Homework Basic Stat Lab

Taylor Vladic

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Contents

1. In Hong Kong, human male height is approximately normally distributed with mean 171.5 cm and standard deviation 5.5 cm. (Use and show R code to produce answers for a – e) You can use any method for part f.

a) What proportion of the Hong Kong population is between 170 cm and 180 cm?

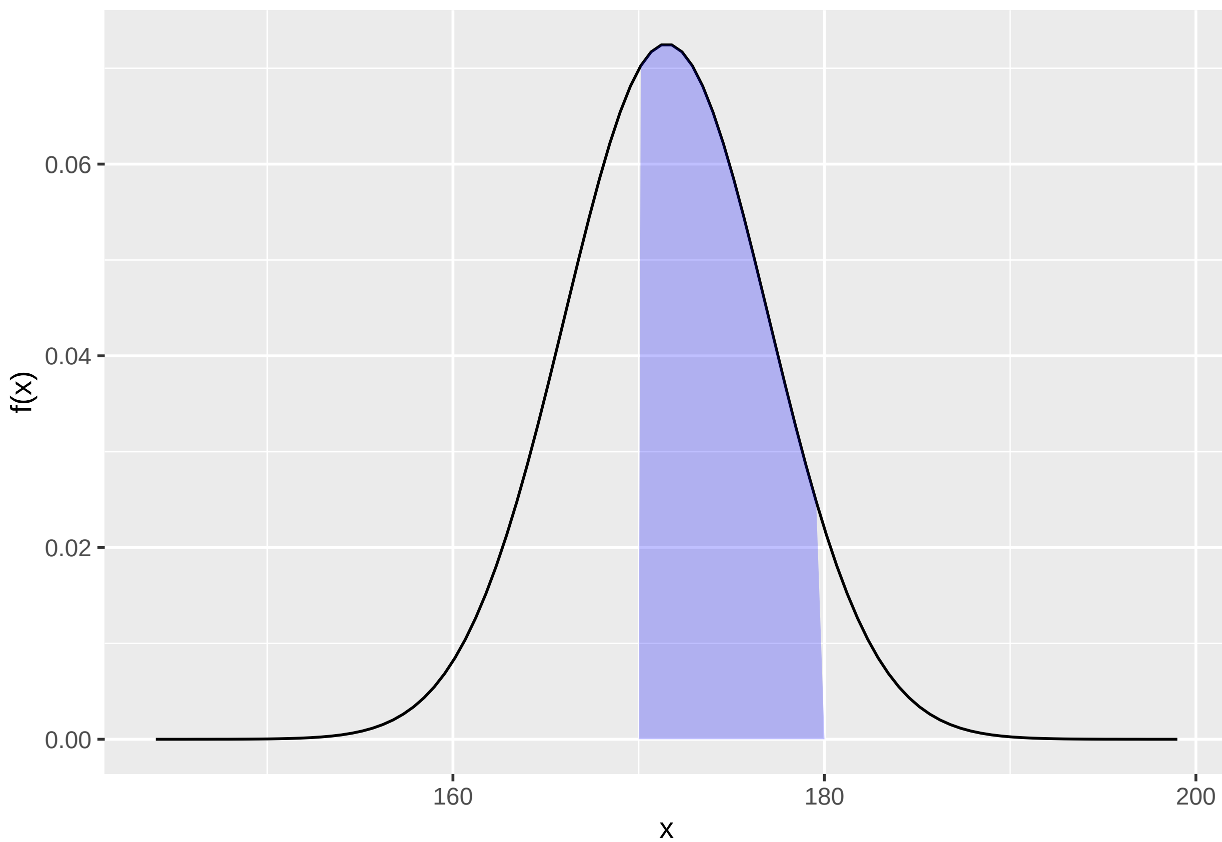
```
pnorm(180, mean = 171.5, sd = 5.5, lower.tail=TRUE) - pnorm(170, mean = 171.5, sd = 5.5, lower.tail=TRU
```

```
## [1] 0.5463504
```

```r
l <- 171.5 - 5*5.5
u <- 171.5 + 5*5.5

x <- seq(l, u, length = 100)
y <- dnorm(x, mean = 171.5, sd = 5.5)

df_1 <- data.frame(x = c(170, x[170 < x & x < 180], 180),
                     y = c(0, y[170 < x & x< 180], 0))
qplot(x, y, geom = "line", ylab = "f(x)") +
  geom_polygon(data = df_1, mapping = aes(x = x, y = y),
               fill = "blue", alpha = 1/4)
```

