Judging Bias in Figure Skating

Graham Lightle

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```
# Load the data set
skating <- read.csv("D:/MSU/SPRING 24/STT461/SkatingData_19-22_FIXED2.csv")
```

```
# Overview of variables
str(skating, list.len=ncol(skating))
```

```
## 'data.frame':    4954 obs. of  69 variables:
##  $ segment        : chr  "sp" "sp" "sp" "sp" ...
##  $ event_name     : chr  "World Championships" "World Championships" "World Championships" "World Cha
##  $ event_type     : chr  "CHAMP" "CHAMP" "CHAMP" "CHAMP" ...
##  $ event_year     : int  2019 2019 2019 2019 2019 2019 2019 2019 2019 2019 ...
##  $ event_country  : chr  "JPN" "JPN" "JPN" "JPN" ...
##  $ discipline     : chr  "Mens" "Mens" "Mens" "Mens" ...
##  $ tech_spec1_name: chr  "Evgeni MARTINOV" "Evgeni MARTINOV" "Evgeni MARTINOV" "Evgeni MARTINOV" ...
##  $ tech_spec1_nat : chr  "UKR" "UKR" "UKR" "UKR" ...
##  $ tech_spec2_name: chr  "Masako KAWAI" "Masako KAWAI" "Masako KAWAI" "Masako KAWAI" ...
##  $ tech_spec2_nat : chr  "JPN" "JPN" "JPN" "JPN" ...
##  $ tech_con_name  : chr  "Leena LAAKSONEN" "Leena LAAKSONEN" "Leena LAAKSONEN" "Leena LAAKSONEN" ...
##  $ tech_con_nat   : chr  "FIN" "FIN" "FIN" "FIN" ...
##  $ j1_name        : chr  "Miroslav MISUREC" "Miroslav MISUREC" "Miroslav MISUREC" "Miroslav MISUREC"
##  $ j1_nat         : chr  "CZE" "CZE" "CZE" "CZE" ...
##  $ j2_name        : chr  "Antica GRUBISIC" "Antica GRUBISIC" "Antica GRUBISIC" "Antica GRUBISIC" ...
##  $ j2_nat         : chr  "CRO" "CRO" "CRO" "CRO" ...
##  $ j3_name        : chr  "Albert ZAYDMAN" "Albert ZAYDMAN" "Albert ZAYDMAN" "Albert ZAYDMAN" ...
##  $ j3_nat         : chr  "ISR" "ISR" "ISR" "ISR" ...
##  $ j4_name        : chr  "Bettina MEIER" "Bettina MEIER" "Bettina MEIER" "Bettina MEIER" ...
##  $ j4_nat         : chr  "SUI" "SUI" "SUI" "SUI" ...
##  $ j5_name        : chr  "Ariadna MORONE" "Ariadna MORONE" "Ariadna MORONE" "Ariadna MORONE" ...
##  $ j5_nat         : chr  "MEX" "MEX" "MEX" "MEX" ...
##  $ j6_name        : chr  "Cynthia BENSON" "Cynthia BENSON" "Cynthia BENSON" "Cynthia BENSON" ...
##  $ j6_nat         : chr  "CAN" "CAN" "CAN" "CAN" ...
##  $ j7_name        : chr  "Anny HOU" "Anny HOU" "Anny HOU" "Anny HOU" ...
##  $ j7_nat         : chr  "TPE" "TPE" "TPE" "TPE" ...
##  $ j8_name        : chr  "Saioa SANCHO" "Saioa SANCHO" "Saioa SANCHO" "Saioa SANCHO" ...
##  $ j8_nat         : chr  "ESP" "ESP" "ESP" "ESP" ...
##  $ j9_name        : chr  "Philippe MERIGUET" "Philippe MERIGUET" "Philippe MERIGUET" "Philippe MERIGU
##  $ j9_nat         : chr  "FRA" "FRA" "FRA" "FRA" ...
##  $ skater         : chr  "Nathan CHEN" "Jason BROWN" "Yuzuru HANYU" "Vincent ZHOU" ...
##  $ nationality    : chr  "USA" "USA" "JPN" "USA" ...
##  $ start          : int  35 32 30 28 26 31 18 20 24 33 ...
##  $ total          : num  107.4 96.8 94.9 94.2 93.4 ...
```

```
##  $ j1_total       : num  105 96.2 95.4 93.6 91.4 ...
##  $ j2_total       : num  110 92.3 94 90.8 94.8 ...
##  $ j3_total       : num  108.5 92.8 95.2 94 95.2 ...
##  $ j4_total       : num  102.6 99.6 93.9 92.3 87.2 ...
##  $ j5_total       : num  102.6 96.5 95.4 88.7 91.4 ...
##  $ j6_total       : num  107 95.9 94.8 96.7 94.1 ...
##  $ j7_total       : num  108.3 100 95 96.5 98.1 ...
##  $ j8_total       : num  110.1 100.3 96.2 96.2 97.2 ...
##  $ j9_total       : num  109.9 95.5 94 93.2 89.5 ...
##  $ level_sum      : int  16 16 16 16 16 15 16 16 15 16 ...
##  $ j1_tes         : num  60 50.1 48.2 52.8 51.4 ...
##  $ j2_tes         : num  62.7 50.1 49.8 52.8 54 ...
##  $ j3_tes         : num  60.7 48.5 47.9 52 52.7 ...
##  $ j4_tes         : num  58.1 51.8 48.2 50.3 49 ...
##  $ j5_tes         : num  56.9 50.5 48.6 47.1 50.4 ...
##  $ j6_tes         : num  61.5 50.9 48 54.2 53.3 ...
##  $ j7_tes         : num  62.6 52.2 49.2 53.3 54.4 ...
##  $ j8_tes         : num  62.9 52.1 48.2 54.7 54.7 ...
##  $ j9_tes         : num  61.6 49 46.5 51.7 50.8 ...
##  $ tes            : num  61 50.7 48.2 52.5 52.4 ...
##  $ ss             : num  9.21 9.04 9.36 8.32 8.32 9.07 7.93 8.36 8.21 8.86 ...
##  $ tr             : num  9.11 9.18 9.32 8.29 7.86 8.79 7.79 8.14 7.79 8.5 ...
##  $ pe             : num  9.39 9.36 9.25 8.32 8.39 8.96 8.07 8.32 7.93 8.54 ...
##  $ co             : num  9.32 9.25 9.39 8.39 8.18 9 8.11 8.36 8 8.57 ...
##  $ in.            : num  9.39 9.32 9.39 8.36 8.21 9.07 8.25 8.39 7.96 8.61 ...
##  $ j1_pcs         : num  45 46 47.2 40.8 40 ...
##  $ j2_pcs         : num  47.2 42.2 44.2 38 40.8 ...
##  $ j3_pcs         : num  47.8 44.2 47.2 42 42.5 ...
##  $ j4_pcs         : num  44.5 47.8 45.8 42 38.2 ...
##  $ j5_pcs         : num  45.8 46 46.8 41.5 41 ...
##  $ j6_pcs         : num  45.5 45 46.8 42.5 40.8 ...
##  $ j7_pcs         : num  45.8 47.8 45.8 43.2 43.8 ...
##  $ j8_pcs         : num  47.2 48.2 48 41.5 42.5 ...
##  $ j9_pcs         : num  48.2 46.5 47.5 41.5 38.8 ...
##  $ pcs            : num  46.4 46.1 46.7 41.7 41 ...
```

```
library("dplyr")
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library("ggplot2")

# Check number of unique competitors per competition
```

```r
competitor_count <- skating %>%
  filter(discipline == "Mens" | discipline == "Womens") %>%
  group_by(event_year, event_name, discipline) %>%
  distinct(skater) %>%
  summarise(n())
```

```
## `summarise()` has grouped output by 'event_year', 'event_name'. You can
## override using the `.groups` argument.
```

```r
competitor_count
```

```
## # A tibble: 82 x 4
## # Groups:   event_year, event_name [41]
##    event_year event_name        discipline `n()`
##         <int> <chr>             <chr>      <int>
##  1       2018 GP Helsinki       Mens          11
##  2       2018 GP Helsinki       Womens        11
##  3       2018 GP Intx de France Mens          11
##  4       2018 GP Intx de France Womens        12
##  5       2018 GP NHK Trophy     Mens          12
##  6       2018 GP NHK Trophy     Womens        12
##  7       2018 GP Rostelecom Cup Mens          12
##  8       2018 GP Rostelecom Cup Womens        10
##  9       2018 GP Skate America  Mens          12
## 10       2018 GP Skate America  Womens        11
## # i 72 more rows
```

```r
# Check number of unique countries per competition
country_count <- skating %>%
  filter(discipline == "Mens" | discipline == "Womens") %>%
  group_by(event_year, event_name, discipline) %>%
  distinct(nationality) %>%
  summarise(n())
```

```
## `summarise()` has grouped output by 'event_year', 'event_name'. You can
## override using the `.groups` argument.
```

```r
country_count
```

```
## # A tibble: 82 x 4
## # Groups:   event_year, event_name [41]
##    event_year event_name        discipline `n()`
##         <int> <chr>             <chr>      <int>
##  1       2018 GP Helsinki       Mens           9
##  2       2018 GP Helsinki       Womens         6
##  3       2018 GP Intx de France Mens           8
##  4       2018 GP Intx de France Womens         6
##  5       2018 GP NHK Trophy     Mens           8
##  6       2018 GP NHK Trophy     Womens         6
##  7       2018 GP Rostelecom Cup Mens           9
##  8       2018 GP Rostelecom Cup Womens         6
```

```
##  9       2018 GP Skate America  Mens           9
## 10       2018 GP Skate America  Womens         6
## # i 72 more rows
```

How do judges score skaters from their own country compared to the other judges on the panel?

```
# Find entries where a judge shares the same nationality as the skater
# Filter out pairs and ice dance disciplines
shared_nat <- skating %>% filter(j1_nat == nationality | j2_nat == nationality
                                 | j3_nat == nationality |
                                   j4_nat == nationality |
                                   j5_nat == nationality |
                                   j6_nat == nationality |
                                   j7_nat == nationality |
                                   j8_nat == nationality |
                                   j9_nat == nationality ) %>%
  filter(discipline == "Mens" | discipline == "Womens")

judge_nats <- shared_nat[c("j1_nat", "j2_nat", "j3_nat", "j4_nat", "j5_nat",
                           "j6_nat", "j7_nat", "j8_nat", "j9_nat","j1_total",
                           "j2_total", "j3_total", "j4_total", "j5_total",
                           "j6_total", "j7_total", "j8_total", "j9_total",
                           "nationality")]

panel_scores <- shared_nat[c("j1_total", "j2_total", "j3_total", "j4_total",
                             "j5_total", "j6_total", "j7_total", "j8_total",
                             "j9_total")]
```

```
#nhk_mens_fp <- skating %>% filter(discipline == "Mens" & segment == "fp" &
#                                  event_name == "GP NHK Trophy" &
#                                  event_year == "2019") %>% arrange(desc(total))
#nhk_mens_fp[c("skater", "nationality", "total")]
#nhk_mens_sp <- skating %>% filter(discipline == "Mens" & segment == "sp" &
#                                  event_name == "GP NHK Trophy" &
#                                  event_year == "2019") %>% arrange(desc(total))
#nhk_mens_sp[c("skater", "nationality", "total")]

# Get the top 3 finishers for each discipline and competition
skating %>% filter(discipline == "Mens" &
                                  event_name == "GP NHK Trophy" &
                                  event_year == "2019") %>% group_by(skater) %>% summarize(overall =
```

```
## # A tibble: 12 x 2
##    skater           overall
##    <chr>              <dbl>
##  1 Yuzuru HANYU        305.
##  2 Kévin AYMOZ         250.
##  3 Roman SADOVSKY      248.
##  4 Sergei VORONOV      239.
##  5 Jason BROWN         231.
##  6 Sota YAMAMOTO       226.
##  7 Makar IGNATOV       222.
##  8 Anton SHULEPOV      218.
```

```
##  9 Koshiro SHIMADA     214.
## 10 Tomoki HIWATASHI    207.
## 11 Alexei BYCHENKO     198.
## 12 Conrad ORZEL        196.
```

```
skating %>% filter(discipline == "Womens" &
                                    event_name == "GP NHK Trophy" &
                                    event_year == "2019") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 12 x 2
##    skater             overall
##    <chr>                <dbl>
##  1 Alena KOSTORNAIA      240
##  2 Rika KIHIRA           232.
##  3 Alina ZAGITOVA        218.
##  4 Yuhana YOKOI          190.
##  5 Mako YAMASHITA        189.
##  6 Sofia SAMODUROVA      183.
##  7 Eunsoo LIM            172.
##  8 Starr ANDREWS         167.
##  9 Karen CHEN            166.
## 10 Kailani CRAINE        165.
## 11 Maé-Bérénice MÉITÉ    160.
## 12 Megan WESSENBERG      132.
```

```
skating %>% filter(discipline == "Mens" &
                                    event_name == "European Championships" &
                                    event_year == "2020") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 35 x 2
##    skater               overall
##    <chr>                  <dbl>
##  1 Dmitri ALIEV           273.
##  2 Artur DANIELIAN        247.
##  3 Morisi KVITELASHVILI   247.
##  4 Daniel GRASSL          245.
##  5 Matteo RIZZO           237.
##  6 Deniss VASILJEVS       233.
##  7 Michal BŘEZINA         231.
##  8 Paul FENTZ             230.
##  9 Vladimir LITVINTSEV    221.
## 10 Alexander SAMARIN      220.
## # i 25 more rows
```

```
skating %>% filter(discipline == "Womens" &
                                    event_name == "European Championships" &
                                    event_year == "2020") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 37 x 2
##    skater             overall
##    <chr>                <dbl>
##  1 Alena KOSTORNAIA      241.
```

```
##  2 Anna SHCHERBAKOVA     238.
##  3 Alexandra TRUSOVA     225.
##  4 Alexia PAGANINI       193.
##  5 Emmi PELTONEN         182.
##  6 Ekaterina RYABOVA     181.
##  7 Eva Lotta KIIBUS      181.
##  8 Alessia TORNAGHI      172.
##  9 Maé-Bérénice MÉITÉ    172.
## 10 Ekaterina KURAKOVA    170.
## # i 27 more rows
```

```
skating %>% filter(discipline == "Mens" &
                                    event_name == "World Championships" &
                                    event_year == "2021") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 33 x 2
##    skater           overall
##    <chr>              <dbl>
##  1 Nathan CHEN         321.
##  2 Yuma KAGIYAMA       292.
##  3 Yuzuru HANYU        289.
##  4 Shoma UNO           277.
##  5 Mikhail KOLYADA     272.
##  6 Keegan MESSING      270.
##  7 Jason BROWN         262.
##  8 Evgeni SEMENENKO    258.
##  9 Kévin AYMOZ         255.
## 10 Junhwan CHA         246.
## # i 23 more rows
```

```
skating %>% filter(discipline == "Womens" &
                                    event_name == "World Championships" &
                                    event_year == "2021") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 37 x 2
##    skater                 overall
##    <chr>                    <dbl>
##  1 Anna SHCHERBAKOVA         233.
##  2 Elizaveta TUKTAMYSHEVA    220.
##  3 Alexandra TRUSOVA         217.
##  4 Karen CHEN                209.
##  5 Loena HENDRICKX           208.
##  6 Kaori SAKAMOTO            208.
##  7 Rika KIHIRA               206.
##  8 Olga MIKUTINA             199.
##  9 Bradie TENNELL            198.
## 10 Haein LEE                 193.
## # i 27 more rows
```

```
skating %>% filter(discipline == "Mens" &
                                    event_name == "Olympic Winter Games" &
                                    event_year == "2022") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 29 x 2
##    skater               overall
##    <chr>                  <dbl>
##  1 Nathan CHEN             333.
##  2 Yuma KAGIYAMA           310.
##  3 Shoma UNO               293
##  4 Yuzuru HANYU            283.
##  5 Junhwan CHA             282.
##  6 Jason BROWN             281.
##  7 Daniel GRASSL           278.
##  8 Evgeni SEMENENKO        274.
##  9 Boyang JIN              270.
## 10 Morisi KVITELASHVILI    269.
## # i 19 more rows
```

```
skating %>% filter(discipline == "Womens" &
                                    event_name == "Olympic Winter Games" &
                                    event_year == "2022") %>% group_by(skater) %>% summarize(overall = s
```

```
## # A tibble: 30 x 2
##    skater             overall
##    <chr>                <dbl>
##  1 Anna SHCHERBAKOVA    256.
##  2 Alexandra TRUSOVA    252.
##  3 Kaori SAKAMOTO       233.
##  4 Kamila VALIEVA       224.
##  5 Wakaba HIGUCHI       214.
##  6 Young YOU            213.
##  7 Alysa LIU            209.
##  8 Loena HENDRICKX      207.
##  9 Yelim KIM            203.
## 10 Mariah BELL          202.
## # i 20 more rows
```

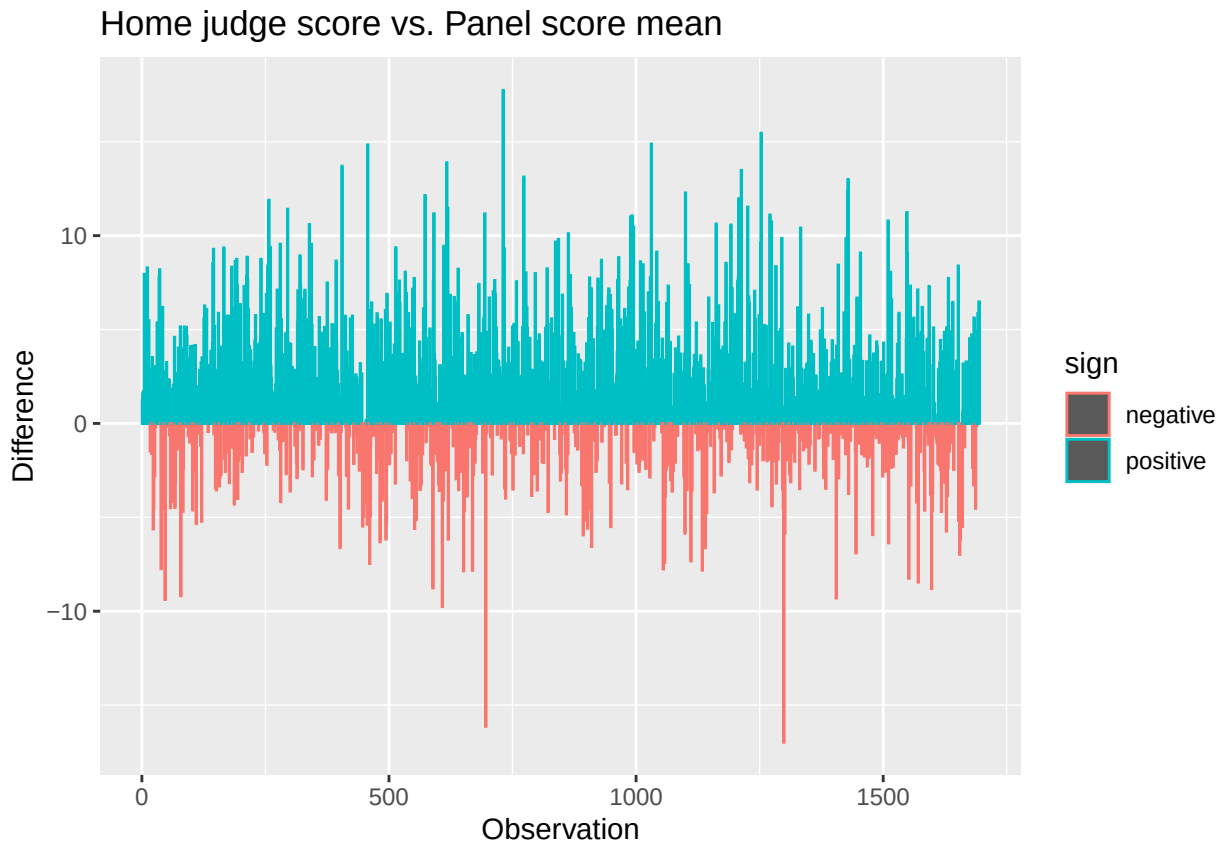
```
# Function to return the score of the 'home judge'
find_home <- function(row) {
  for (col in 1:9) {
    if (is.na(row[col])) {
      next
    }
    else {
      if (row[col] == row["nationality"]) {
      return(row[col + 9])
      }
    }
  }
}

