7.3 Areas Under Any Normal Curve

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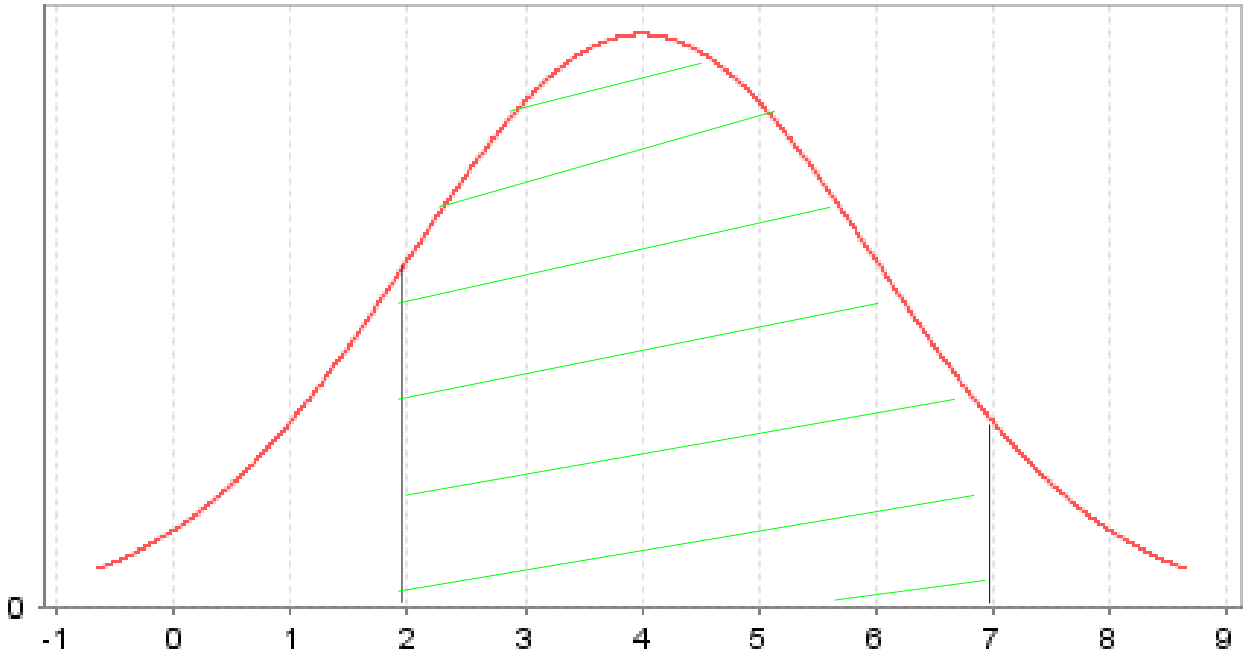
$P(2 \le x \le 7)$ = *(area under the normal curve for x between 2 and 7)*

