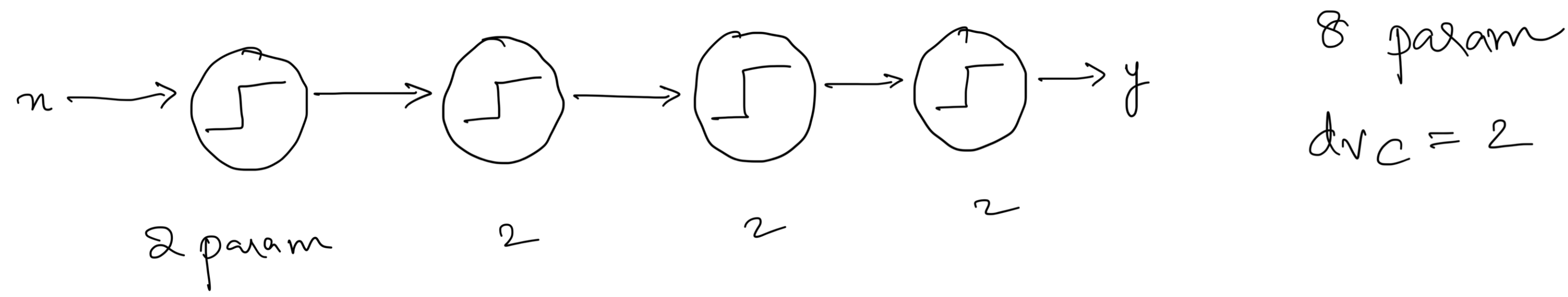
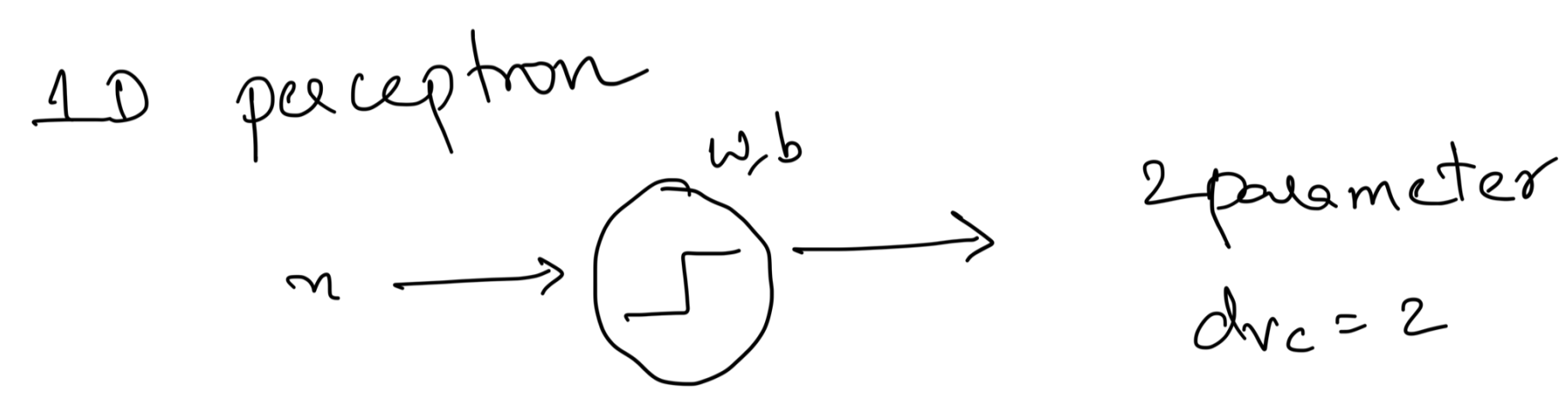