home_judge <- apply(judge_nats, 1, find_home)
home_judge <- as.numeric(unlist(home_judge))

panel_scores["home"] = home_judge
```

```r
# Function to calculate the mean of the remaining judges' scores (panel mean)
find_mean <- function(row) {
  panel_sum <- sum(row[1:9], na.rm = TRUE)
  n <- sum(is.na(row[1:9]))
  mean <- (panel_sum - row["home"])/(8-n)
}

panel_mean <- apply(panel_scores, 1, find_mean)
```

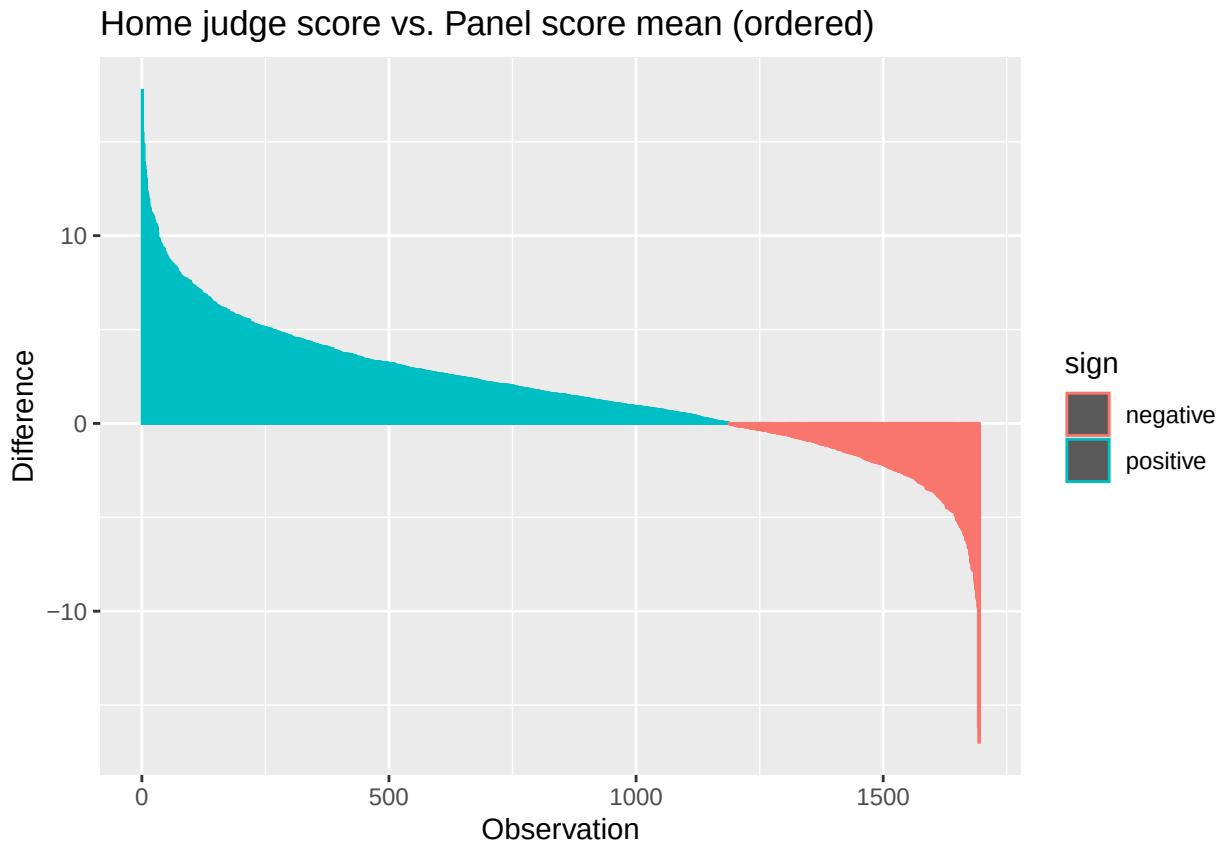
```r
wilcox.test(home_judge, panel_mean, paired = TRUE, alternative = "greater")
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  home_judge and panel_mean
## V = 1093783, p-value < 2.2e-16
## alternative hypothesis: true location shift is greater than 0
```

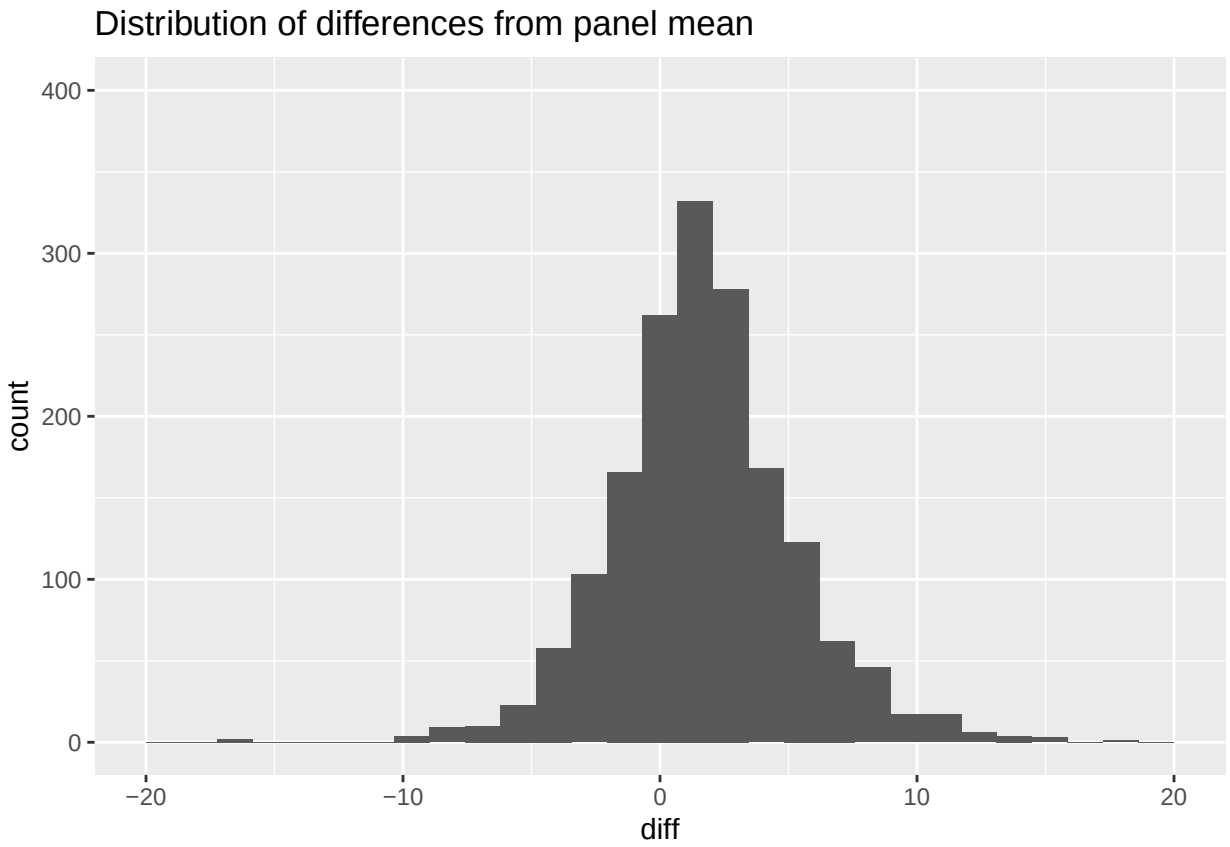
```r
# Data frame for the differences between the home judge and mean of the others
diffs <- data.frame(diff = home_judge - panel_mean)
# solely for visualization purposes
diffs$index <- 1:nrow(diffs)
diffs$sign <- ifelse(diffs$diff > 0, "positive", "negative")

# mean difference for all singles observations
mean_diffs <- mean(diffs$diff, na.rm = TRUE)

# Overview of the differences for each observation
ggplot(diffs, aes(x= index, y=diff)) + geom_col(aes(color = sign)) +
  xlab("Observation") + ylab("Difference") +
  ggtitle("Home judge score vs. Panel score mean")
```



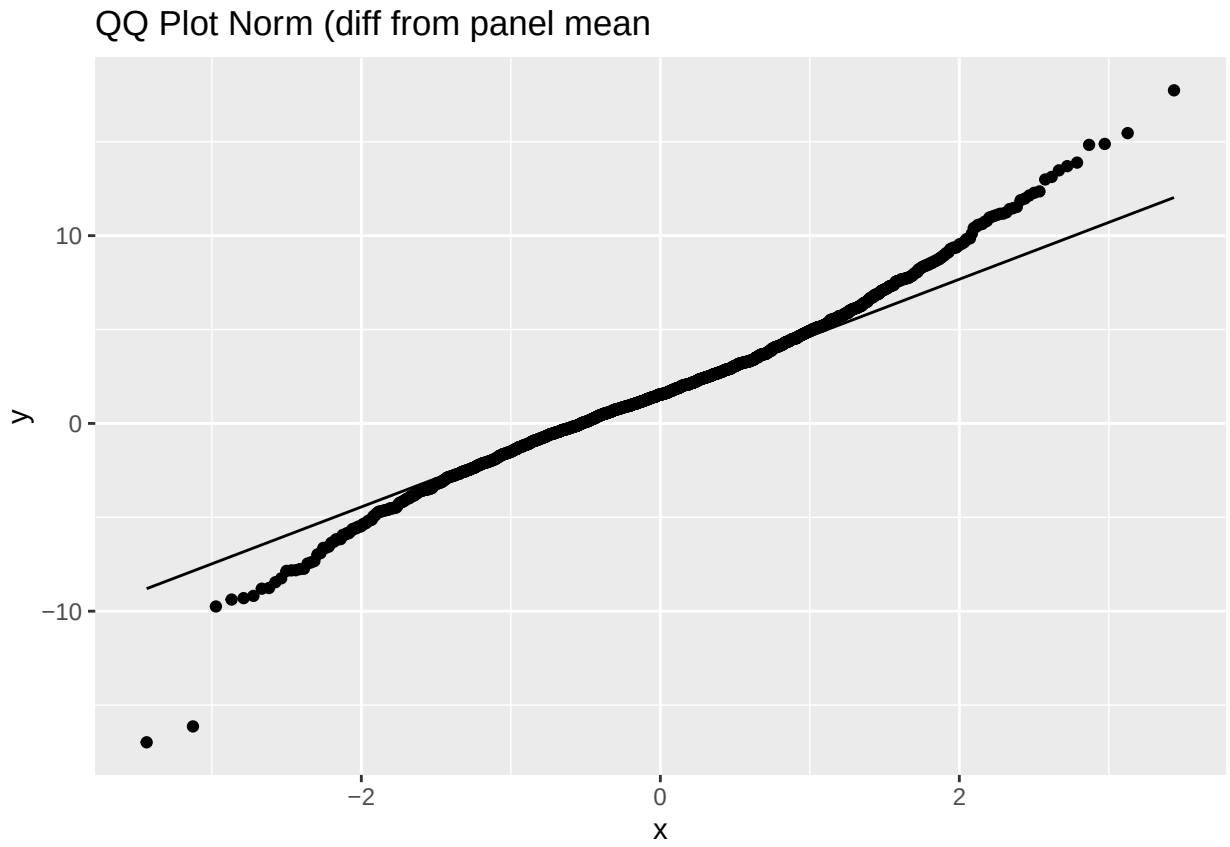

```
temp <- diffs %>% arrange(desc(diff))
temp$index <- 1:nrow(diffs)

temp %>% arrange(desc(diff)) %>% ggplot(., aes(x= index, y=diff)) +
  geom_col(aes(color = sign)) + xlab("Observation") + ylab("Difference") +
  ggtitle("Home judge score vs. Panel score mean (ordered)")
```




```
# Distribution of differences
ggplot(diffs, aes(x= diff)) + geom_histogram(bins = 30) +
  ggtitle("Distribution of differences from panel mean") +
  scale_x_continuous(limits = c(-20, 20)) +
  scale_y_continuous(limits = c(0, 400))
```



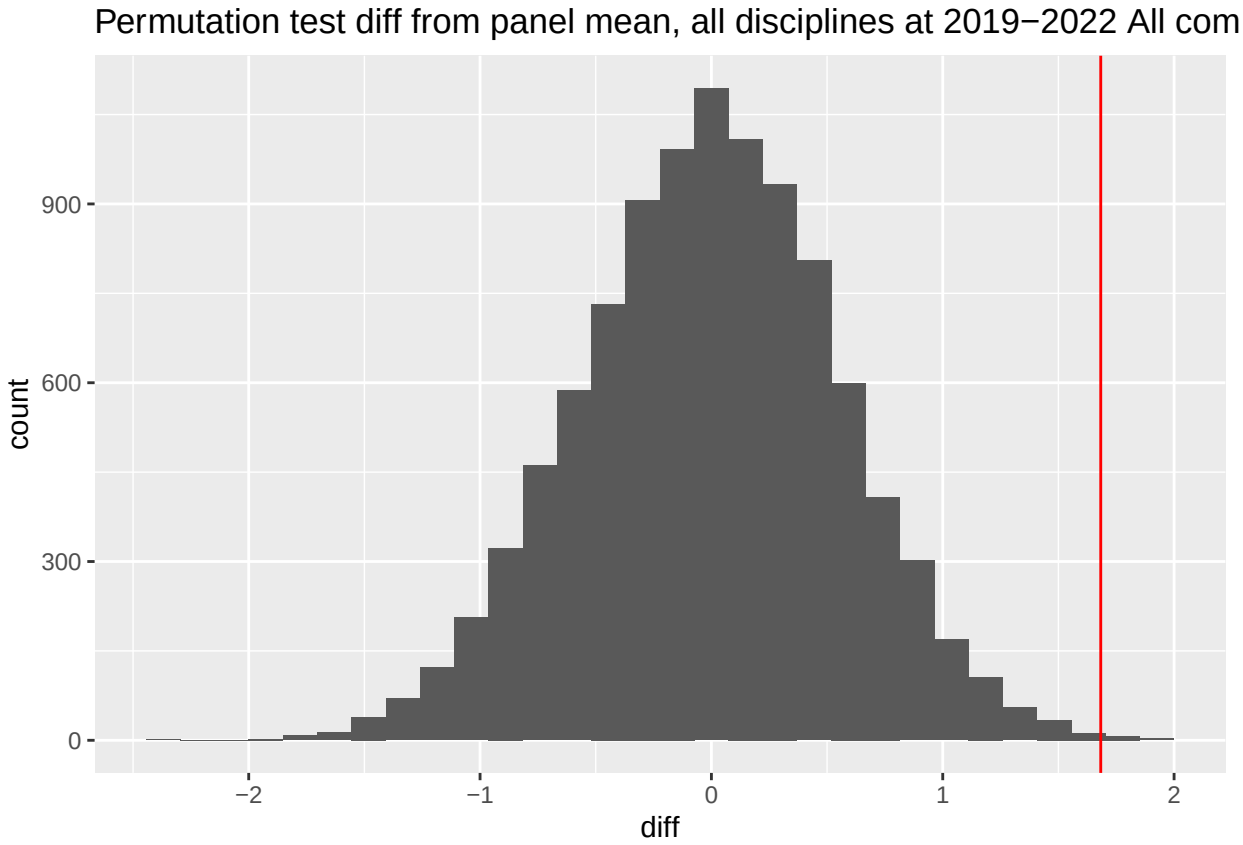

```
# Checking normality of differences
ggplot(diffs, aes(sample= diff)) + geom_qq() + geom_qq_line() +
  labs(title = "QQ Plot Norm (diff from panel mean")
```




```r
# Paired permutation test
paired_perm <- function(diffs, n, mean, name, year, discipline, segment) {
  set.seed(1)
  diff <- replicate(10000, {
    # sample differences
    diffs_permuted <- sample(diffs$diff, size=n, replace = FALSE)
    # assign random positive or negative to each observation
    diffs_permuted <- sample(c(-1,1), size=n, replace=TRUE) * abs(diffs_permuted)
    # calculate the mean
    mean_permuted <- mean(diffs_permuted)
  })
  # Histogram of results
  h1 <- ggplot(data.frame(diff), aes(x = diff)) + geom_histogram(bins = 30)
  h1 <- h1 + geom_vline(xintercept = mean, col = 'red') +
    ggtitle(paste0("Permutation test ", discipline, " ", segment, " at ",
                   year, " ", name))

  # Determine which hypothesis to test
  if (mean > 0) {
    hypothesis <- "hA = true mean is greater than 0 (overscoring)"
    pval <- mean(diff > mean)
  } else if (mean <= 0) {
    hypothesis <- "hA = true mean is less than 0 (underscoring)"
    pval <- mean(diff <= mean)
  }
```