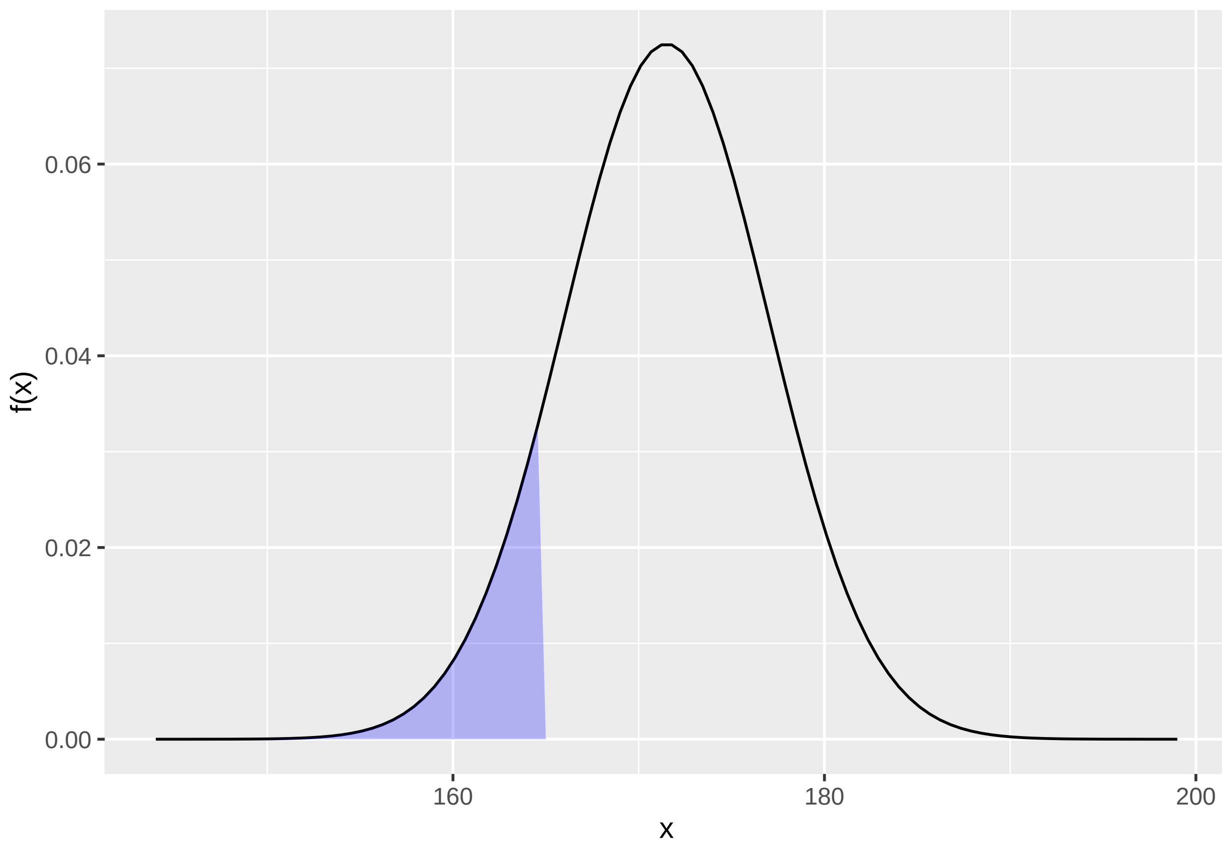


b) What proportion of the Hong Kong population is less that 165 cm ?

```r
pnorm(165, mean = 171.5, sd = 5.5, lower.tail=TRUE)
```

```
## [1] 0.1186389
```

```r
df_2 <- data.frame(x = c(min(x), x[x < 165], 165),
                    y = c(0, y[x < 165], 0))
qplot(x, y, geom = "line", ylab = "f(x)") +
  geom_polygon(data = df_2, mapping = aes(x = x, y = y),
               fill = "blue", alpha = 1/4)
```

