

# Applications of the Normal Distribution Solutions

Use the information in the following setting to answer questions 1 through 4:

The length of human pregnancies from conception to birth is, on average, 266 days with a standard deviation of 16 days. Enough medical study has been done on this variable that we know it follows an approximate normal distribution.

1) What proportion of human pregnancies is longer than 295 days?

A) Compute  $z$

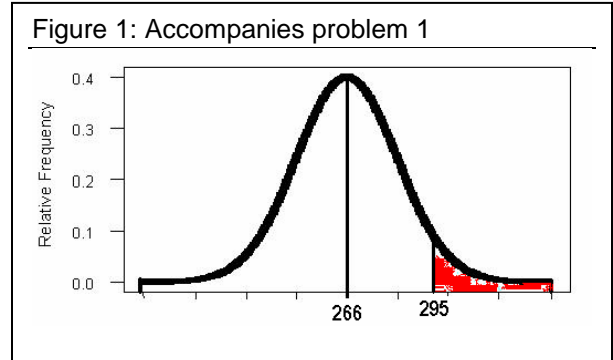
$$z = \frac{295 - 266}{16} = 1.81$$

B) Look up in table A

$$\Pr\{z < 1.81\} = 0.9649$$

C) Now subtract from 1 because this is a type II problem

$$\Pr\{x > 295\} = \Pr\{z > 1.81\} = 1 - 0.9649 = 0.0351$$



2) What is the probability that a woman's pregnancy will last between 222 and 258 days?

A) Compute  $z$ -scores for each value of  $x$

$$z = \frac{222 - 266}{16} = -2.75$$

$$z = \frac{258 - 266}{16} = -0.50$$

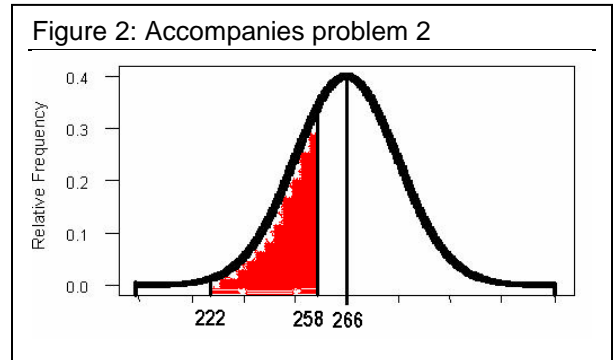
B) Look up probabilities in Table A

$$\Pr\{z < -2.75\} = 0.0030$$

$$\Pr\{z < -0.50\} = 0.3085$$

C) Subtract to get the type III "central" probability

$$\Pr\{222 < x < 258\} = \Pr\{-2.75 < z < -0.50\} = 0.3085 - 0.0030 = 0.3055$$

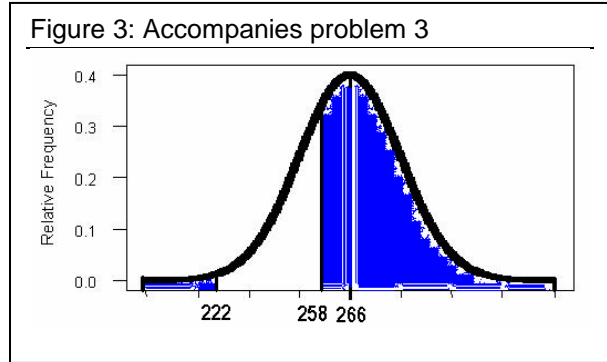


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- 3) What is the probability that a woman's pregnancy will last more than 258 or less than 222 days?

Here we can use the fact that the total area under the normal "density" is 1. We've already computed the area (probability) for pregnancies between 222 and 258 days in problem 2. To get the corresponding probability that a pregnancy will last less than 222 days or more than 258 days we can, simply subtract from 1. Hence,

$$\Pr\{x < 222 \text{ or } x > 258\} = 1 - 0.3055 = 0.6945$$



- 4) What proportion of human pregnancies is shorter than 282 days?

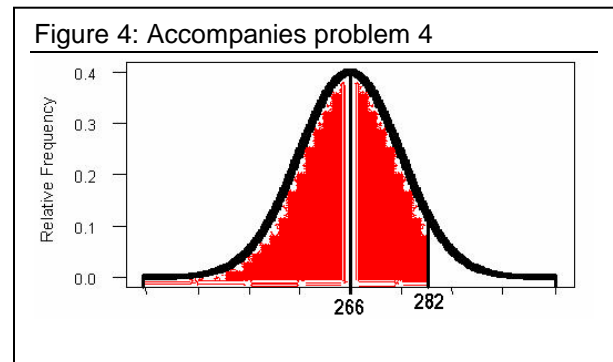
This is a type I problem!

A) Convert to z

$$z = \frac{282 - 266}{16} = 1.00$$

B) Look up probability in Table A

$$\Pr\{x < 282\} = \Pr\{z < 1.00\} = 0.8413$$



- 5) What two values enclose the middle 95% of human gestation periods? (Hint: for a "close enough" answer use the empirical rule)

According to the empirical rule, 95% of the data in a BSD will lie between  $\pm 2\sigma$  of the mean. Since gestation length is normally distributed (bell shaped) with a mean of 266 and a standard deviation of 16, we would expect 95% of the data to lie between  $266 \pm 2(16)$  days. So, 95% of all pregnancies will last between 234 and 298 days.