Untitled

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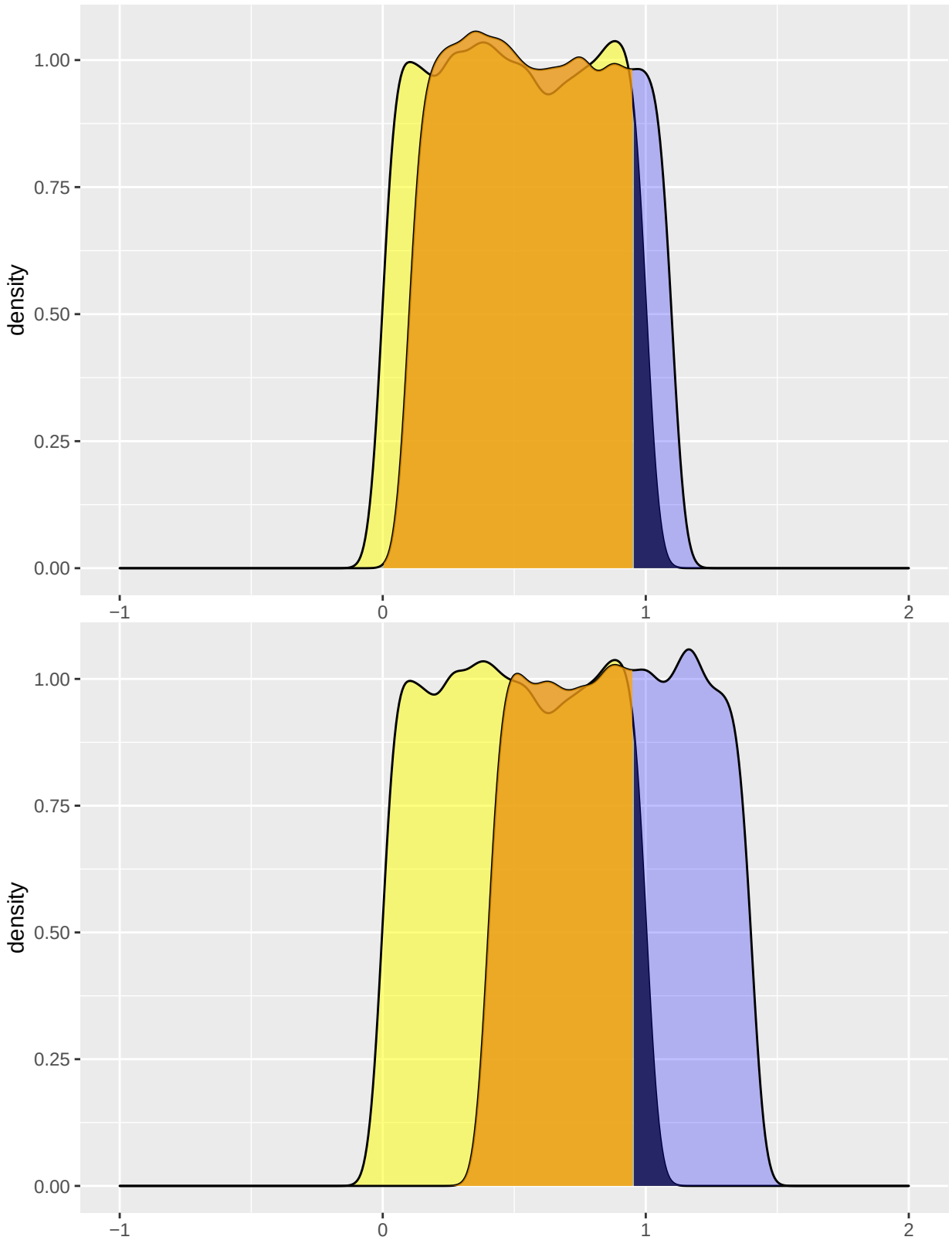
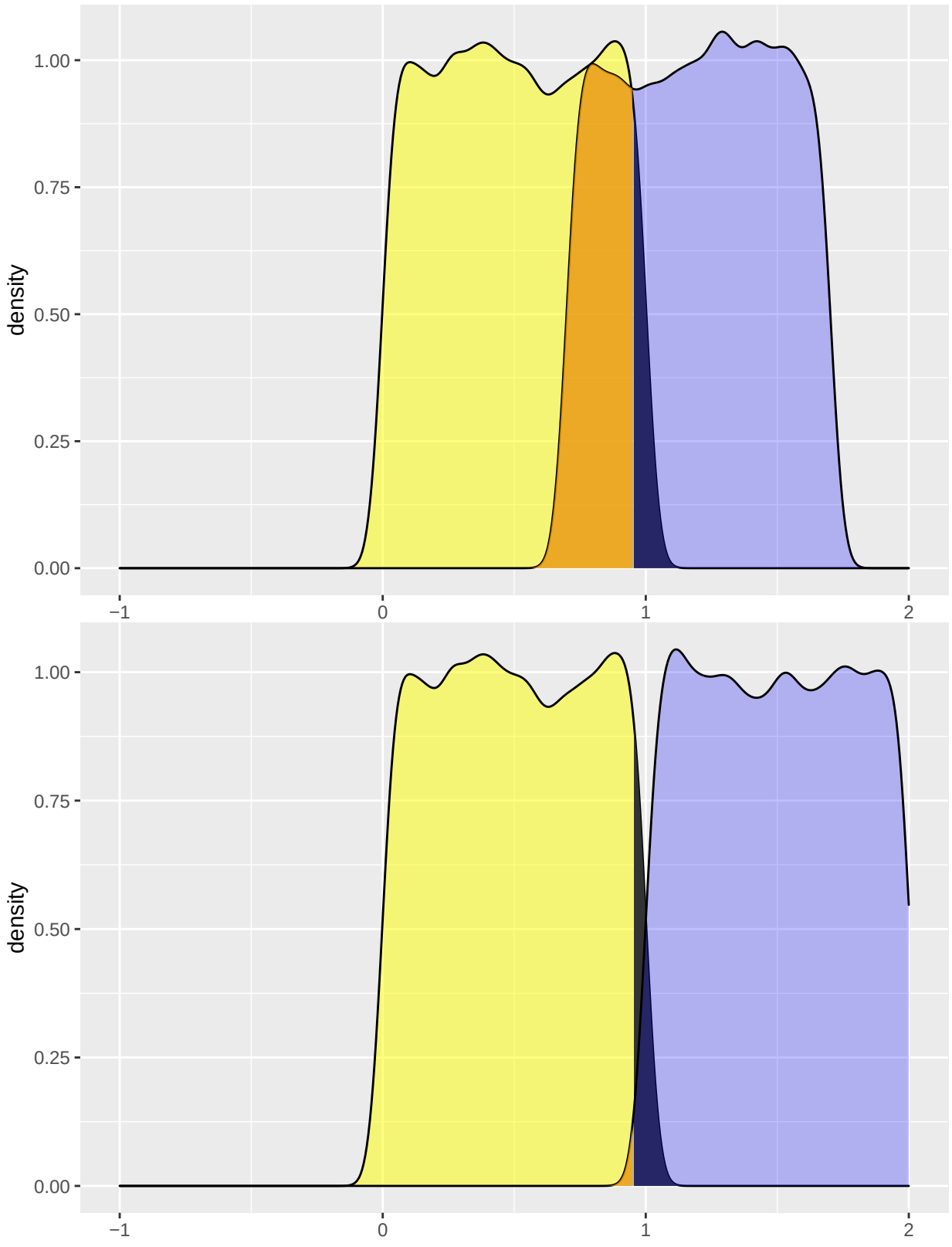
Problem 1 a)

