A normal approximation

The normal density and its distribution function

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The standard bell curve: normal (Gaussian) density

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$$\phi(x) = \frac{e^{-x^2/2}}{\sqrt{2\pi}}$$

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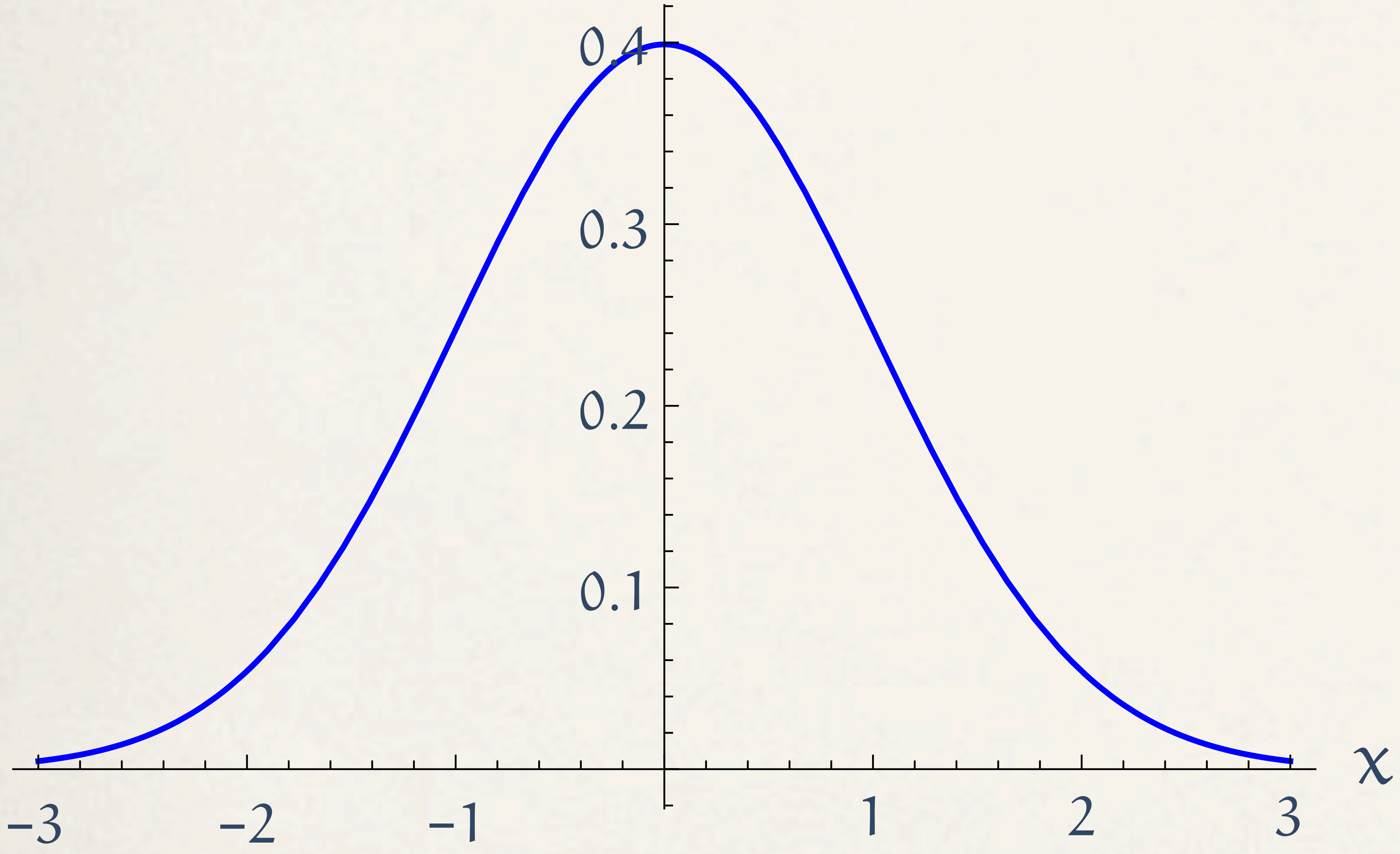

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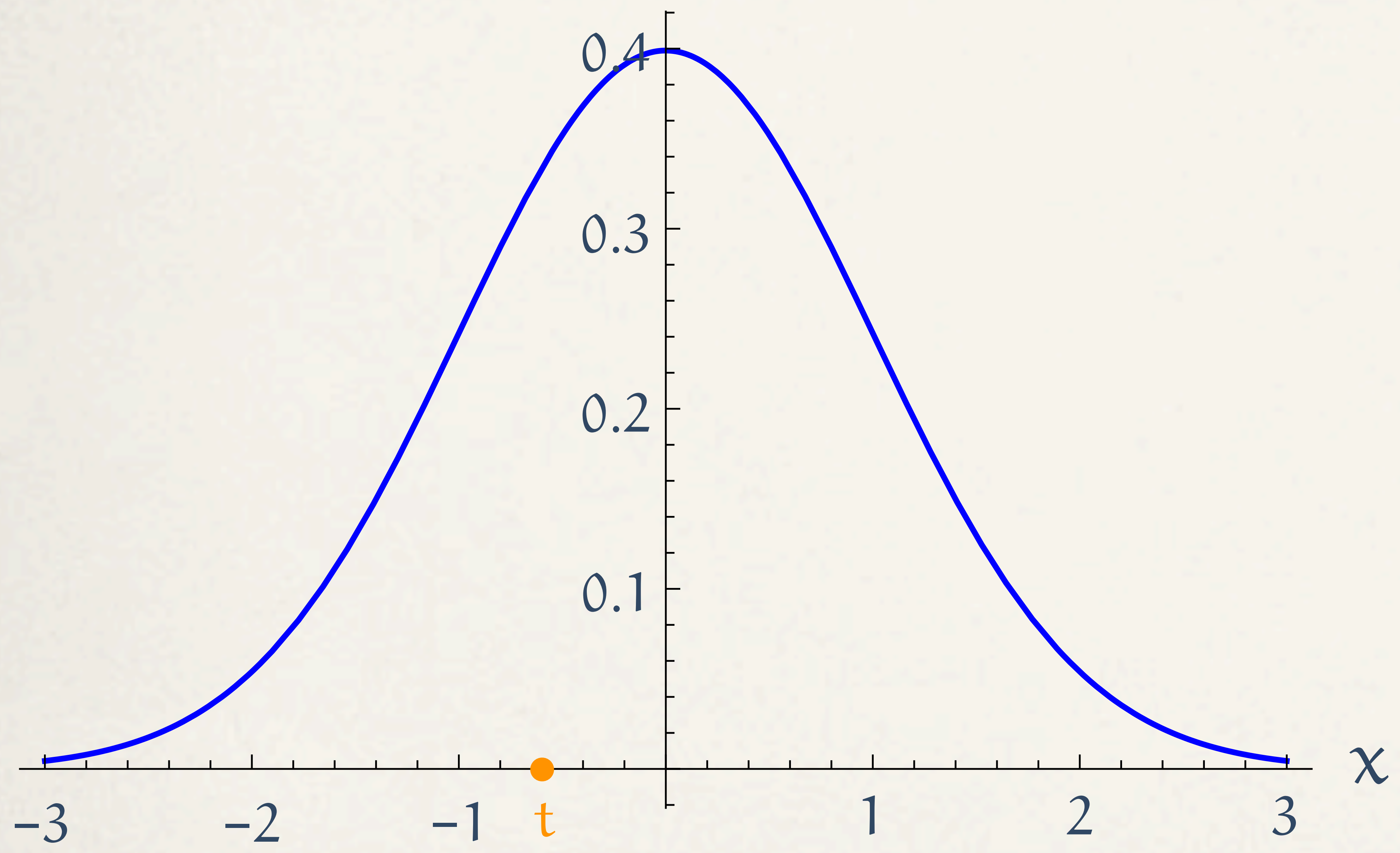

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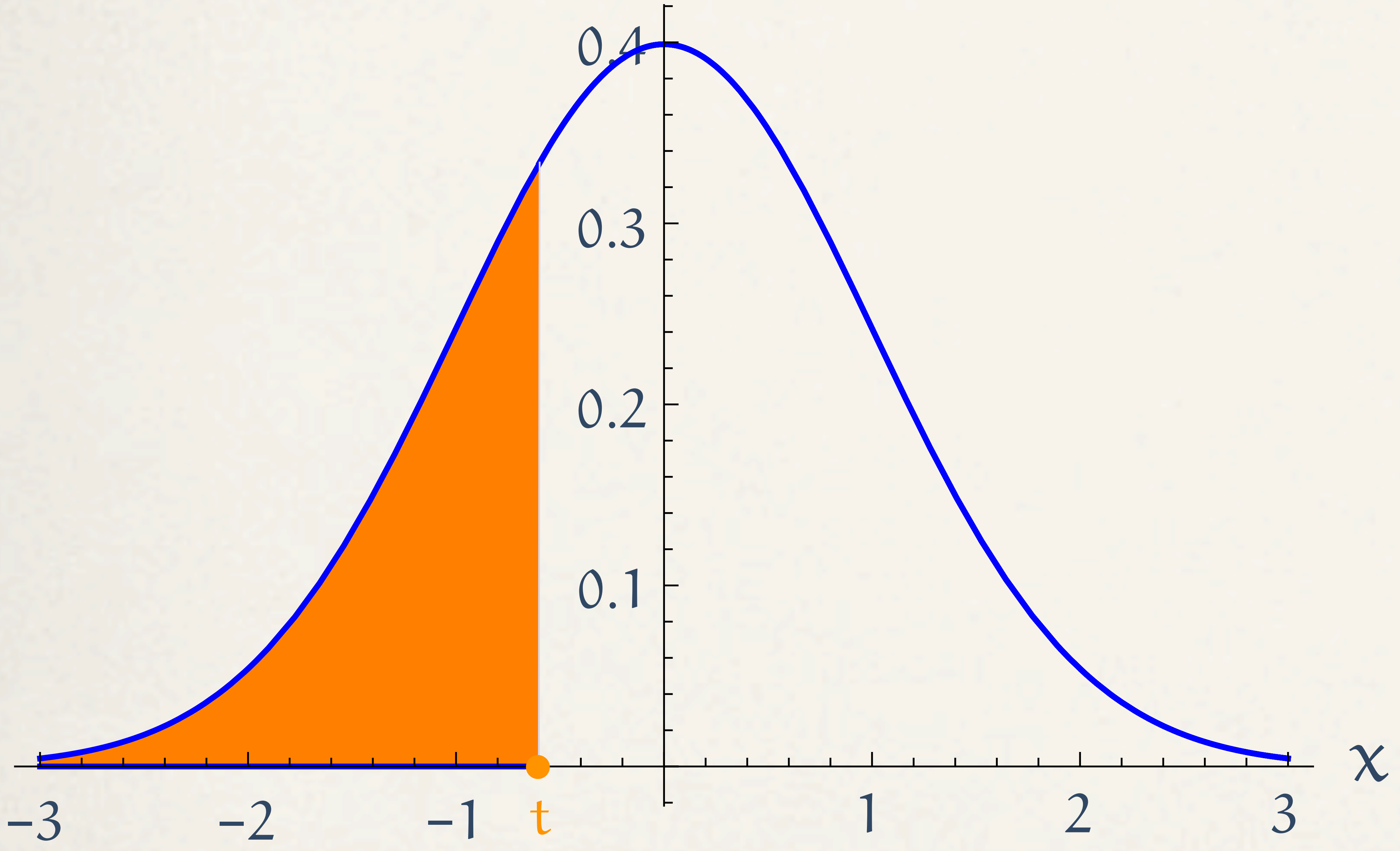

