

# Random Process learning notes

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## Chapter 1

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- **Characteristic function:**  $g(X) = e^{jtX}$

$$\Phi(t) = E\{e^{jtX}\} = \int_{-\infty}^{+\infty} e^{jtx} p(x) dx$$

- 类比连续时间傅里叶变换  $f(w) = \int_{-\infty}^{+\infty} e^{-jex} p(x) dx$
- 随机变量  $Z = X + Y$ :

$$\begin{aligned}\Phi_Z(t) &= E\{e^{jt(X+Y)}\} \\ &= E\{e^{jtX}\} * E\{e^{jtY}\} \\ &= \Phi_X(t) * \Phi_Y(t)\end{aligned}$$

- For a nonnegative integer-valued random variable X it is often more convenient to work with the *z transform* of the pmf.

**Moment-generating function:**  $g(x) = e^{sX}$

$$\Phi(s) = E\{e^{sX}\} = \int_{-\infty}^{+\infty} e^{sx} p(x) dx$$

$$\begin{aligned}\Phi(s) &= E\{e^{sX}\} \\ &= E\left\{1 + sX + \frac{s^2}{2!}X^2 + \dots\right\} \\ &= 1 + sE\{X\} + \frac{s^2}{2!}E\{X^2\} + \dots\end{aligned}$$

- so there is  $E\{X^n\} = \frac{d^n}{ds^n} \Phi(s)|_{s=0}$

## Chapter 2

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### Frequently used distributions:

- **Bernoulli:**
  - pmf(probability mass function)