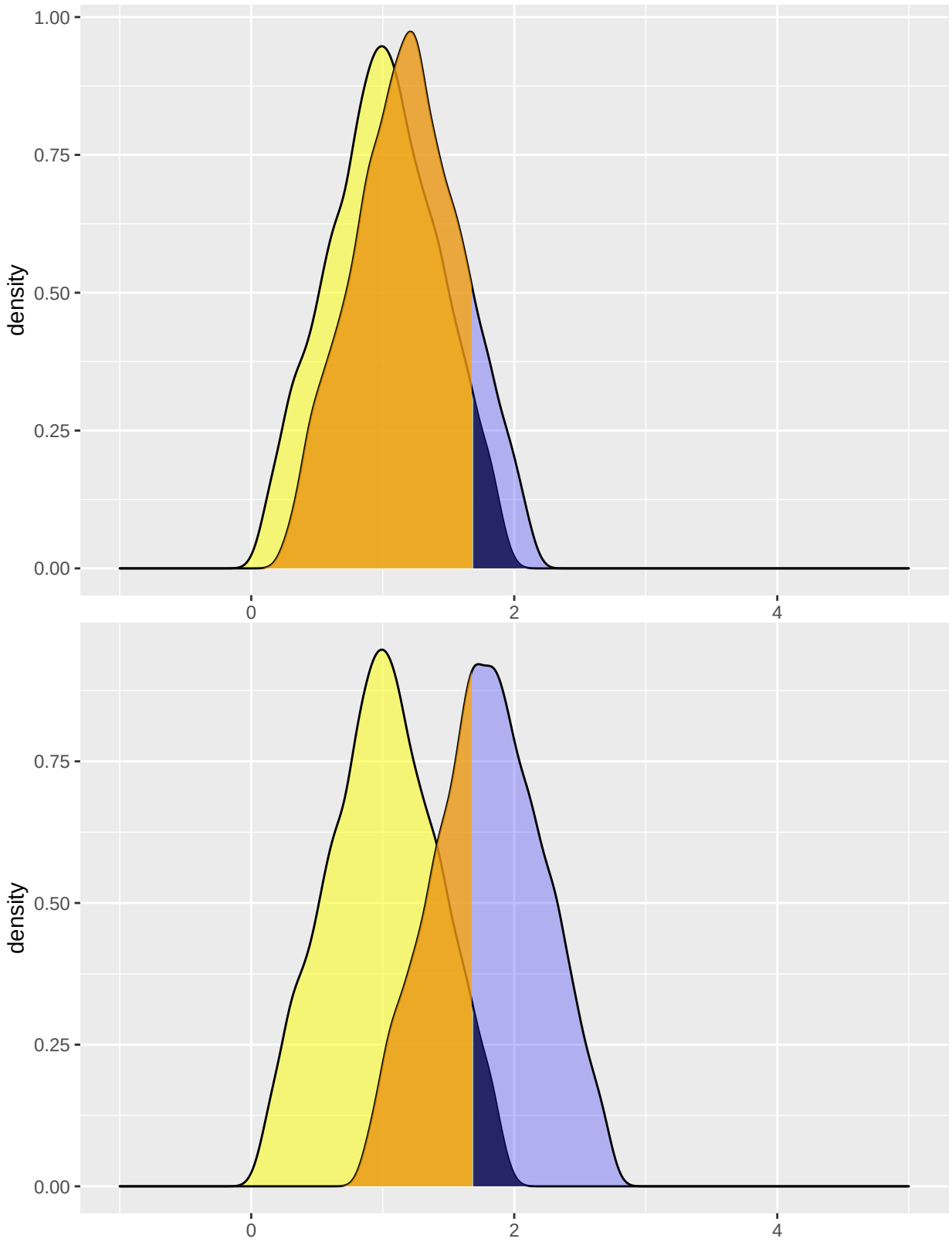
```
set.seed(1)

theta_0 <- 0
theta_a <- c(0.1, 0.4, 0.7, 1)

alpha <- 0.05

Y1 <- runif(10000, theta_0, theta_0 + 1)
Y2 <- runif(10000, theta_0, theta_0 + 1)

Y3 <- Y1 + Y2

for (i in 1:4){
    YA <- runif(10000, theta_a[i], theta_a[i] + 1)
    df_Y <- tibble(Y1, Y2, Y3, YA)

    plot_ <-
    ggplot(data = df_Y) +
    geom_density(aes(Y1), fill = "yellow", alpha = 0.5) +
    geom_area(
    aes(x = stage(Y1,
                  after_stat = oob_censor(x, (1 - alpha)))),
        stat = "density") +

    geom_density(aes(YA), fill = "blue", alpha = 0.25) +
    geom_area(
    aes(x = stage(YA, after_stat = oob_censor(x, c(0, (1 - alpha))))),
    stat = "density", fill = "orange", alpha = 0.75) + xlab("") + xlim(-1, 2)

    print(plot_)
    }
```