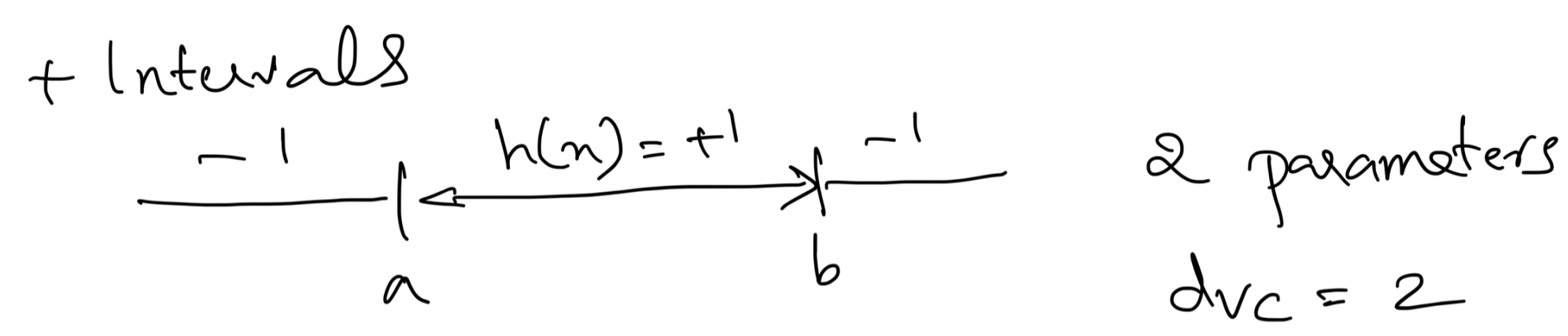
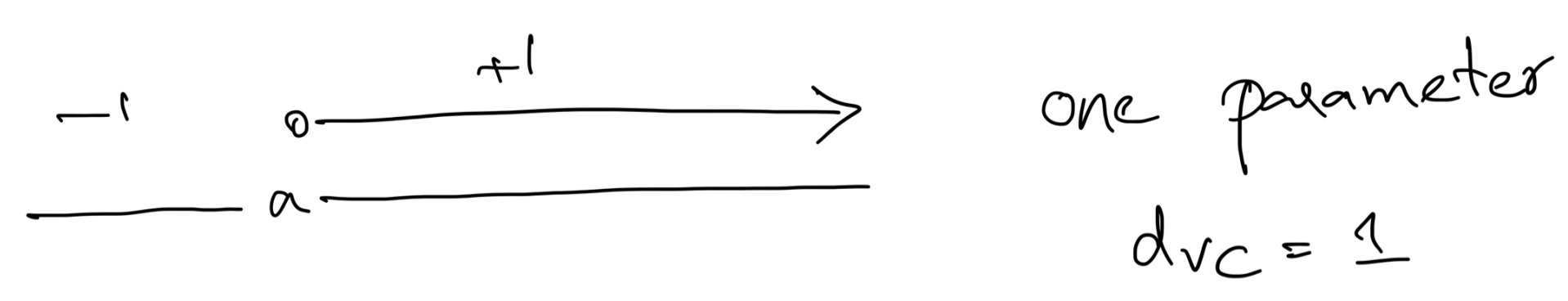