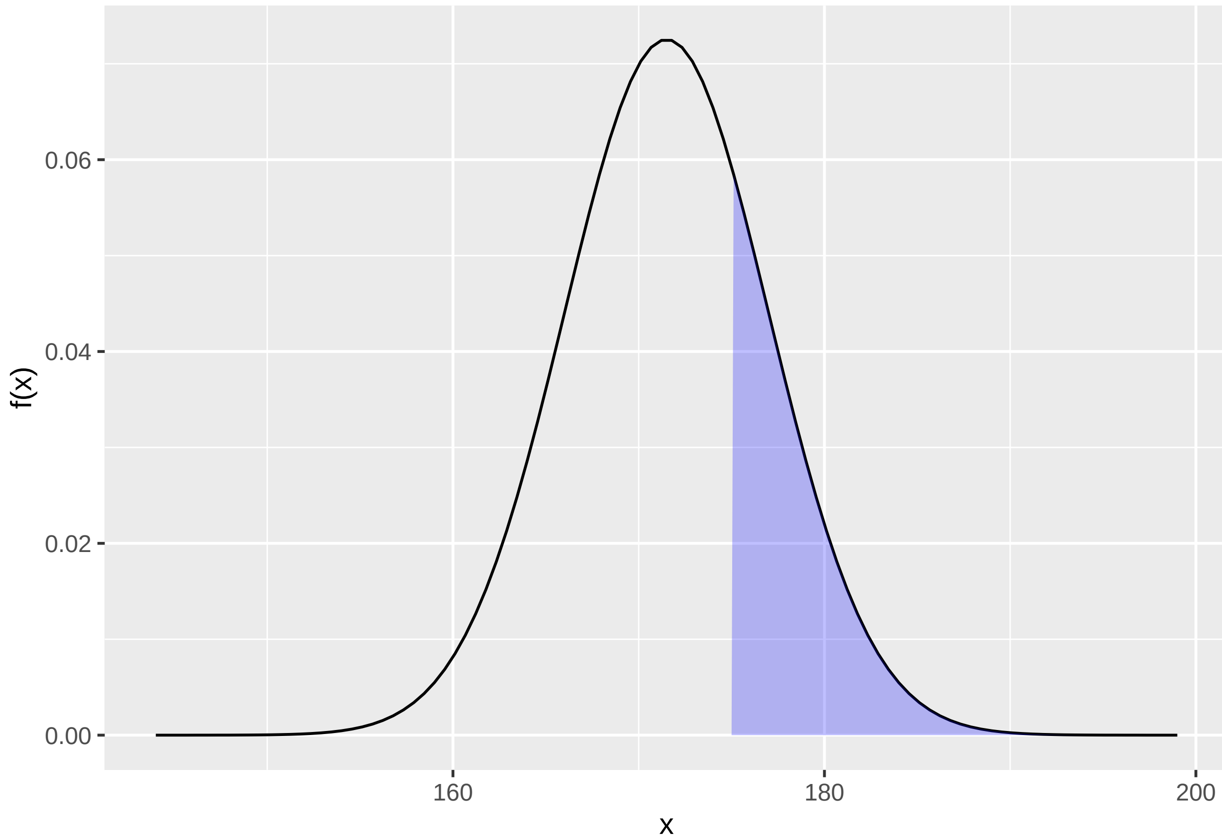


c) What proportion of the Hong Kong population is greater than 175?

```
pnorm(175, mean = 171.5, sd = 5.5, lower.tail=FALSE)
```

```
## [1] 0.2622697
```

```
df_3 <- data.frame(x = c(175, x[x > 175], max(x)),
                   y = c(0, y[x > 175], 0))
qplot(x, y, geom = "line", ylab = "f(x)") +
  geom_polygon(data = df_3, mapping = aes(x = x, y = y),
               fill = "blue", alpha = 1/4)
```