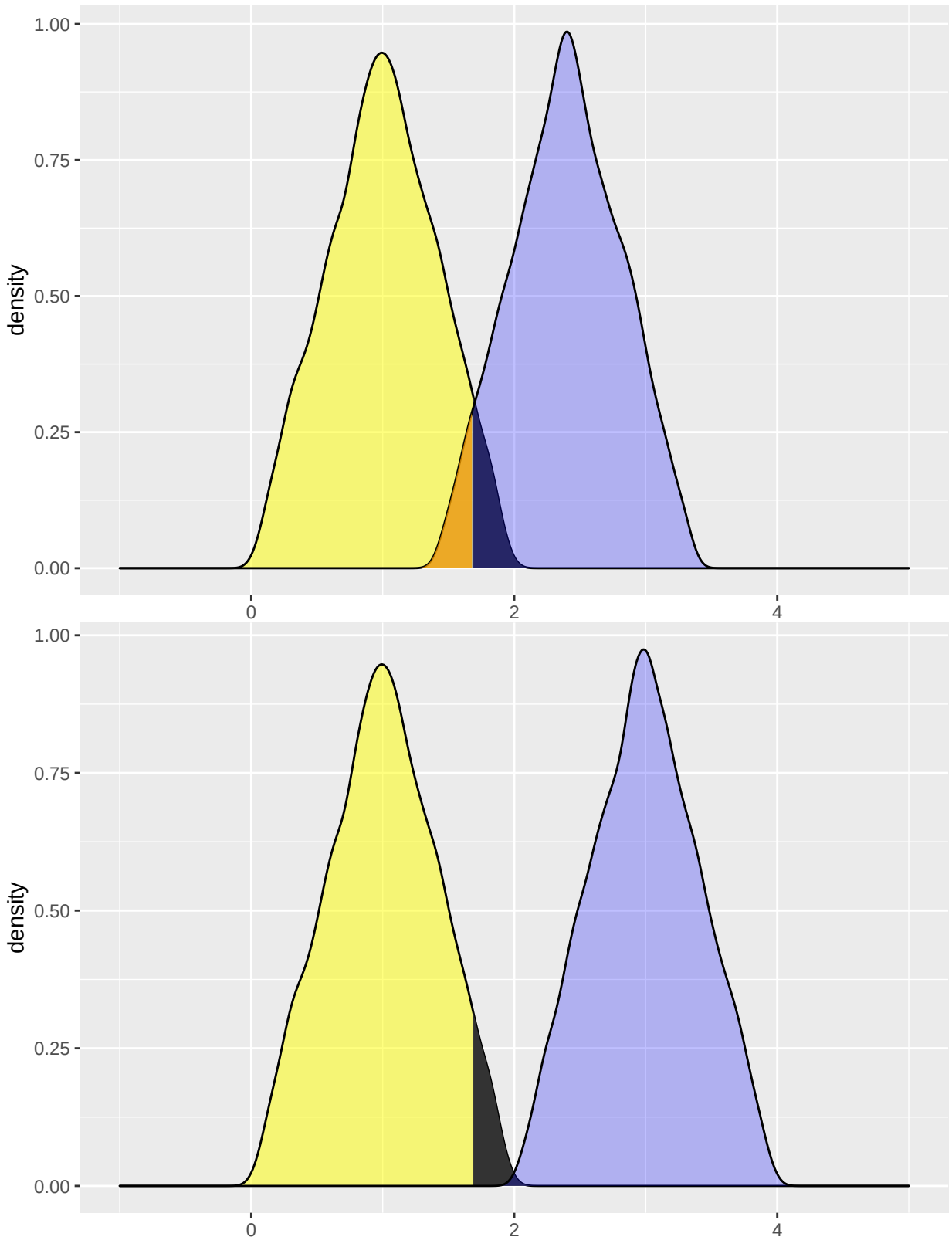

density
1.00
0.75
0.50
0.25
0.00
−1
0
1
2
density
1.00
0.75
0.50
0.25
0.00
−1
0
1
2


density
1.00
0.75
0.50
0.25
0.00
−1
0
1
2
density
1.00
0.75
0.50
0.25
0.00
−1
0
1
2

Problem 1 b)

```
set.seed(1)

theta_0 <- 0
theta_a <- c(0.1, 0.4, 0.7, 1)

c <- 1.684

Y1 <- runif(10000, theta_0, theta_0 + 1)
Y2 <- runif(10000, theta_0, theta_0 + 1)

Y3 <- Y1 + Y2

for (i in 1:4){
    YA1 <- runif(10000, theta_a[i], theta_a[i] + 1)
    YA2 <- runif(10000, theta_a[i], theta_a[i] + 1)

    YA <- YA1 + YA2
    df_Y <- tibble(Y1, Y2, Y3, YA)

    plot_ <-
    ggplot(data = df_Y) +
    geom_density(aes(Y3), fill = "yellow", alpha = 0.5) +
    geom_area(

    aes(x = stage(Y3,
                  after_stat = oob_censor(x, c))),
                  stat = "density") +

    geom_density(aes(YA), fill = "blue", alpha = 0.25) +
    geom_area(
        aes(x = stage(YA, after_stat = oob_censor(x, c(0, c))
                      )
           ),
                       stat = "density",
            fill = "orange",
            alpha = 0.75) +
        xlab("") + xlim(-1, 5)

    print(plot_)
    }
```


