Chapter 1

Distribution

1.1 χ^2 distribution

Let $z_1, z_2, \ldots, z_k$ be independent random variables with $z_i \sim \mathcal{N}(0,1)$ (iid), then

$$Z = z_1^2 + z_2^2 + \cdots + z_k^2 = \sum_{i=1}^{n} z_i \sim \chi_k^2 \tag{1.1}$$

χ^2 is a class of distribution indexed by its degree of freedom, like the t-distribution. In fact, χ^2 has a relation with t.

If $x_1, x_2, \ldots, x_n$ are independent random variables with $x_i \sim \mathcal{N}(\mu, \sigma)$, then

$$X = \sum_{i=1}^{n} \left(\frac{x_i - \mu}{\sigma} \right)^2 \sim \chi_n^2 \tag{1.2}$$

Let $X_1 \sim \chi_n^2$ and $X_2 \sim \chi_m^2$. If X_1 and X_2 are independent, then

$$X_1 + X_2 \sim \chi_{n+m}^2. \tag{1.3}$$

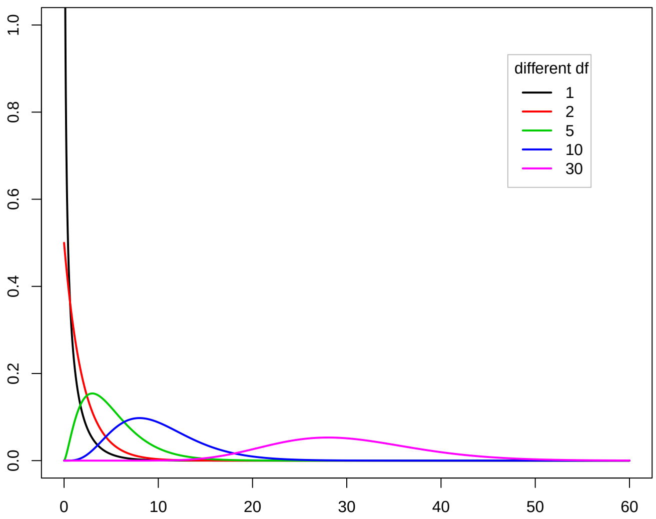

Figure 1.1: χ^2 with different df