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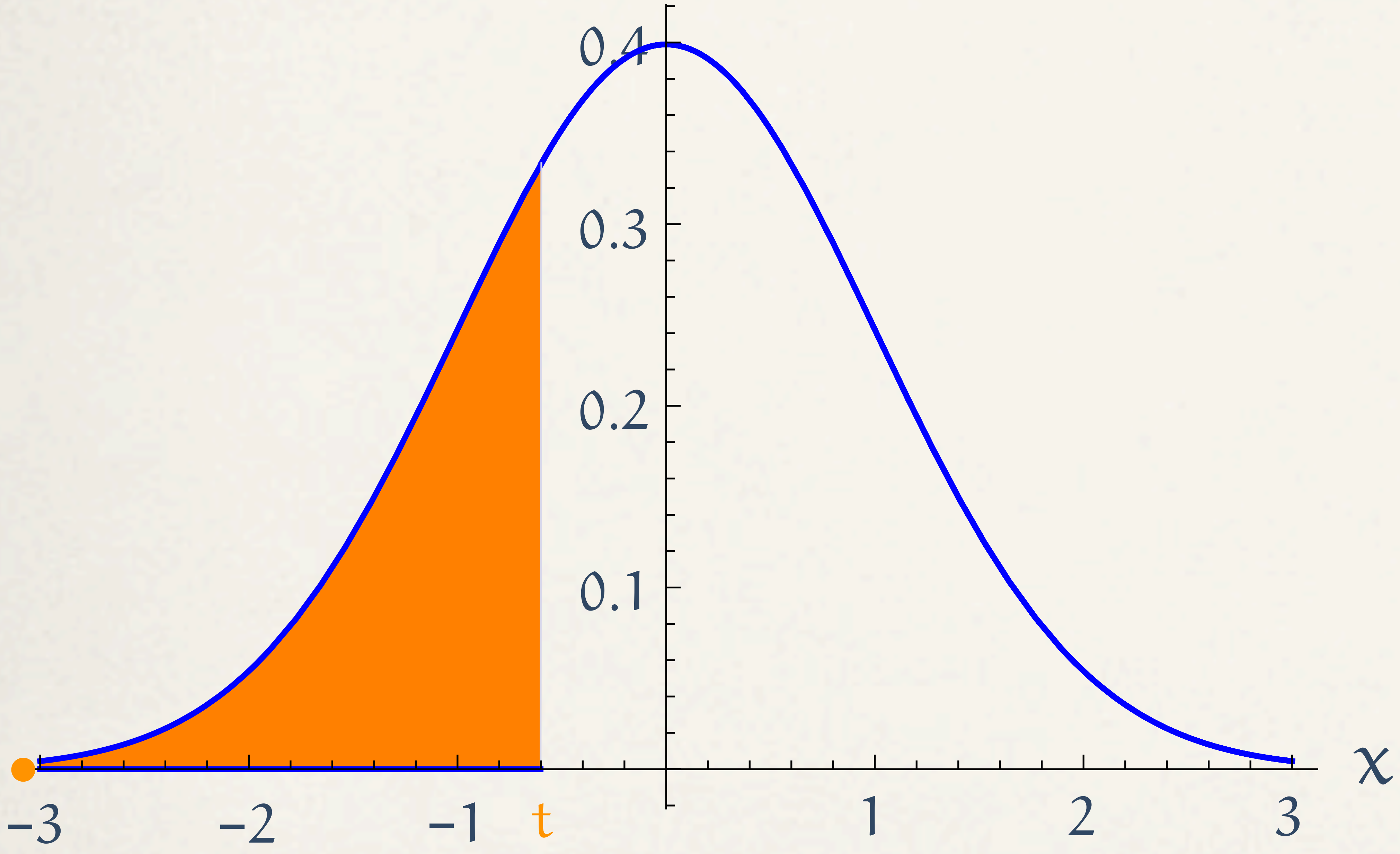

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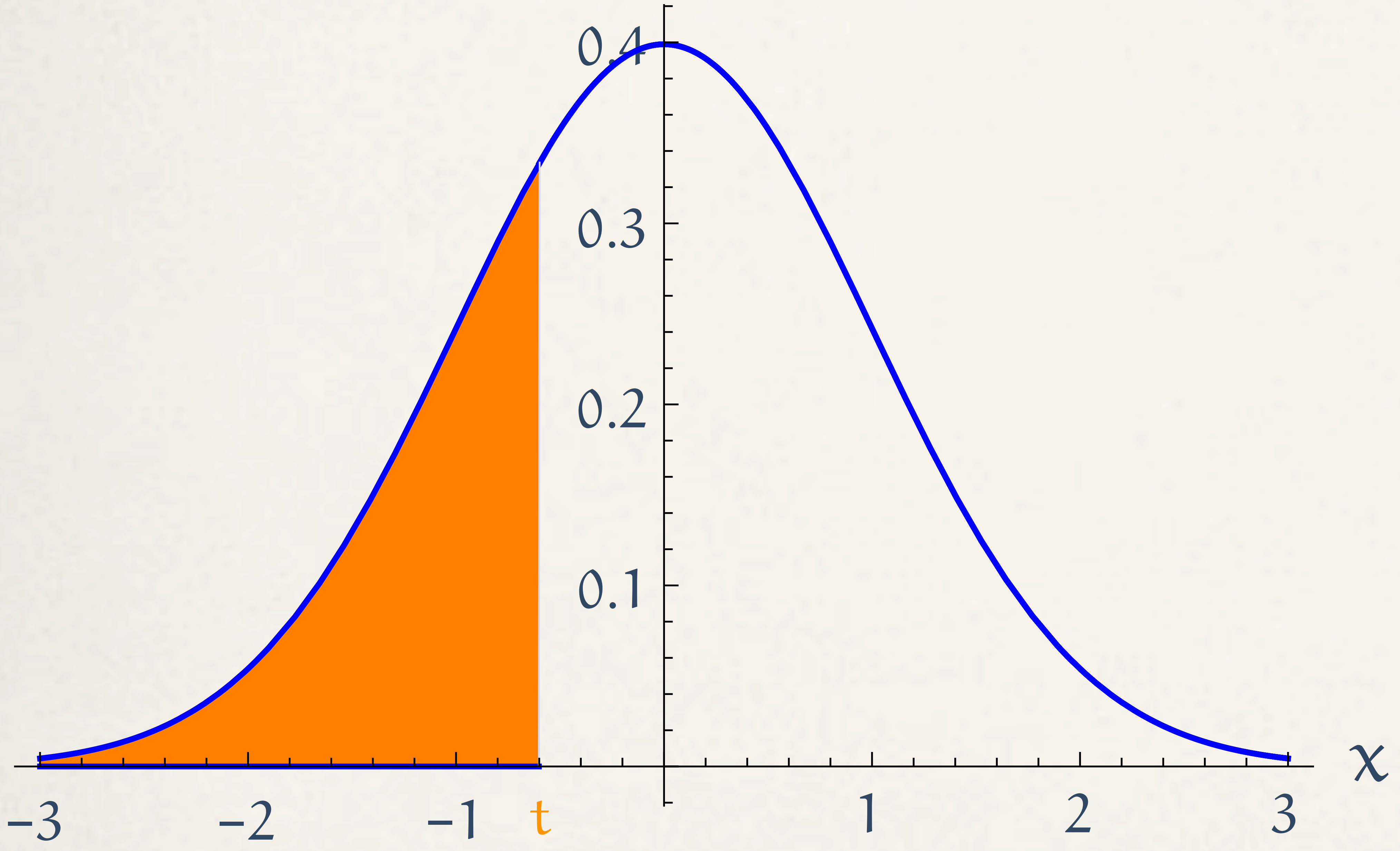

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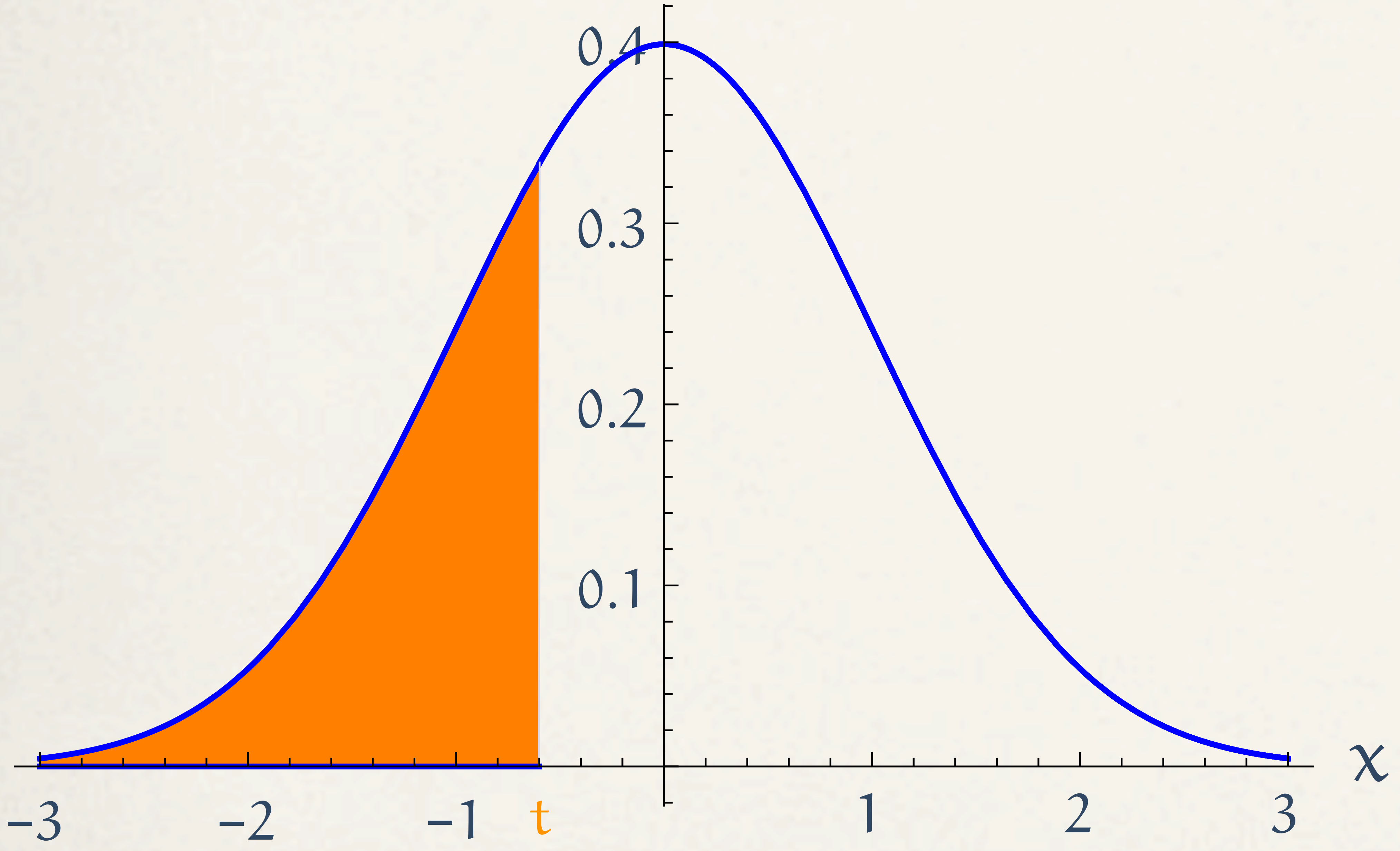

