

- A nonnegative function  $f_X(x)$  is called a **probability density function** (pdf) of  $X$  if

$$F_X(\textcolor{red}{x}) = \int_{-\infty}^{\textcolor{red}{x}} f_X(u) \, du$$

for all  $x$ .

- By the fundamental theorem of calculus,

$$\frac{d}{dx} F_X(x) = \frac{d}{dx} \int_{-\infty}^{\textcolor{red}{x}} f_X(u) \, du = f_X(\textcolor{red}{x}).$$

- If  $X$  has a pdf, then  $X$  is continuous, but not vice versa.