1. A lot of 50 semiconductor chips contains 5 that are defective. Two chips are selected at random, without replacement, from the lot.
   (a) What is the probability that the first one selected is defective?
   (b) What is the probability that both are defective?
   (c) What is the probability that the second one selected is defective given that the first one was defective?
   (d) What is the probability that the second one selected is defective?

2. A factory produces its entire output with 3 machines. Machines I, II and III produce 70%, 10% and 20% of the output, respectively, but 5%, 20% and 10% of their outputs are defective, respectively. What fraction of the total output is defective?

3. In a particular county, only 60% of the people who take the driving test pass. Calculate the probability of not passing even after 2 independent trials. You are told that three young family members have taken the test and that at least one of them passes. Calculate the probability (given that information) that at least two passed.

4. Consider the binary communication channel shown in Figure 1. The channel input symbol $X$ may be assumed to be 0 or 1. Similarly, the channel output symbol $Y$ may also be assumed 0 or 1. Because of the channel noise, an input 0 may convert to an output 1 and vice versa. The channel is characterized by the channel transition probabilities $p_0; q_0; p_1; q_1$, defined by:

\begin{align*}
p_0 &= P(Y = 1 | X = 0); \\
p_1 &= P(Y = 0 | X = 1);
\end{align*}

\begin{align*}
q_0 &= P(Y = 0 | X = 0); \\
q_1 &= P(Y = 1 | X = 1);
\end{align*}

Note that

\[ p_0 + q_0 = p_1 + q_1 = 1. \]

Now, let $P(X = 0) = 0.5$, $p_0 = 0.2$, $p_1 = 0.3$

(a) Find $P(Y = 0)$ and $P(Y = 1)$.
(b) If a 1 was observed at the output, what is the probability that a 0 was the input state?
(c) What is the probability of error?