PDF:

$$f(x;k) = \frac{1}{2^{k/2}\Gamma(k/2)} x^{(k/2)-1} e^{-x/2} \quad \text{for } x > 0$$

The chi-squared distribution looks different for different degrees of freedom (k)

- If k=2, its PDF is the exponential distribution
- For k ≥ 30, it is roughly Gaussian or normal — fits N(k, 2k)

If the random variable X follows a chi-squared distribution with k degrees of freedom, then

- E(X) = k
- E(X^2) = k(k+2)
- So Var(X) = 2k

These follow from the properties of the gamma function.

Theorem 29 *Let $W_1, W_2, \ldots, W_n$ be independent random variables with $W_i \sim \chi^2(k_i)$. Then $S = \sum_{i=1}^{n} W_i \sim \chi^2(\sum_{i=1}^{n} k_i)$.*