Problem 8.11 A random process is defined by the function

$$X(t,\theta) = A\cos(2\pi f t + \theta)$$

where A and f are constants, and  $\theta$  is uniformly distributed over the interval 0 to  $2\pi$ . Is X stationary to the first order?

## **Solution**

Denote

$$Y = X(t_1, \theta) = A\cos(2\pi f t_1 + \theta)$$

for any  $t_1$ . From Problem 8.7, the distribution of Y and therefore of X for any  $t_1$  is

$$F_{X(t_1)}(y) = \begin{cases} 0 & y < -A \\ \frac{2\pi - 2\cos^{-1}(y/A)}{2\pi} & |y| < A \\ 1 & y > A \end{cases}$$

Since the distribution is independent of *t* it is stationary to first order.

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