

**553.633/433**

**Homework #3**

**Due Mon. 9/18/17**

Three problems:

1.19

A. *Given:* The components of a random vector are jointly Gaussian if the vector is multivariate normally (MVN) distributed. Suppose that two random variables  $X$  and  $Y$  are jointly Gaussian and satisfy  $\text{cov}(X, Y) = 0$ . It is then well known that  $X$  and  $Y$  are independent (see any of many textbooks on probability).

*Question:* Now, consider the case where  $X$  is normally distributed and  $Y$  is normally distributed and  $\text{cov}(X, Y) = 0$ . Show that  $X$  and  $Y$  are not necessarily independent. (Hint: Consider the counterexample to MVN discussed in class lecture.)

B. Consider an LCG with  $c = 0$ ,  $X_0 = 1$ , and modulus,  $m = 13$ . Suppose we consider 12 possible values of  $a$ , namely  $a \in \{1, 2, \dots, 12\}$ . Which values of  $a$  in the set of 12 possible values will yield a generator that produces all possible outcomes  $X_k \in \{1, 2, \dots, 12\}$ ? (Note that  $X_k$  cannot equal 0, or else the algorithm will get stuck at 0.)