```r
  return(list(h1, pval, hypothesis))
}

# Bootstrap for confidence intervals
boot <- function(diffs, n, name, year, discipline, segment) {
  set.seed(1)
  diff <- replicate(10000, {
    # sample differences
    diffs_permuted <- sample(diffs$diff, size=n, replace = TRUE)
    # calculate the mean
    mean_permuted <- mean(diffs_permuted, na.rm = TRUE)
  })
  conf_int <- quantile(diff, c(0.025, 0.975), names = FALSE)
  moe <- conf_int[2]-conf_int[1]
  # Histogram of results
  h1 <- ggplot(data.frame(diff), aes(x = diff)) + geom_histogram(bins = 30) +
    geom_vline(xintercept = conf_int, col = 'red') +
    ggtitle(paste0("Bootstrap Confidence Interval for ", discipline, " ",
                   segment, " at ", year, " ", name))

  return(list(h1, conf_int, moe))
}

# Apply functions to all singles data
paired_perm(diffs, 50, mean_diffs, "All competitions", "2019-2022", "diff from panel mean, all", "disci
```

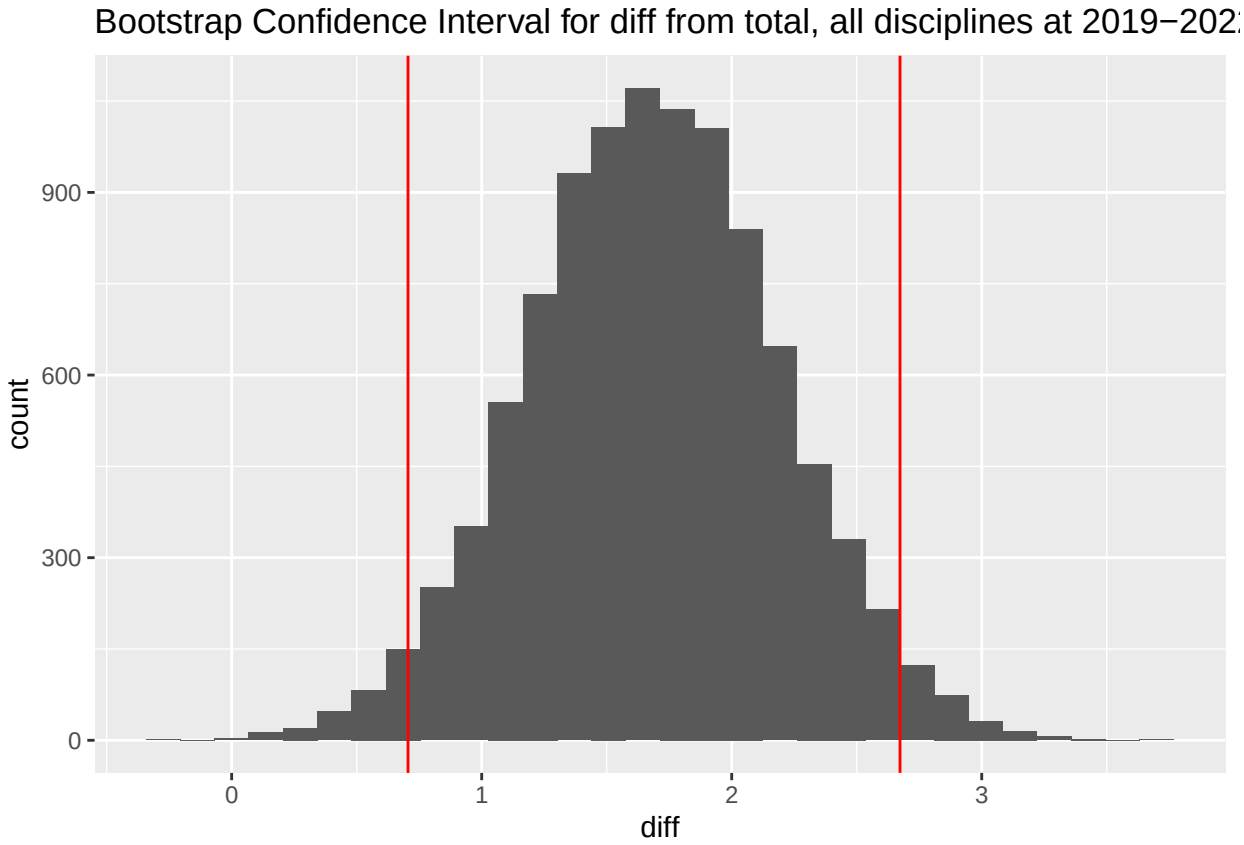
```
## [[1]]
```




```
##
## [[2]]
## [1] 0.001
##
## [[3]]
## [1] "hA = true mean is greater than 0 (overscoring)"
```

```
boot(diffs, 50, "All competitions", "2019-2022", "diff from total, all", "disciplines")
```

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




```
##
## [[2]]
## [1] 0.7053638 2.6731274
##
## [[3]]
## [1] 1.967764
```

```
# Testing by country of judge (for all singles data)
scores <- data.frame(event = shared_nat$event_name, year = shared_nat$event_year,
                     country = shared_nat$nationality, home = home_judge,
                     away = panel_mean, hj_diff = home_judge - panel_mean,
                     discipline = shared_nat$discipline,
                     segment = shared_nat$segment)
head(scores)
```

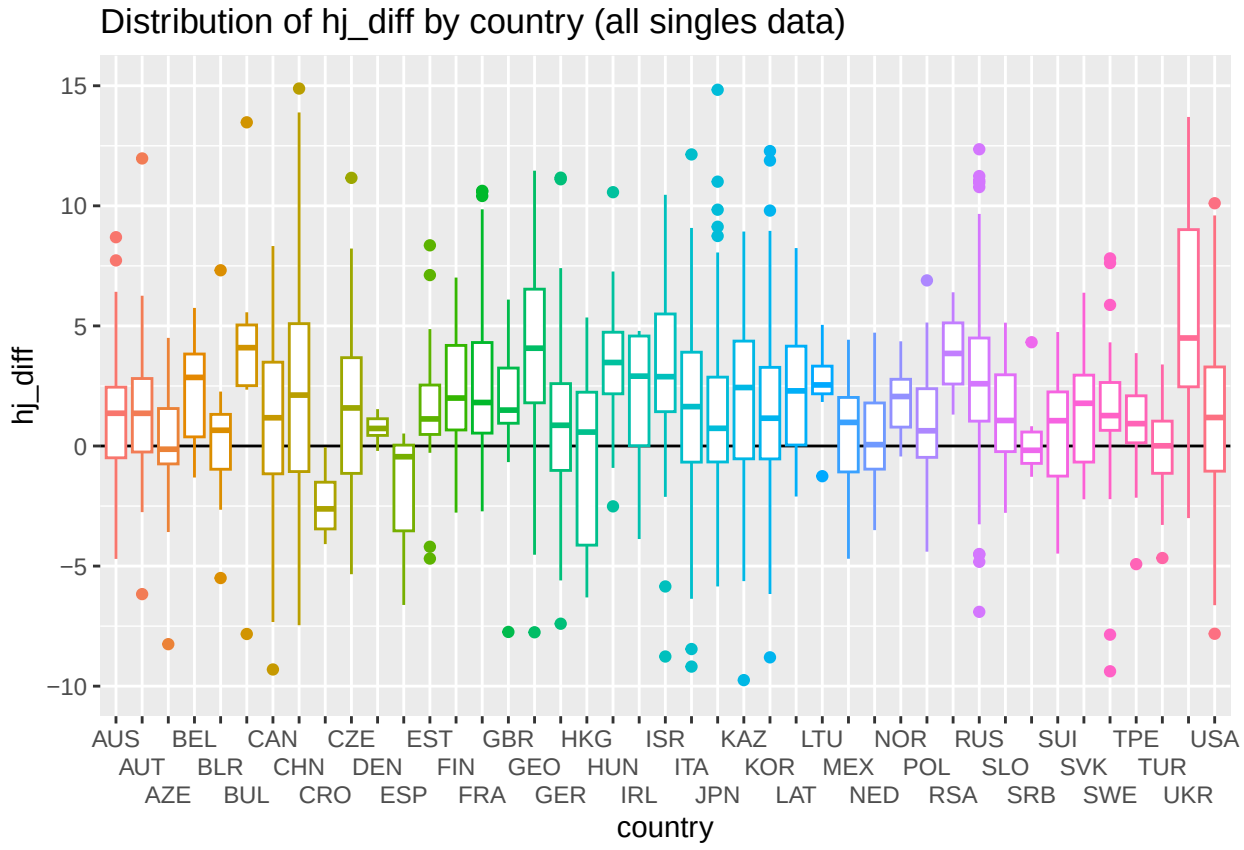
```
##                 event year country  home     away hj_diff discipline segment
## 1 World Championships 2019     FRA 88.86 87.64000 1.22000       Mens      sp
## 2 World Championships 2019     CZE 88.07 86.48500 1.58500       Mens      sp
## 3 World Championships 2019     CAN 84.28 82.58125 1.69875       Mens      sp
## 4 World Championships 2019     CAN 83.28 82.23125 1.04875       Mens      sp
## 5 World Championships 2019     ISR 88.72 80.77250 7.94750       Mens      sp
## 6 World Championships 2019     ISR 80.39 77.30375 3.08625       Mens      sp
```

```r
# Group by country
by_country <- scores %>% group_by(country) %>%
  summarize(mean_diff = mean(hj_diff, na.rm = TRUE),
            st_dev = sd(hj_diff, na.rm = TRUE), n()) %>% arrange(desc(mean_diff))
by_country
```

```
## # A tibble: 43 x 4
##    country mean_diff st_dev `n()`
##    <chr>       <dbl>  <dbl> <int>
##  1 UKR          6.52   5.42    12
##  2 RSA          3.85   3.60     2
##  3 GEO          3.81   4.78    26
##  4 HUN          3.59   2.89    19
##  5 BUL          3.55   6.26     7
##  6 ISR          3.09   3.90    35
##  7 RUS          2.93   3.15   244
##  8 FRA          2.53   3.34    76
##  9 LTU          2.48   1.94     7
## 10 LAT          2.44   3.19    14
## # i 33 more rows
```

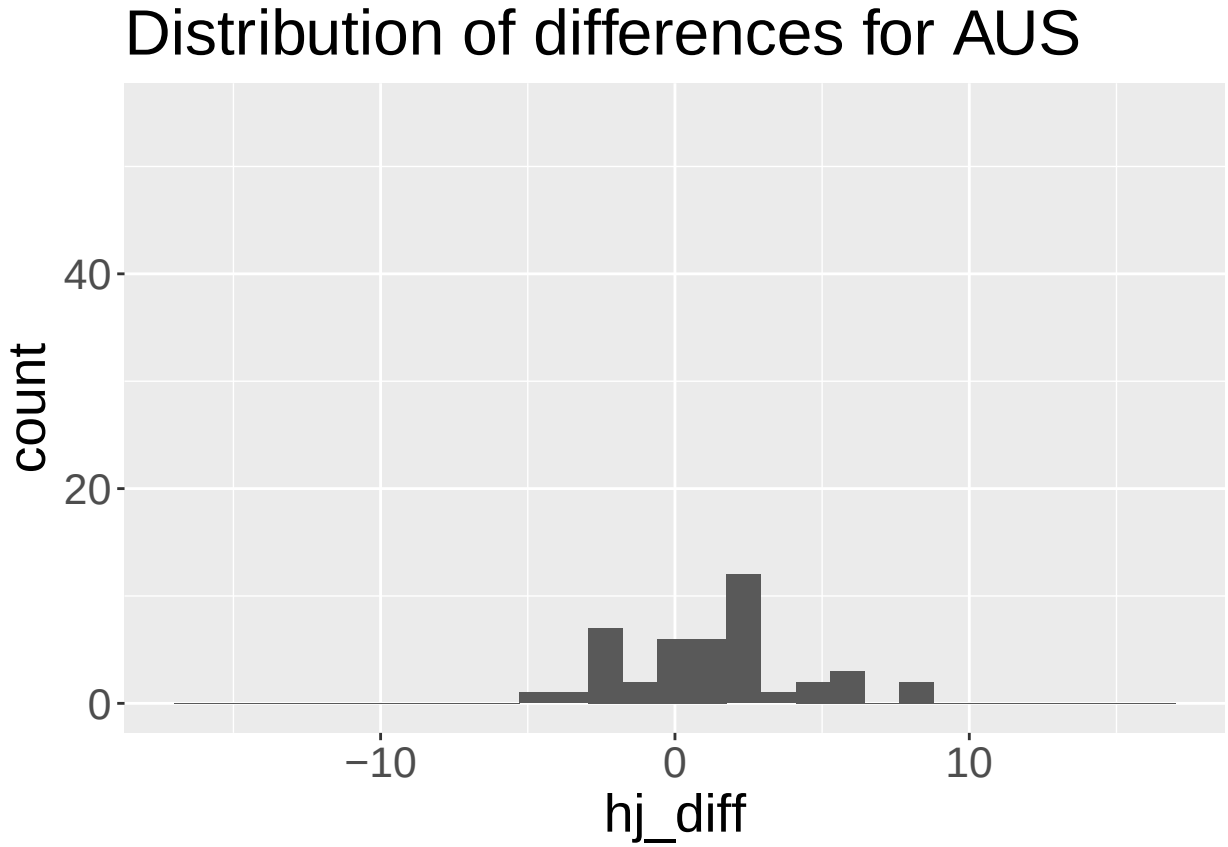
```r
# Plot boxplots
ggplot(scores, aes(x= country, y= hj_diff)) +
  geom_hline(yintercept = 0, col = 'black') +
  geom_boxplot(aes(color = country), show.legend = FALSE) +
  scale_x_discrete(guide = guide_axis(n.dodge=3)) +
  scale_y_continuous(limits = c(-10, 15)) +
  ggtitle("Distribution of hj_diff by country (all singles data)")
```

```
## Warning: Removed 4 rows containing non-finite values (`stat_boxplot()`).
```

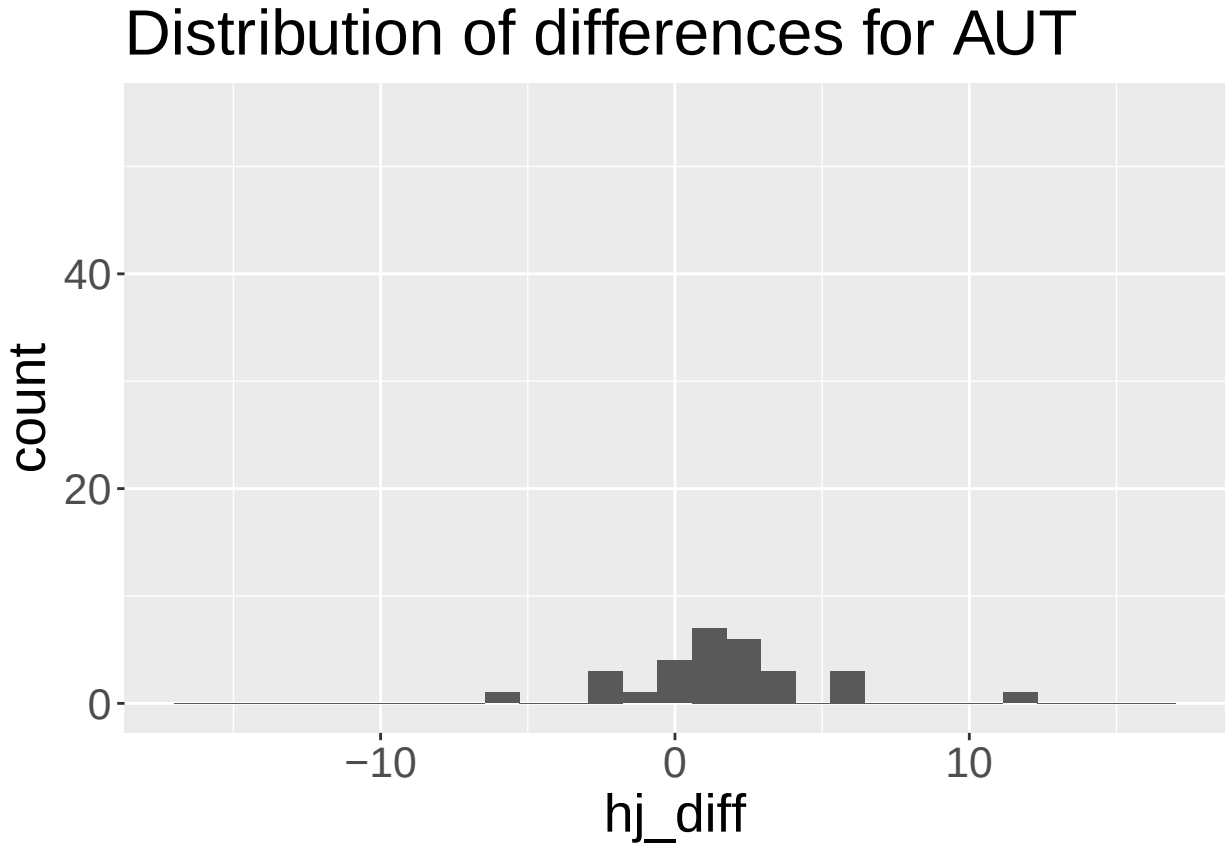