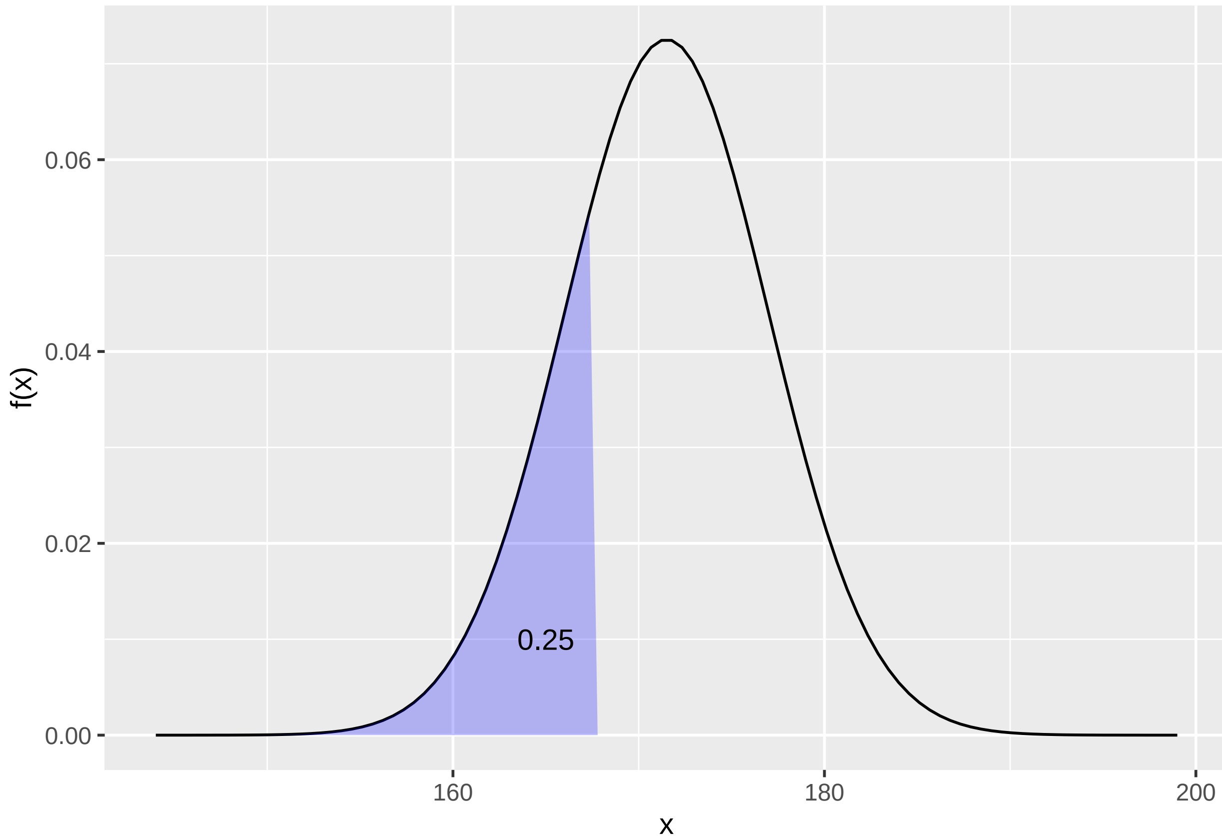


d) The proportion .25 is less than what male height value ?

```
qnorm(p = .25, mean = 171.5, sd = 5.5, lower.tail = TRUE)
```

```
## [1] 167.7903
```

```
df_4 <- data.frame(x = c(min(x), x[x < 167.7903], 167.7903),
                   y = c(0, y[x < 167.7903], 0))
qplot(x, y, geom = "line", ylab = "f(x)") +
  geom_polygon(data = df_4, mapping = aes(x = x, y = y),
               fill = "blue", alpha = 1/4) +
  annotate(geom = "text", x = 165, y = 0.01, label = 0.25, color = "black")
```