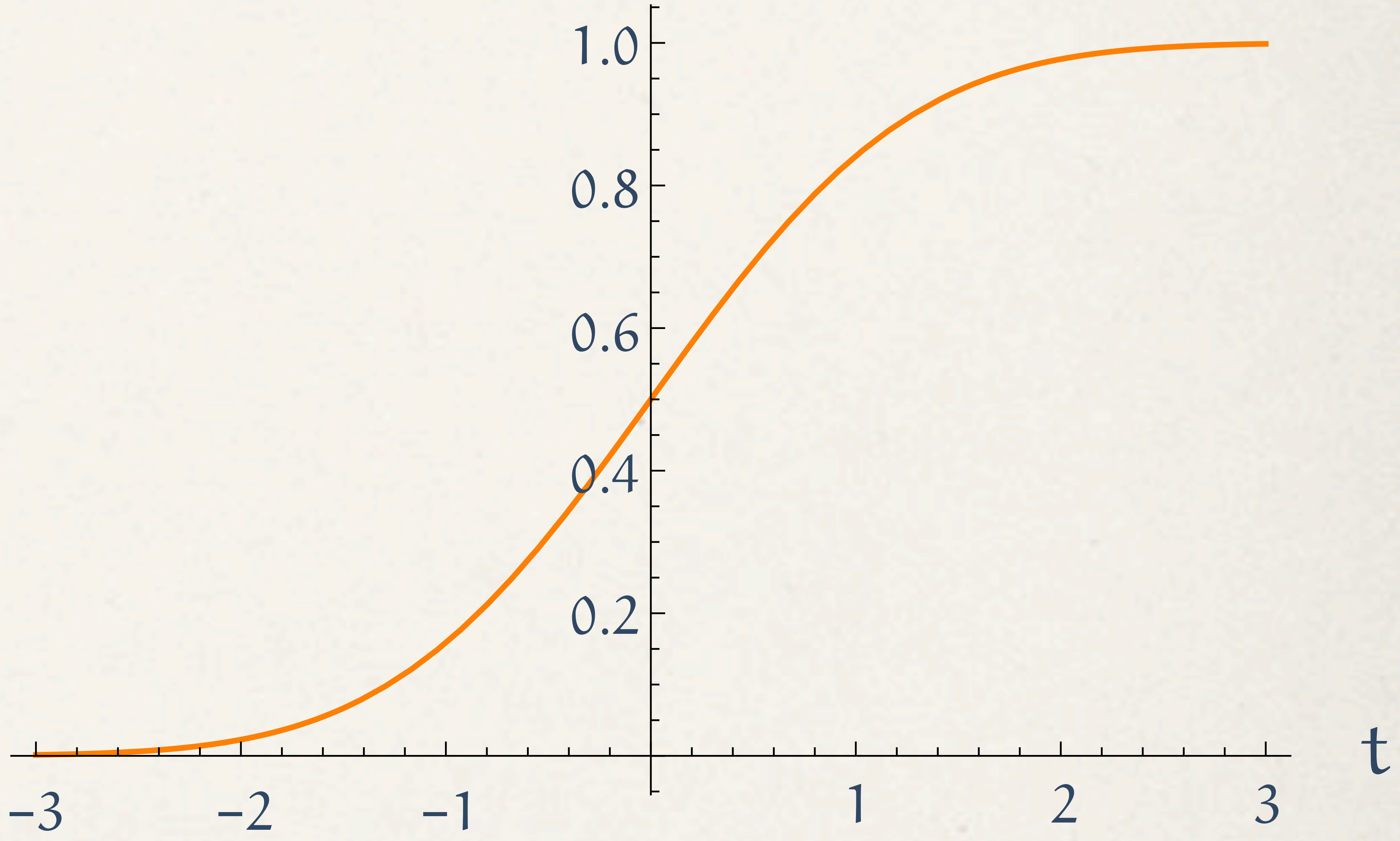

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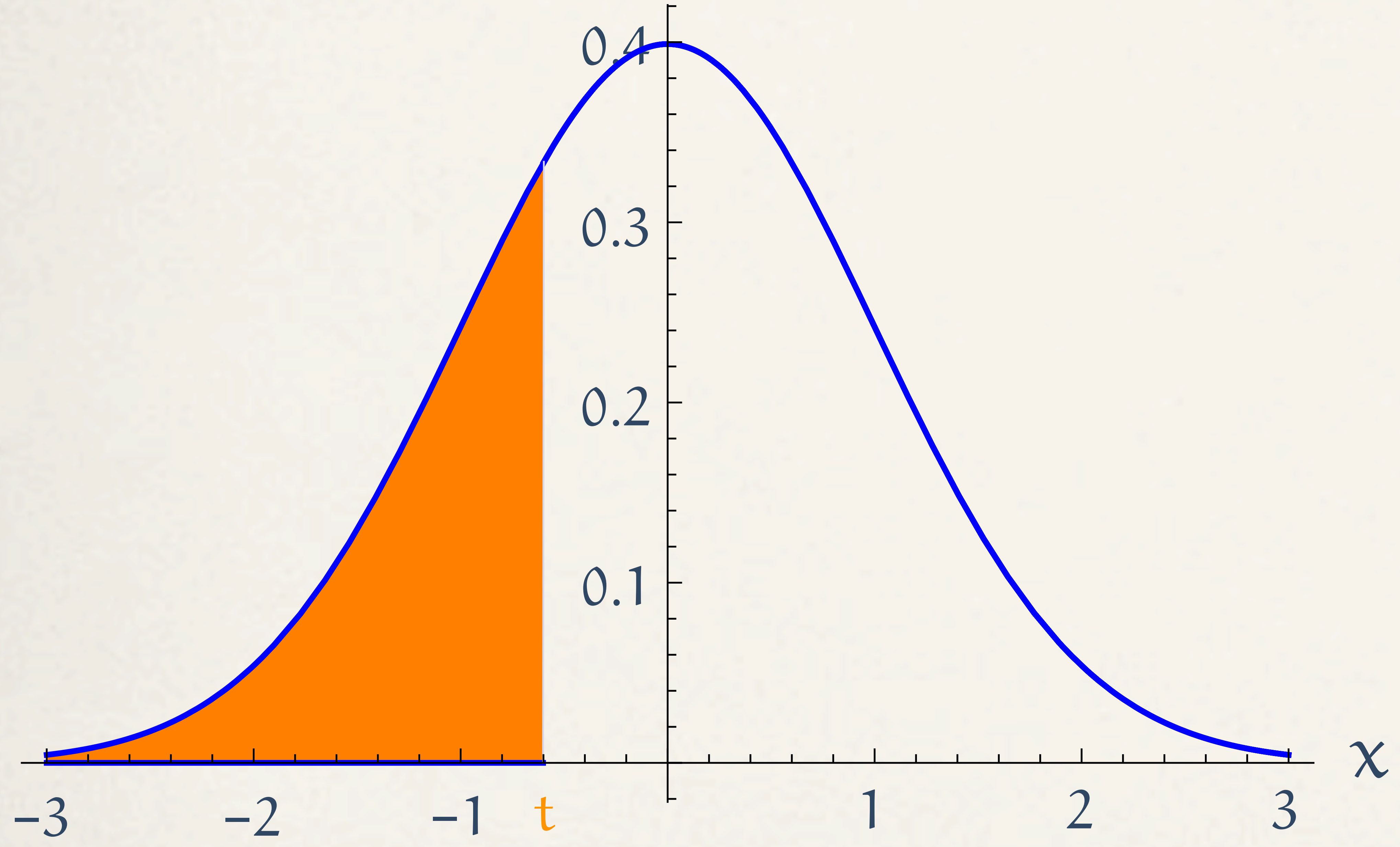

