

## ECS315 2018/1 Part VII Dr.Prapun

### 13 Three Types of Random Variables

**13.1.** Review: You may recall<sup>56</sup> the following properties for cdf of discrete random variables. These properties hold for any kind of random variables.

- (a) The cdf is defined as  $F_X(x) = P[X \leq x]$ . This is valid for any type of random variables.
- (b) Moreover, the cdf for any kind of random variable must satisfies three properties which we have discussed earlier:

CDF1  $F_X$  is non-decreasing

CDF2  $F_X$  is right-continuous

CDF3  $\lim_{x \rightarrow -\infty} F_X(x) = 0$  and  $\lim_{x \rightarrow \infty} F_X(x) = 1$ .

- (c)  $P[X = x] = F_X(x) - F_X(x^-)$  = the jump or saltus in  $F$  at  $x$ .

**Theorem 13.2.** If you find a function  $F$  that satisfies CDF1, CDF2, and CDF3 above, then  $F$  is a cdf of some random variable.

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<sup>56</sup>If you don't know these properties by now, you should review them as soon as possible.



**Example 13.3.** Consider an input  $X$  to a device whose output  $Y$  will be the same as the input if the input level does not exceed 5. For input level that exceeds 5, the output will be saturated at 5. Suppose  $X \sim \mathcal{U}(0, 6)$ . Find  $F_Y(y)$ .

**13.4.** We can categorize random variables into three types according to its cdf:

- (a) If  $F_X(x)$  is piecewise flat with discontinuous jumps, then  $X$  is **discrete**.
- (b) If  $F_X(x)$  is a continuous function, then  $X$  is **continuous**.
- (c) If  $F_X(x)$  is a piecewise continuous function with discontinuities, then  $X$  is **mixed**.

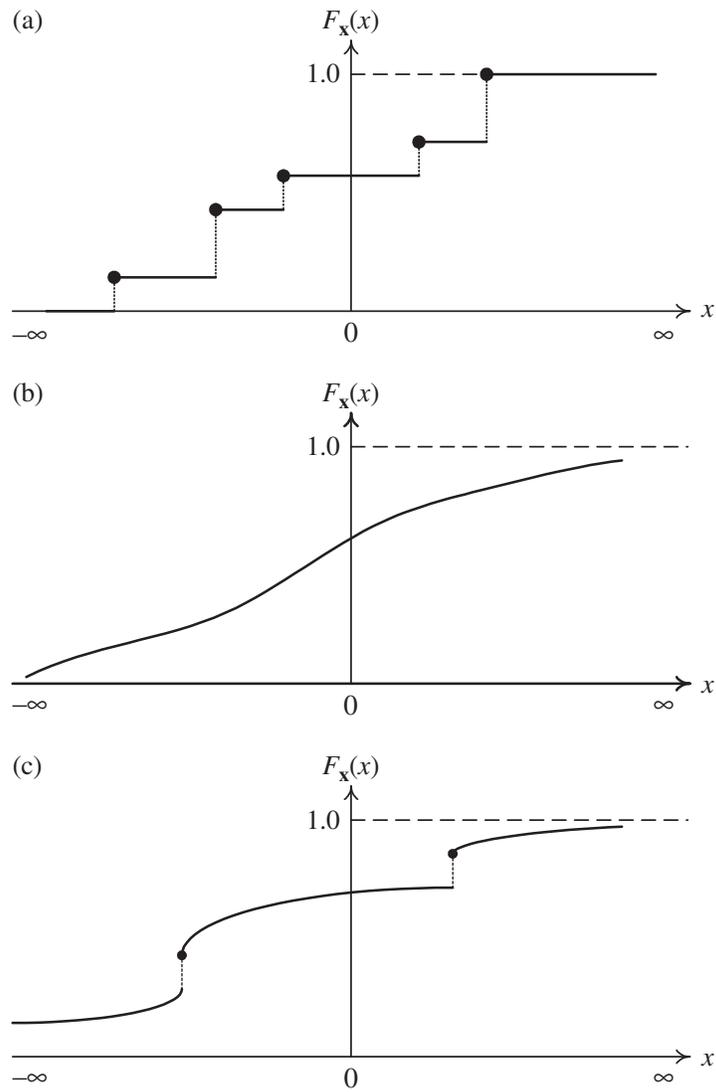


Figure 40: Typical cdfs: (a) a discrete random variable, (b) a continuous random variable, and (c) a mixed random variable [16, Fig. 3.2].