Homework 3

Darian-Florian Voda

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Exercise 29

An engine produces wooden staff with a length of $\mu = 1.2$ m and a standard deviation of $\sigma = 2$ cm. The length of the wooden staff follows a normal distribution. What is the probability, that the length of a randomly selected staff

1. lies between 1175 mm and 1195 mm?
2. is longer than 1190 mm?
3. shows a maximal deviation of 10 mm for the expectation?

```
### Exercise 29
library(mosaic)
library(gridExtra)
library(ggplot2)
mu <- 1.2
sigma <- 0.02


# 1)
low.prob <- xpnorm(1.175, return="value", plot=FALSE, mean=mu, sd=sigma)
low.prob
```

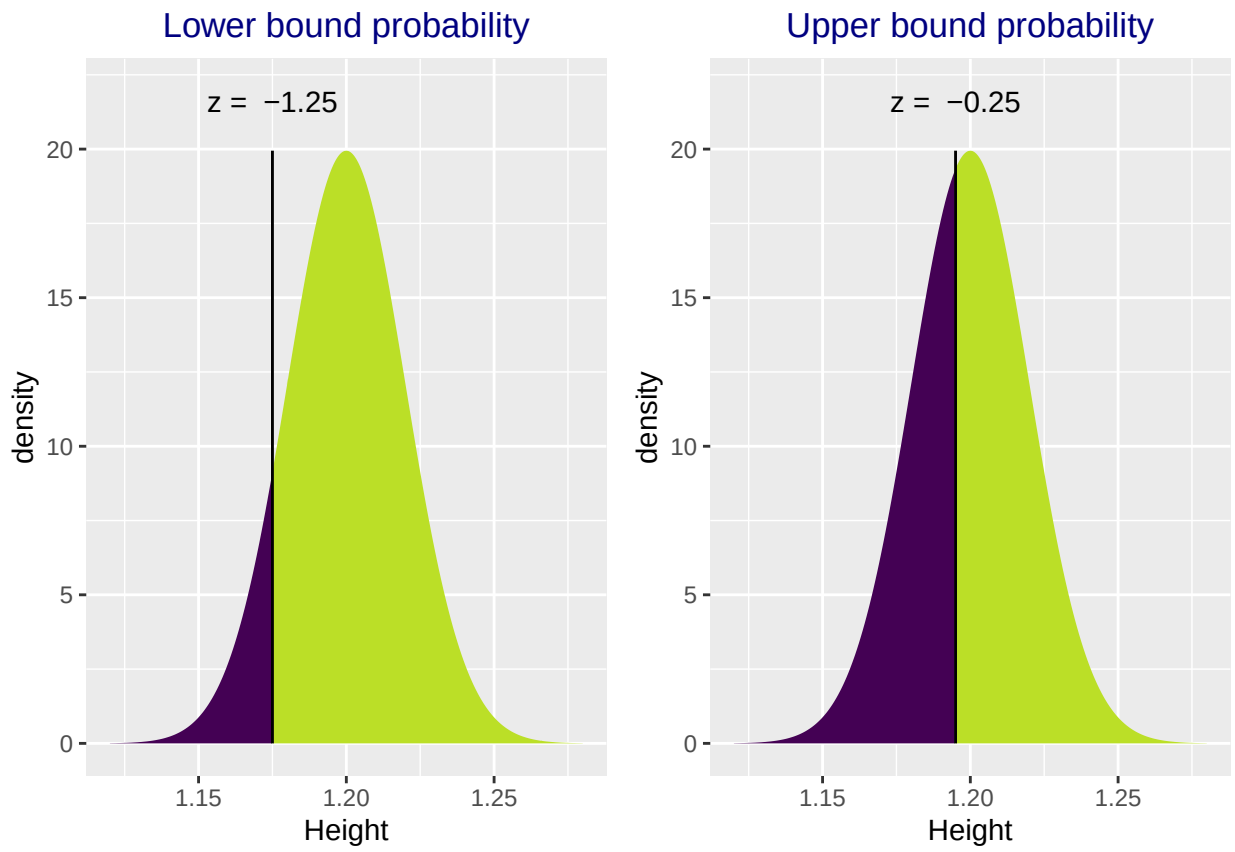
```
## [1] 0.1056498
```

```
# Plot

h2 = xpnorm(1.175, mean=mu, sd=sigma, return = "plot", system = "gg") %>%
  gf_labs(title = "Lower bound probability", x = "Height") %>%
  gf_theme(plot.title = element_text(hjust = 0.5, color = "navy"))


high.prob <- xpnorm(1.195, return="value", plot=FALSE, mean=mu, sd=sigma)
high.prob
```

```
## [1] 0.4012937
```

```
h1 = xpnorm(1.195, mean=mu, sd=sigma, return = "plot", system = "gg") %>%
  gf_labs(title = "Upper bound probability", x = "Height") %>%
  gf_theme(plot.title = element_text(hjust = 0.5, color = "navy"))
```