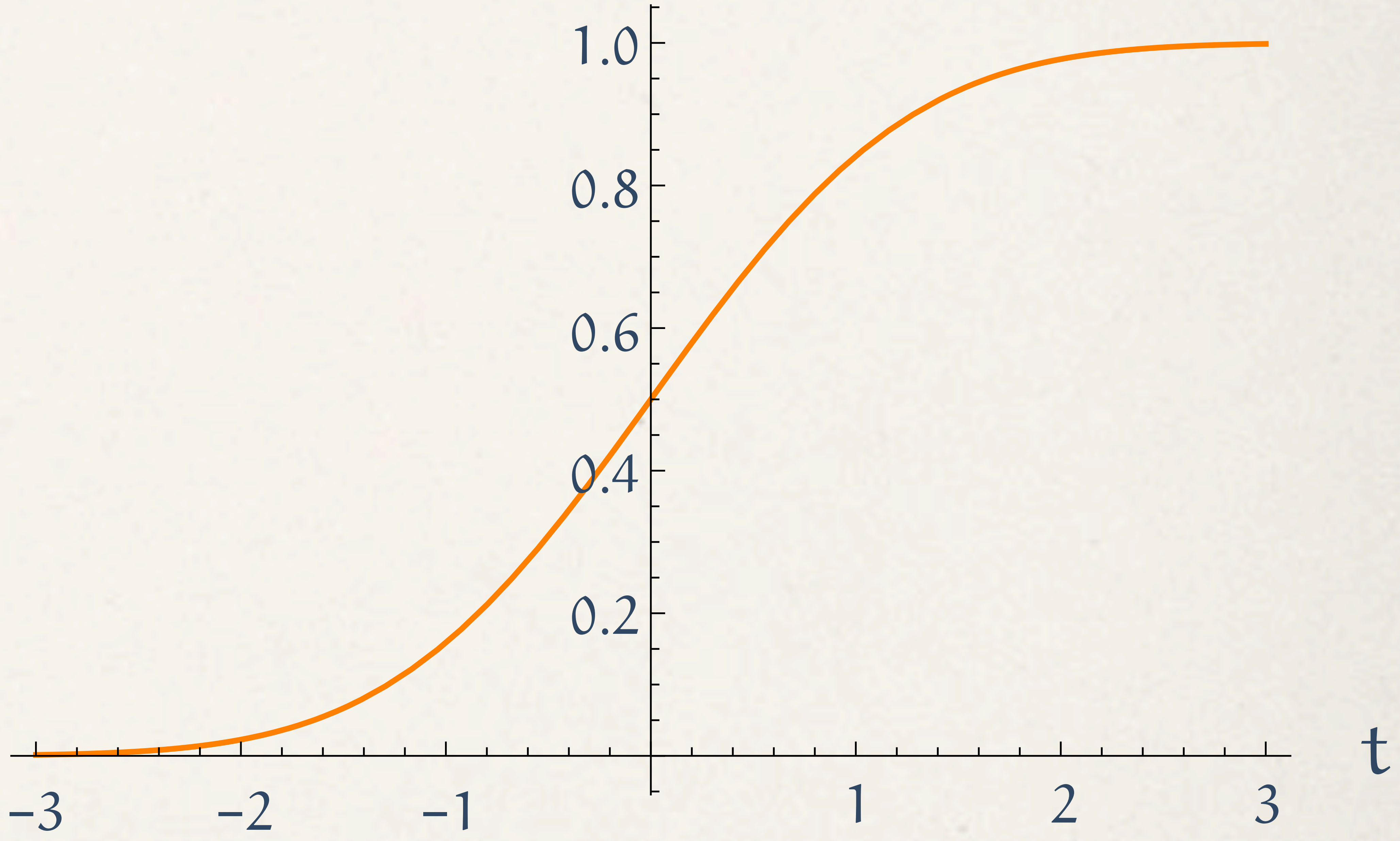

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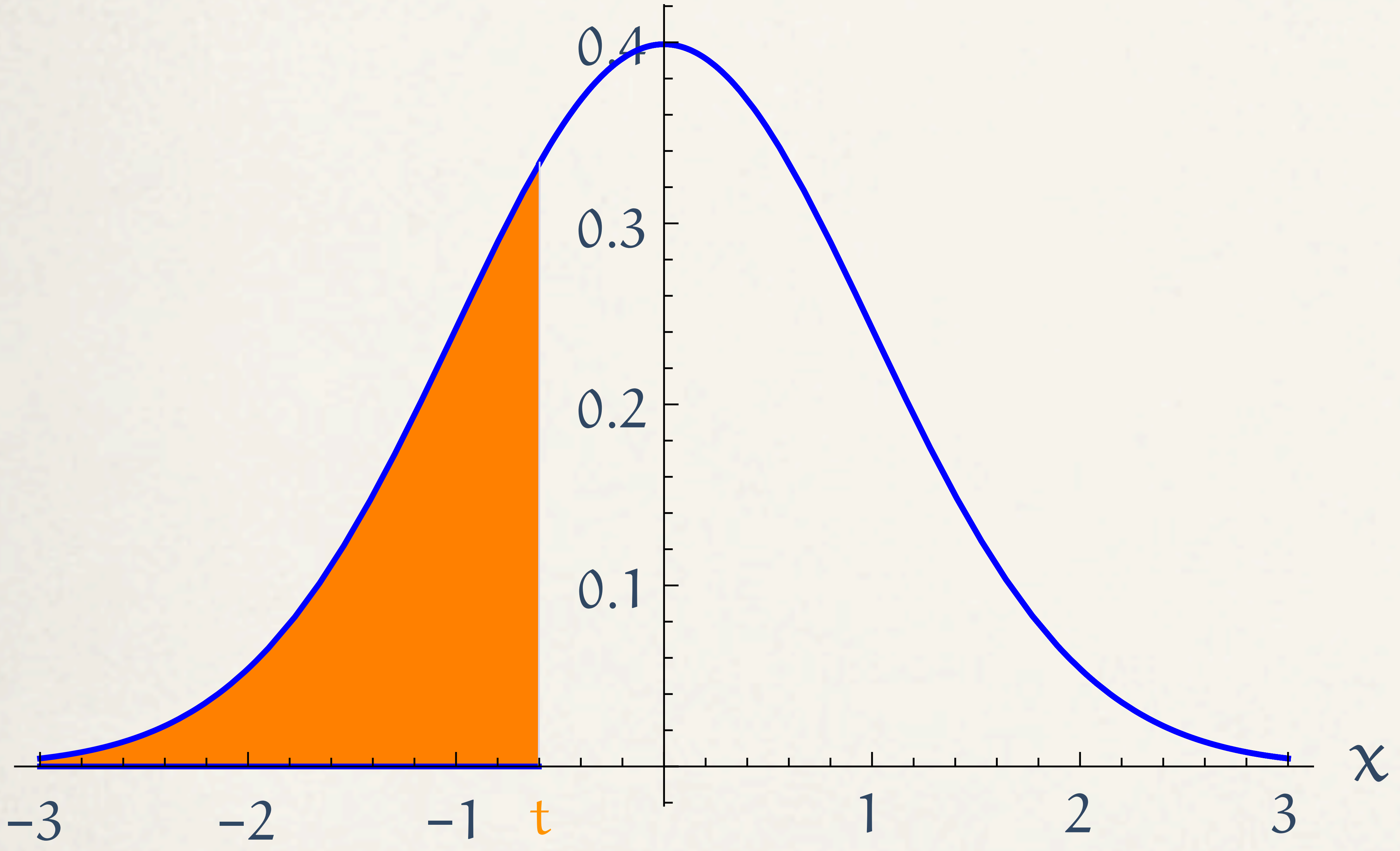
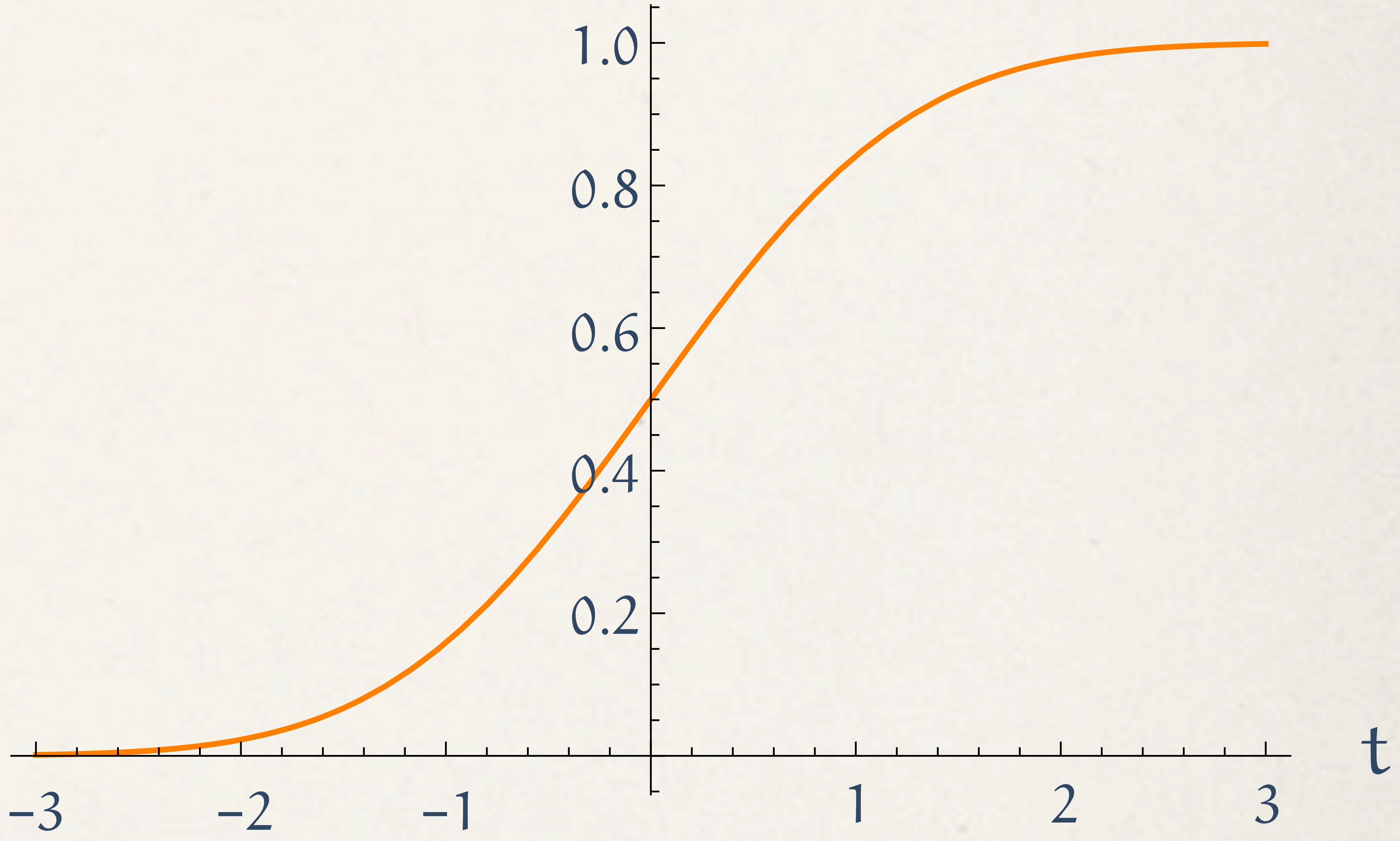


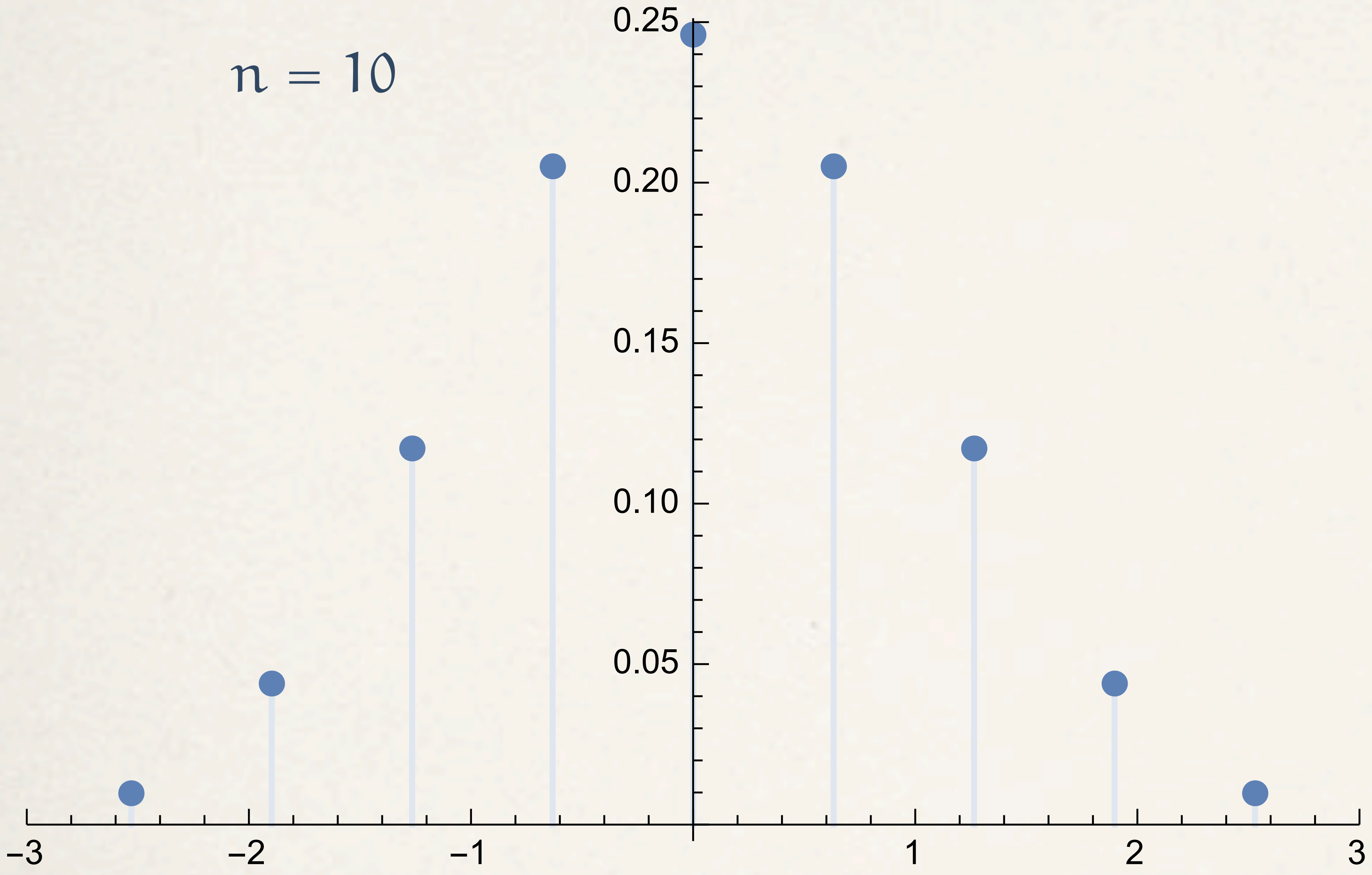
normal distribution function

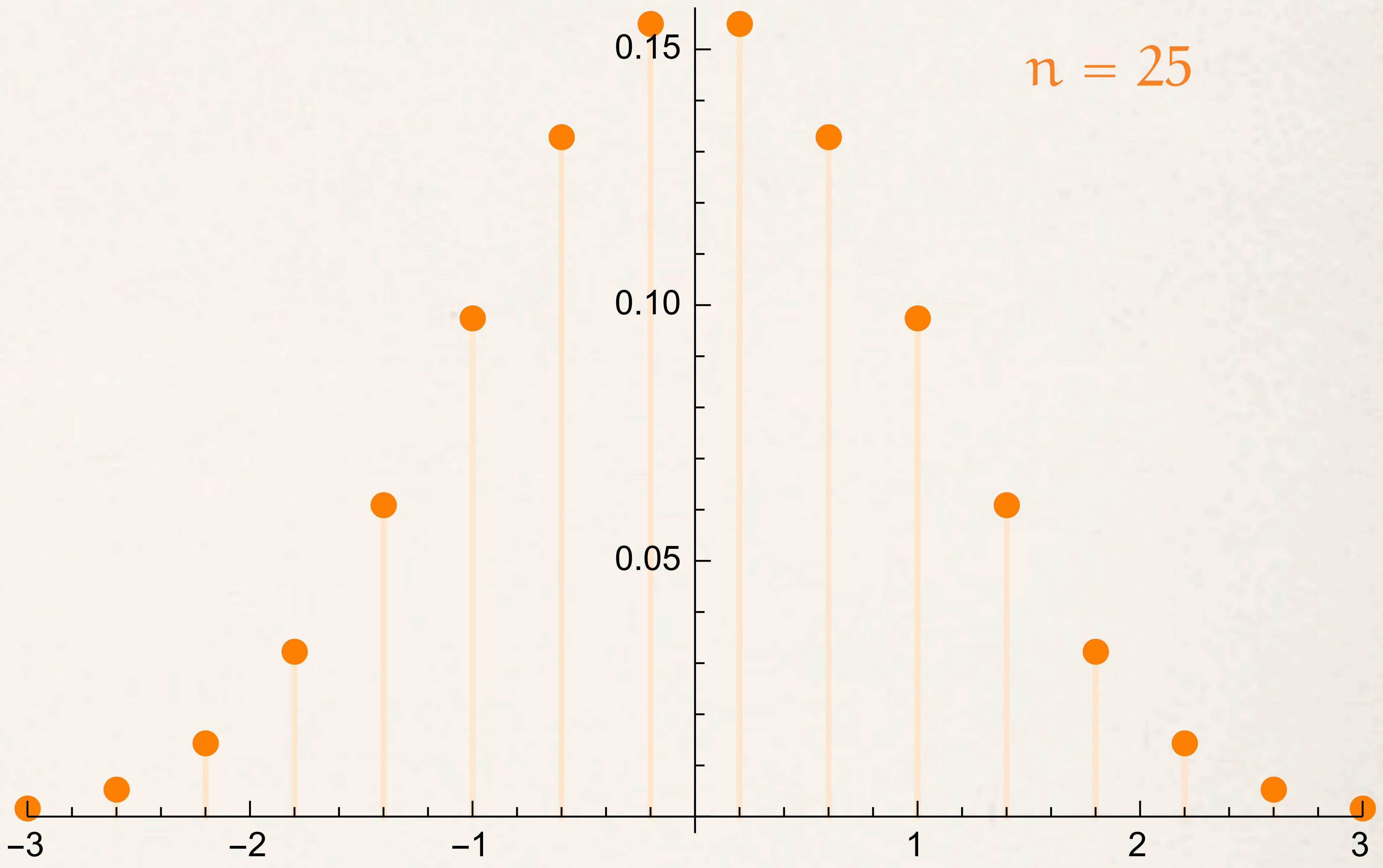
$$\Phi(t) = \int_{-\infty}^{t} \phi(x)\, dx$$

