\begin{aligned} P(X = 6) &= \binom{10}{63} 0.12^6 (1 - 0.12)^{10-6} \\ &\approx 0.000376043 \end{aligned}$$

c)

$$\begin{aligned} P(X \leq 2) &= P(X = 2) + P(X = 1) + P(X = 0) \\ &\approx 0.233043 + 0.379774 + 0.278501 \\ &\approx 0.891318 \end{aligned}$$

d)

$$\begin{aligned} P(X \geq 7) &= 1 - P(X \leq 6) \\ &= 1 \qquad -P(X = 6) + P(X = 5) + P(X = 4) + P(X = 3) + P(X = 2) + P(X = 1) + P(X \\ &\approx 1 - 0.999969023 \\ &\approx 0.000030977 \end{aligned}$$

e)

$$\begin{aligned} E(X) &= p \\ &= 0.12 \end{aligned}$$

f)

$$\begin{aligned} \text{Var}(X) &= p(1 - p) \\ &= 0.12(1 - 0.12) \\ &= 0.1056 \end{aligned}$$

3.1.5

a)

$$P(X = 5)\text{for}X \sim B(8, 0.5) \approx 0.021875$$

b)

$$P(X = 1)\text{for}X \sim B(8, \frac{1}{6}) \approx 0.3721$$

c)

$$P(X = 0)\text{for}X \sim B(8, \frac{1}{6}) \approx 0.2326$$

d)

$$\begin{aligned} P(X \geq 6)\text{for}X \sim B(8, \frac{2}{3}) &= 1 - P(X \leq 5) \\ &\approx 1 - 0.273129 + 0.170706 + 0.0682823 + 0.0170706 + 0.00243865 + 0.000152416 \\ &\approx 1 - 0.531778966 \\ &\approx 0.468221034 \end{aligned}$$

3.2.1

a)

$$P(X = 4) \approx 0.018$$

b)

$$P(X = 1) = 0.7$$

c)

$$P(X \leq 5) \approx 0.99757$$

d)

$$\begin{aligned} P(X \geq 8) &= 1 - P(X \leq 7) \\ &\approx 0.9999781 \end{aligned}$$

3.4.5

a)

$$P(X = 0) \approx 0.778801$$

b)

$$\begin{aligned} P(X \leq 1) &= P(X = 1) + P(X = 0) \\ &\approx 0.778801 + 0.1947 \\ &\approx 0.973501 \end{aligned}$$

3.4.7

a) Using the formulas $\frac{e^{-\lambda}\lambda^x}{x!}$ and $\lambda = np \approx B(n,p)$, I tried to calculate as follows for $p = 0.005$:

$$P(X \leq 3) = P(X = 3) + P(X = 2) + P(X = 1) + P(X = 0)$$

Calculating each of the equations as follows:

$$\frac{e^{-3\times 0.005}(3 \times 0.005)^3}{3!} \approx 5.54125 \times 10^{-7}$$
$$\frac{e^{-2\times 0.005}(2 \times 0.005)^2}{2!} \approx 0.0000495025$$
$$\frac{e^{-1\times 0.005}(1 \times 0.005)^1}{1!} \approx 0.00497506$$
$$\frac{e^{-0\times 0.005}(0 \times 0.005)^0}{0!} = \text{indeterminate}$$

So I don't know what to do now.

3.5.1

a)

$$\frac{11!}{4!5!2!} \times 0.23^4 \times 0.48^5 \times 0.29^2 \approx 0.0415572$$

b)

$$\frac{7!}{2!5!} \times 0.23^2 \times 0.77^5 \approx 0.300697$$
$$\frac{7!}{1!6!} \times 0.23^1 \times 0.77^6 \approx 0.335560$$
$$\frac{7!}{0!7!} \times 0.23^0 \times 0.77^7 \approx 0.160485$$

And then sum...

$$0.300697 + 0.335560 + 0.160485 \approx 0.796742$$

3.5.3

a)

$$\frac{8!}{2!1!5!} \times 0.09^2 \times 0.12^1 \times 0.79^5 \approx 0.0502471$$

b)

$$\frac{8!}{1!2!5!} \times 0.09^1 \times 0.12^2 \times 0.79^5 \approx 0.0669961$$

c) 0.96