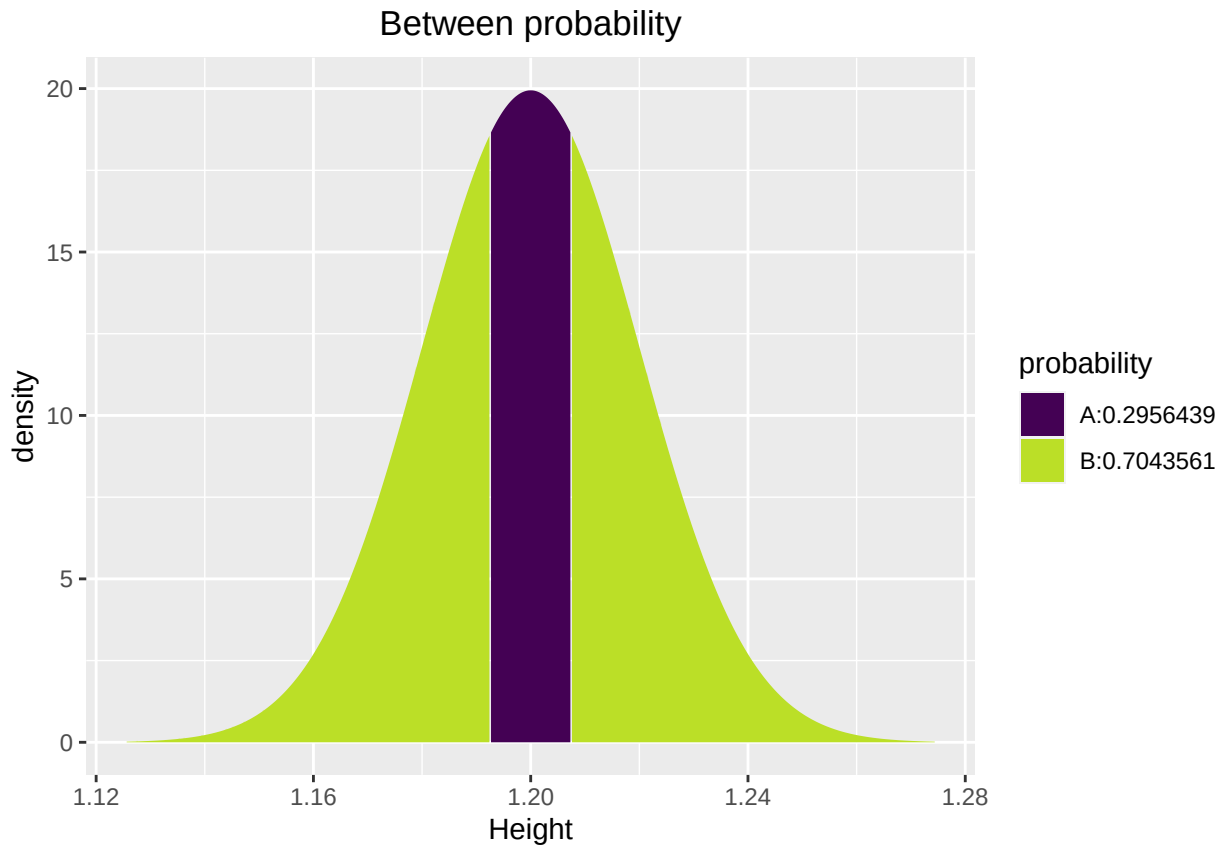
```
grid.arrange(h2, h1, ncol=2)
```



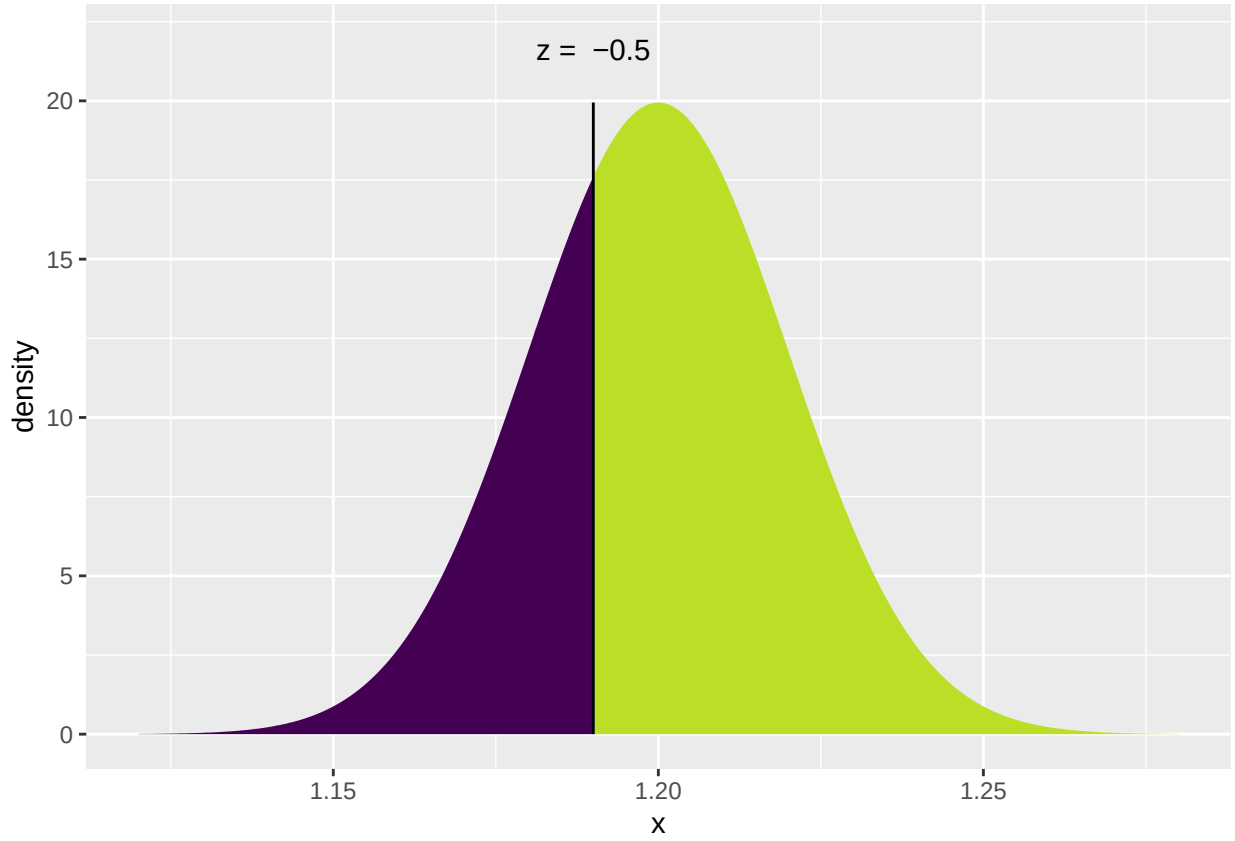

```
diff.prob <- high.prob - low.prob
diff.prob
```

```
## [1] 0.2956439
```

```
diff_plot = xcnorm(diff.prob, mean=mu, return="plot", sd=sigma, system="gg") %>%