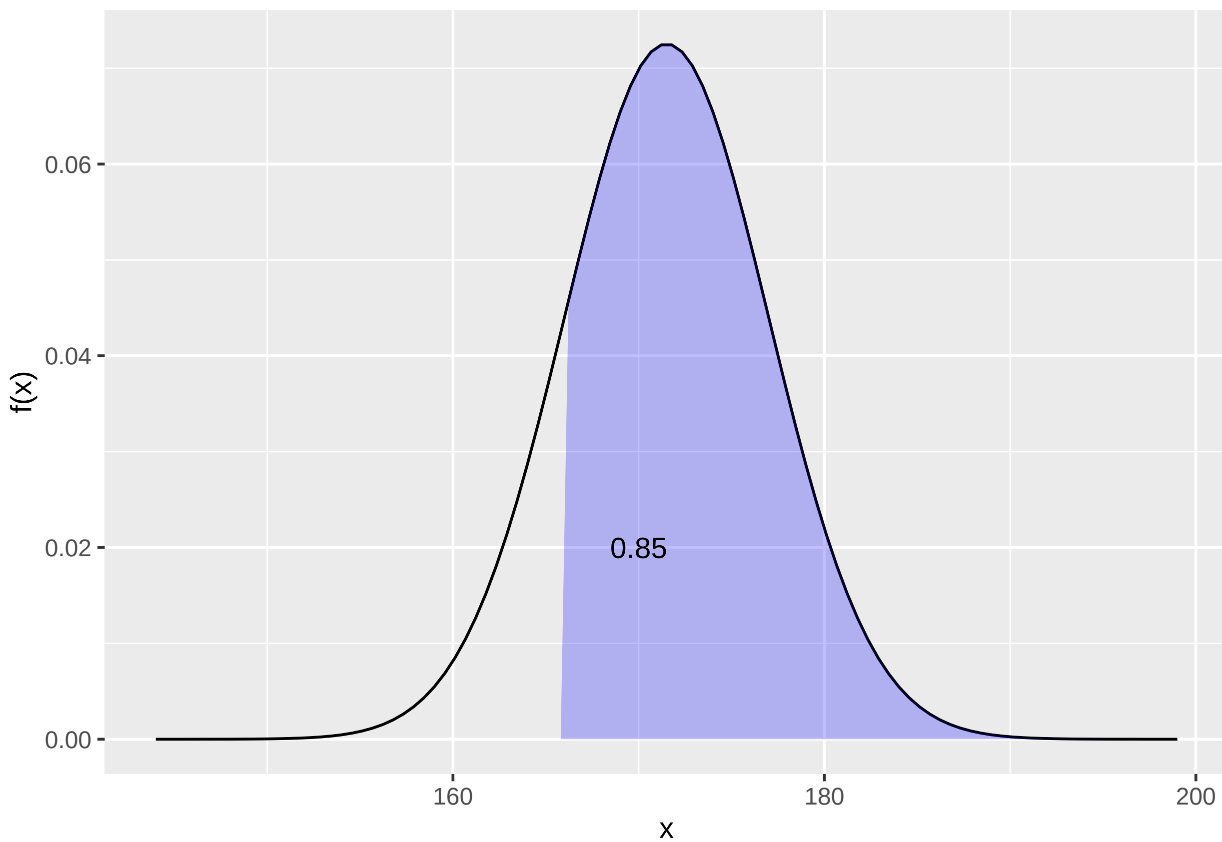


e) The proportion .85 is greater than what male height value ?

```
qnorm(p = .85, mean = 171.5, sd = 5.5, lower.tail = FALSE)
```

```
## [1] 165.7996
```

```
df_5 <- data.frame(x = c(165.7996, x[x > 165.7996], max(x)),
                   y = c(0, y[x > 165.7996], 0))
qplot(x, y, geom = "line", ylab = "f(x)") +
  geom_polygon(data = df_5, mapping = aes(x = x, y = y),
               fill = "blue", alpha = 1/4) +
    annotate(geom = "text", x = 170, y = 0.02, label = 0.85, color = "black")
```



f) The proportion of .68 is between what two male height values ?

```
qnorm(p = 0.16, mean = 171.5, sd = 5.5)
```

```
## [1] 166.0305
```

```
qnorm(p = 0.16, mean = 171.5, sd = 5.5, lower.tail = FALSE)
```

```
## [1] 176.9695
```

2. Use and show R code to determine the height of the standard normal curve at a Z value of 2.5.

```
dnorm(2.5, 0, 1)
```

```
## [1] 0.0175283
```

3. Use and show R code to determine the height of the standard normal curve at a Z value of .4.

```
dnorm(.4, 0, 1)
```

```
## [1] 0.3682701
```

