Math 146 6.2 — Applications of Normal Distributions

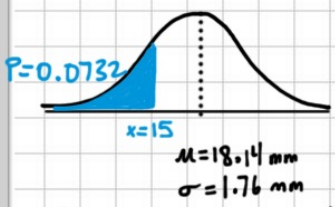
To calculate the area under a normal distribution with mean μ and standard deviation σ, first calculate the *z*-score (from chapter 3)

$$z = \frac{x-\mu}{\sigma}$$ (round to two decimal places)

and then use Table A-2 or your calculator to calculate the areas.

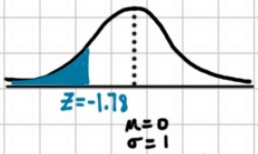
EXAMPLE 1 One of the larger species of tarantulas is the *Grammostola mollicoma*, whose common name is the Brazilian Giant Tawny Red. A tarantula has two body parts. The anterior part of the body is covered above by a shell, or carapace. It has been found that the carapace length of the adult male is normally distributed with mean $\mu = 18.14$ mm and standard deviation $\sigma = 1.76$ mm.

a) Find the percentage of adult male *G. mollicoma* that have carapace lengths less than 15 mm.



$$z = \frac{x-\mu}{\sigma} = \frac{15-18.14}{1.76}$$

$$z = -1.78$$



$P = \text{normalcdf}(a, b, \mu, \sigma)$

$= \text{normalcdf}(-1E99, 15, 18.14, 1.76)$

$= 0.0372$

Excel: normdist(15, 18.14, 1.76, 1)

or

$P = \text{normalcdf}(-1E99, -1.78)$

$= 0.038$

EXCEL : normdist(-1.78, 0, 1, 1)

b) Find $P(16 < x < 17)$

$\mu = 18.14$ mm

$\sigma = 1.76$ mm

$P = \text{normalcdf}(16, 17, 18.14, 1.76)$

$P = 0.1466$

normdist(17, 18.14, 1.76, 1) − normdist(16, 18.14, 1.76, 1)

c) $P(x > 19)$

$\mu = 18.14$

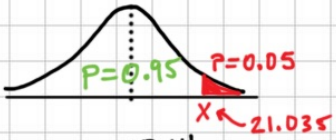
$\sigma = 1.76$

$P = \text{normalcdf}(19, 1E99, 18.14, 1.76)$

$P = 0.3125$

1 − normdist(19, 18.14, 1.76, 1)

d) Find the 95th percentile: P_{95}



$\mu = 18.14$

$\sigma = 1.76$

$\text{invNorm}(P, \mu, \sigma)$

$P_{95} = \text{invNorm}(0.95, 18.14, 1.76)$

$P_{95} = 21.035$

norm.inv(0.95, 18.14, 1.76)

EXAMPLE 2 ANSWERS: $\mu = 272.2$ yds $\sigma = 8.12$ yds

a) $P(260 < x < 280) = 0.7651$

b) $P(x > 300) = 0.00031$

c) $P_{20} = 265.4$ yds

d) $P_{95} = 285.6$ yds

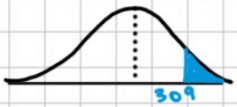
WHO'S THE DADDY?

$\mu = 266$ days
$\sigma = 16$ days

$\frac{365}{12} \approx 30.4$ days/month

10 months 5 days $= 10(30.4) + 5$
$= 309$ days

Find: $P(x > 309)$



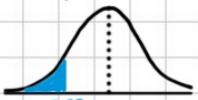
$\mu = 266$
$\sigma = 16$

$P =$ normalcdf(309, 1E99, 266, 16)
≈ 0.0036
1-normdist(309, 266, 16, 1)

⇒ She either had an extremely rare long pregnancy, or.... ☺

How many births are premature?

Before the 37 week would be 36 weeks or less
36 wk = 36·7
= 252 days



$\mu = 266$
$\sigma = 16$

$P =$ normalcdf(-1E99, 252, 266, 16)
$P = 0.19$
normdist(252, 266, 16, 1)

About 19% of births are premature.
(This is actually a little high, closer to 11%)

HEART RATES

$\bar{x} = 69.7 \rightsquigarrow \mu$
$s = 9.62 \rightsquigarrow \sigma$

a) $P(x < 60) = 0.1567$

b) $P(60 < x < 80) = 0.7012$

c) $P(x > 35) = 0.9998$ wow!

d) $P_{99} = 92.1$ bpm