Degrees of Freedom

no. of parameters = analog degrees of freedom  
 $d_{vc}$  = equivalent binary degrees of freedom



$d_{vc}$  = measure ~~effective~~ no. of parameters

No. of Data points needed

$$\mathbb{P}[|E_{in}(g) - E_{out}(g)| > \epsilon] \leq \underbrace{4 m_H(dN)}_{\delta} e^{-\frac{1}{8} \epsilon^2 N}$$

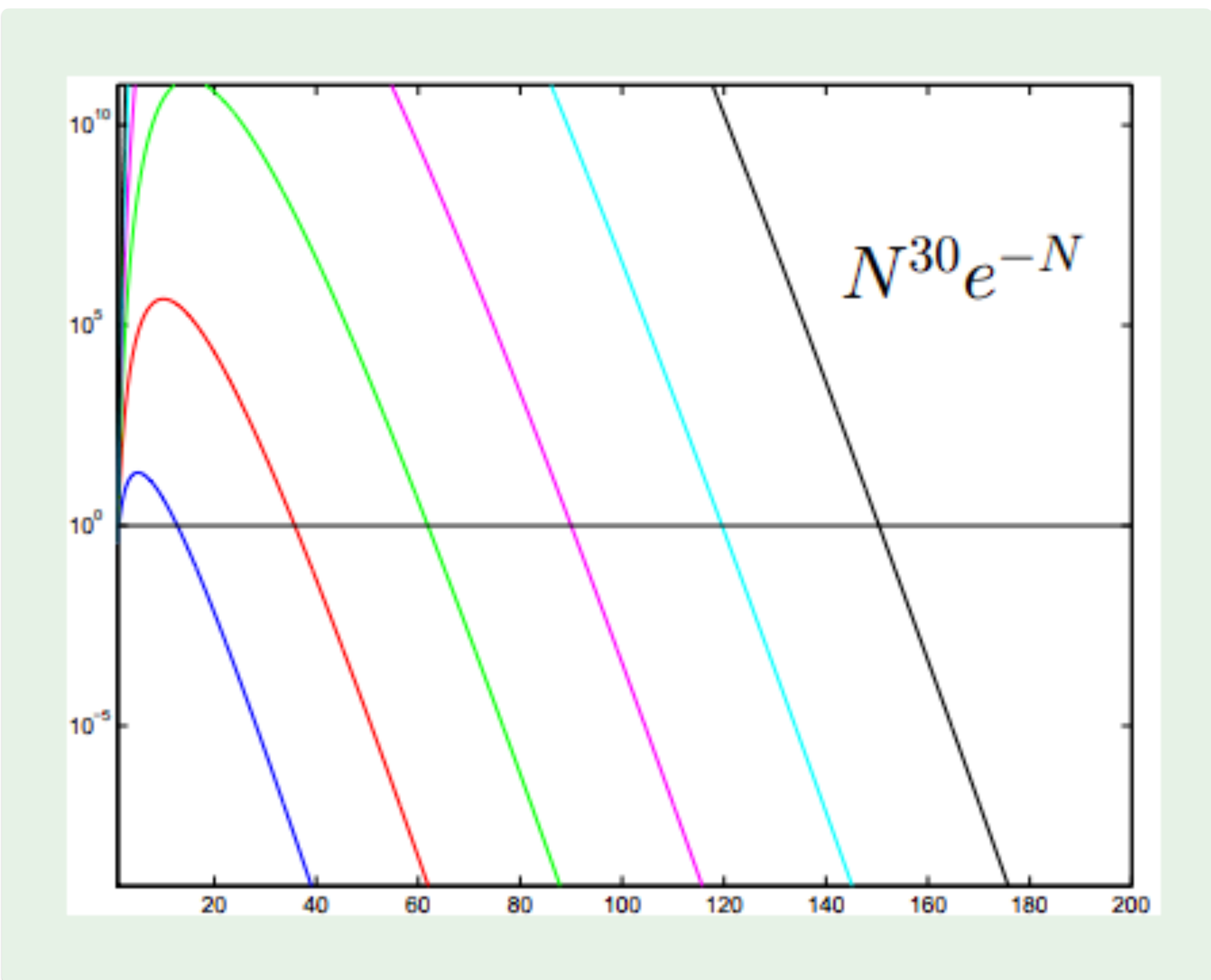
