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Assignment 2
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1) (a) - Hypogeometric Distribution
- where $N_1 = 10$, $N_2 = 6$, $N = 16$, $0 \leq x \leq N_1$, $0 \leq n-x \leq N_2$, $n = 3$.

(b) $P(X=1) = \frac{\binom{N_1}{x}\binom{N_2}{n-x}}{\binom{N}{n}} = \frac{\binom{10}{1}\binom{6}{3-1}}{\binom{16}{3}} = \underline{0.2679}$

(c) $P(X \leq 1) = P(X=0) + P(X=1)$
$= \frac{\binom{10}{0}\binom{6}{3}}{\binom{16}{3}} + 0.2679$
$= 0.0357 + 0.2679$
$= \underline{0.3036}$

2) $x = \{0, 1, 2\}$

(a)

X	0	1	2
P(X=x)	$\frac{2}{5}$	$\frac{2}{5}$	$\frac{1}{5}$

$P(X=0) = \frac{4}{5} \times \frac{1}{2}$
$P(X=1) = \frac{4}{5} \times \frac{1}{2}$
$P(X=2) = \frac{1}{5}$

(b) $E(X) = (0 \times \frac{2}{5}) + (1 \times \frac{2}{5}) + (2 \times \frac{1}{5})$
$= \frac{2}{5} + \frac{2}{5}$
$= \frac{4}{5}$

$Var(X) = E(X^2) - [E(X)]^2$
$= (0 + \frac{2}{5} + \frac{4}{5}) - (\frac{4}{5})^2$
$= 0.56$

(3)(b) p.m.f of X, $M(t) = E(e^{tX})$
$= \sum_{x \in S} e^{tx} f(x)$
$= 0.3e^{t} + 0.4e^{2t} + 0.2e^{3t} + 0.1e^{5t}$

(a)

X	1	2	3	5
p.m.f f(x)	0.3	0.4	0.2	0.1

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(b) $\mu = M'(0)$
$= E(X)$
$= 1(0.3) + 2(0.4) + 3(0.2) + 5(0.1)$
$= 2.2$

$\sigma^2 = E(X^2) - (E(X))^2$
$= ((0.3)(1)^2 + 0.4(2)^2 + 0.3(3)^2 + 0.1(5)^2) - (2.2)^2$
$= 1.36$

(c) $P(X \geq 2) = 1 - P(X<2)$
$= 1 - P(X=1)$
$= 1 - 0.3$
$= 0.7$

Great

(d) $E(2^X) = 0.3(2^1) + 0.4(2^2) + 0.2(2^3) + 0.1(2^5)$
$= 7$

(e) $E(e^{t(X^2-1)}) = 0.3e^{t(2-1)} + 0.4e^{t(2^2-1)} + 0.2e^{t(3^2-1)} + 0.1e^{t(5^2-1)}$
$= 0.3 + 0.4e^{3t} + 0.2e^{8t} + 0.1e^{24t}$

4(a) - Binomial Distribution

(b) $\mu = E(X)$
$= np$
$= 4(0.75)$
$= 3$

$\sigma^2 = E(X^2) - (E(X))^2$
$= np(1-p)$
$= 4(0.75)(1-0.75)$
$= 0.75$

(c) $P(1 \leq X \leq 2) = P(X=1) + P(X=2)$
$= \binom{4}{1}(0.75)^1(0.25)^3 + \binom{4}{2}(0.75)^2(0.25)^2$
$= 0.046875 + 0.2109$
$= 0.258$

5(a) - Geometric Distribution

(b) $\mu = \frac{1}{p}$
$= \frac{1}{0.25}$
$= 4$

$\sigma^2 = \frac{q}{p^2}$
$= \frac{0.75}{(0.25)^2}$
$= 12$

(c) $P(X \geq 2) = 1 - P(X<2)$
$= 1 - P(X=1)$
$= 1 - 0.25(0.75)^{1-1}$
$= 0.75$

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(d) $E[(1-0.75e^{-1})e^{-x+1} + 0.75]$

$= E[(0.25e^{-1})e^{-x+1} + 0.75]$

$= (0.25e^{-1}e^{-1+1} + 0.75) + (0.25e^{-1}e^{-2+1} + 0.75) + (0.25e^{-1}e^{-3+1} + 0.75)$

$+ (0.25e^{-1}e^{-4+1} + 0.75)$

$= 3.143$

6) (a) $P(X=2) = q \cdot p$

$= 0.9(0.1)$

$= 0.09$

(b) $P(X=x) = 0.9^{x-1}(0.1)$

(c) $P(X>3) = q^k$

$= 0.9^3$

$= 0.729$

(d) $P(X=x) = 1$ -0.5

$0.9^{x-1}(0.1) = 1$

$0.9^{x-1} = 10$ E(X) = 1/p= 10.

$(x-1)\log^{0.9} = \log^{10}$

$x-1 = \frac{\log^{10}}{\log 0.9}$

$x-1 = \log\left(\frac{10}{0.9}\right)$ $\therefore$ 2 shots to suffer the first miss

$x-1 = 1.045$

$x = 2.045$

$x = 2$ -0.5

C_10^2

(e) Probability 2 misses in 10 shots $= {}^{9}C_2 (0.1)^2 (0.9)^8$

$= \underline{0.155}$ 0.1937

(f) $n=10$, $p=0.1$, $q=0.9$

$P(X \geq 1) = 1 - P(X=0)$

$= 1 - \binom{10}{0}(0.1)^0(0.9)^{10}$

$= 0.651$

(g) Probability misses 2nd time in 10 shot $= (0.9^8 \times 0.1)\ {}^{9}C_1 \times 0.1$

$= \underline{0.03874}$

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