1. Consider process $X_k = \cos(k\pi/2 + P)$ where $P$ is uniform on $[0, 2\pi]$.
   (a) What is $E[X_k]$?
   (b) What is $E[X_kX_l]$?
   (c) Is $\{X_k\}$ wide sense stationary?
   (d) Is $\{X_k\}$ mean ergodic?
   (e) Suppose now that $P$ is uniformly chosen from the set $\{\pi/4, \pi/2, 3\pi/4, \pi, 5\pi/4, 3\pi/2, 7\pi/4, 2\pi\}$. Is $\{X_k\}$ a Markov chain?

2. Consider the Markov chain $\{X_k\}$ with transition probability
   \[
   p = \begin{bmatrix} .3 & .7 & 0 \\ .7 & .3 & 0 \\ 0 & 0 & 1 \end{bmatrix}.
   \]
   (a) Suppose $X_0$ is uniformly distributed across states $\{1, 2, 3\}$. Is $\{X_k\}, k \geq 0$ stationary?
   (b) What is $E[X_n]$?
   (c) What is $\lim_{N \to \infty} \frac{1}{N} \sum_{k=1}^{N} X_k$?
   (d) Is the process mean ergodic?

3. Durrett 5.1 pp 121
4. Durrett 5.3 pp 121
5. Durrett 5.5 pp 121
6. Durrett 5.9 pp 122
   Hint: Consider the stopping time $T = \min\{m > 0 : X_m > \lambda\}$. Also note that is possible that $P(T < \infty) < 1$. 