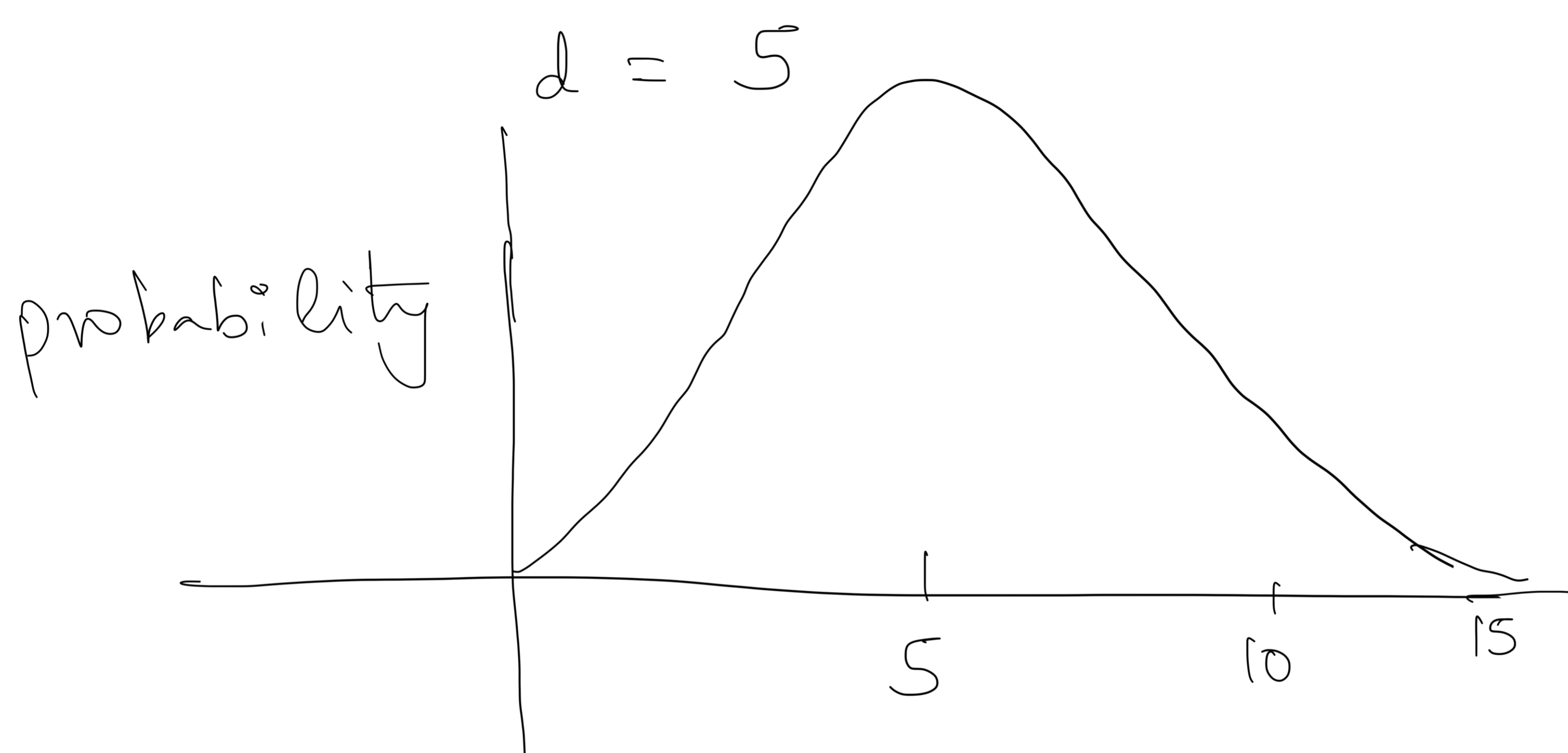
For  $\epsilon, \delta$  how does  $N$  depend on  $d_{vc}$

$N e^{-N}$  is the upper bound

For  $d=4$   $N^4 e^{-N}$

We want  $\delta$  to be very small (0.05)

How  $N$  changes with  $d$



Requiring that  $N$  be at least 10 x  $d_{vc}$  to get decent generalization is a popular rule of thumb.

$$N \geq 10 d_{vc}$$