Assignment 11

Kotikalapudi Karthik (CS21BTECH11030)

May 28, 2022

Outline

Question

Probability, Random Variables and Stochastic Processes Chapter 2, Problem 5-42

Show that if $E\{x\} = \eta$, $\mu_n = E\left\{(x-\eta)^n\right\}$ then

$$E\{e^{sx}\} = e^{s\eta} \sum_{n=0}^{\infty} \mu_n \frac{s^n}{n!}$$

Known Equations

We know that

$$E\{x\} = \eta \tag{1}$$

$$\mu_n = E\left\{(x-\eta)^n\right\} \tag{2}$$

$$E\{kx\} = kE\{x\} \tag{3}$$

Solution

From equations (1), (2), (3),

$$E\left\{e^{sx}\right\} = E\left\{e^{s(x-\eta)}e^{s\eta}\right\} \tag{4}$$

$$= e^{s\eta}E\left\{e^{s(x-\eta)}\right\} \tag{5}$$

$$= e^{s\eta}E\left\{\sum_{n=0}^{\infty}\frac{s^n}{n!}(x-\eta)^n\right\} \tag{6}$$

$$= e^{s\eta}\sum_{n=0}^{\infty}\frac{s^n}{n!}E\left\{(x-\eta)^n\right\} \tag{7}$$

$$\implies E\left\{e^{sx}\right\} = e^{s\eta}\sum_{n=0}^{\infty}\mu_n\frac{s^n}{n!} \tag{8}$$