- **Stirling's Formula**:

$$n! = \sqrt{2\pi n}\left(\frac{n}{e}\right)^n\left(1 + \frac{1}{12n} + O\left(\frac{1}{n^2}\right)\right)$$

- Let $n \geq k \geq 0$

$$\binom{n}{k} \leq (\frac{ne}{k})^k$$

$$\binom{n}{k} \geq (\frac{n}{k})^k$$

- For all $t \in \mathbb{R}$, $e^t \geq 1 + t$ with equality holding at $t = 0$.

- For all $t, n \in \mathbb{R}$, such that $n \geq 1$ and $|t| \leq n$,

$$e^t\left(1 - \frac{t^2}{n}\right) \leq \left(1 + \frac{t}{n}\right)^n \leq e^t$$

  Note that this even holds for negative values of t.

- For all $n \in \mathbb{N}$, we define the nth Harmonic number H_n, as follows:

$$H_n = 1 + \frac{1}{2} + \cdots + \frac{1}{n}$$

  For all $n \in \mathbb{N}$, the nth Harmonic number H_n is:

$$H_n = \ln n + \mathbf{\Theta}(1)$$

- **Chernoff's Bound:** For any $\delta > 0$,

  –
$$\mathbf{P}(\mathbf{X} \leq (1-\delta)\mu) \leq e^{-\mu\delta^2/2}$$

  –
$$\mathbf{P}(\mathbf{X} \geq (1+\delta)\mu) \leq \left(\frac{e^\delta}{(1+\delta)^{(1+\delta)}}\right)^\mu$$

  Alternate and more usable forms:
  If $\delta \geq 2e - 1$ then

$$\mathbf{P}(\mathbf{X} \geq (1+\delta)\mu) \leq 2^{-(1+\delta)\mu}$$

  If $0 < \delta < 2e - 1$, then

$$\mathbf{P}(\mathbf{X} \geq (1+\delta)\mu) \leq e^{-\mu\delta^2/4}$$