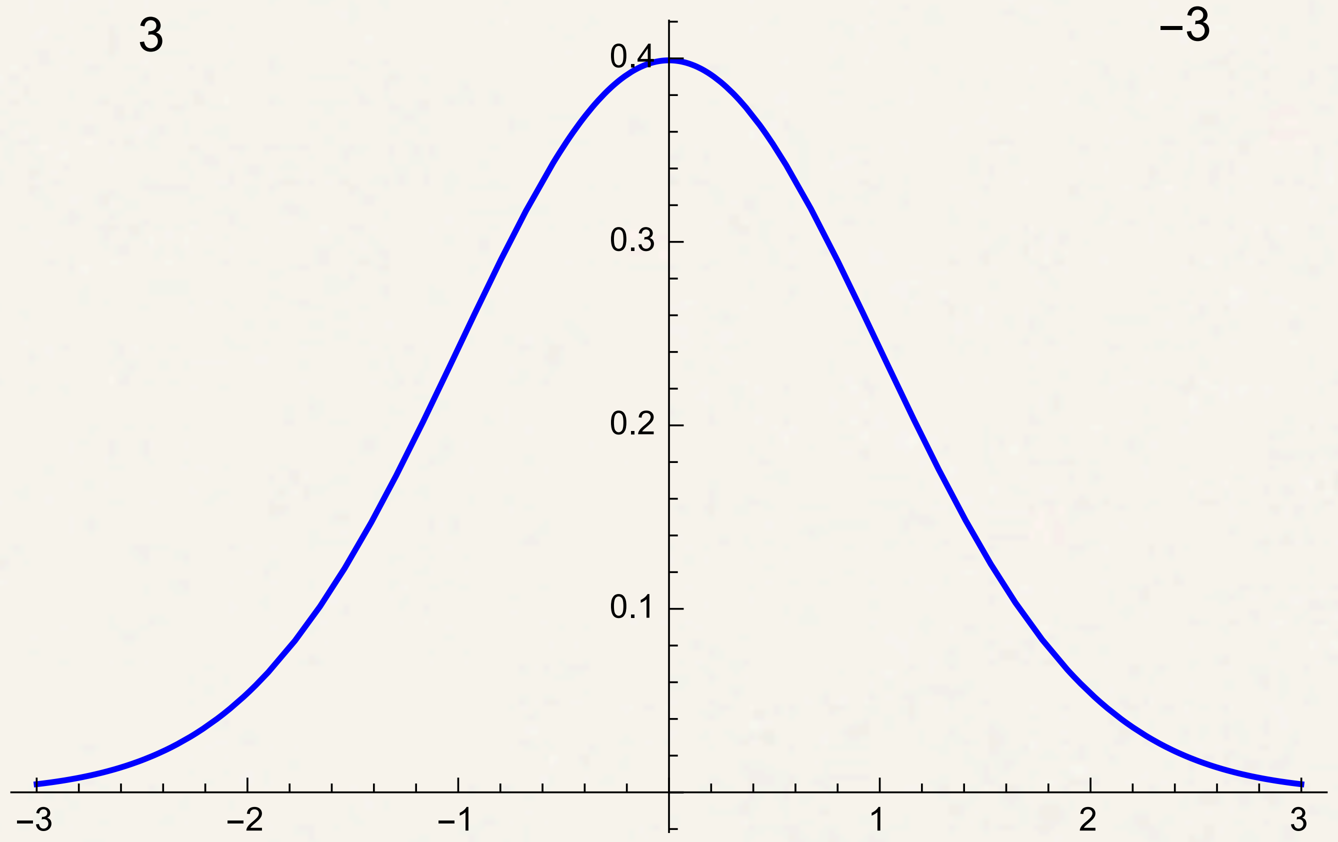


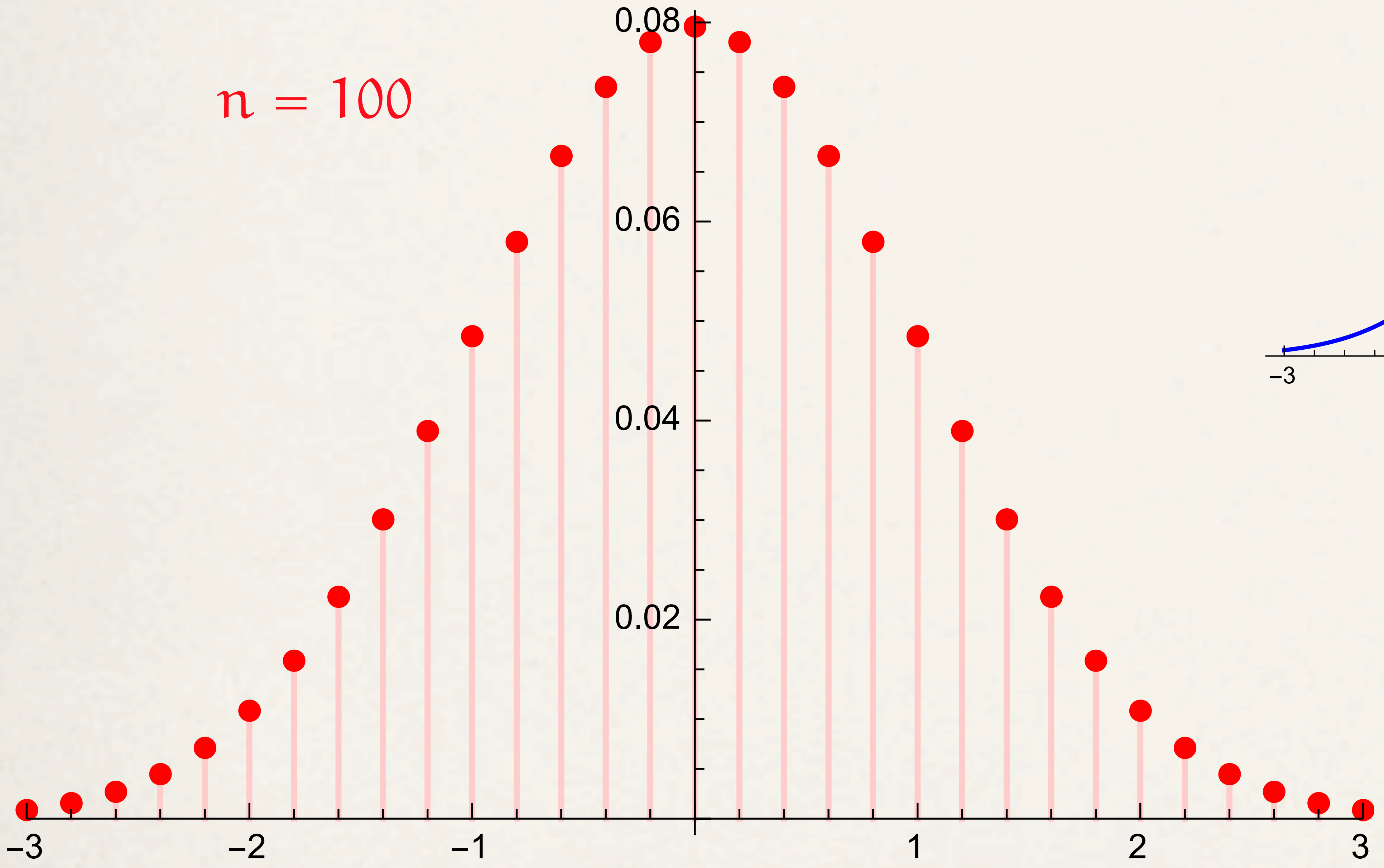
The mass function of S_n^*

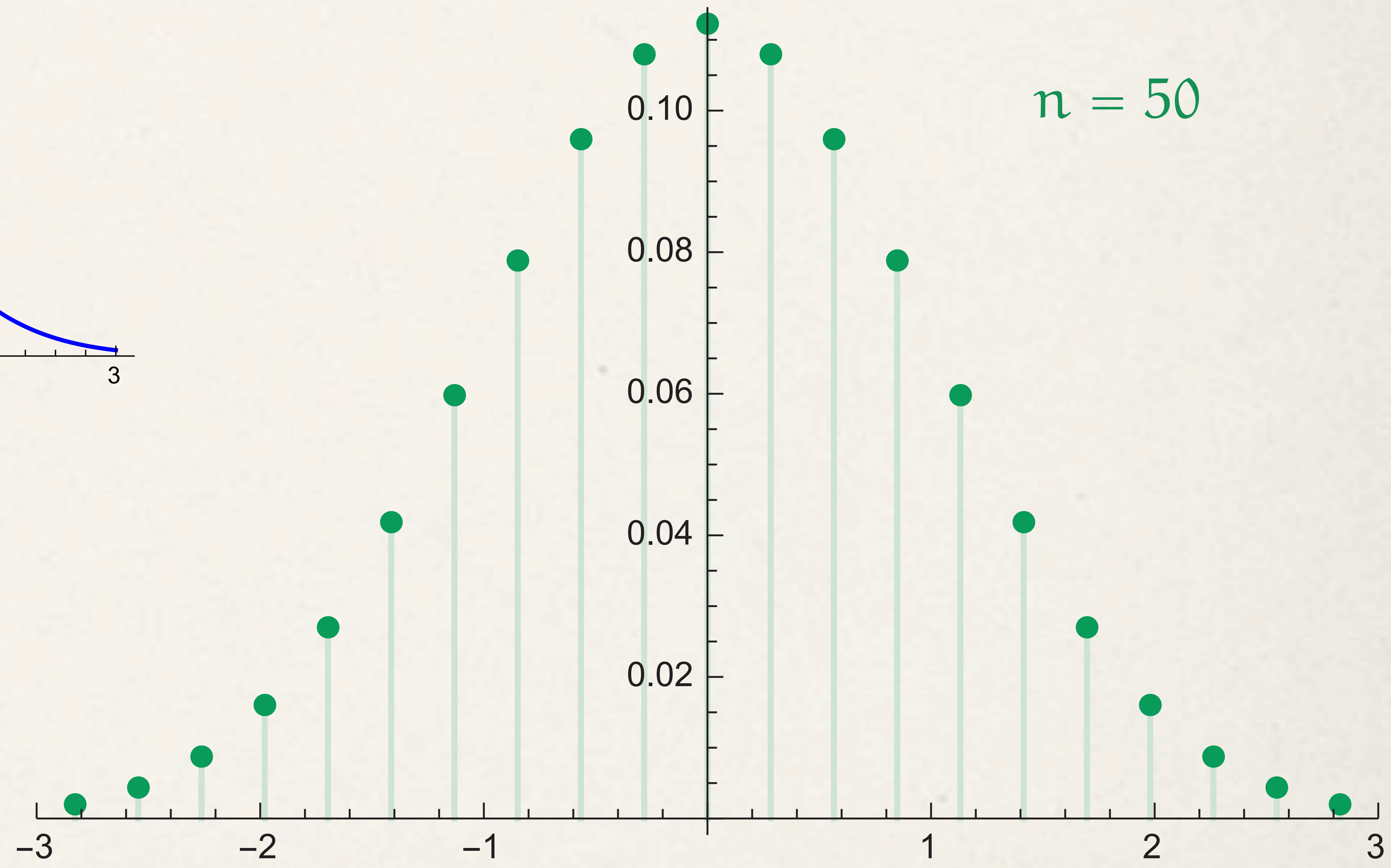
$$S_n^* = \frac{S_n - n/2}{\sqrt{n}/2}$$











