(1) Car types $A, B, C$ are bought in numbers $100, 200, 300$ respectively, and have accident rates $0.3, 0.2, 0.1$ respectively. Given an accident, what is the probability that the car type $B$ is involved?
2(a) Suppose we toss 3 fair coins, and let $X$ be the number of heads. Find the probability mass function for $X$.

Please write your answer here:

$P(X = 0) = \quad P(X = 1) = \quad P(X = 2) = \quad P(X = 3) =$

2(b) Find $E_X$ and $\text{Var}(X)$.

Please write your answer here:

$E_X = \quad \text{Var}(X) =$

(more questions on the next page)
(2c) Suppose again we toss 3 fair coins, and let $X$ be the number of heads. Find the cumulative distribution function $F_X$ of $X$ using the cases provided below.

\[
F_X(x) = \begin{cases} 
0, & \text{for } -\infty < x < \underline{\quad} \\
\underline{\quad}, & \text{for } \underline{\quad} \leq x < \underline{\quad} \\
\underline{\quad}, & \text{for } \underline{\quad} \leq x < \underline{\quad} \\
\underline{\quad}, & \text{for } \underline{\quad} \leq x < \infty 
\end{cases}
\]

(2d) Plot the cumulative distribution function $F_X$ of $X$ using the chart provided below. Accurately label values at $x$ and $y$ axes.

(more questions on the next page)
(3a) Suppose we have 3 black and 3 red pens, and we select 2 pens in random.
Let $A = \{\text{the first pen is red}\}$ and $B = \{\text{the second pen is red}\}$.
Find if these events are independent.

Please write your answer here:

\[
\mathbb{P}(A) = \quad \mathbb{P}(B) = \quad \mathbb{P}(A \cap B) = \quad \text{Are } A \text{ and } B \text{ independent?}
\]

3(b) Find the probability the second pen is red, given that the first pen is red.

Please write your answer here:

\[
\mathbb{P}(B|A) =
\]

(more questions on the next page)
(3c) Suppose again that we have 3 black and 3 red pens, and we select 2 pens in random. Let $X$ be the number of red pens. Find the probability mass function for $X$.

Please write your answer here:

<table>
<thead>
<tr>
<th>$P(X = 0)$</th>
<th>$P(X = 1)$</th>
<th>$P(X = 2)$</th>
</tr>
</thead>
</table>

3(d) Find $\mathbb{E}X$ and $\text{Var}(X)$.

Please write your answer here:

| $\mathbb{E}X =$ | $\text{Var}(X) =$ |

(more questions on the next page)
Optional problem for extra credit. Suppose that currently 0.2 of population is infected with flu. We have a test with overall error rate $\alpha$, so that $\alpha$ is the false positive rate, and also is the false negative rate. Assume that if we administer this test to a random person, and it is positive, then the probability that this person has the flu is 0.8. What is $\alpha$?

Please write your answer here:

$\alpha =$

end of the test