  gf_labs(title = "Between probability", x = "Height") %>%
  gf_theme(plot.title = element_text(hjust = 0.5, color = "black"))
diff_plot
```



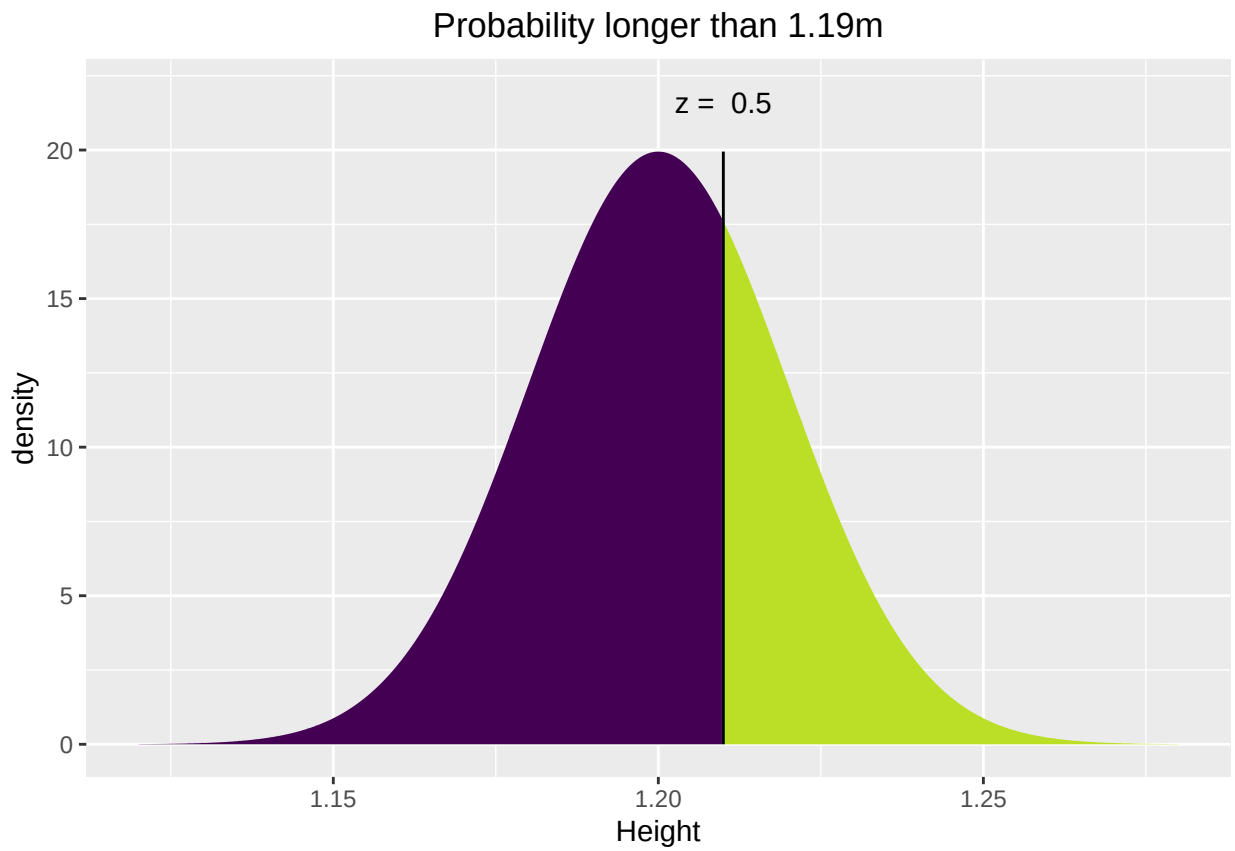

```
# 2)
longer = 1 - xpnorm(1.190, return="value", mean=mu, sd=sigma)
```