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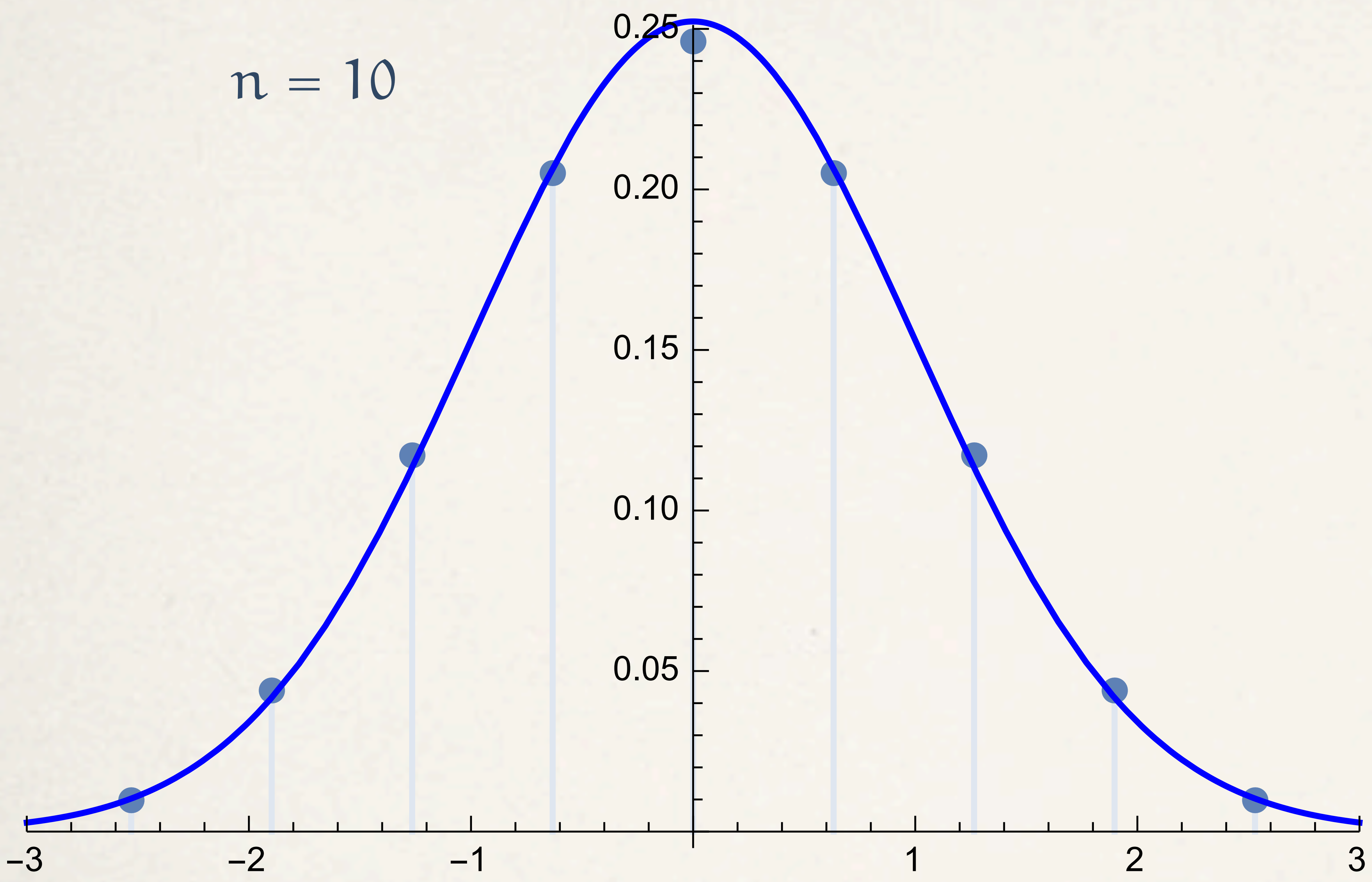
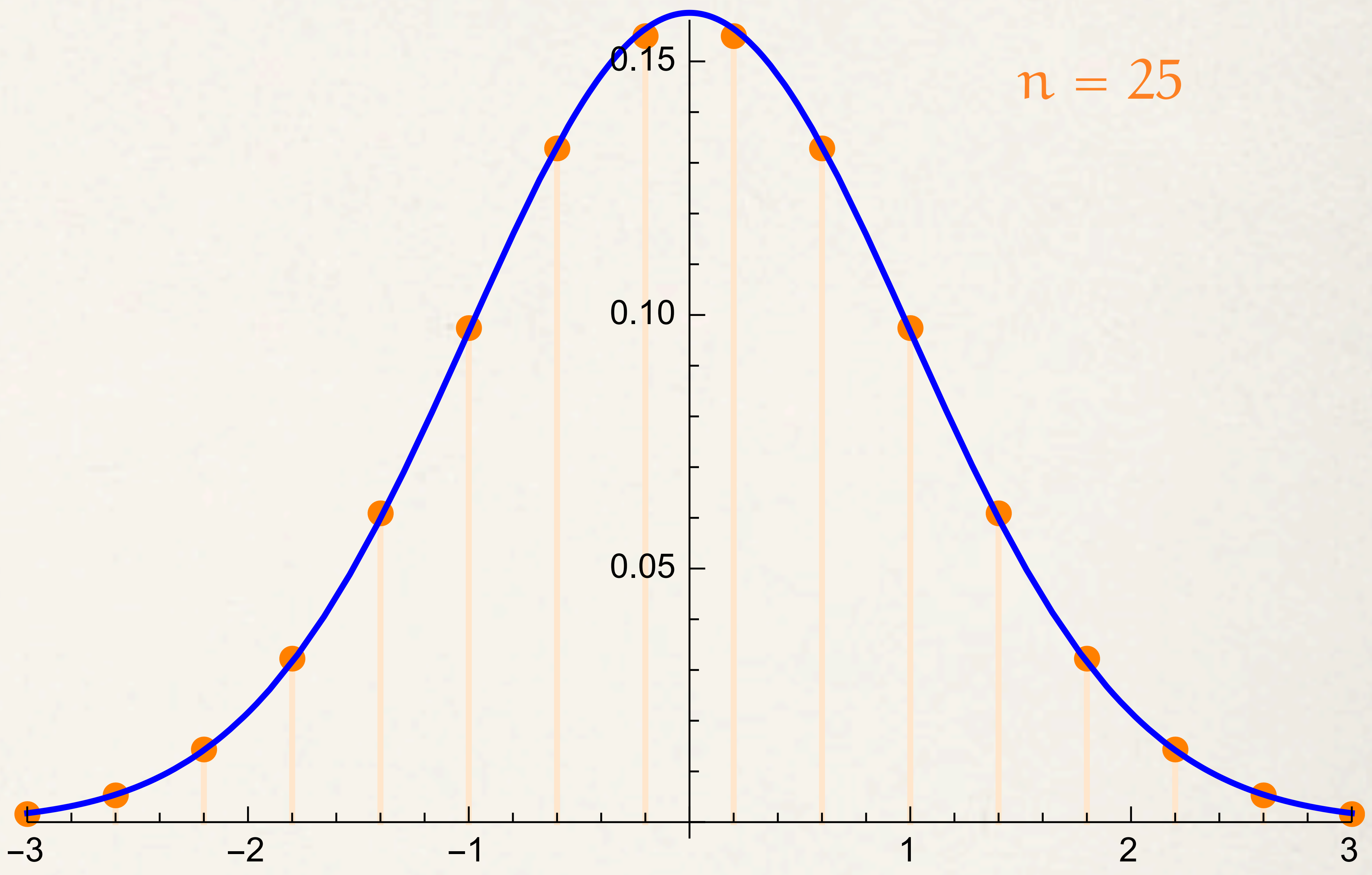
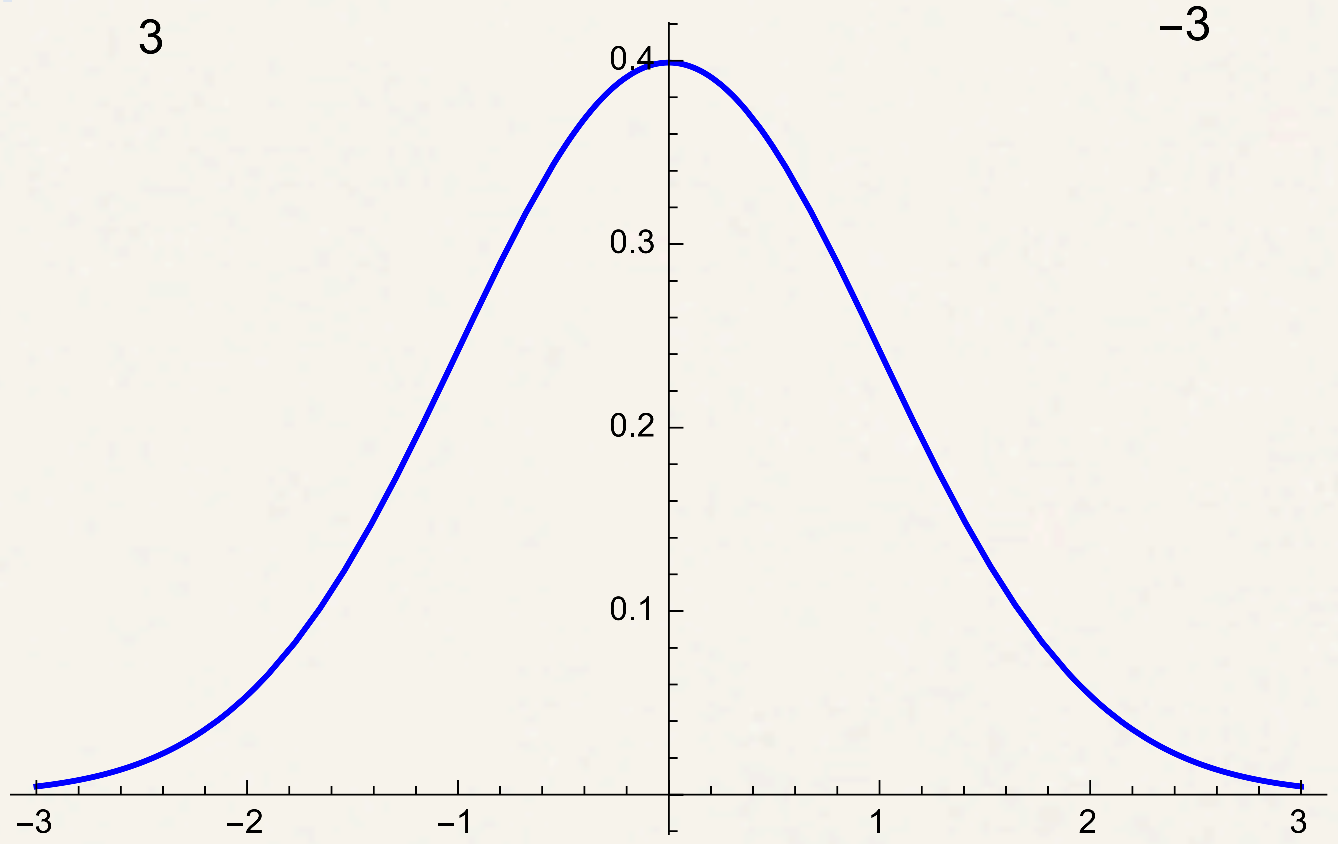
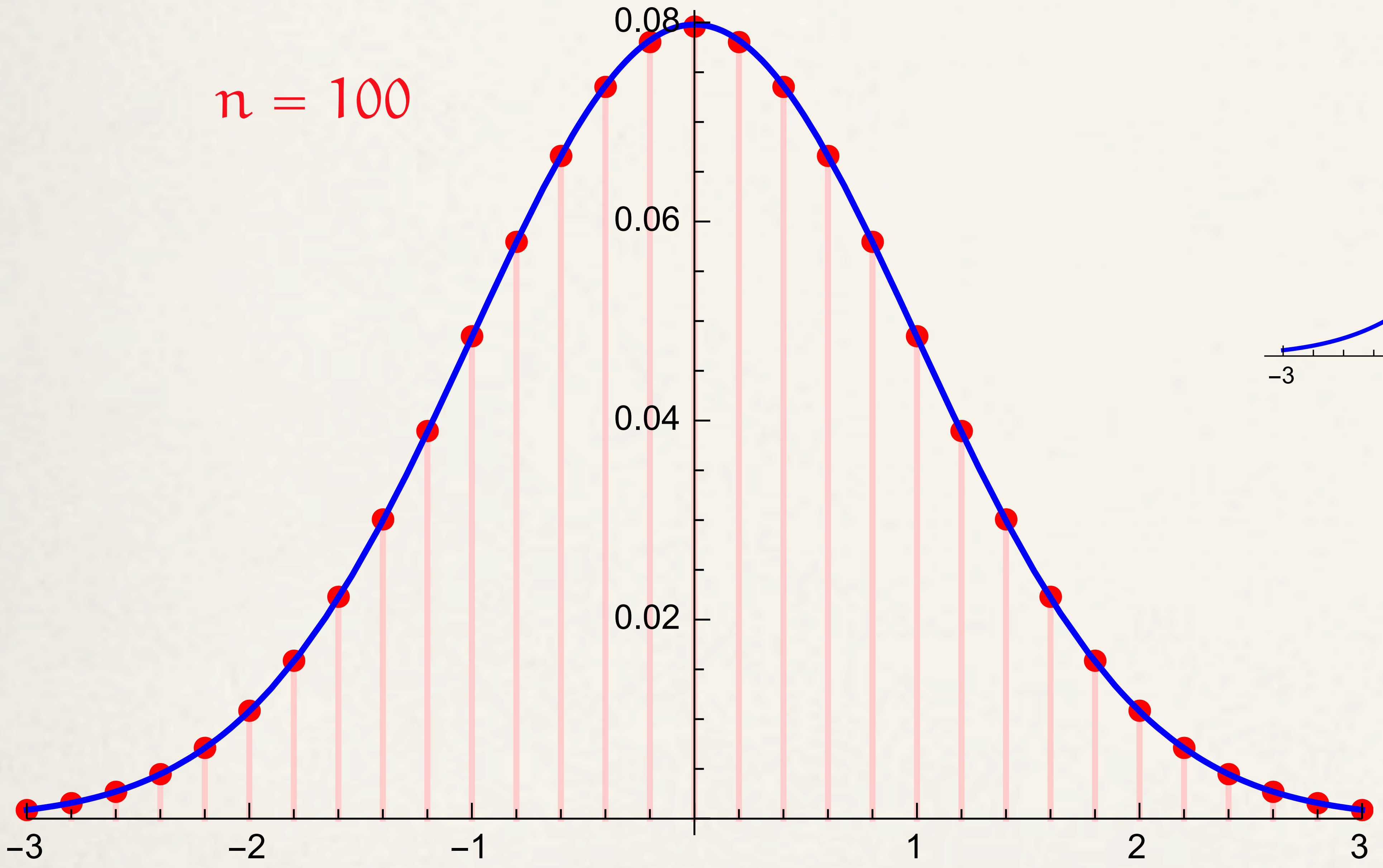
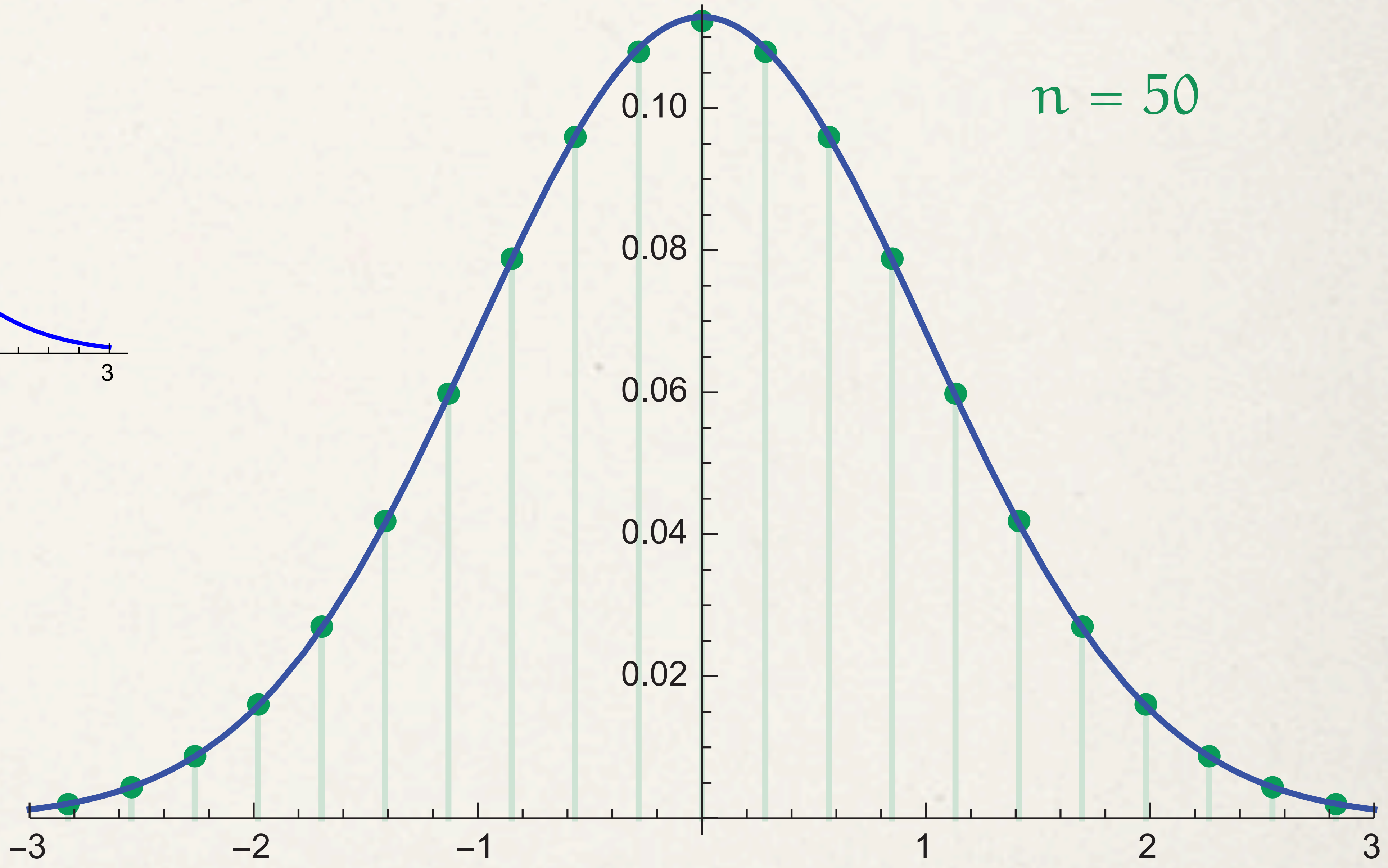