1.00
0.75
0.50
0.25
0.00
density
0
2
4
0.75
0.50
0.25
0.00
density
0
2
4


1.00
0.75
0.50
0.25
0.00
density
0
2
4
1.00
0.75
0.50
0.25
0.00
density
0
2
4

Problem 2

```
no_accidents <- c(1735, 1657, 1812, 1962, 1965, 1849, 1755,
                  1892, 1796, 1900, 1846, 1757)

no_days <- c(31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31)

df_accident <- tibble(month.name, no_accidents, no_days)
colnames(df_accident) <- c("Month", "Observed", "Number of days/Month")

df_accident["daily_ave"] <- df_accident[, 2] / df_accident[, 3]

ave_day <- sum(df_accident["Observed"]) / 365

df_accident["daily_ave_delta"] <- df_accident[, 4] - ave_day

df_accident["Expected"] <- round(ave_day * df_accident[, 3])

df_accident["Observed - Expected"] <-
  df_accident["Observed"] - df_accident["Expected"]

df_accident["Probs"] <-
  df_accident["Observed - Expected"]^2 / sum(df_accident["Observed"])

df_accident
```

```
## # A tibble: 12 x 8
##    Month     Observed `Number of days/Month` daily_ave daily_ave_delta Expected
##    <chr>        <dbl>                  <dbl>     <dbl>           <dbl>    <dbl>
##  1 January       1735                     31      56.0          -4.10      1862
##  2 February      1657                     28      59.2          -0.893     1682
##  3 March         1812                     31      58.5          -1.62      1862
##  4 April         1962                     30      65.4           5.33      1802
##  5 May           1965                     31      63.4           3.32      1862
##  6 June          1849                     30      61.6           1.56      1802
##  7 July          1755                     31      56.6          -3.46      1862
##  8 August        1892                     31      61.0           0.961     1862
##  9 September     1796                     30      59.9          -0.205     1802
## 10 October       1900                     31      61.3           1.22      1862
## 11 November      1846                     30      61.5           1.46      1802
## 12 December      1757                     31      56.7          -3.39      1862
## # ... with 2 more variables: Observed - Expected <dbl>, Probs <dbl>
```

```
X_2 = sum(df_accident["Probs"])
print(X_2)
```

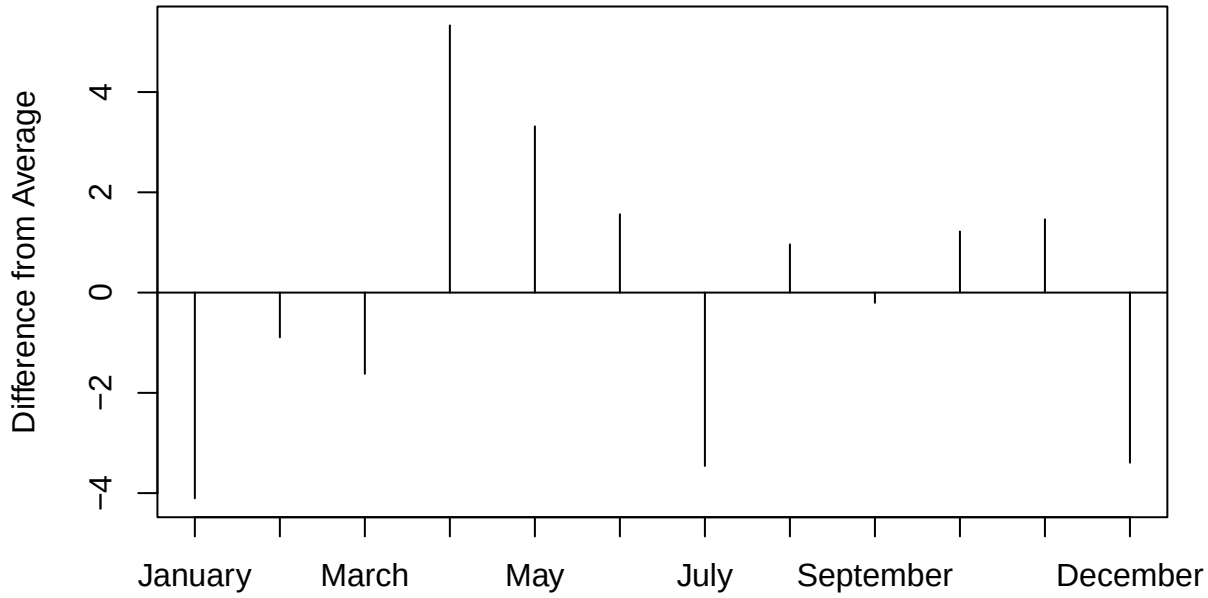
```
## [1] 3.852139
```

```
print(qt(0.95, 12 - 1 - 1))
```

```
## [1] 1.812461
```

We reject the null hypothesis because the observed test statstic is greater than the calculated value at an alpha level of 0.05. Our observed statistic is 3.852139 which is greater than 1.8124611.