Normal Curve for x distribution with $\mu = 4, \sigma = 2$



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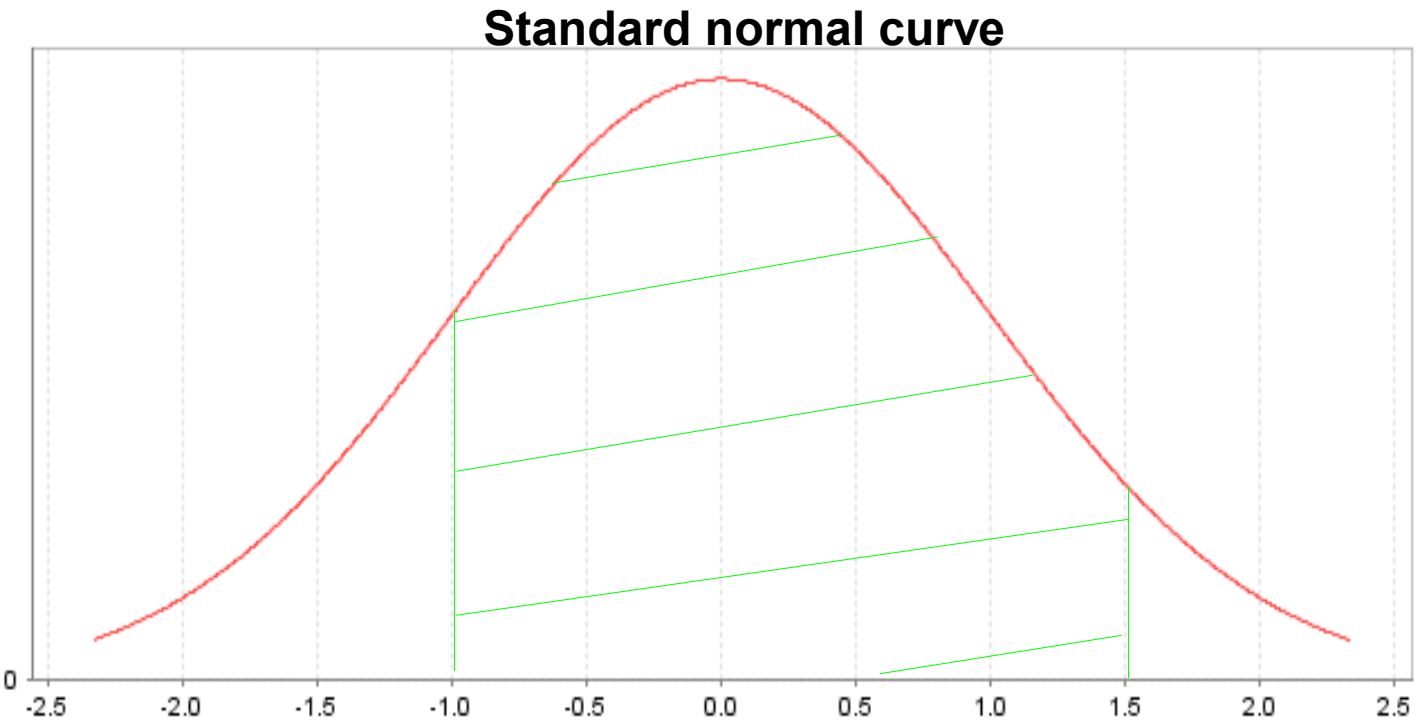
$P(2 \le x \le 7)$ = *(area under the normal curve for x between 2 and 7)*

Let's convert the interval (from raw values to z values):

$$2 \quad \le \quad x \quad \le \quad 7$$

$$\frac{(2-4)}{2} \quad \frac{(x-\mu)}{\sigma} \quad \frac{(7-4)}{2}$$

$$-1 \quad \le \quad z \quad \le \quad 1.5$$



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$\mu = 4, \sigma = 2$
Find $P(2 \le x \le 7)$

$P(2 \le x \le 7)$ = *(area under the normal curve for x between 2 and 7) =*
= P(-1 ≤ z ≤ 1.5) = (area under the standard normal curve for z between -1 and 1.5) =
= (area to the left of 1.5) – (area to the left of -1) = P(z ≤ 1.5) – P(z ≤ -1) = (use Table 3) = 0.9332 – 0.1587 = 0.7745

$P(2 \le x \le 7) = 0.7745$

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Example2 (p. 277/15):
Find the z-value such that 8% of the standard normal curve lies to the right of z.
Sketch the area described.