```
# Plot distributions for each country
charts <- scores %>% group_by(country) %>%
  group_map(.f = ~ ggplot(.x,aes(x= hj_diff)) + geom_histogram(bins = 30) +
  ggtitle(paste0("Distribution of differences for ", .y$country)) +
  scale_x_continuous(limits = c(-17, 17)) +
  scale_y_continuous(limits = c(0, 55)) + theme(text = element_text(size = 20)))
charts
```

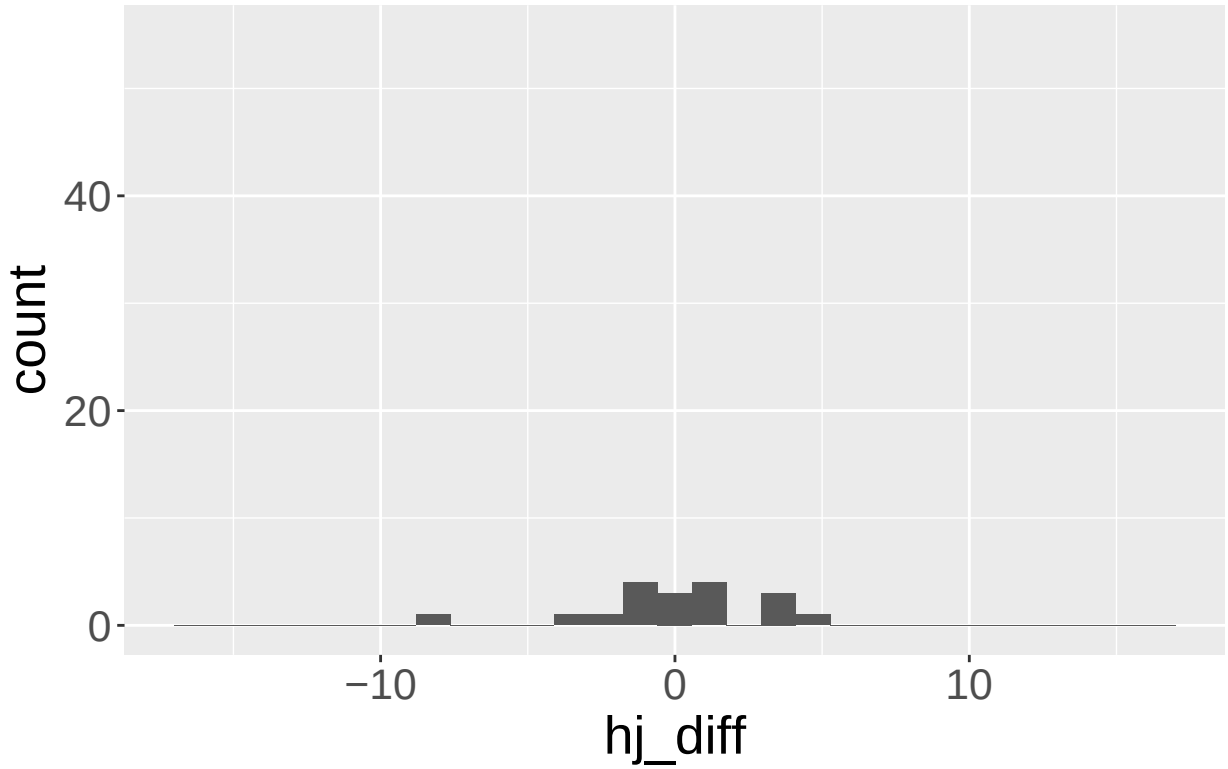
```
## [[1]]
```


Distribution of differences for AUS
count
40
20
0
−10
0
10
hj_diff

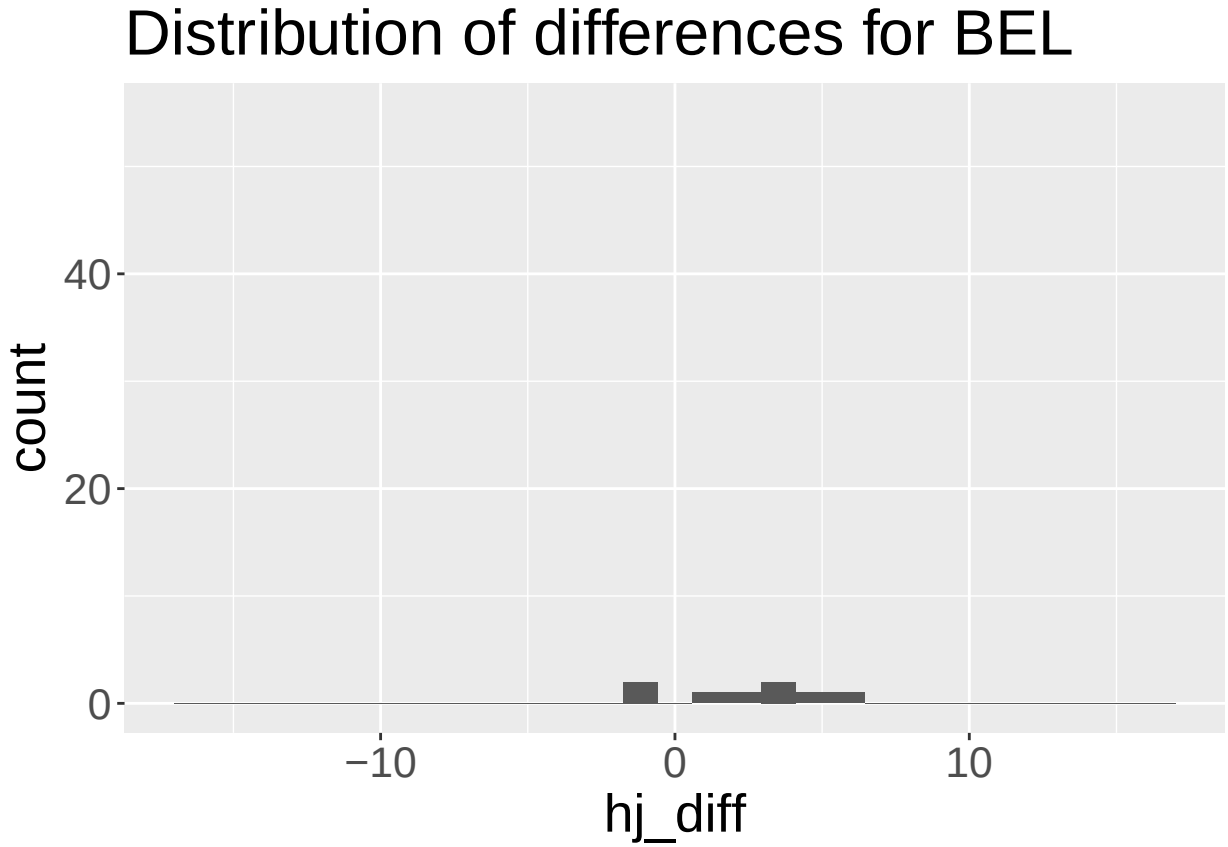
```
##
## [[2]]
```


Distribution of differences for AUT
count
40
20
0
−10
0
10
hj_diff

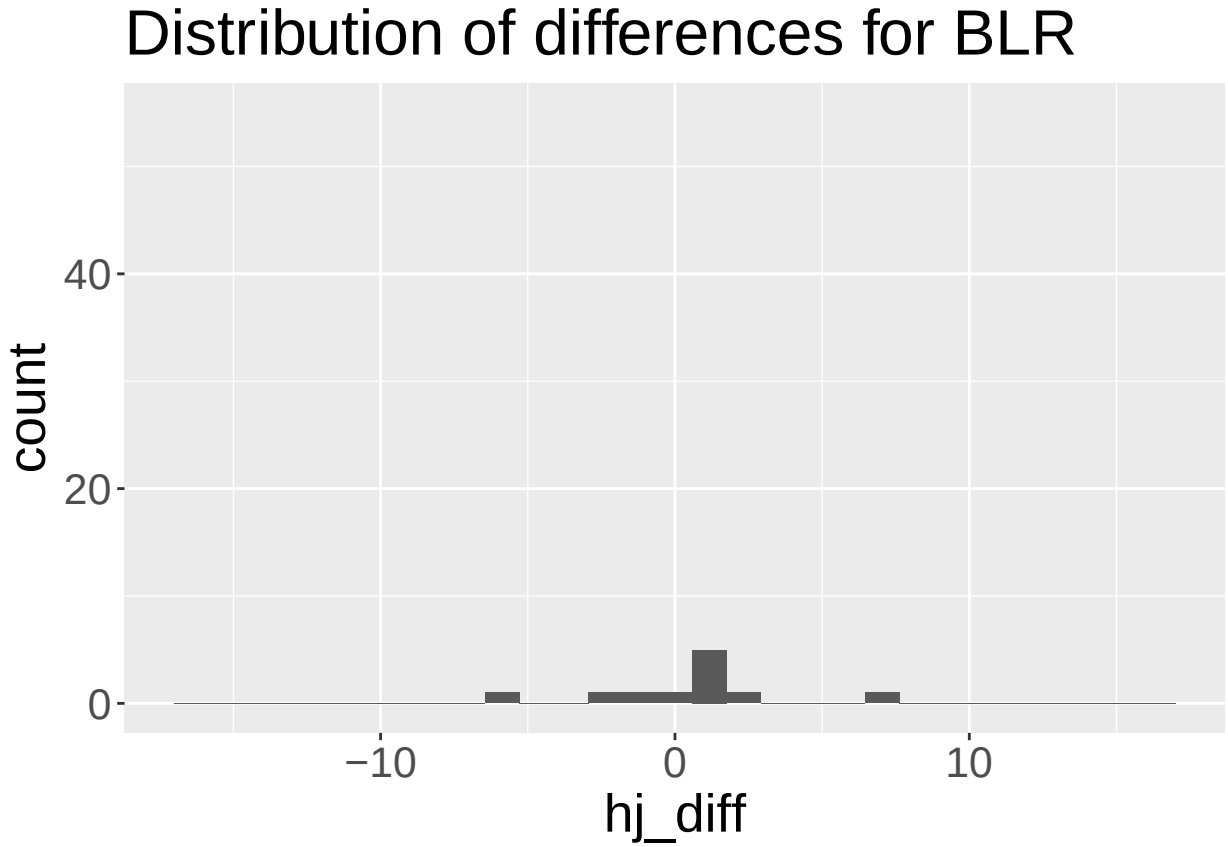
```
##
## [[3]]
```


Distribution of differences for AZE
count
40
20
0
−10
0
10
hj_diff

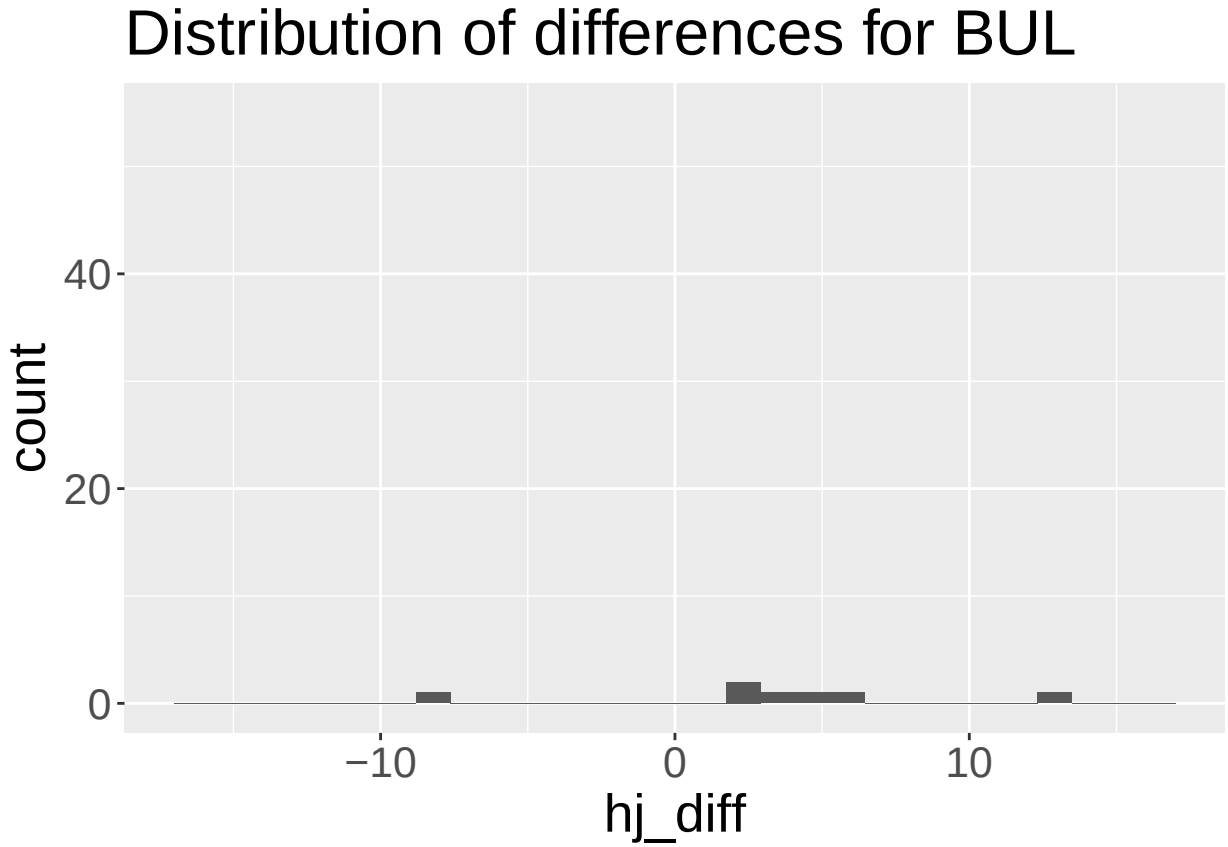
```
##
## [[4]]
```


Distribution of differences for BEL
count
40