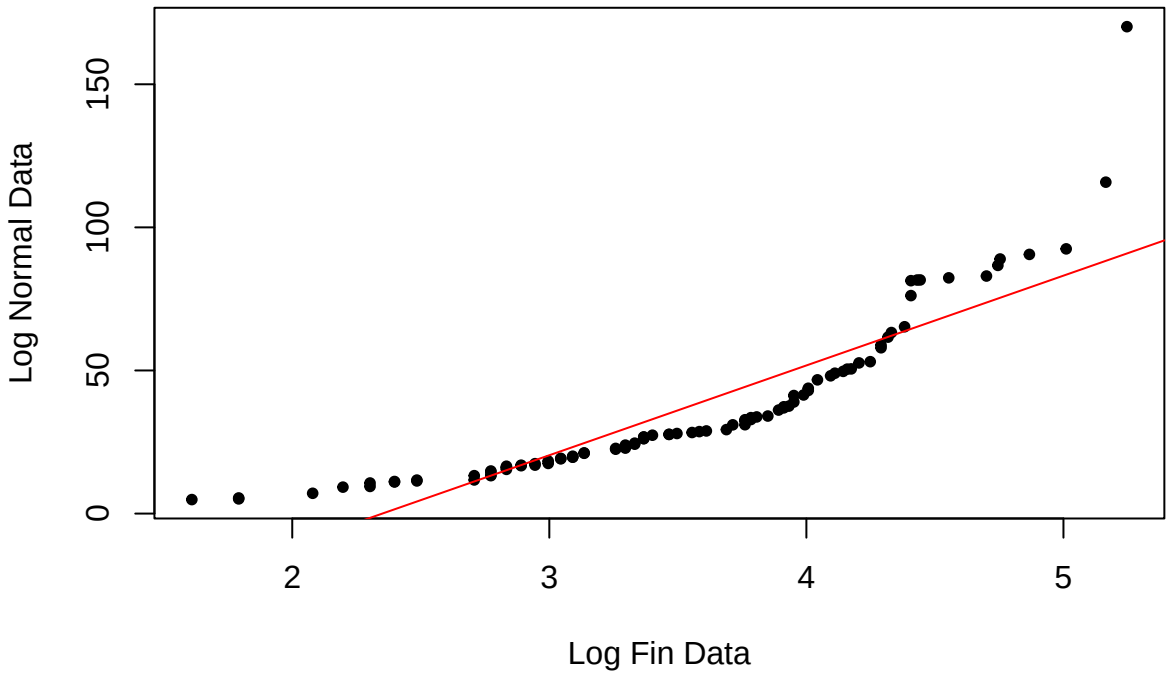
```
plot(df_accident$daily_ave_delta, type = "h", xaxt = "n", xlab = "",
     ylab = "Difference from Average")
axis(1, at = 1:12, labels = df_accident$Month)
abline(h = 0)
```



July and the winter months seem to indicate a drop in the number of accidents.

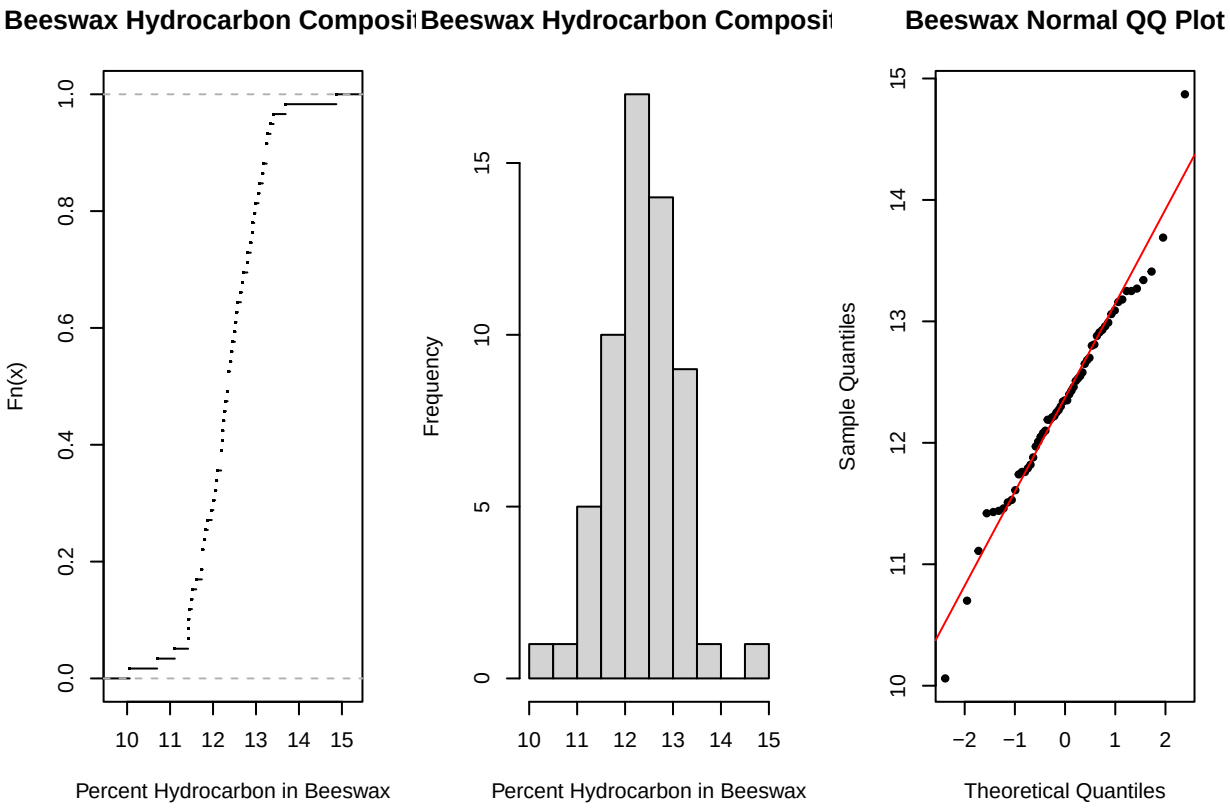
Problem 3

```
options(repr.plot.width = 5, repr.plot.height = 5, repr.plot.res = 225)

fin_data <- c(110,15,60,54,19,115,73,190,57,43,44,18,37,43,55,19,23,82,175,50,
              80,65,63,36,16,10,17,52,43,70,22,95,20,41,17,15,12,11,29,29,61,22,
              40,17,26,30,16,116,28,32,33,29,27,16,55,8,11,49,82,85,20,67,27,44,
              16,6,35,17,26,32,76,150,21,5,6,51,75,23,29,64,22,47,9,10,28,18,84,
              52,130,50,45,12,21,73)

fin_data <- sort(log(fin_data))

n_fin <- length(fin_data)

lnorm_data <- sort(rlnorm(n_fin, meanlog = mean(fin_data),
                          sdlog = sqrt(var(fin_data))))

plot(x = fin_data, y = lnorm_data, pch = 20,
     xlab = "Log Fin Data", ylab = "Log Normal Data")

abline(lm(lnorm_data ~ fin_data), col = "red")
```