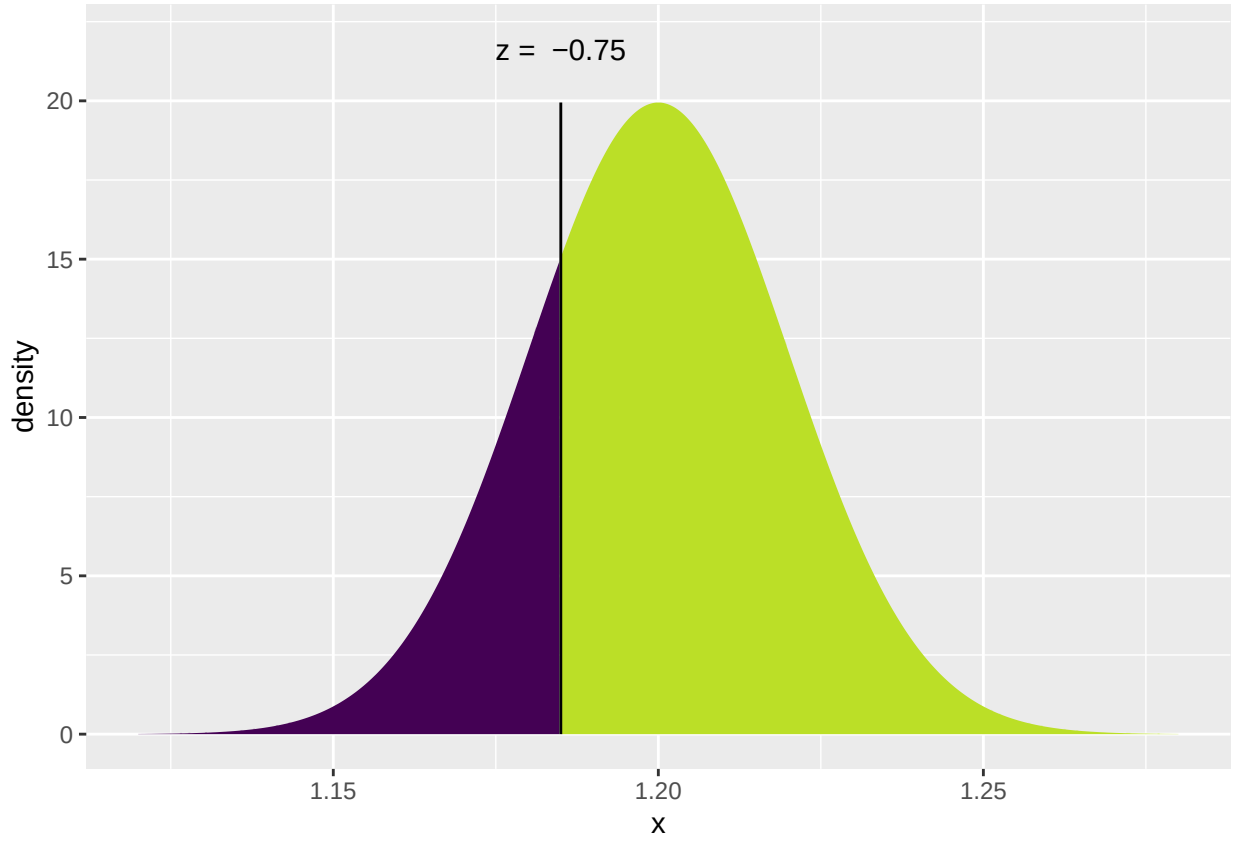

```
longer
```

```
## [1] 0.6914625
```

```
xqnorm(longer, mean=mu, return="plot", sd=sigma, system="gg") %>%
  gf_labs(title = "Probability longer than 1.19m", x = "Height") %>%
  gf_theme(plot.title = element_text(hjust = 0.5, color = "black"))
```