20
0
−10
0
10
hj_diff

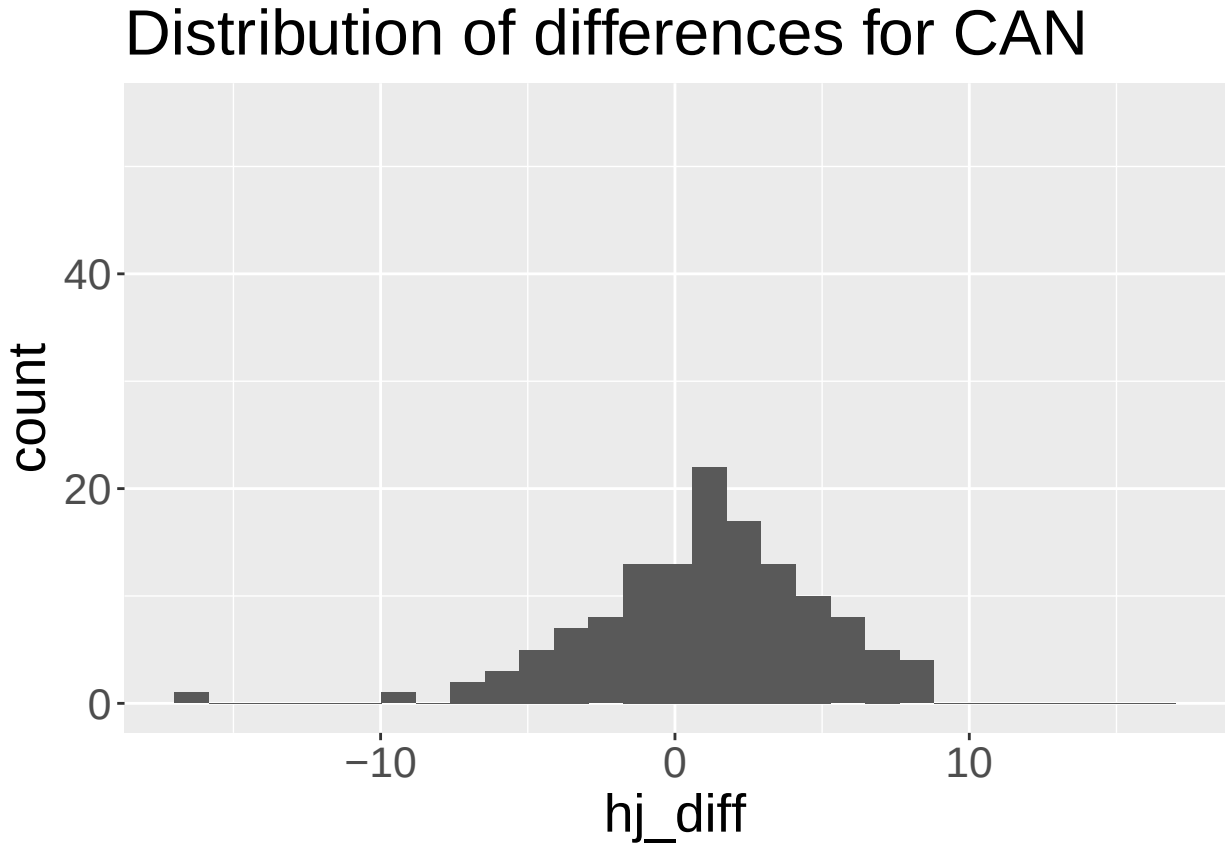
```
##
## [[5]]
```


Distribution of differences for BLR
count
40
20
0
−10
0
10
hj_diff

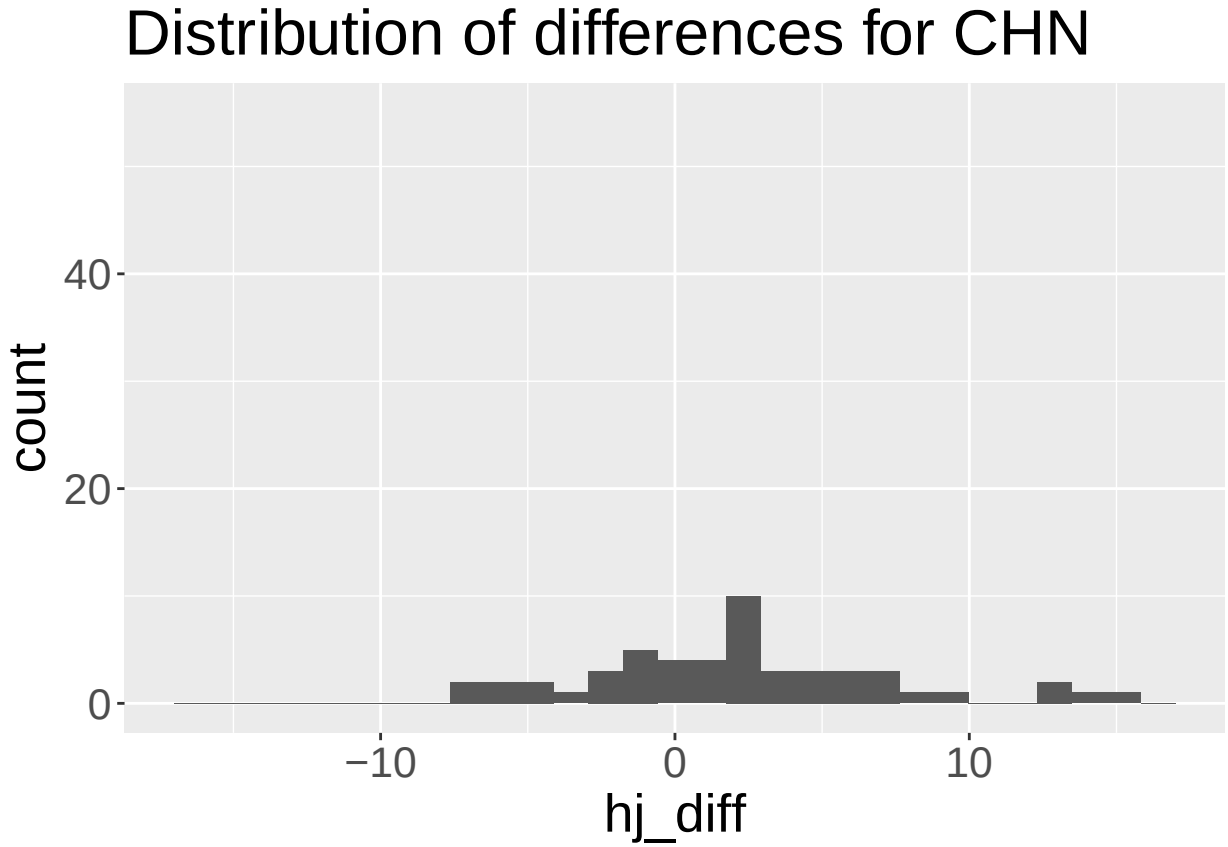
```
##
## [[6]]
```


Distribution of differences for BUL
count
40
20
0
−10
0
10
hj_diff

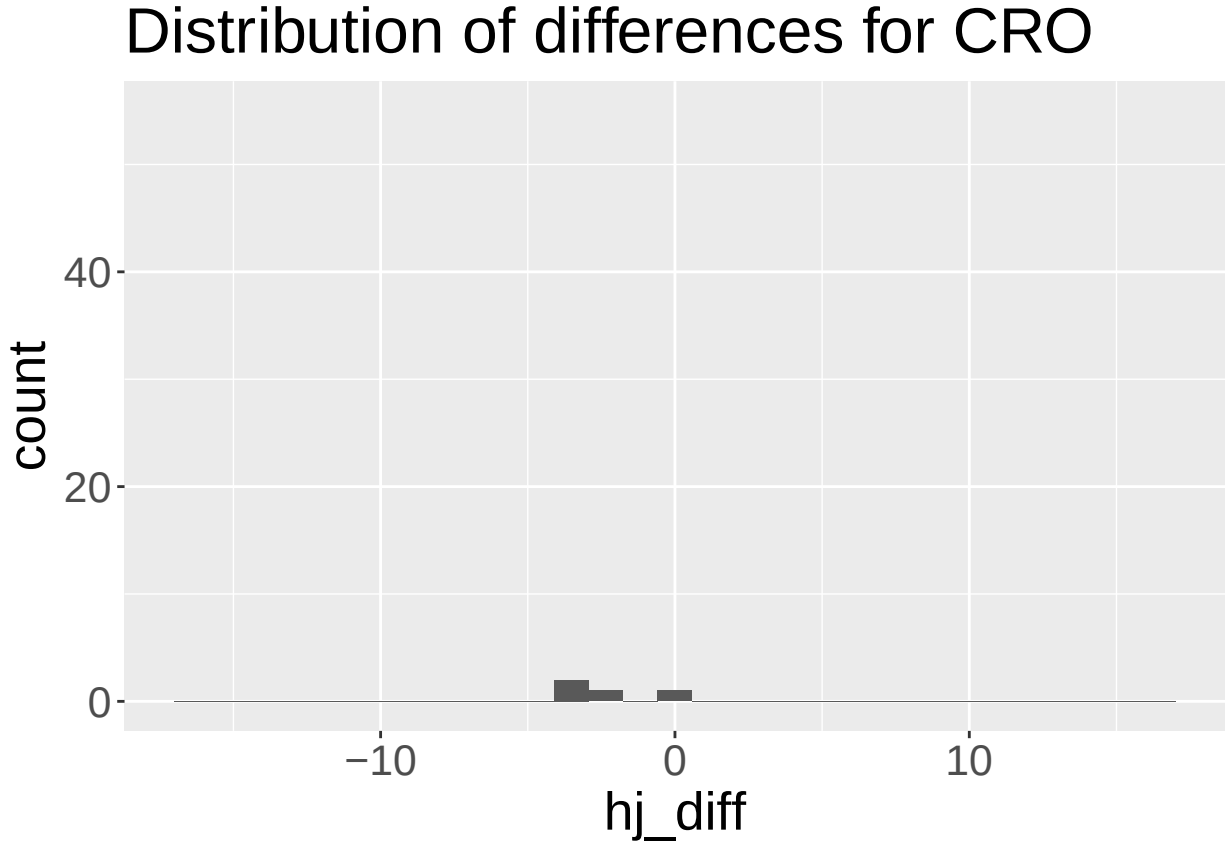
```
##
## [[7]]
```


Distribution of differences for CAN
count
40
20
0
−10
0
10
hj_diff

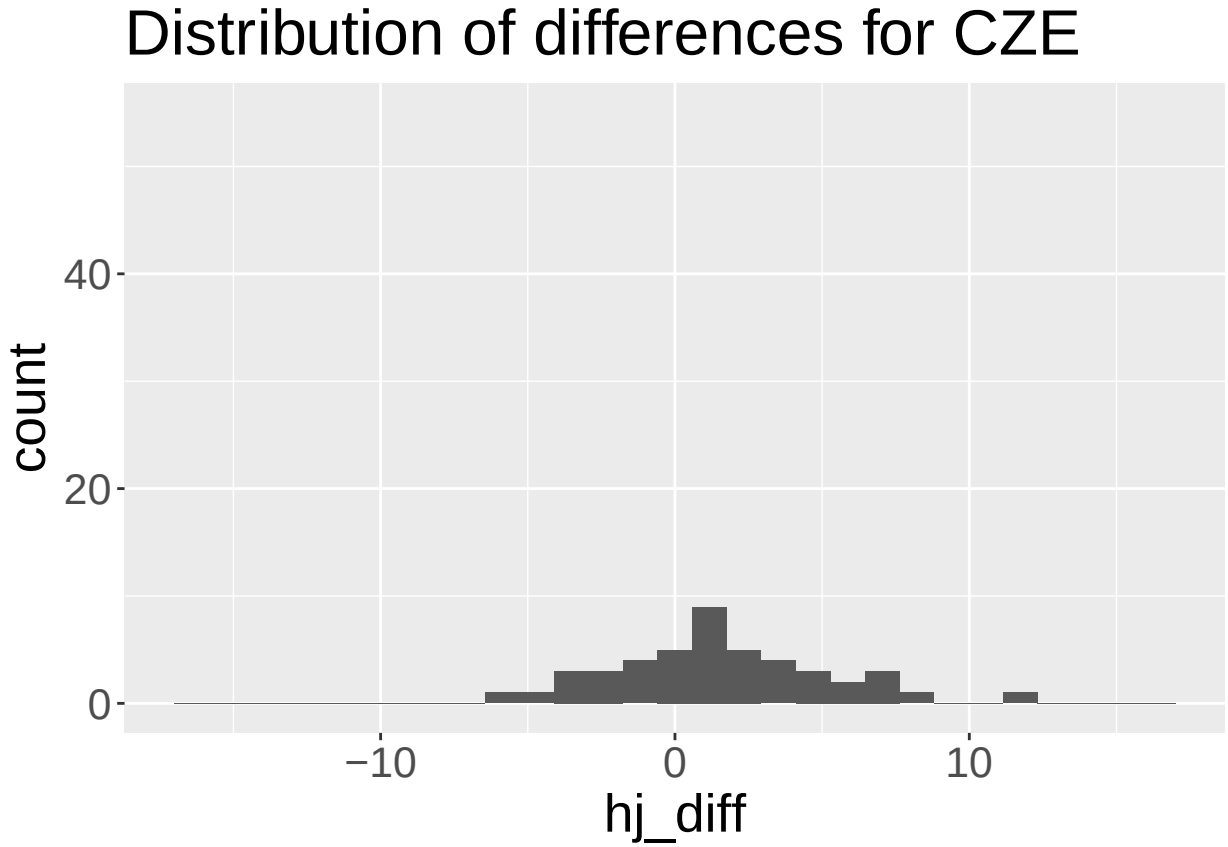
```
##
## [[8]]
```


Distribution of differences for CHN
count
40
20
0
−10
0
10
hj_diff

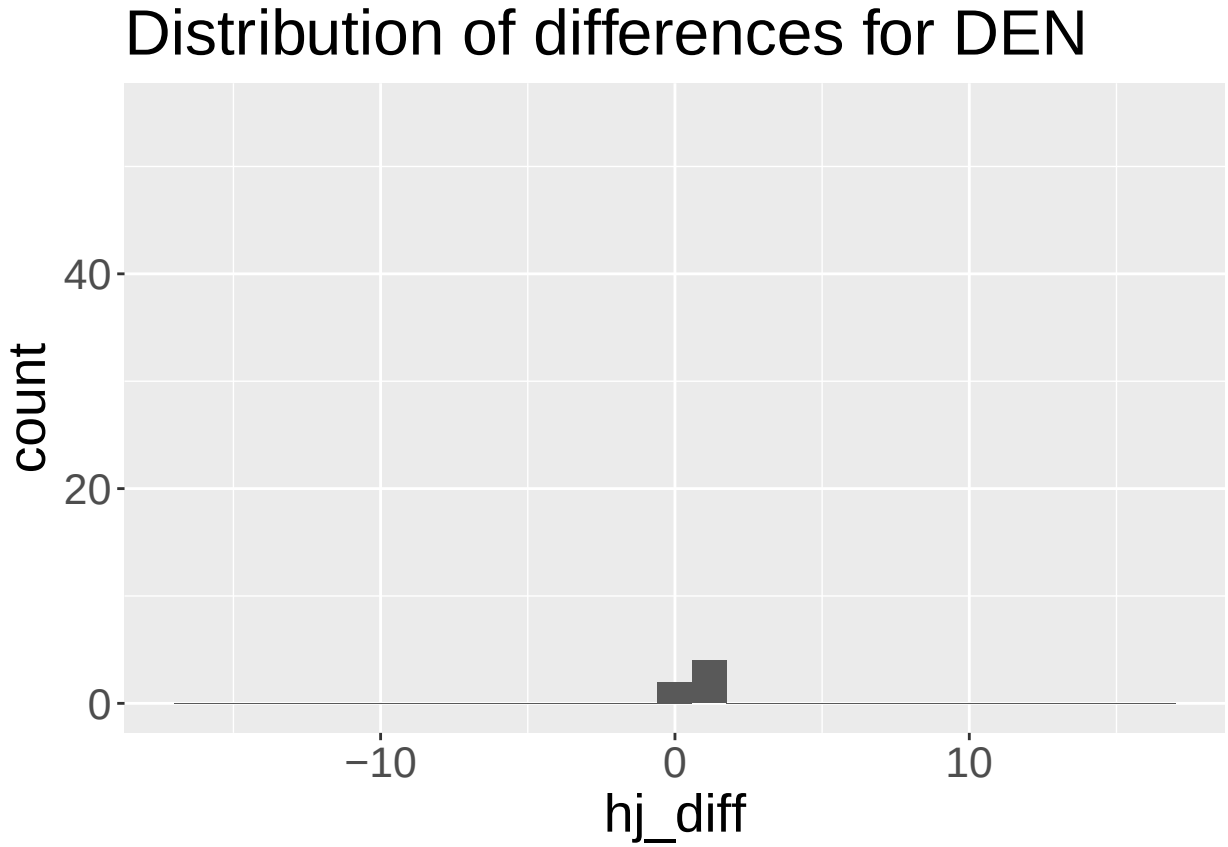
```
##
## [[9]]
```


Distribution of differences for CRO
count
40
20
0
−10
0
10
hj_diff

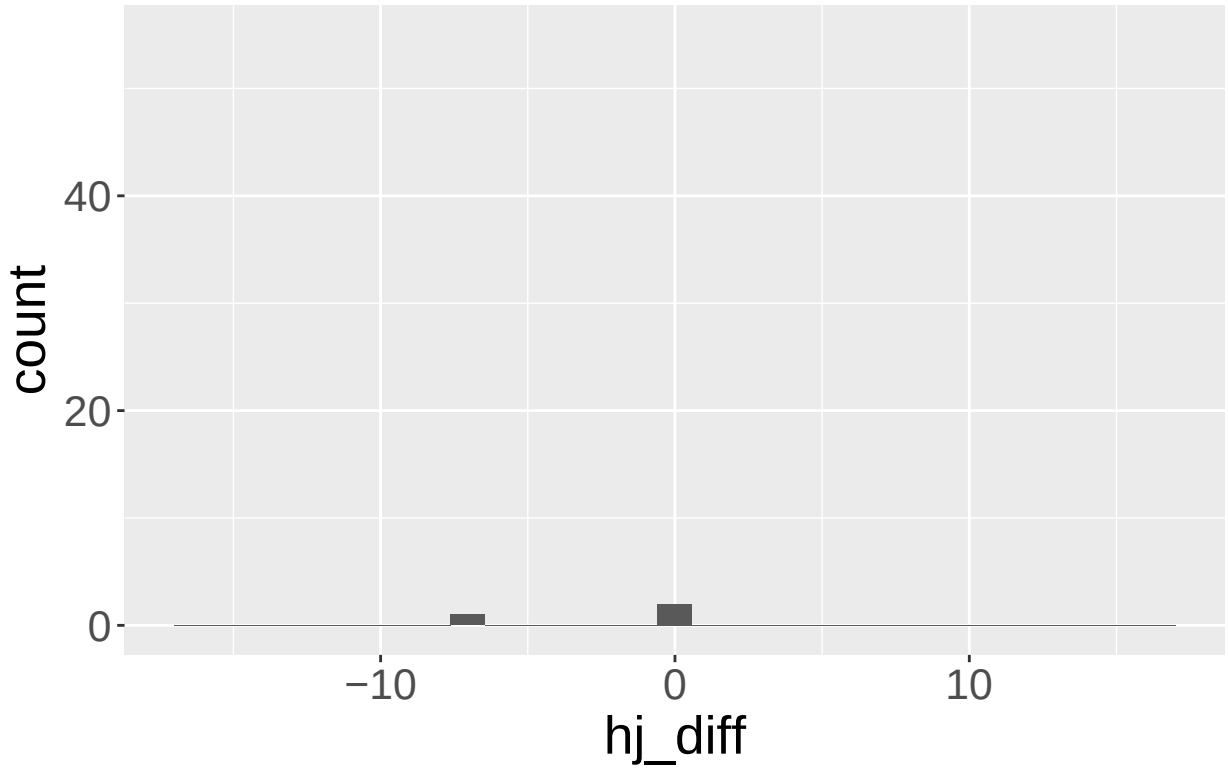
```
##
## [[10]]
```


Distribution of differences for CZE
count
40
20
0
−10
0
10
hj_diff

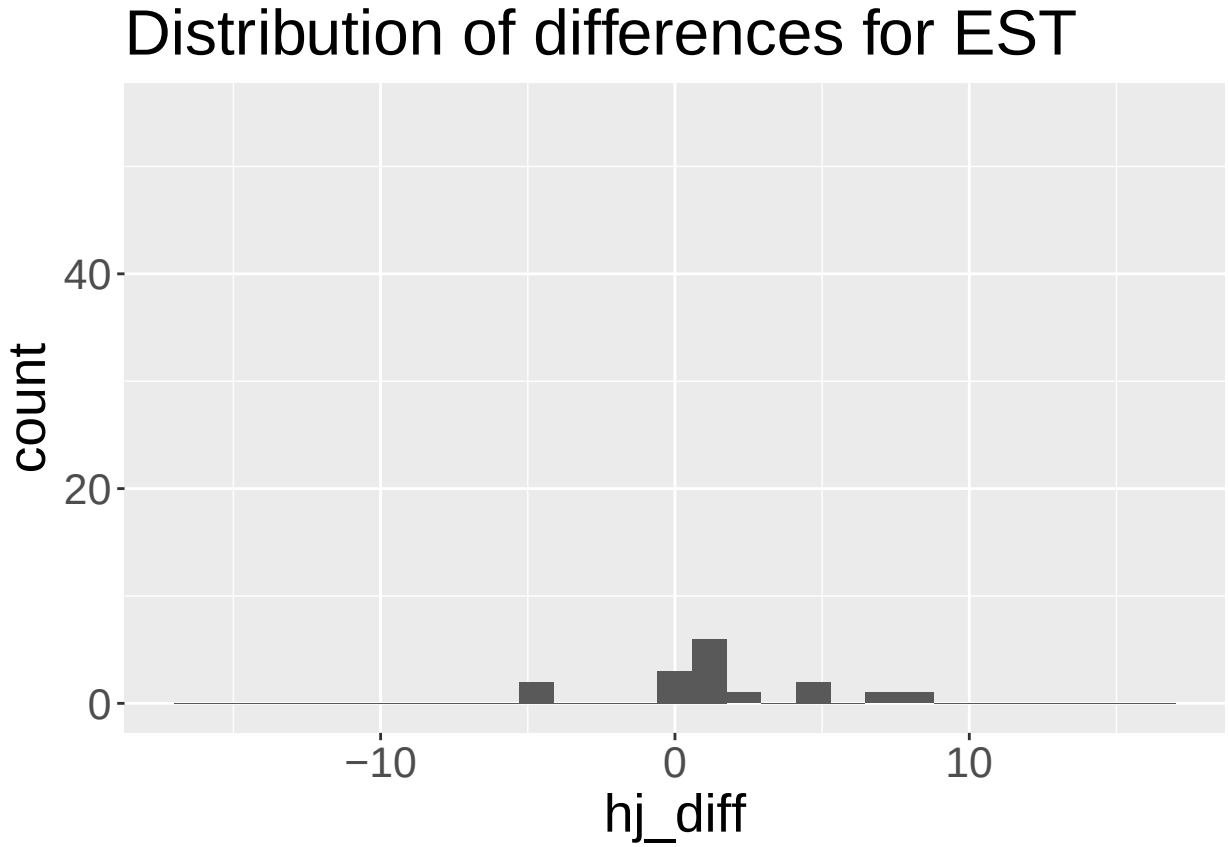
```