Problem 4

```
data <- c(12.05,12.58,10.06,14.87,12.88,10.7,13.34,13.16,12.93,11.76,12.68,
          13.69,12.3,13.41,11.61,11.44,11.76,12.25,12.43,12.51,12.96,12.27,
          12.34,12.81,13.18,12.46,11.11,12.19,11.97,12.99,12.53,12.19,11.82,
          11.46,13.09,12.1,11.42,12.55,12.08,12.4,11.88,13.25,11.51,11.43,
          12.8,11.79,12.7,13.25,11.53,12.65,13.06,12.21,11.74,12.35,13.27,
          12.91,12.01,12.22,12.35)

# plots
options(repr.plot.width = 12, repr.plot.height = 5, repr.plot.res = 225)

par(mfrow = c(1, 3))

ecdf_plot <- plot(ecdf(data), xlab = "Percent Hydrocarbon in Beeswax",
                  main = "Beeswax Hydrocarbon Composition", pch = ".")
hist_plot <- hist(data, breaks = 12, main = "Beeswax Hydrocarbon Composition",
                  xlab = "Percent Hydrocarbon in Beeswax")
qq_plot <- qqnorm(data, pch = 20, main = "Beeswax Normal QQ Plot")
           qqline(data, col = "red")
```




```
# Find Quantiles

print(quantile(data, probs = c(0.9, 0.75, 0.5, 0.25, 0.1)))
```

```
##    90%    75%    50%    25%    10%
## 13.250 12.895 12.350 11.850 11.456
```

Problem 5

```
df_data <- read_csv("oldfaithful.csv")
```

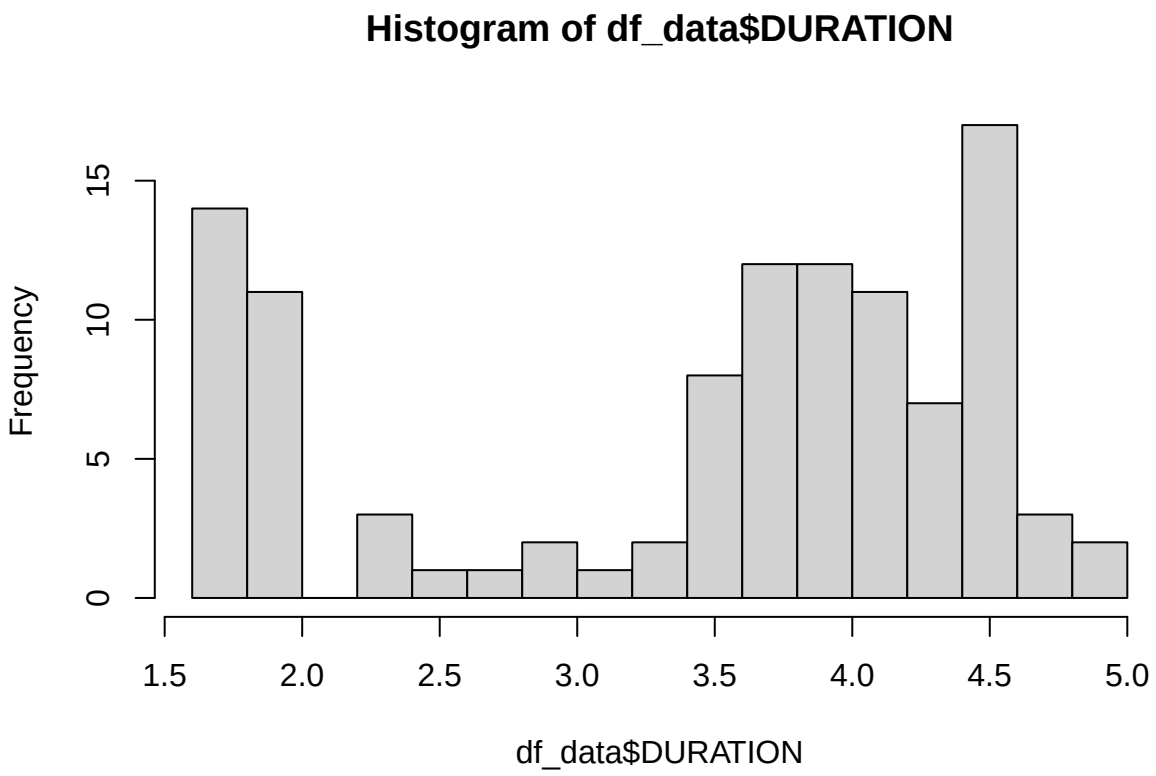
```
##
## -- Column specification --------------------------------------------------------
## cols(
##   DAY = col_double(),
##   INTERVAL = col_double(),
##   DURATION = col_double()
## )
```

```
str(df_data)
```

