"$X \sim N(\mu, \sigma^2)$"

$\iff$ "X is a normally distributed r.v. with $E(X) = \mu$ and $Var(X) = \sigma^2$"

$\iff$ The <u>standardised version</u>:

$$Z = \frac{X - \mu}{\sigma} \qquad \left[\text{so } E(Z) = 0,\ Var(Z) = 1\right]$$

is <u>standard normal</u> ~~is~~

i.e. $N(0,1)$

So for any real z,

$$P(Z \leq z) = \int_{-\infty}^{z} \phi(t)\,dt = \Phi(z) \quad \left[N(0,1) \text{ CDF}\right]$$

where $\phi(t) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}t^2}$

is the $N(0,1)$ PDF.

The $N(0,1)$ $\begin{cases} \text{CDF } \Phi(z) \text{ is given by pnorm}(z) \\ \text{PDF } \phi(z) \text{ ... ... dnorm}(z). \end{cases}$

So ~~P~~ if $X \sim N(\mu, \sigma^2)$, $P(X \leq x) = P\left(\frac{X-\mu}{\sigma} \leq \frac{x-\mu}{\sigma}\right) = P\left(Z \leq \frac{x-\mu}{\sigma}\right) = \Phi\left(\frac{x-\mu}{\sigma}\right)$ $\boxed{= \text{pnorm}\left(\frac{x-\mu}{\sigma}\right)}$

since $Z = \frac{X-\mu}{\sigma} \sim N(0,1)$