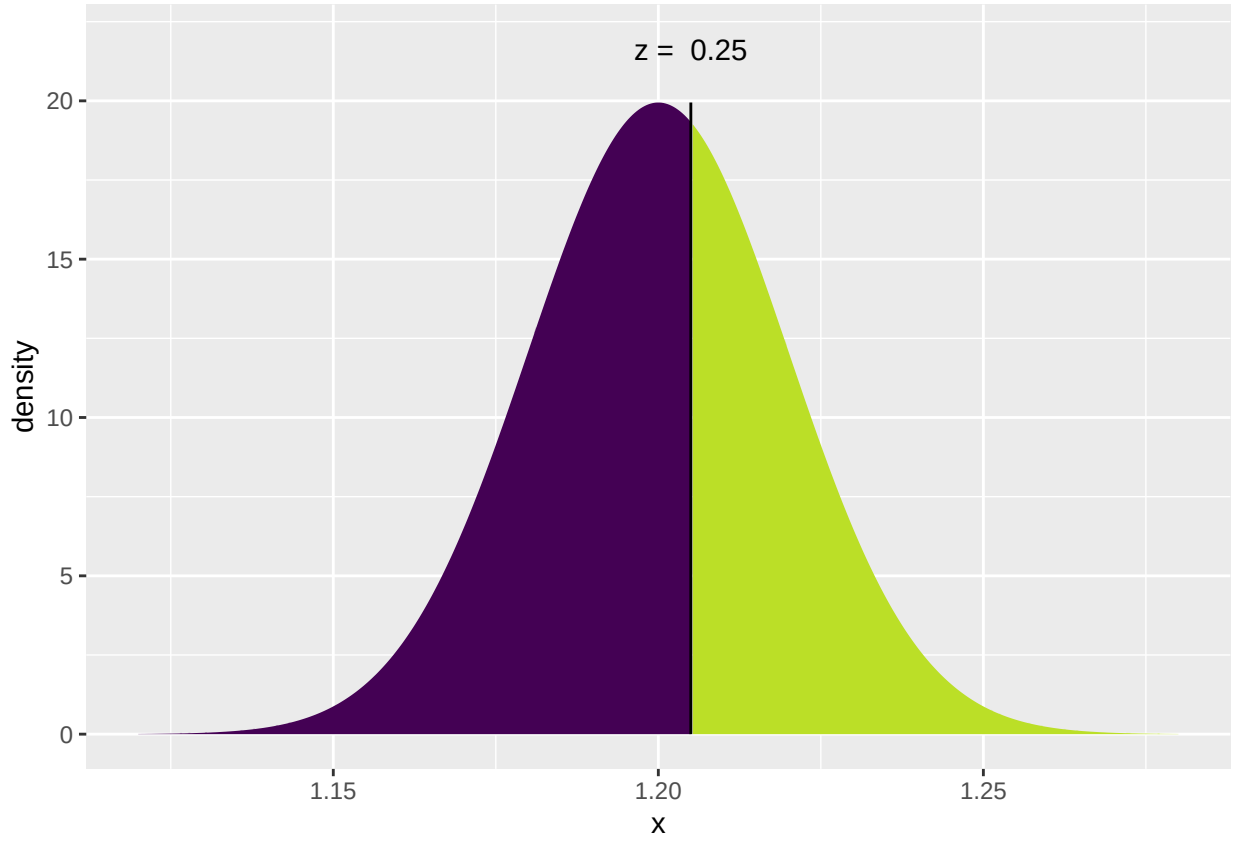

```
# 3)

#value = mu + (sigma/sqrt(0.01))
#value

new_low.prob <- xpnorm(1.185, mean=mu, sd=sigma)
```




```
new_low.prob
```

```
## [1] 0.2266274
```

```
new_high.prob <- xpnorm(1.205, mean=mu, sd=sigma)
```