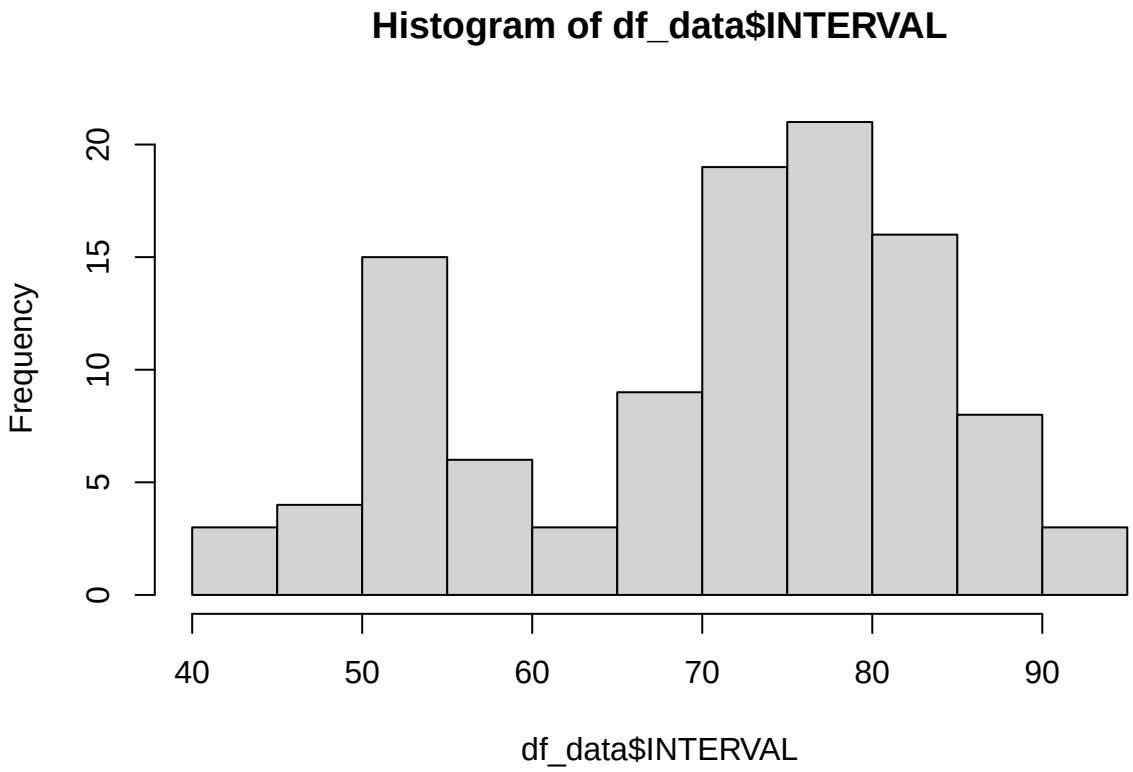
```
## spec_tbl_df [107 x 3] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ DAY     : num [1:107] 1 1 1 1 1 1 1 1 1 1 ...
##  $ INTERVAL: num [1:107] 78 74 68 76 80 84 50 93 55 76 ...
```

```
##  $ DURATION: num [1:107] 4.4 3.9 4 4 3.5 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   DAY = col_double(),
##   ..   INTERVAL = col_double(),
##   ..   DURATION = col_double()
##   .. )
```

```
hist(df_data$DURATION, breaks = 12)
```




```
hist(df_data$INTERVAL, breaks = 15)
```


Histogram of df_data$INTERVAL
Frequency
0
5
10
15
20
40
50
60
70
80
90
df_data$INTERVAL