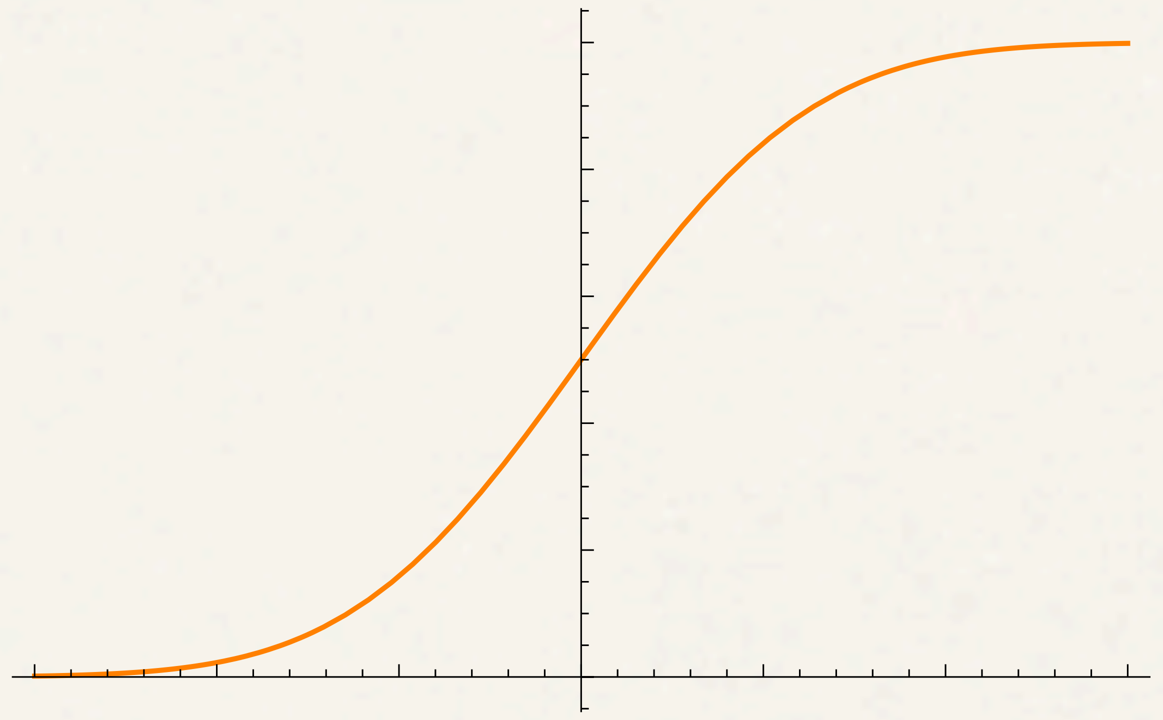






The distribution function of S_n^*

$$F_n^*(t) = \mathbf{P}\{S_n^* \leq t\}$$



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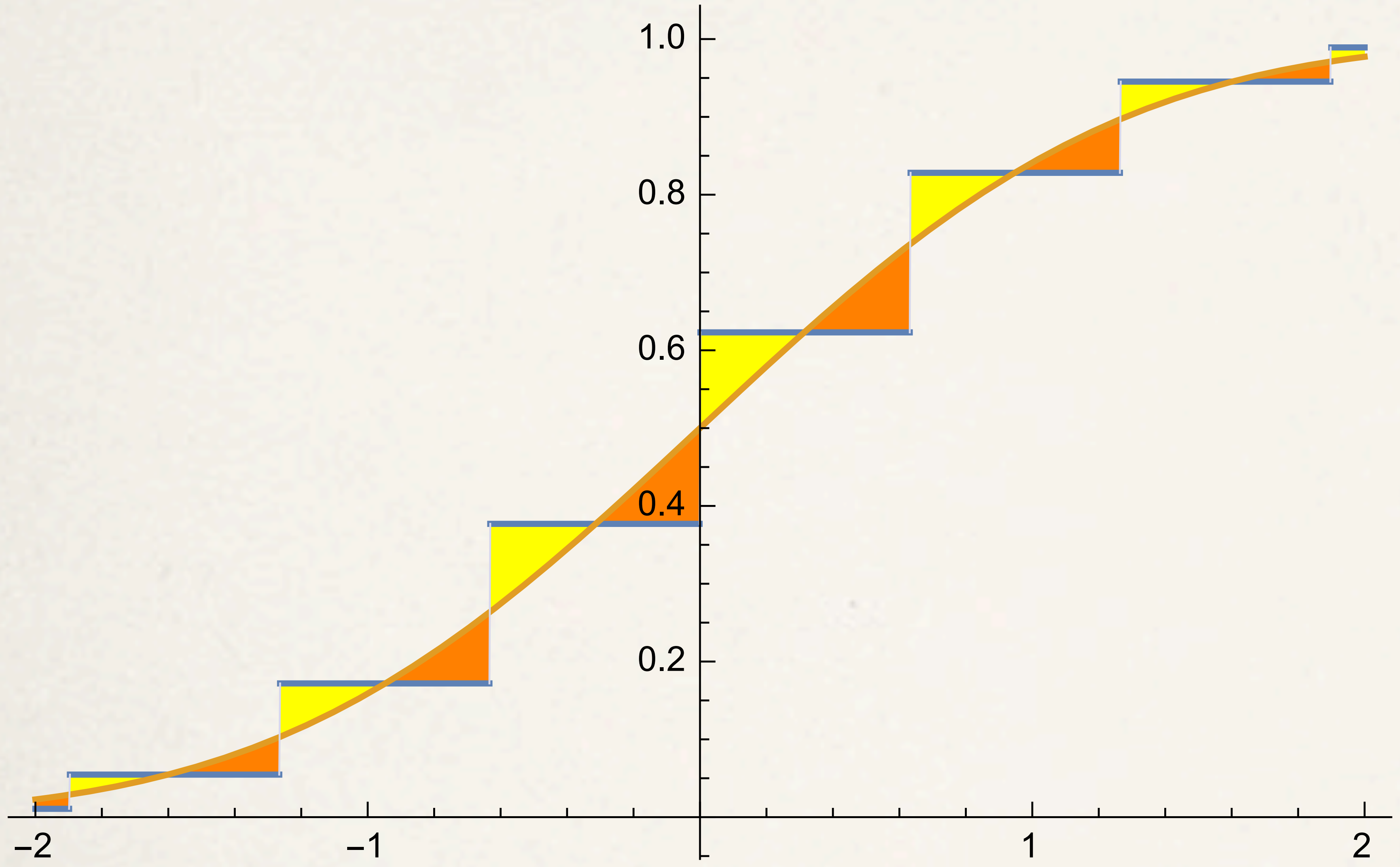
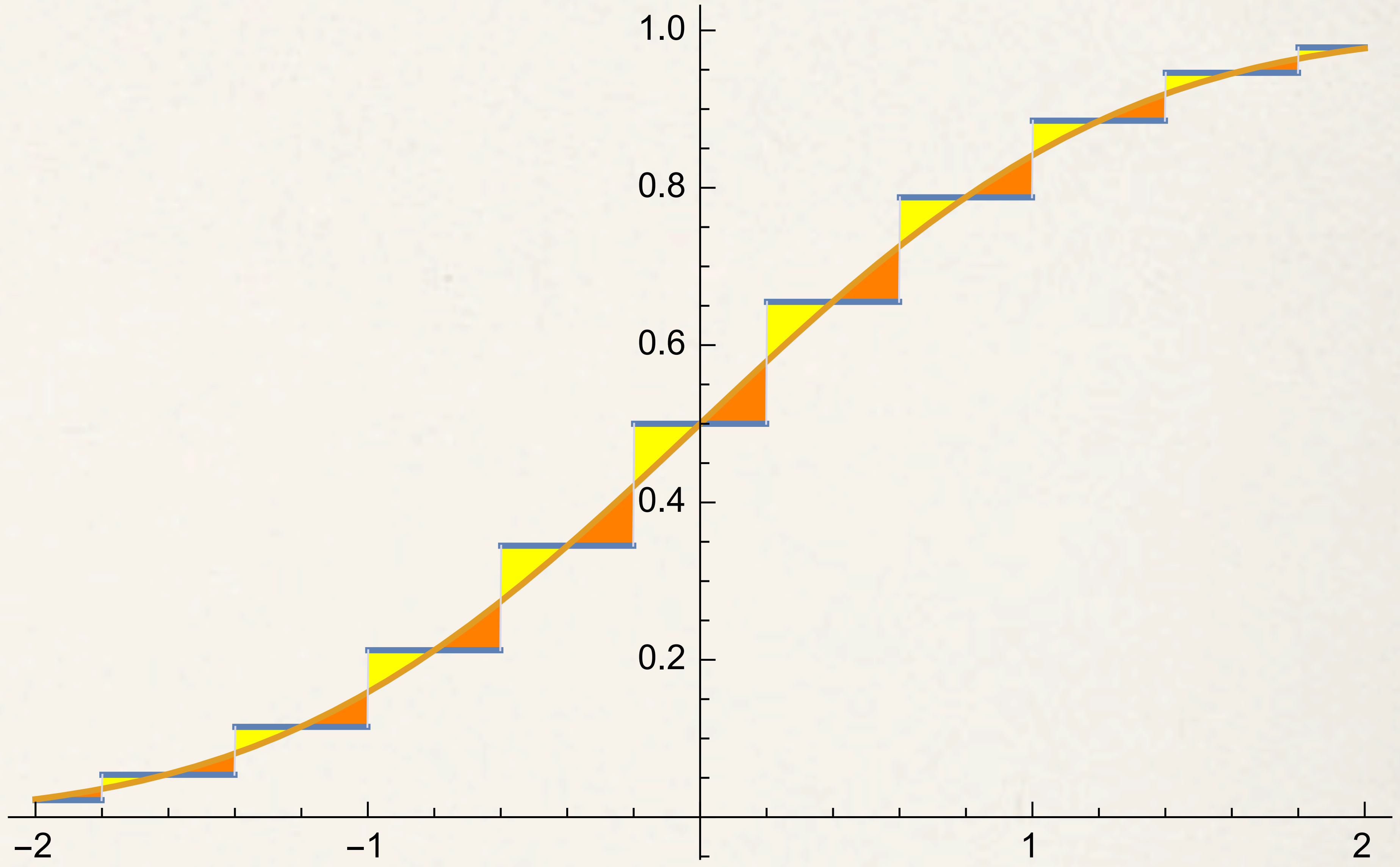
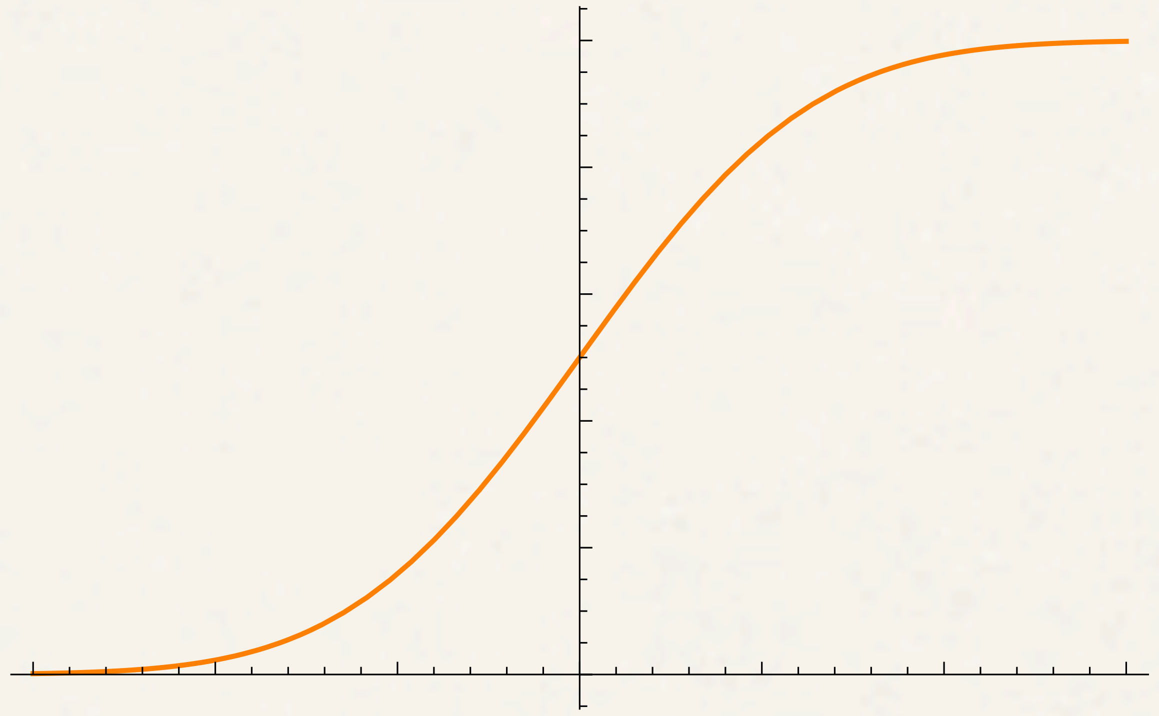
$n = 10$