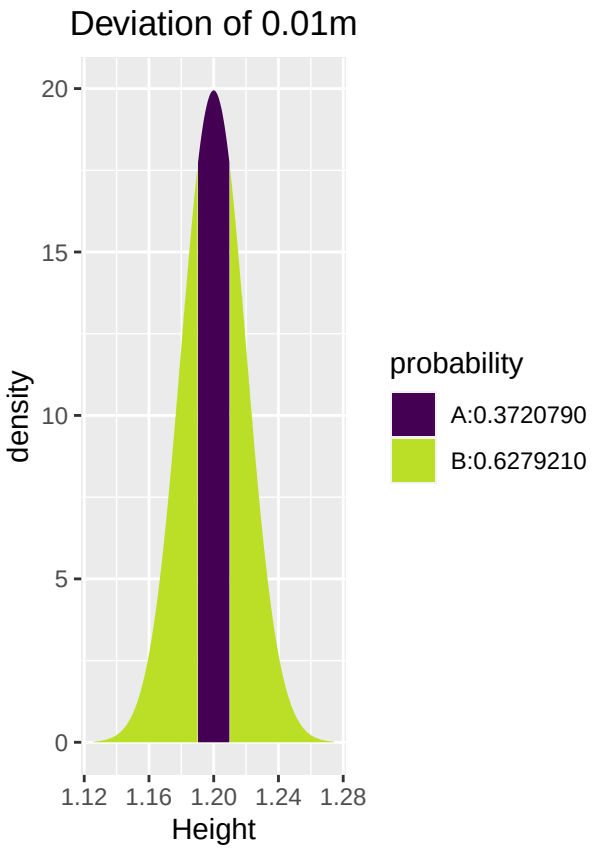

```
new_high.prob
```

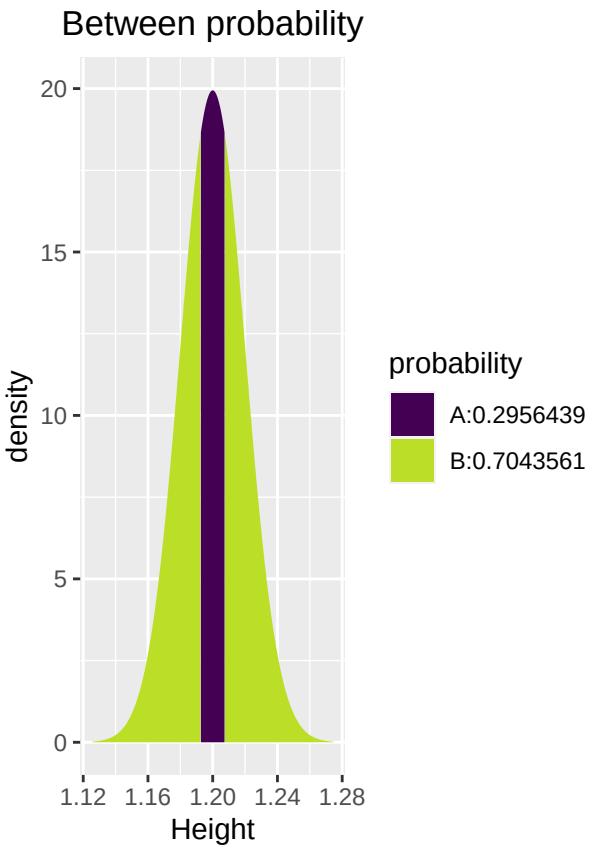
```
## [1] 0.5987063
```

```
new_diff.prob <- new_high.prob - new_low.prob
new_diff.prob
```

```
## [1] 0.372079
```

```
new_plot = xcnorm(new_diff.prob, mean=mu, return="plot", sd=sigma, system="gg") %>%
  gf_labs(title = "Deviation of 0.01m", x = "Height") %>%
  gf_theme(plot.title = element_text(hjust = 0.5, color = "black"))

grid.arrange(new_plot, diff_plot, ncol=2)
```



