# ECE 302 Homework 2
Due June 28, 2016

Reading assignment: chapter 2 sections 2.5,2.6; chapter 3 sections 3.1,3.2; chapter 4 sections 4.1,4.2

1. A ternary digit (0, 1, or 2) is transmitted over a noisy channel. The transition probabilities for each input and output combination are shown on the diagram below. Assume that each digit is sent with probability 1/3.

   (a) Find the probabilities of the output digits.

   (b) Find the probability that a digit is received in error.

   (c) Find the probability that the digit sent was a 1 given an error occurs.
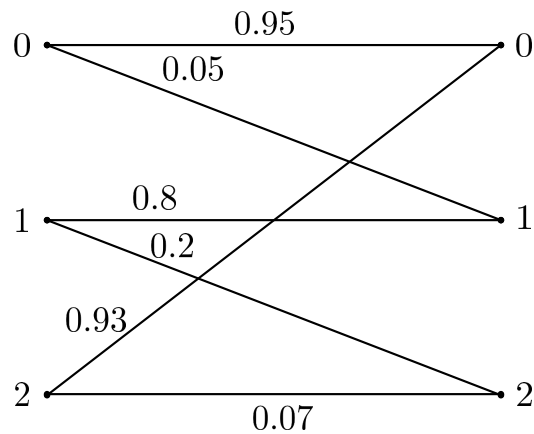
2. An experiment consists of picking one of two urns at random and then selecting a ball from the urn and noting its color (black or white). Let A be the event "urn 1 is selected" and B the event "a black ball is observed." Assume that each urn is equally likely of being selected. Under what conditions are A and B independent?

3. A student needs eight chips of a certain type to build a circuit. It is known that 5% of these chips are defective. How many chips should he buy for there to be a greater than 90% probability of having enough chips?

4. A student has accidentally shuffled a deck of cards without removing the joker. In order to remove the joker from the 53 cards, she draws cards from the top of the deck one at a time and sets them in a different pile until she finds the joker. Let X denote the number of cards she draws. Find the pmf of X.

5. A modem sends a +1, 0, or -1 voltage signal into a channel with equal probability. The channel adds to this signal a noise term that is +1 V or -1 V, where the probability of the noise being 1 V is p. Let X denote the output of the channel.

   (a) Find the pmf of X.

   (b) What is the most likely value of X? Does the answer depend on p? Explain why this makes sense.

   (c) Find the probability that X is nonnegative.

   (d) Find the probability that $|X| \leq 1$.

6. A random variable X has pdf:

$$f_X(x) = \begin{cases} c(1 - e^{\frac{1}{5}(x-3)}) & , -2 \leq x \leq 3 \\ 0 & , \text{else} \end{cases}$$

   (a) Find the value of c.

   (b) Find the probability that $-1 < X \leq 2$.

   (c) Find the probability that $(X - 1)^2 < 4$.

   (d) Find the cdf of X. Plot the pdf and the cdf of X.