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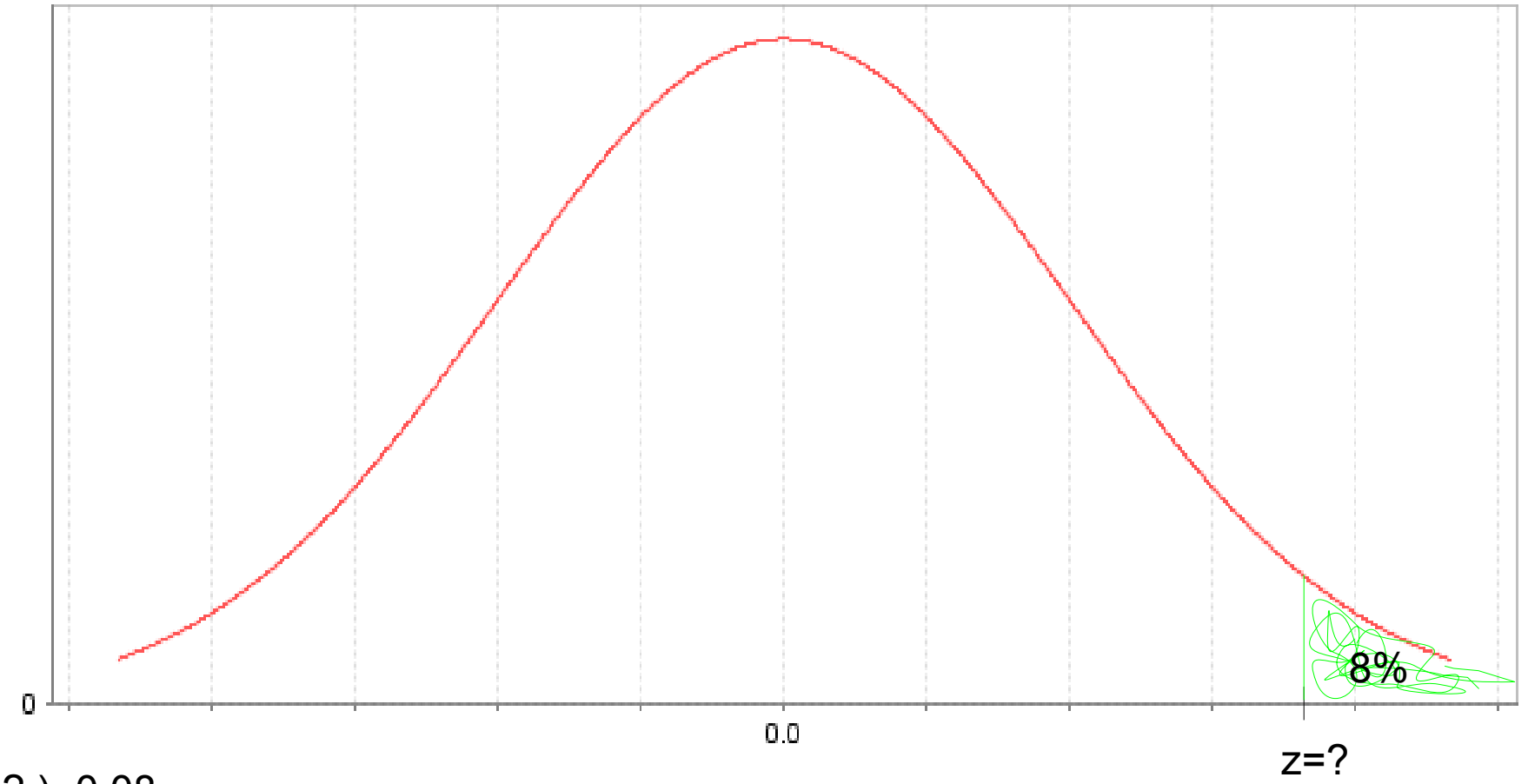

P(z ≥ ?)=0.08

P(z ≤ ?) = 1-0.08 = 0.92 Let's find the area .9200 in the Table 3 (or the closest to it):
- closest is .9207 (.9192 is farther). Thus z ≈ 1.41

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Example3 (p. 278/25):
Quick Start Company makes 12-volt car batteries. After many years of product testing, the company knows that the average life of a Quick Start battery is normally distributed, with a mean of 45 months and a standard deviation of 8 months.

(a) If Quick Start guarantees a full refund on any battery that fails within the 36-month period after purchase, what percentage of its batteries will the company expect to replace?

(b) If Quick Start does not want to make refunds for more than 10% of its batteries under the full-refund guarantee policy, for how long should the company guarantee the batteries (to the nearest tenth)?

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Example3 (p. 278/25):
Quick Start Company makes 12-volt car natteries. After many years of product testing, the company knows that the average life of a Quick Start battery is normally distributed, with a mean of 45 months and a standard deviation of 8 months.

Summary: $\mu = 45, \sigma = 8$

(a) If Quick Start guarantees a full refund on any battery that fails within the 36-month period after purchase, what percentage of its batteries will the company expect to replace?

x=36, find P(x ≤ 36)

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Summary: $\mu = 45, \sigma = 8$

(a) If Quick Start guarantees a full refund on any battery that fails within the 36-month period after purchase, what percentage of its batteries will the company expect to replace?

x=36, find P(x ≤ 36) = P(z ≤ $\frac{(36-45)}{8}$) = P(z $\overset{*}{\leq}$ -1.12) = (Table 3) = .1314

13% of the batteries the company should expect to replace.

*: $\frac{(36-45)}{8}$ = -1.125,

Table 3 has areas for z values with only two decimal places, thus we need either to round off -1.125 or to do something else. We decide to take the z-value with larger area.
(area to the left of -1.12) is more than (the area to the left of -1.13). Thus let's take P(z ≤ -1.12)

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Summary: $\mu = 45, \sigma = 8$

(b) If Quick Start does not want to make refunds for more than 10% of its batteries under the full-refund guarantee policy, for how long should the company guarantee the batteries (to the nearest tenth)?

area=.10, find z value for that area, then find the raw score (x) for that z.

P(z ≤ ?) = .1000

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area=.10, find z value for that area, then find the raw score (x) for that z.

P(z ≤ ?) = .1000
Look into Table 3 (find the area closest to 0.1000):
.1003 is the closest (.0985 is farther)

z value for area 0.1003 is -1.28 (in standard units)

x value = -1.28*8 + 45 = 34.76 (months)

Guarantee the batteries for 35 months.