1. If \(X_1, X_2, X_3\) are independent and identically distributed exponential random variables with parameter \(\lambda\), compute
   
   (a) (10 points) \(P(\min(X_1, X_2, X_3) \leq \alpha)\).
   
   (b) (10 points) \(P(\max(X_1, X_2, X_3) \leq \alpha)\).

2. Consider the sum of two complex sinusoids with random coefficients:

   \[X(t) = X_1 e^{j\omega_1 t} + X_2 e^{j\omega_2 t}\]

   where \(\omega_1 \neq \omega_2\), and \(X_1\) and \(X_2\) are complex-valued random variables.

   (a) (15 points) Find the autocorrelation function of \(X(t)\).

   (b) (15 points) Find conditions on \(X_1\) and \(X_2\) that make \(X(t)\) a wide-sense stationary process.

3. Let \(A_n\) be a real-valued wide-sense stationary zero-mean discrete-time random process that has autocorrelation function

   \[R_A(k) = \sigma^2 \delta[k]\]

   A decimator takes every other sample to form the random process \(V_m, m = 1, 2, \ldots\):

   \[A_1 A_3 A_5 A_7 A_9 A_{11} \ldots\]

   (a) (10 points) Find the autocorrelation function of \(V_m\).

   (b) (10 points) An interpolator takes the sequence \(V_m\) and inserts zeros between samples to form the sequence \(W_k\):

   \[A_1 0 A_3 0 A_5 0 A_7 0 A_9 0 A_{11} \ldots\]

   Find the autocorrelation function of \(W_k\).

   (c) (10 points) Is \(V_m\) wide-sense stationary? Is \(W_k\) wide-sense stationary?

4. (20 points) Let \(X_n\) converge in distribution to a constant \(a\) and let \(Y_n\) converge in distribution to a constant \(b\). If \(X_n\) and \(Y_n\) are independent sequences, does \(X_n + Y_n\) converge in distribution to \(a + b\)? You must justify your answer.