4. Use and show R code to determine the height of a t distribution curve for a t value of 1.5 with 3 degrees of freedom.

```
dt(1.5, 3)
```

```
## [1] 0.1200172
```

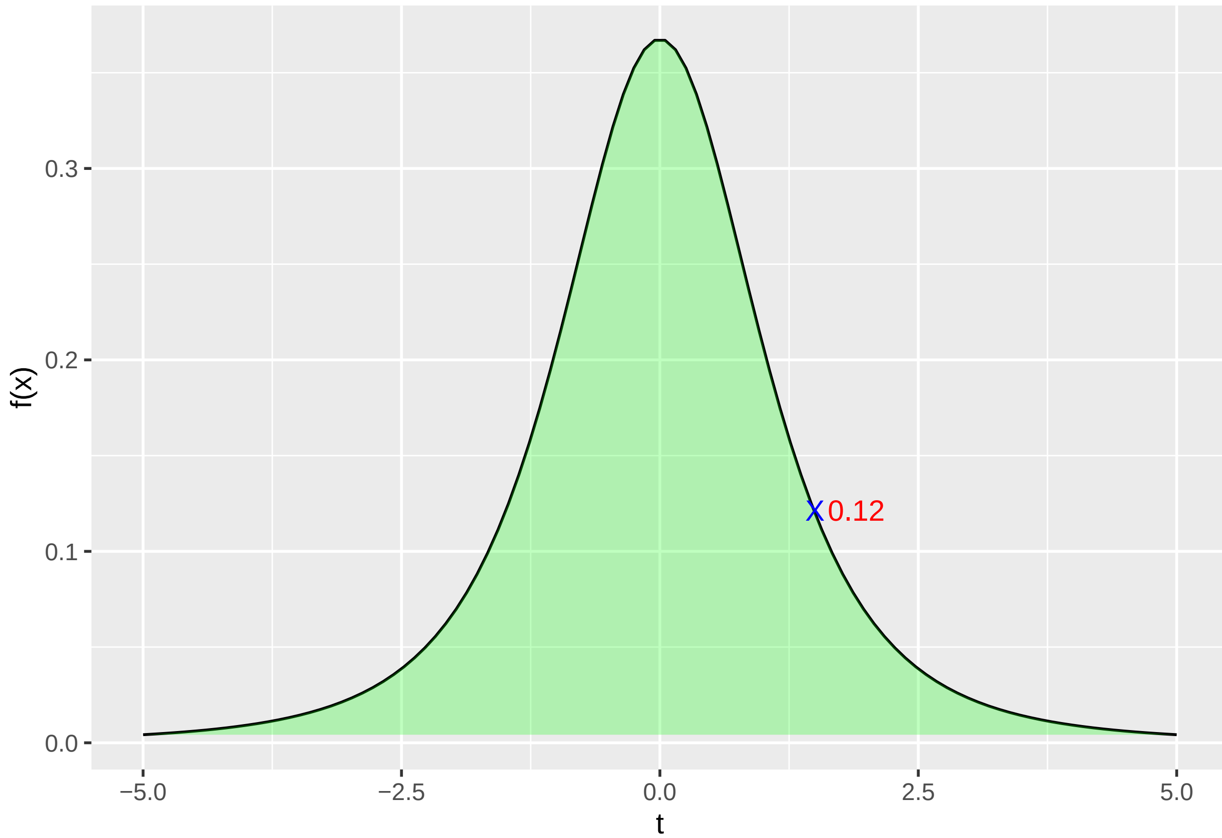
```
t <- seq(-5, 5, length = 100)
y_t <- dt(t, df = 3)
df_t <- tibble(t, y_t)
head(df_t)
```

```
## # A tibble: 6 x 2
##       t     y_t
##   <dbl>   <dbl>
## 1 -5    0.00422
## 2 -4.90 0.00454
## 3 -4.80 0.00489
## 4 -4.70 0.00527
## 5 -4.60 0.00568
## 6 -4.49 0.00614
```

```
dt(1.5, 3)
```

```
## [1] 0.1200172
```

```
 qplot(t, y_t, geom = "line", ylab = "f(x)") +
   geom_polygon(data = df_t, mapping = aes(x = t, y = y_t),
               fill = "green", alpha = 1/4) +
   annotate(geom = "text", x = 1.5, y = .12+0.0015, label = "X", color = "blue") +
   annotate(geom = "text", x = 1.5 + 0.4, y = .12+ 0.0015,
            label = round(.12,2), color = "red")
```