##
## [[11]]
```


Distribution of differences for DEN
count
40
20
0
−10
0
10
hj_diff

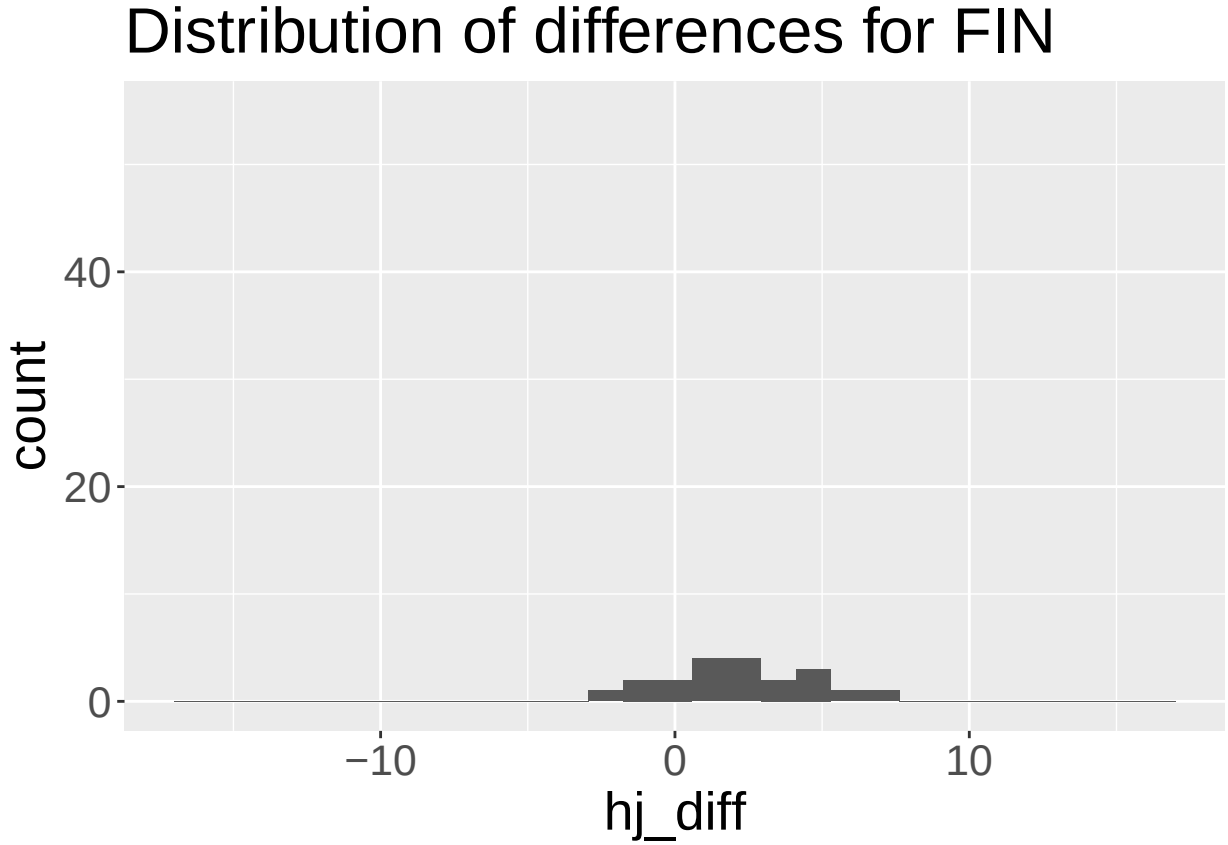
```
##
## [[12]]
```


Distribution of differences for ESP
count
40
20
0
−10
0
10
hj_diff

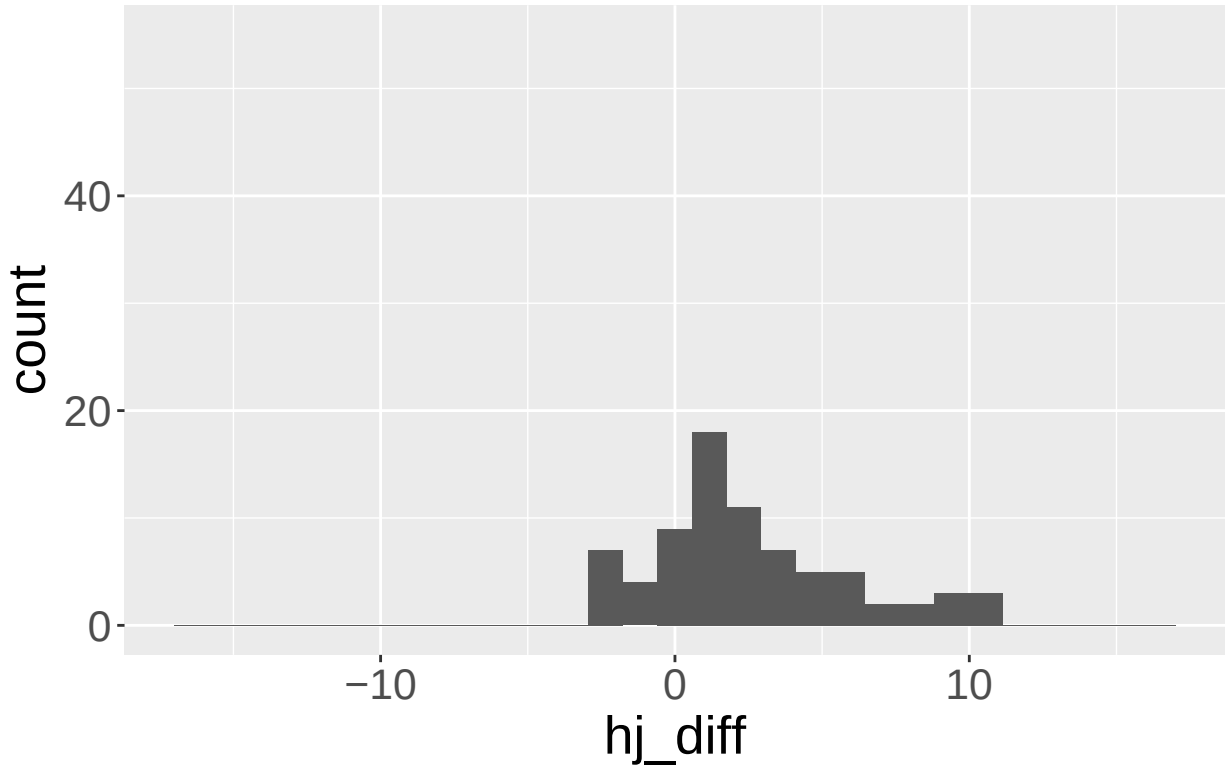
```
##
## [[13]]
```


Distribution of differences for EST
count
40
20
0
−10
0
10
hj_diff

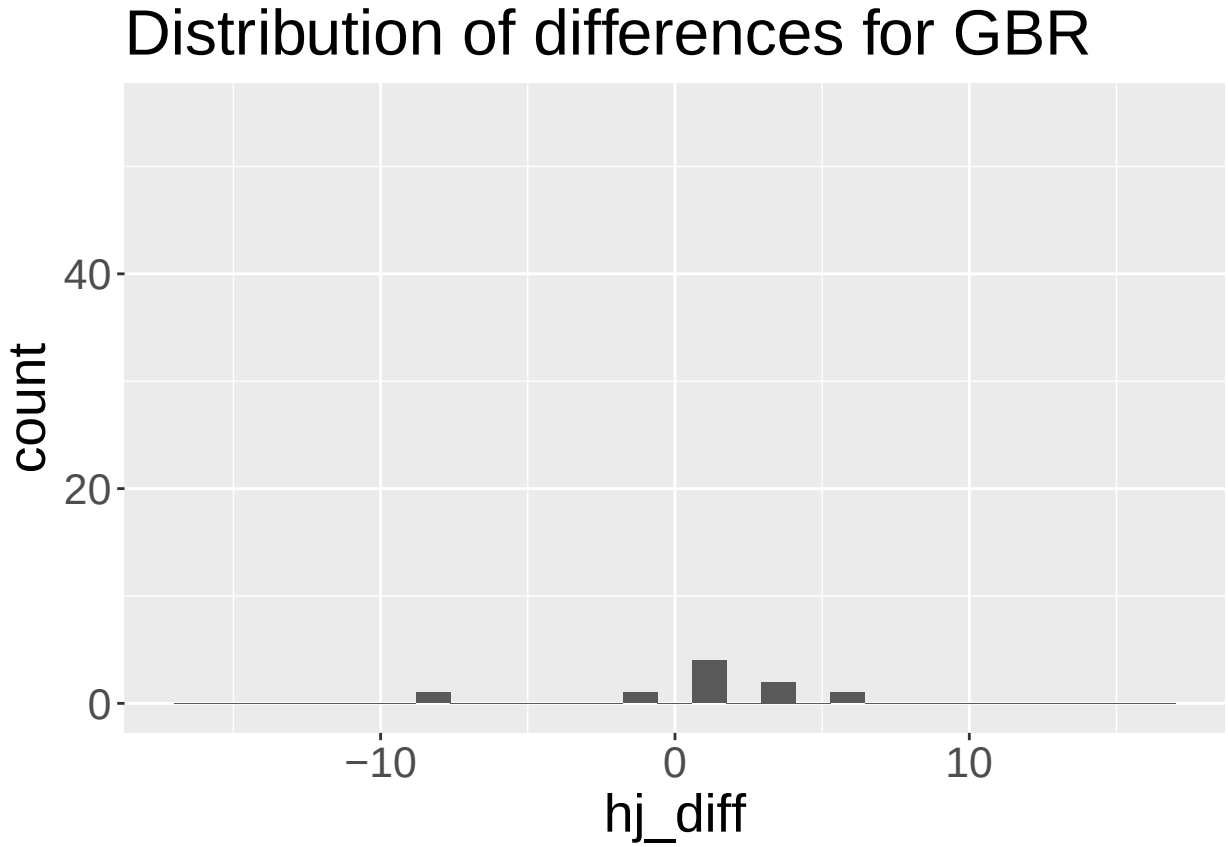
```
##
## [[14]]
```


Distribution of differences for FIN
count
40
20
0
−10
0
10
hj_diff

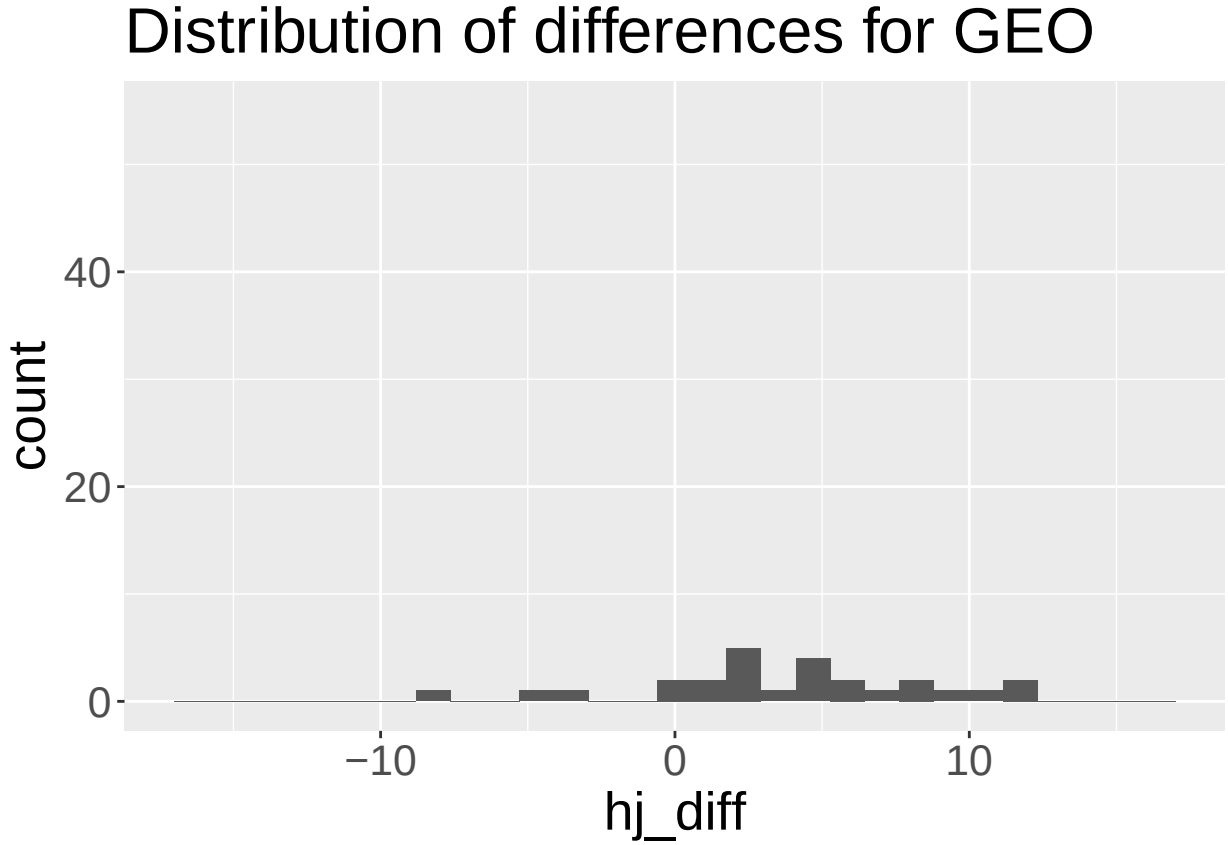
```
##
## [[15]]
```


Distribution of differences for FRA
count
40
20
0
−10
0
10
hj_diff

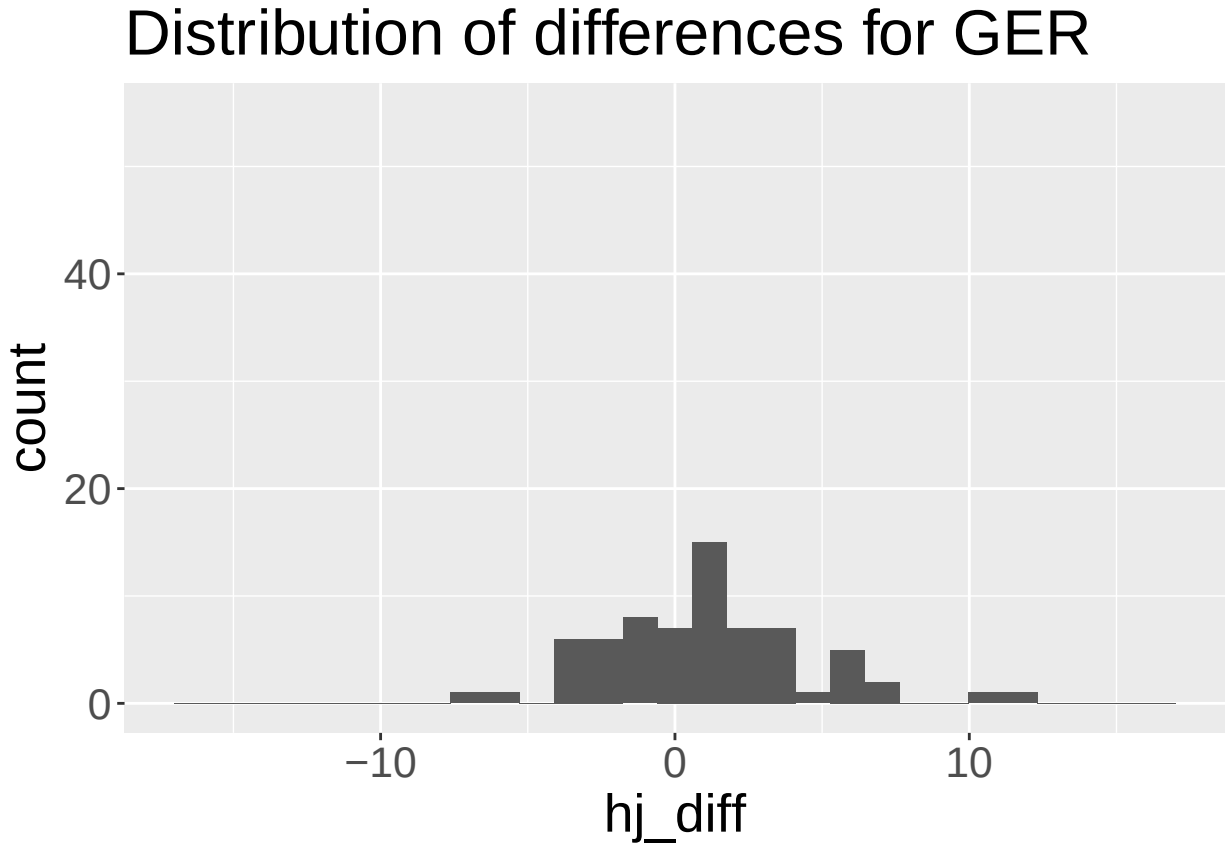
```
##
## [[16]]
```


Distribution of differences for GBR
count
40
20
0
−10
0
10
hj_diff

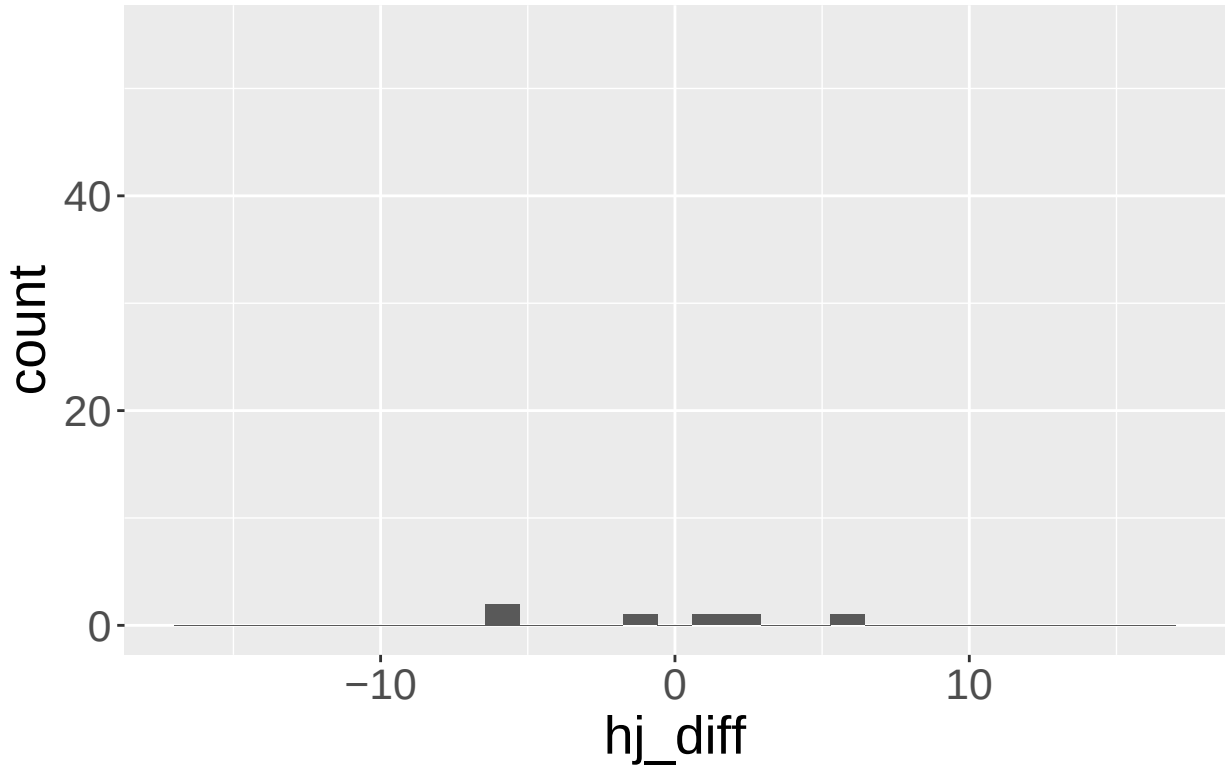
```
##
## [[17]]
```


Distribution of differences for GEO
count
40
20
0
−10
0
10