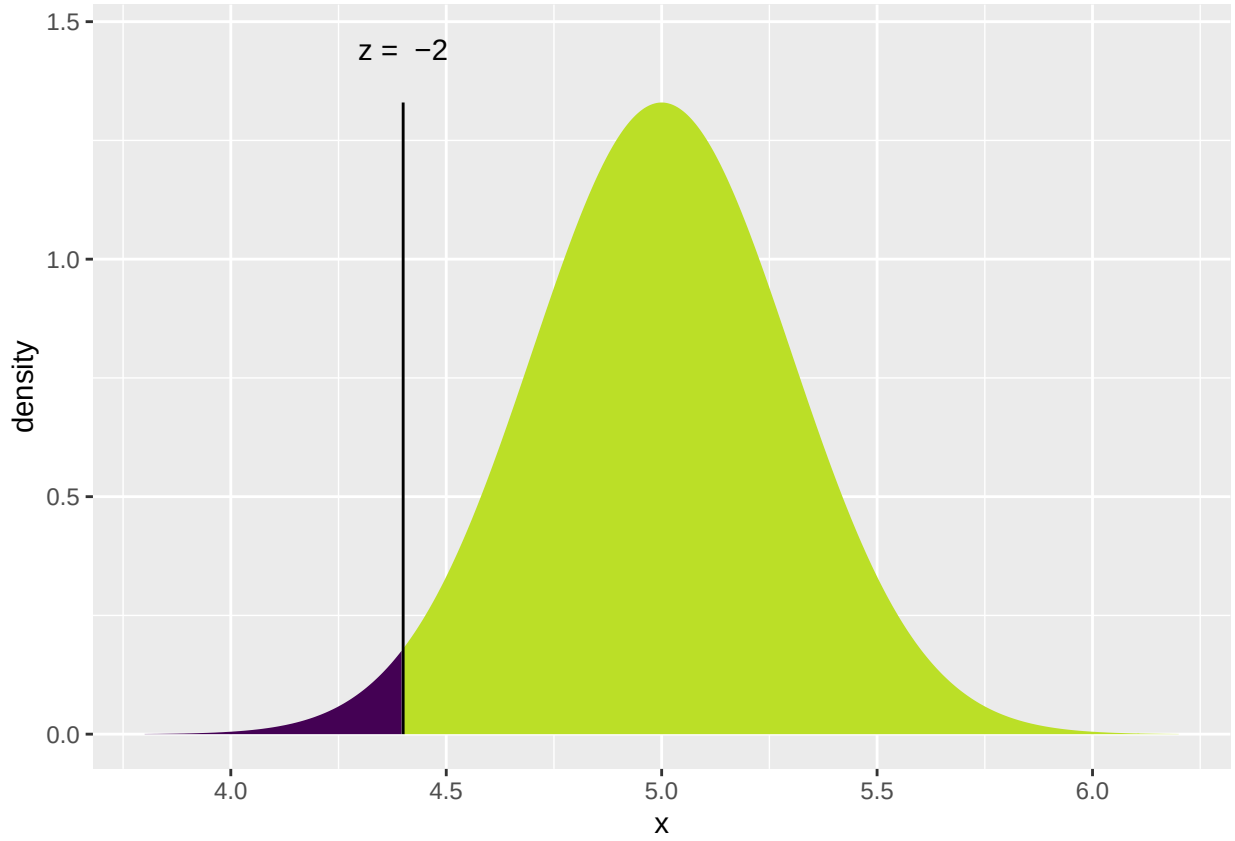


Exercise 30

An engine produces metal plates with a thickness of $\mu = 5$ mm and a standard deviation of $\sigma = 0.3$ mm. The thickness of the metal plates follows a normal distribution.

1. How many plates are useless, because their thickness is below 4.4 mm?
2. How many plates are useless, because their thickness is above 5.4 mm?

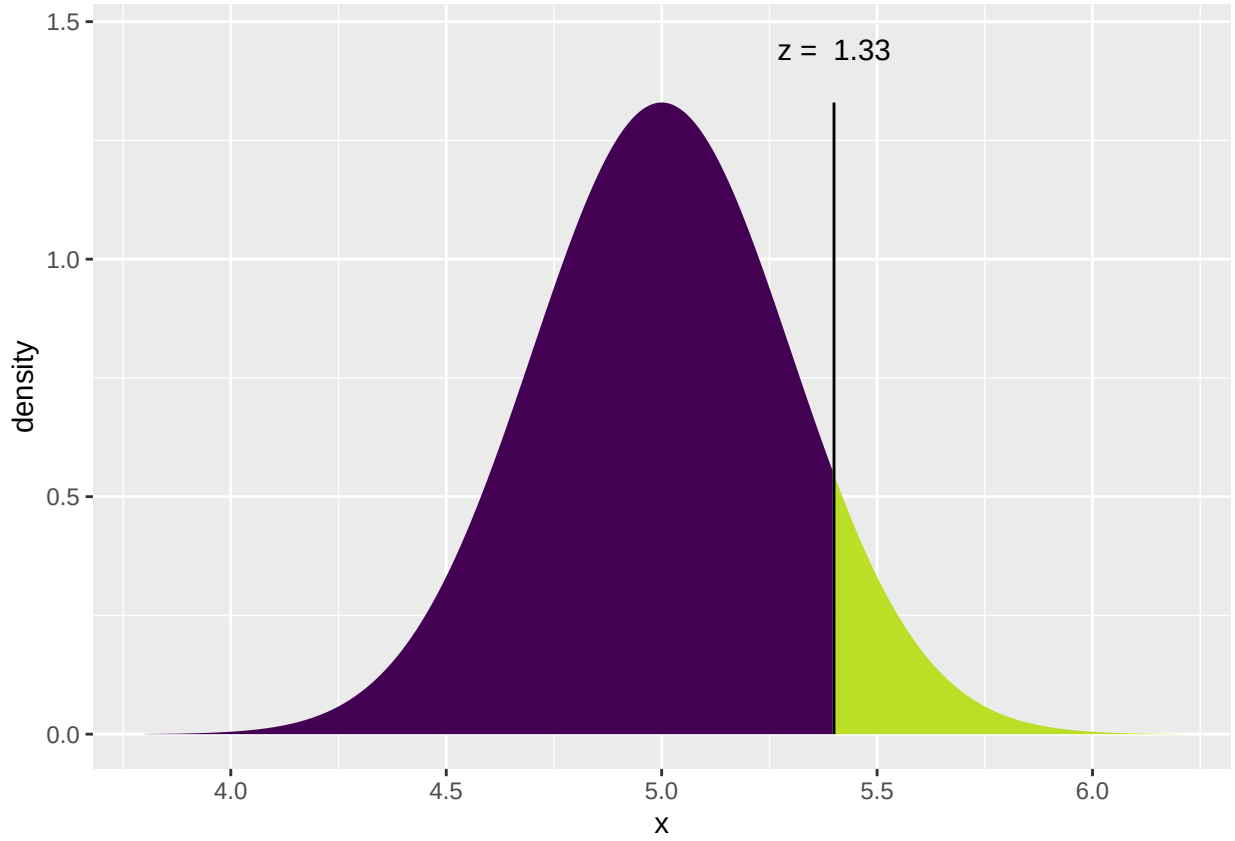
```
### Exercise 30

mu_2 = 5
sigma_2 = 0.3

# 1)
ex30_1 = xpnorm(4.4, mean=mu_2, sd=sigma_2)
```




```
ex30_1
```

```
## [1] 0.02275013
```

```
# 2)
ex30_2 = 1-xpnorm(5.4, mean=mu_2, sd=sigma_2)
```




```
ex30_2
```

```
## [1] 0.09121122
```

Exercise 32

A certain population has an IQ (intelligence quotient) of $\mu = 100$ with a standard deviation of $\sigma = 15$. The IQ follows a normal distribution.