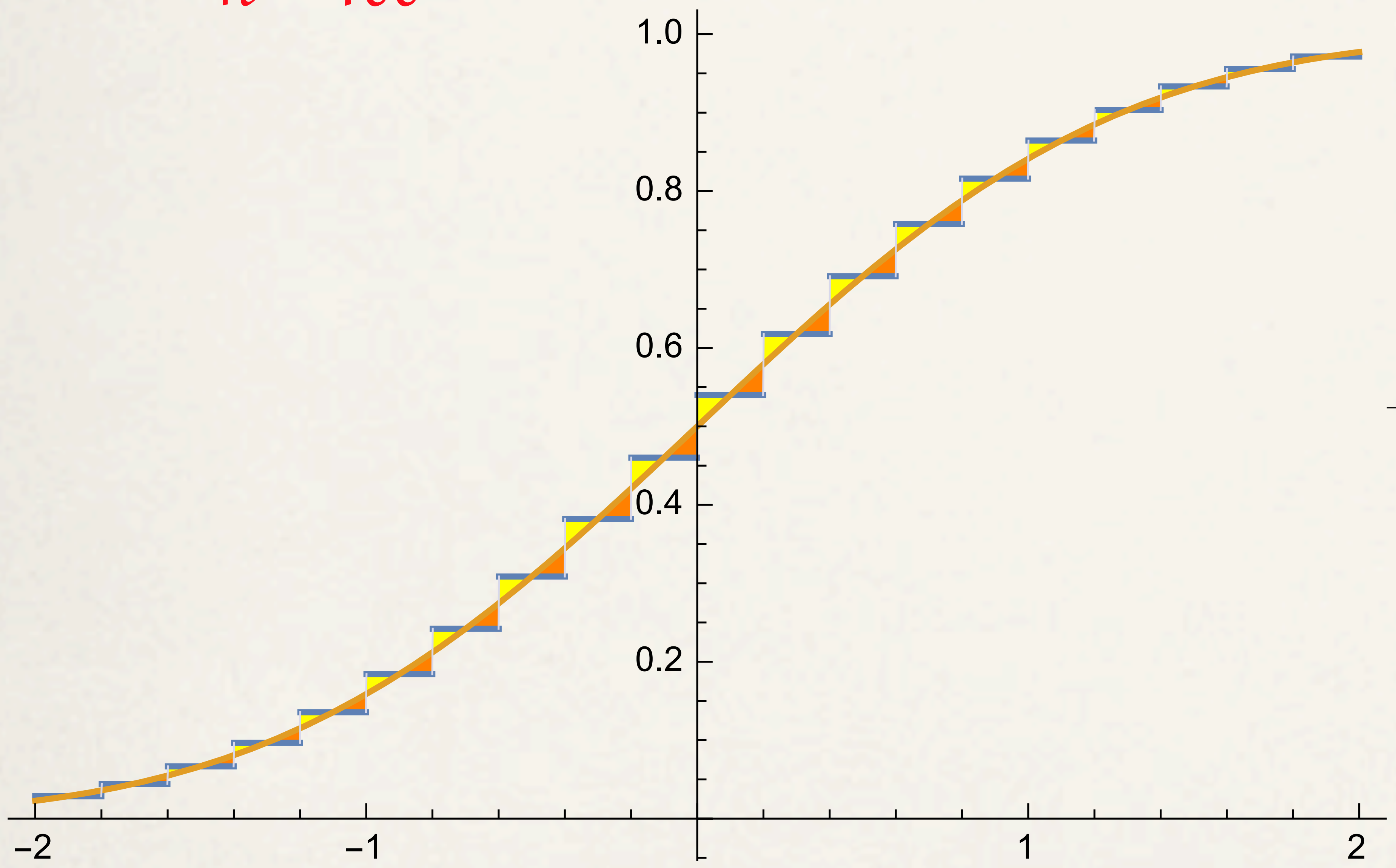


$n = 25$

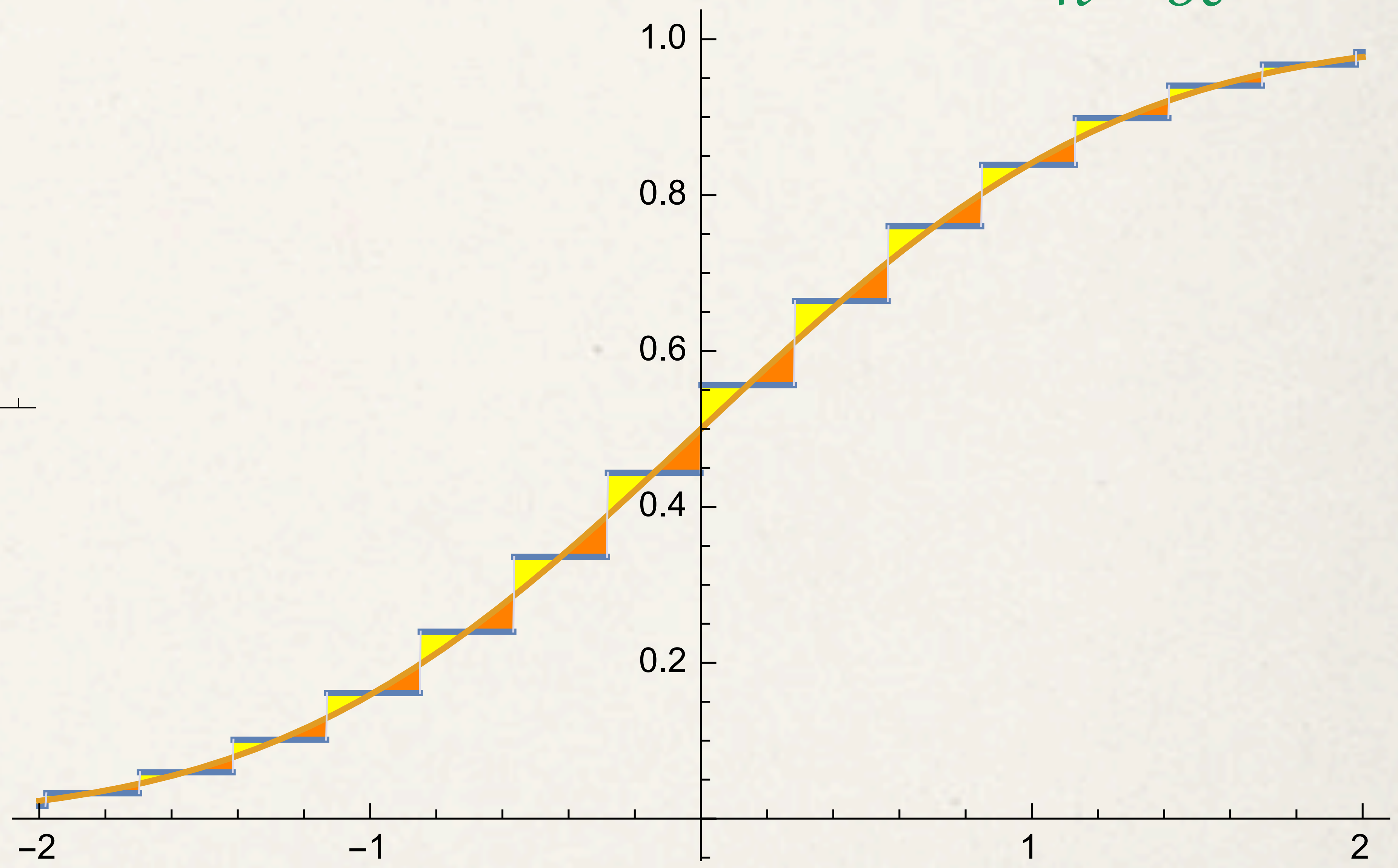




$n = 100$



$n = 50$



Proof by picture!

The pictorial evidence suggests that the area under the normal curve gives very good approximations for binomial probabilities (viewed in the proper scale).