5. Use and show R code to determine the height of a t distribution curve for a t value of -2 with 2 degrees of freedom.

```
dt(-2, 2)
```

```
## [1] 0.06804138
```

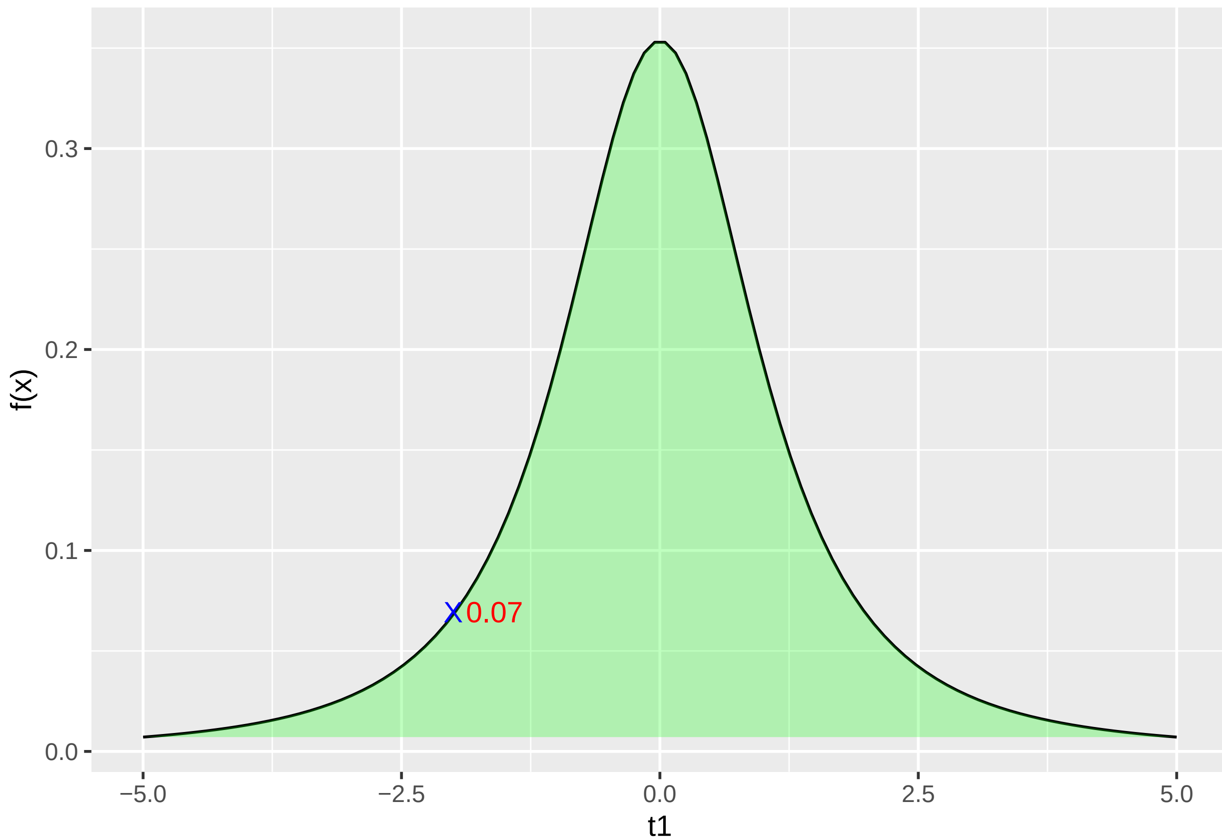
```
t1 <- seq(-5, 5, length = 100)
y_t1 <- dt(t, df = 2)
df_t1 <- tibble(t1, y_t1)
head(df_t1)
```

```
## # A tibble: 6 x 2
##      t1    y_t1
##   <dbl>   <dbl>
## 1 -5    0.00713
## 2 -4.90 0.00754
## 3 -4.80 0.00799
## 4 -4.70 0.00847
## 5 -4.60 0.00899
## 6 -4.49 0.00956
```

```r
dt(-2, 2)
```

```
## [1] 0.06804138
```

```r
qplot(t1, y_t1, geom = "line", ylab = "f(x)") +
  geom_polygon(data = df_t1, mapping = aes(x = t1, y = y_t1),
               fill = "green", alpha = 1/4) +
  annotate(geom = "text", x = -2, y = .068 + 0.0015, label = "X", color = "blue") +
  annotate(geom = "text", x = -2 + 0.4, y = .068 + 0.0015,
           label = round(.068,2), color = "red")
```



