# 1 sharply peaked functions

first, we will be showing that$\Gamma(1) = 1$

$$\Gamma(1) = \int_0^\infty \frac{dx}{x} x^1 e^{-x} = \int_0^\infty e^{-x} dx = -e^{-x}\Big|_0^\infty = 1 \tag{1}$$

next using integration by ports, we will satisfy the identity:

$$\Gamma(n+1) = n\Gamma(n) \tag{2}$$

$$\Gamma(n+1) = \int_0^\infty \frac{dx}{x} x^{n+1} e^{-x} = \int_0^\infty e^{-x} x^n dx \tag{3}$$

, now we use integration by parts:

$$u = x^n \rightarrow du = nx^{n-1} \tag{4}$$

$$dv = e^{-x}dx \rightarrow v = -e^{-x} \tag{5}$$

$$\Gamma(n+1) = \tag{6}$$