hj_diff

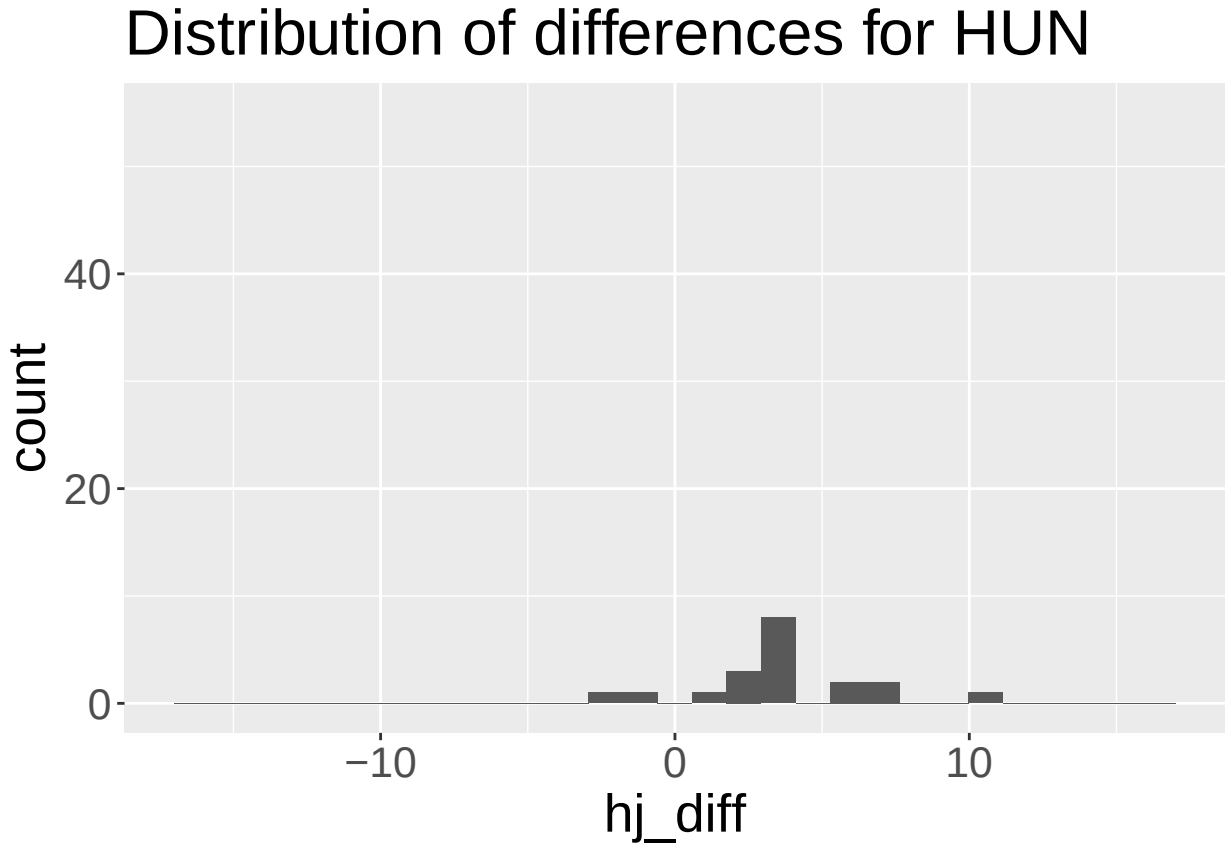
```
##
## [[18]]
```


Distribution of differences for GER
count
40
20
0
−10
0
10
hj_diff

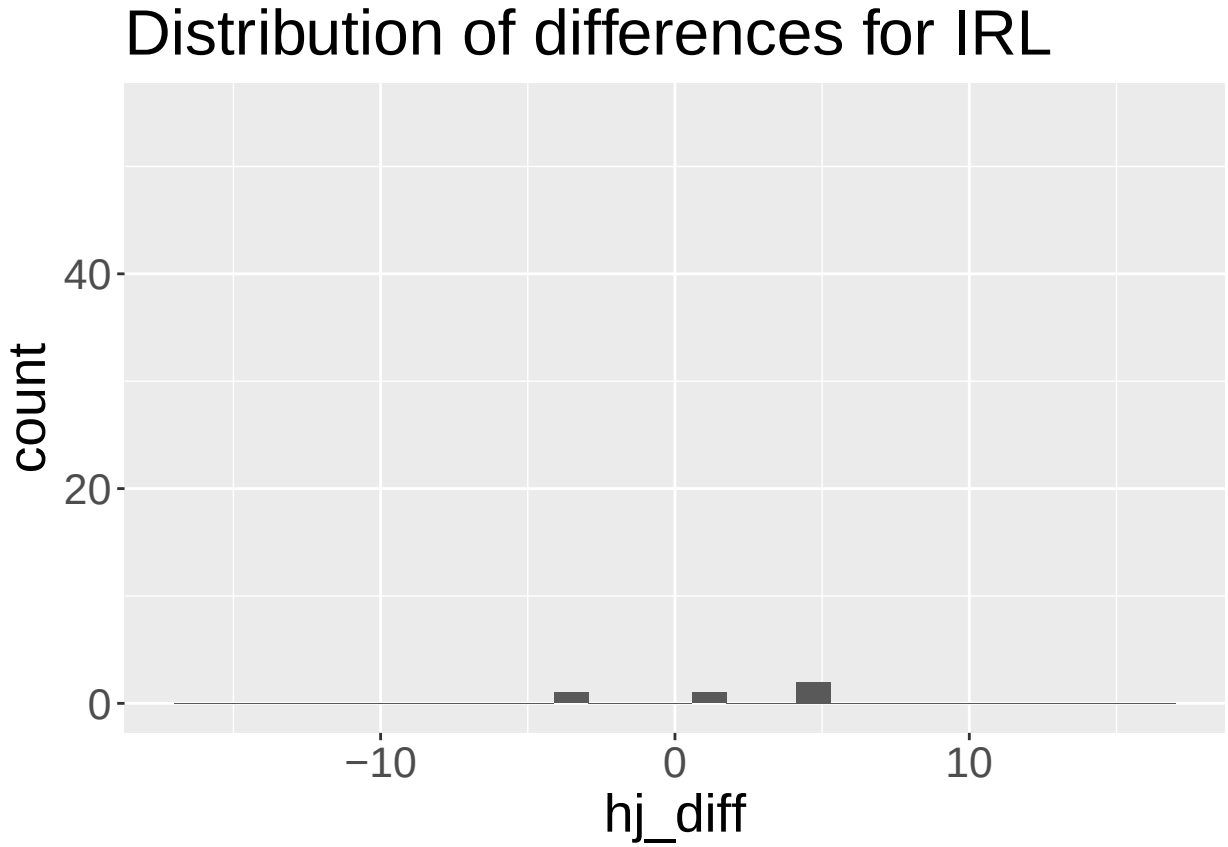
```
##
## [[19]]
```


Distribution of differences for HKG
count
40
20
0
−10
0
10
hj_diff

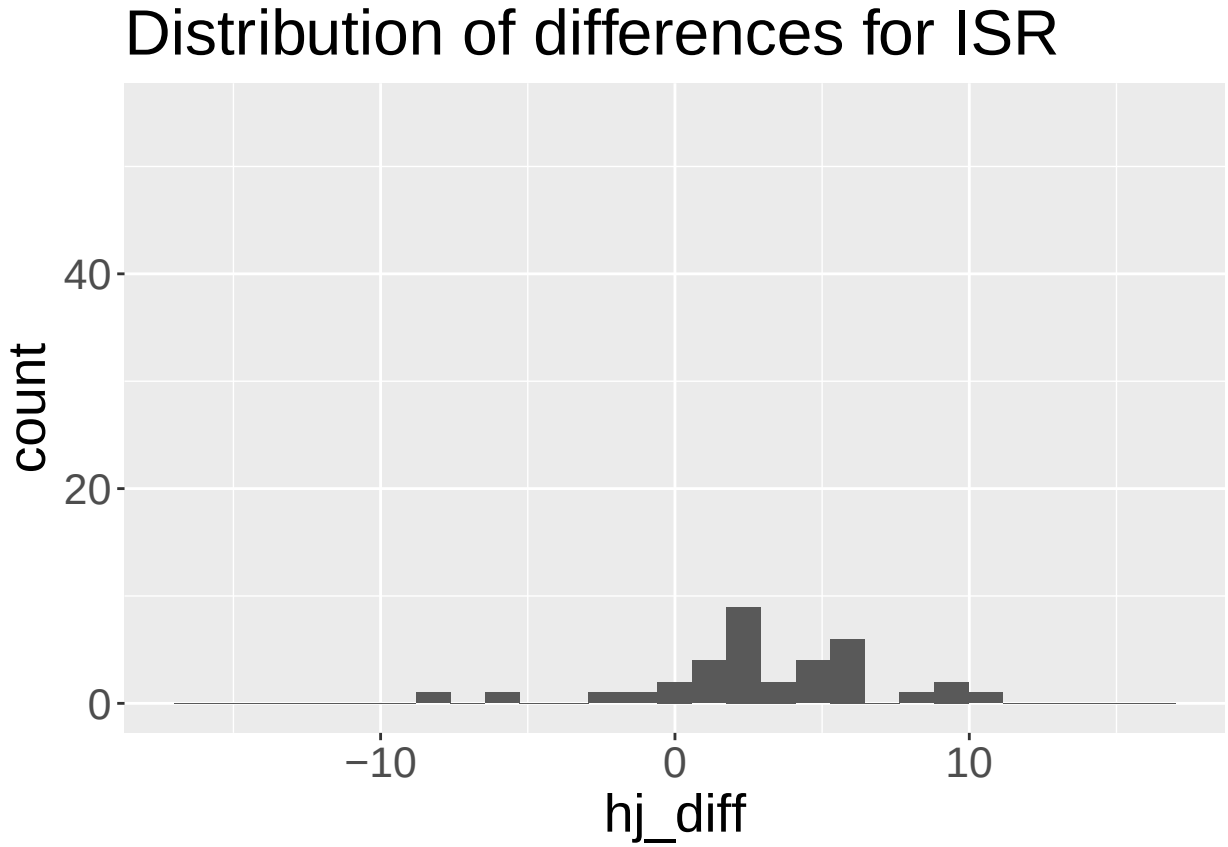
```
##
## [[20]]
```


Distribution of differences for HUN
count
40
20
0
−10
0
10
hj_diff

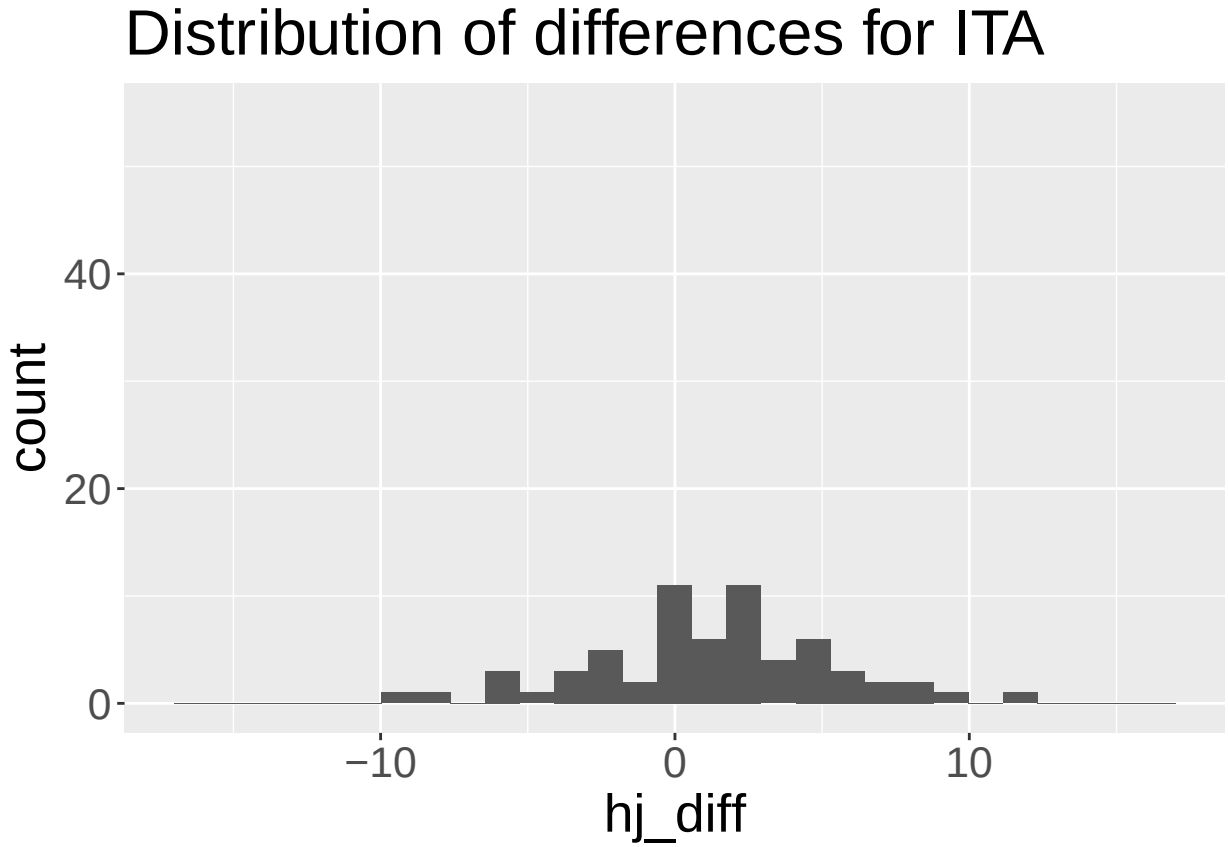
```
##
## [[21]]
```


Distribution of differences for IRL
count
40
20
0
−10
0
10
hj_diff

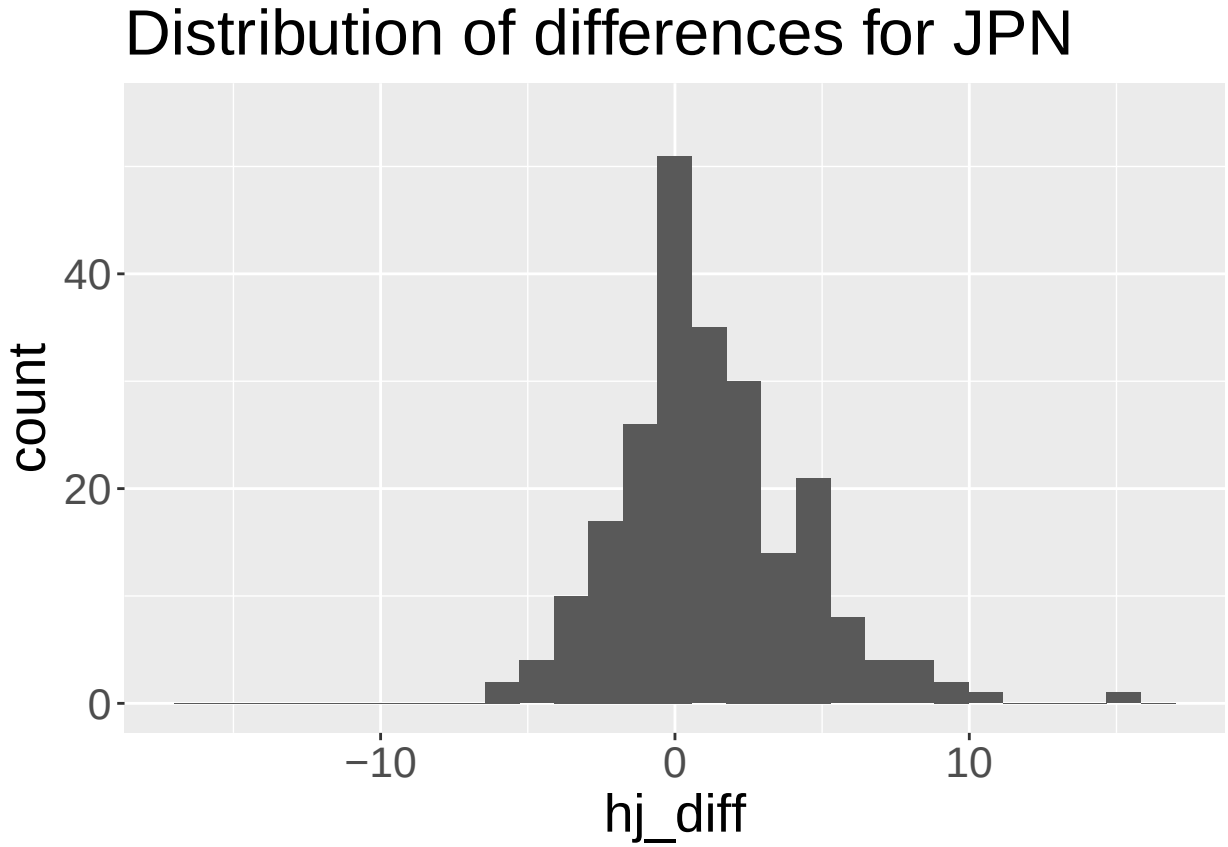
```
##
## [[22]]
```


Distribution of differences for ISR
count
40
20
0
−10
0
10
hj_diff

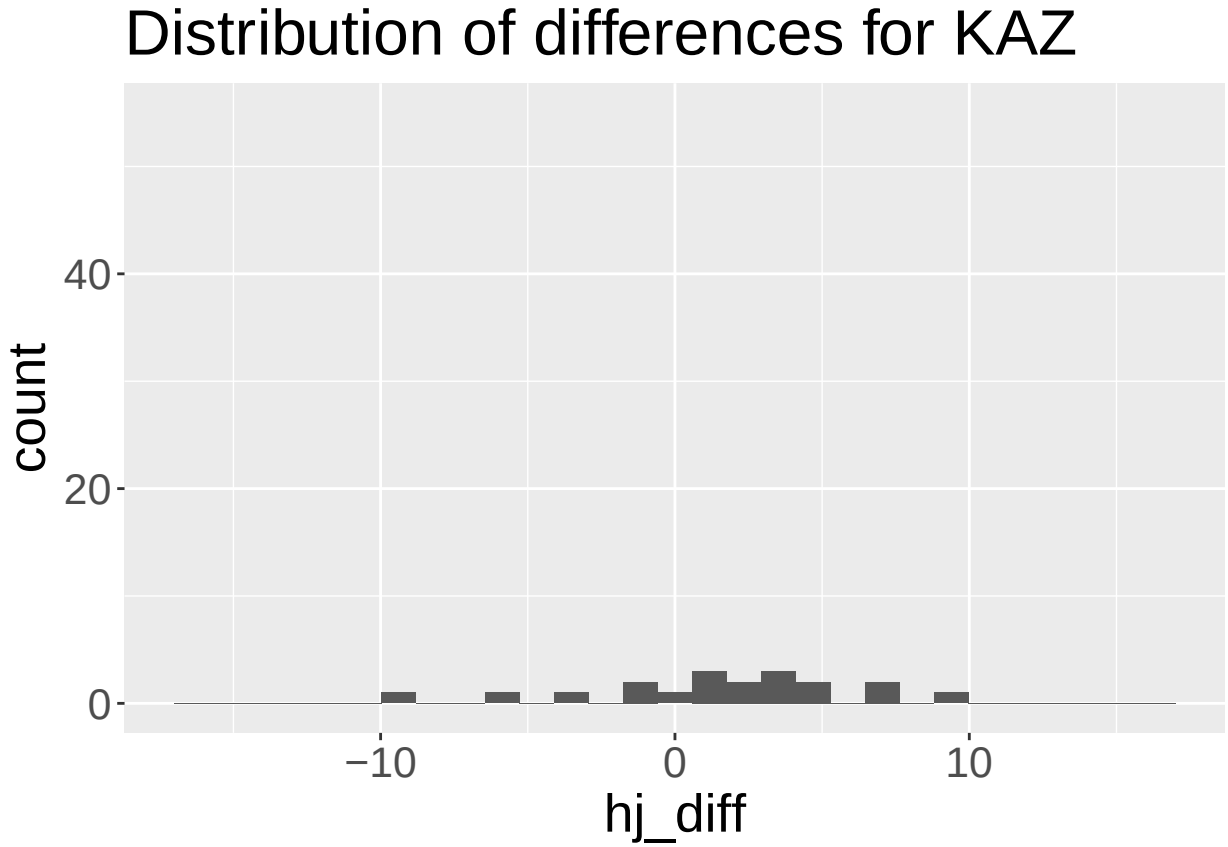
```
##
## [[23]]
```


Distribution of differences for ITA
count
40
20
0
−10
0
10
hj_diff

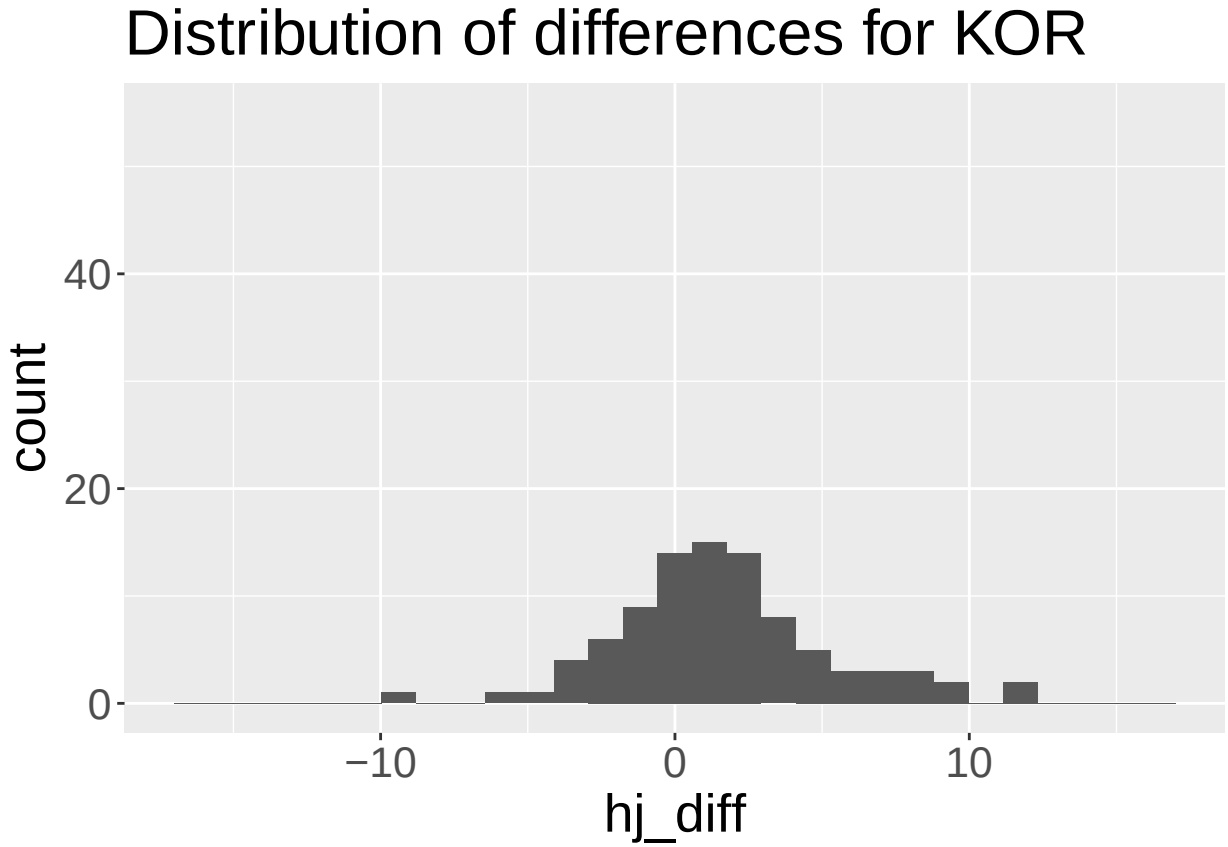
```
##
## [[24]]
```