6. For a t distribution with 3 degrees of freedom, use and show R code that will find the proportion less than 2.5.

```r
pt(2.5, 3)
```

```
## [1] 0.9561467
```

7. For a t distribution with 1 degree of freedom, use and show R code that will find the proportion that is greater than 1.75.

```
pt(1.75, 1, lower.tail = FALSE)
```

```
## [1] 0.1652493
```

8. For a t distribution with 2 degrees of freedom, use and show R code that will find the value immediately above a proportion of .355.

```
qt(0.355, 2, lower.tail = FALSE)
```

```
## [1] 0.4285376
```

9. An educator believes that new directed reading activities in the classroom will help elementary school pupils improve some aspects of their ability. She arranges for a third -grade class of 23 students to take part in these activities for an eight-week period. A control classroom of 23 third graders follows the same curriculum without the activities. At the end of the eight weeks, all students are given a Degree of Reading Power (DRP) test, which measures the aspects of reading ability that the treatment is designed to improve. The sample data performance results are provided below;

Treatment Group: 24,61,59,46,43,44,52,43,58,67,62,57,71,49,54,43,53,57,49,56,33,74,70

Control Group: 42,33,46,37,43,41,10,42,55,19,17,55,26,54,60,28,62,20,53,48,37,85,42

Design and execute a two sample t test.

```
Treatment_Group <- c(24,61,59,46,43,44,52,43,58,67,62,57,71,49,54,43,53,57,49,56,33,74,70)

Control_Group <- c(42,33,46,37,43,41,10,42,55,19,17,55,26,54,60,28,62,20,53,48,37,85,42)
```

a) State the appropriate null and alternative hypotheses.

Null Hypothesis (H_0): There is no significant difference between the mean scores of the treatment and control groups on the DRP test. (There is no relationship)

Alternative Hypothesis (H_A): There is a significant difference between the mean scores of the treatment and control groups on the DRP test. (There is a relationship)

b) Use and show R code to produce the p value and the confidence interval

```
tout1 <- t.test(Treatment_Group, Control_Group, mu = 0, var.equal = FALSE)
tout1
```

```
##
##  Welch Two Sample t-test
##
## data:  Treatment_Group and Control_Group
## t = 2.6853, df = 39.487, p-value = 0.01054
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   2.900188 20.578072
## sample estimates:
## mean of x mean of y
##  53.26087  41.52174
```

```
tdf1 <- tidy(tout1)
tdf1
```

```
## # A tibble: 1 x 10
##   estim~1 estim~2 estim~3 stati~4 p.value param~5 conf.~6 conf.~7 method alter~8
##     <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl> <chr>  <chr>
## 1    11.7    53.3    41.5    2.69  0.0105    39.5    2.90    20.6 Welch~ two.si~
## # ... with abbreviated variable names 1: estimate, 2: estimate1, 3: estimate2,
## #   4: statistic, 5: parameter, 6: conf.low, 7: conf.high, 8: alternative
```

```
tdf1$p.value
```

```
## [1] 0.01054229
```

```
c(tdf1$conf.low, tdf1$conf.high)
```

```
## [1]  2.900188 20.578072
```

c) Determine if you should reject or fail to reject the null hypothesis using the p value and the confidence interval.

- Looking at the p-value above (0.01054229), we should reject the null hypothesis and accept the alternative that there is a significant difference between the mean scores of the treatment and control groups on the DRP test. There is a relationship between the reading activities and the Degree of Reading Power (DRP) test scores.