$$\left(\frac{n}{2}\right)^{\frac{n}{2}} \leq n! \leq n^n$$

$$\log\left(\left(\frac{n}{2}\right)^{\frac{n}{2}}\right) \leq \log n! \leq \log n^n$$

$$\frac{n}{2}\log\frac{n}{2} \leq \log n! \leq n \log n$$

$$\Theta$$

$$\log n! = \Theta(n \log n)$$

$$\log\left(\frac{n!}{2^n}\right) = \log n! - \log 2^n$$

$$= \Theta(n \log n) - n$$

$$= \Theta(n \log n)$$