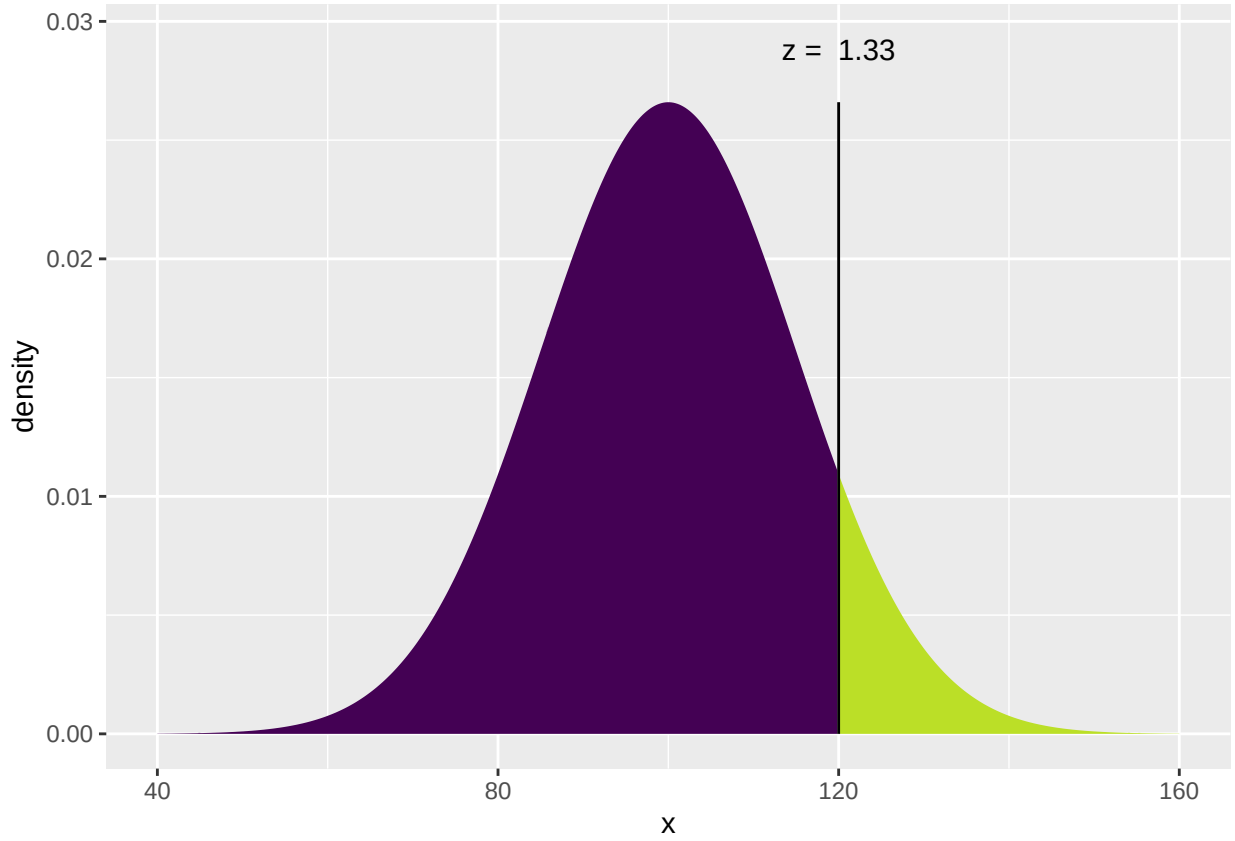
1. What is the range of the IQ of 95% of the population?
2. To get a leading position, you need an IQ of more than 120. What is the percentage of people, who are not qualified for a leading position?
3. What is the minimum IQ to belong to 5% of the most intelligent persons?

```
### Exercise 32

mu_3 = 100
sd_3 = 15

# 1)
mu_3 <- 100
sigma_3 <- 15
lower.bound.pct <- (1 - 0.95) / 2
upper.bound.pct <- (1 - 0.95) / 2 + 0.95
```

```
interval.95 <- c(qnorm(lower.bound.pct, mu_3, sigma_3),
                 qnorm(upper.bound.pct, mu_3, sigma_3))
interval.95
```

```
## [1]  70.60054 129.39946
```

```
# 2)
ex32_2 = xpnorm(120, mean = mu_3, sd=sigma_3)
```




```
ex32_2
```

```
## [1] 0.9087888
```

```
# 3)

ex32_3 = qnorm(0.95, mean=mu_3, sd=sigma_3)
ex32_3
```

```
## [1] 124.6728
```