Homework Set #1

1. Determine whether the following random processes are strictly stationary:
   
   (a) A process of independent random variables (i.e., a process for which the random variables \( X(t_1), \ldots, X(t_k) \) are independent for any \( k \) and any \( t_1, \ldots t_k \)).

   (b) A process of independent identically-distributed (iid) random variables.

   (c) A process of exchangeable random variables. (A set of random variables \( X_1, \ldots X_k \) is called exchangeable if their joint probability density function is invariant to any permutation of its arguments, i.e.,

   \[
   p_{X_1, \ldots, X_k}(x_1, \ldots, x_k) = p_{X_{i_1}, \ldots, X_{i_k}}(x_{i_1}, \ldots, x_{i_k})
   \]

   where \((i_1, \ldots, i_k)\) is any permutation of \((1, \ldots, k)\). A process of exchangeable random variables is one for which the random variables \( X(t_1), \ldots, X(t_k) \) are exchangeable for any \( k \) and any \( t_1, \ldots t_k \).

   (d) The process

   \[
   Y(t) = X(t) \cos(\omega t + \theta),
   \]

   where \( X(t) \) is a strictly stationary process and \( \theta \) is a random phase uniformly distributed between 0 and \( 2\pi \). (Recall in class we showed that if \( X(t) \) is wide-sense stationary, then so is \( Y(t) \).)

   (e) The process

   \[
   Y(t) = \cos X(t),
   \]

   where \( X(t) \) is a strictly stationary process.

2. Problem 1.1 in Haykin.

3. Problem 1.6 in Haykin.