**Problem 8.11**  A random process is defined by the function

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

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

$$Y = X(t_1,\theta) = A\cos(2\pi ft_1 + \theta)$$

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

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

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