Distribution of differences for JPN
count
40
20
0
−10
0
10
hj_diff

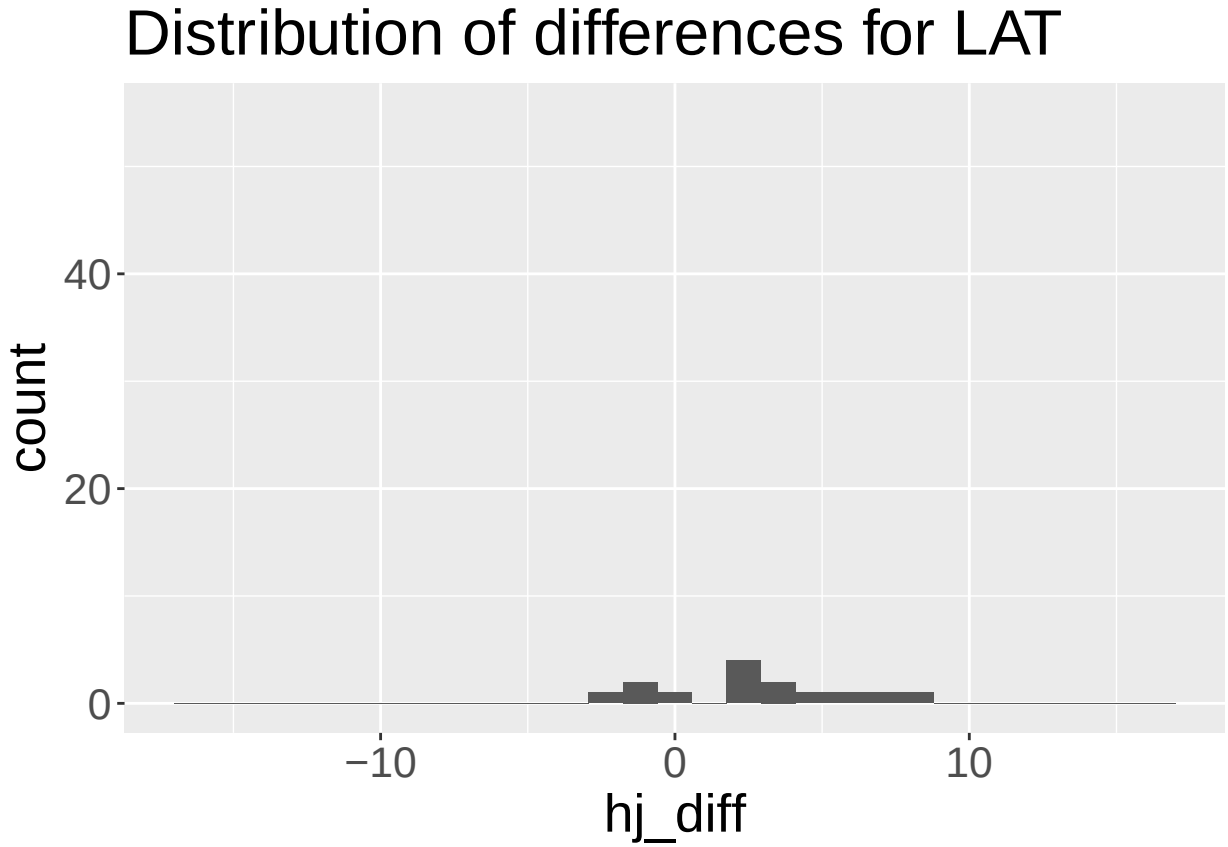
```
##
## [[25]]
```


Distribution of differences for KAZ
count
40
20
0
−10
0
10
hj_diff

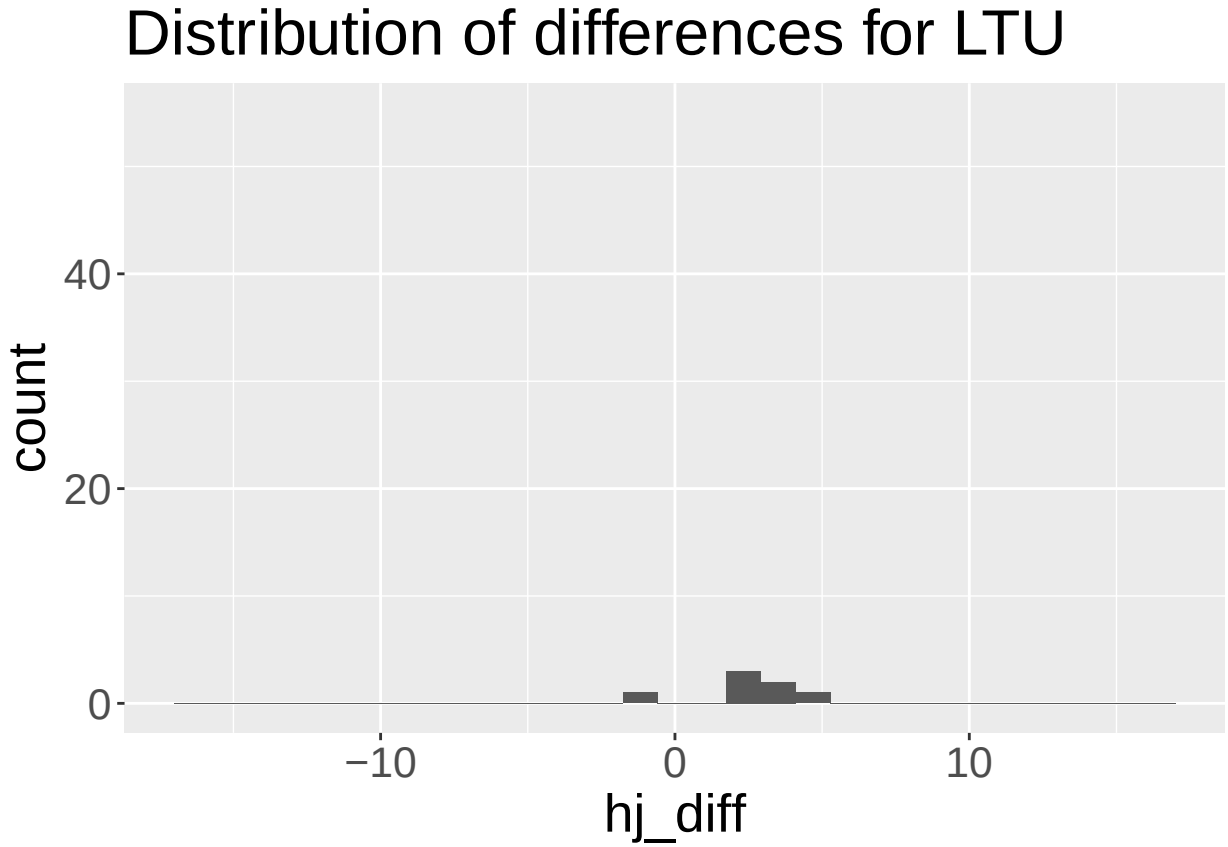
```
##
## [[26]]
```


Distribution of differences for KOR
count
40
20
0
−10
0
10
hj_diff

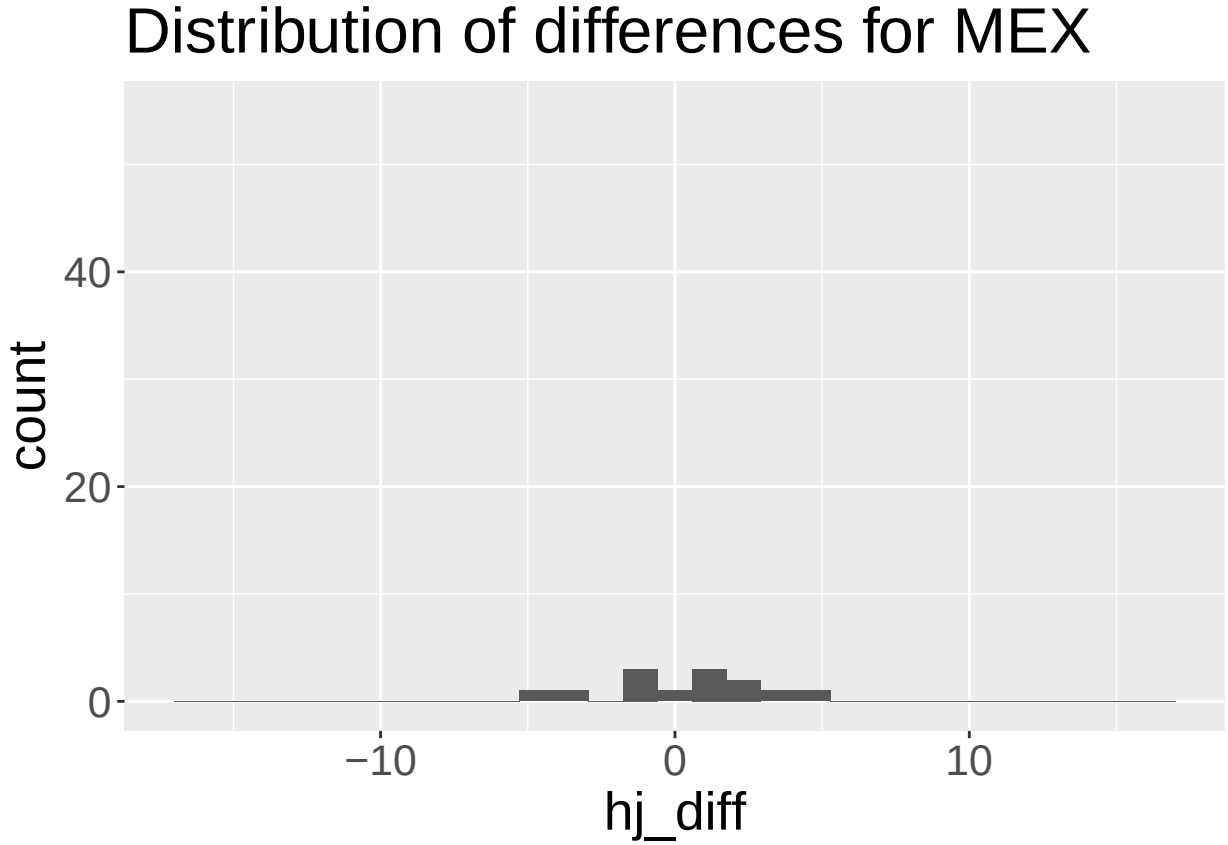
```
##
## [[27]]
```


Distribution of differences for LAT
count
40
20
0
−10
0
10
hj_diff

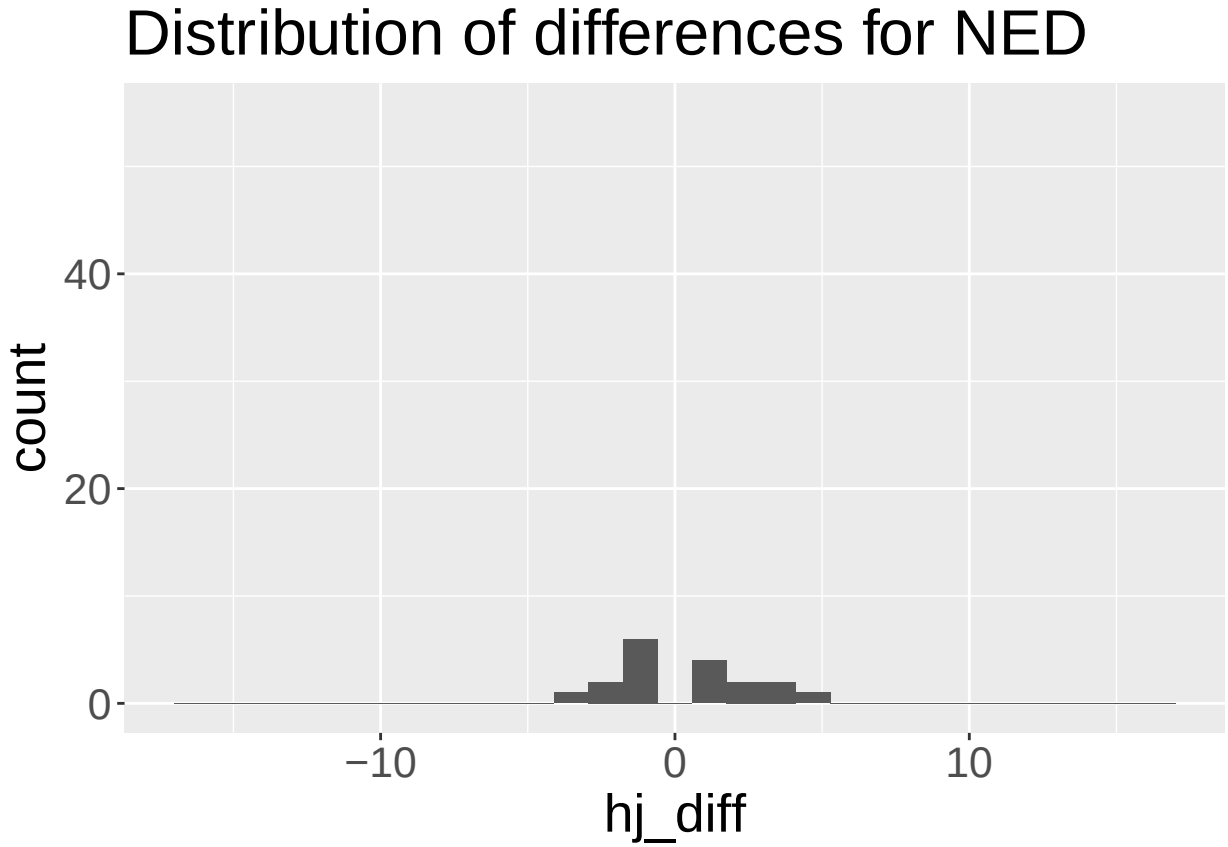
```
##
## [[28]]
```


Distribution of differences for LTU
count
40
20
0
−10
0
10
hj_diff

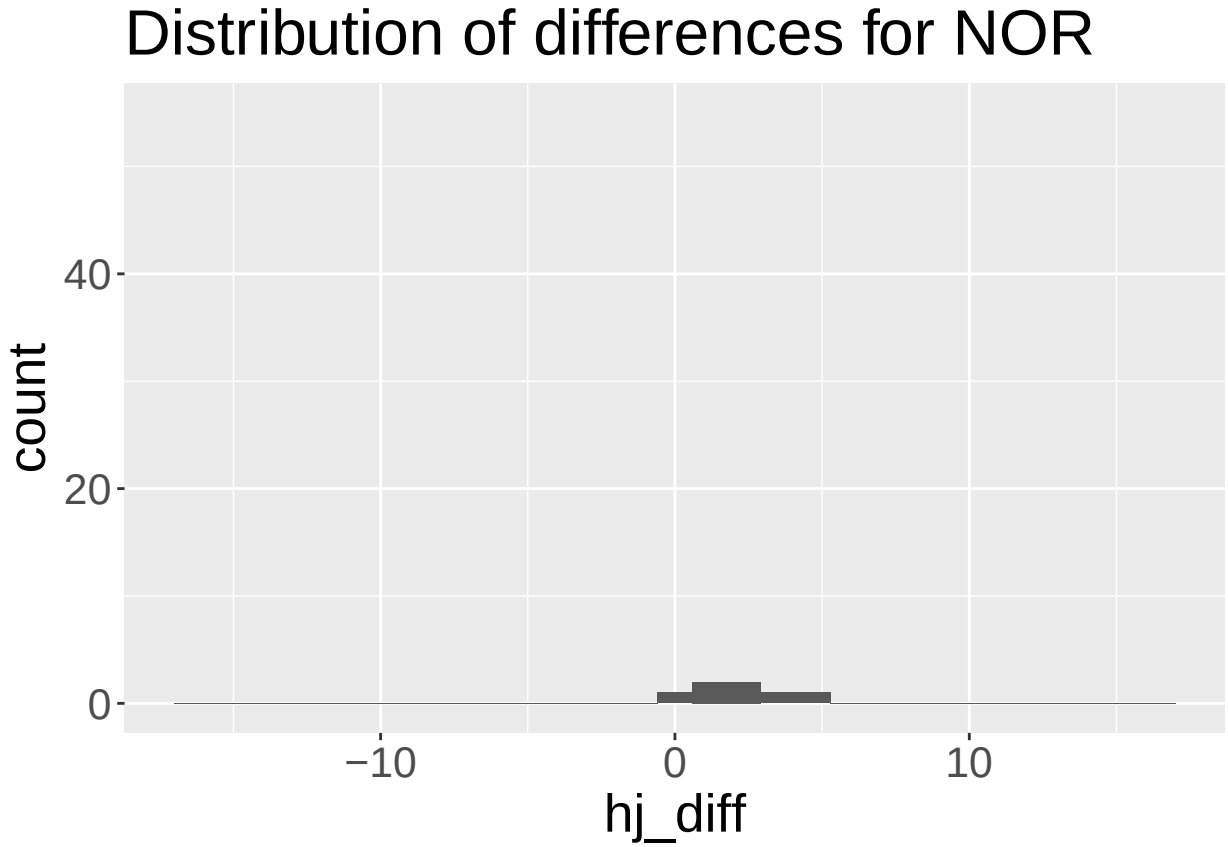
```
##
## [[29]]
```


Distribution of differences for MEX
count
40
20
0
−10
0
10
hj_diff

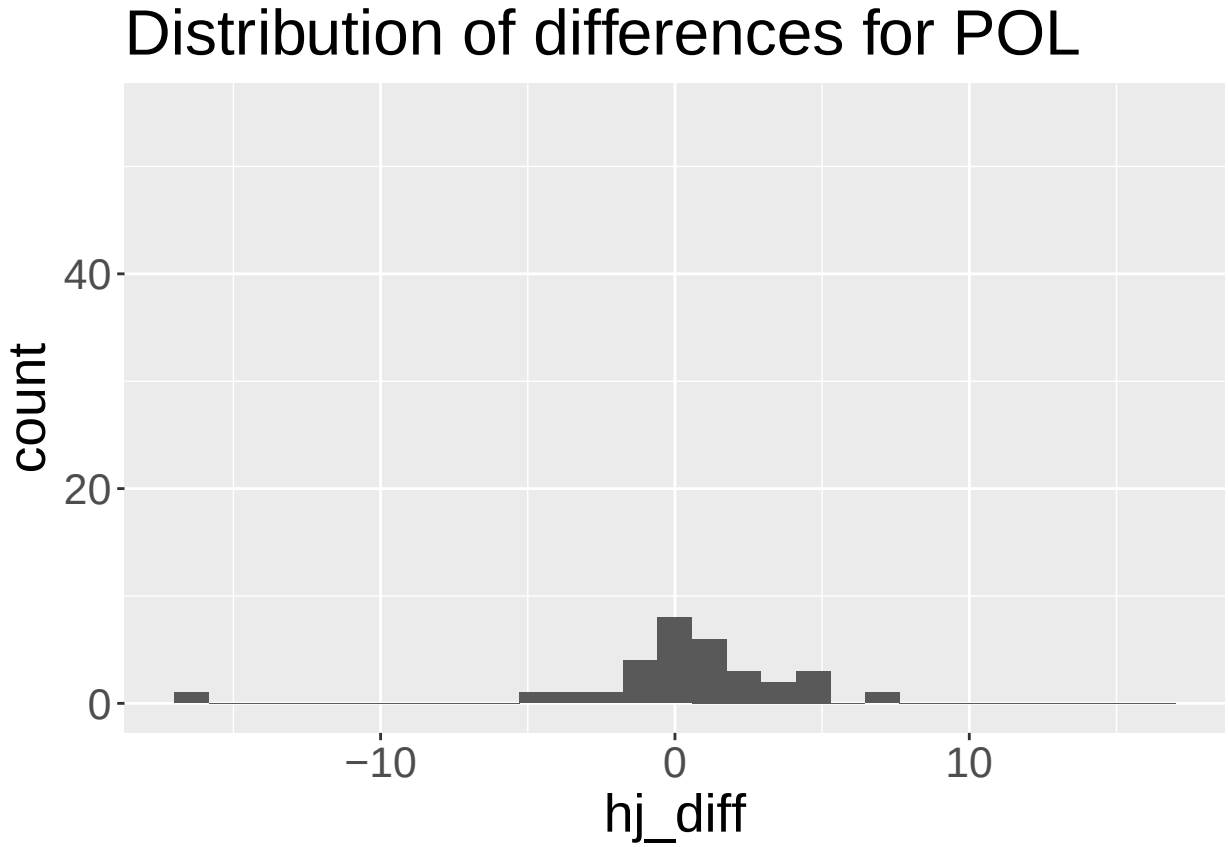
```
##
## [[30]]
```


Distribution of differences for NED
count
40
20
0
−10
0
10
hj_diff

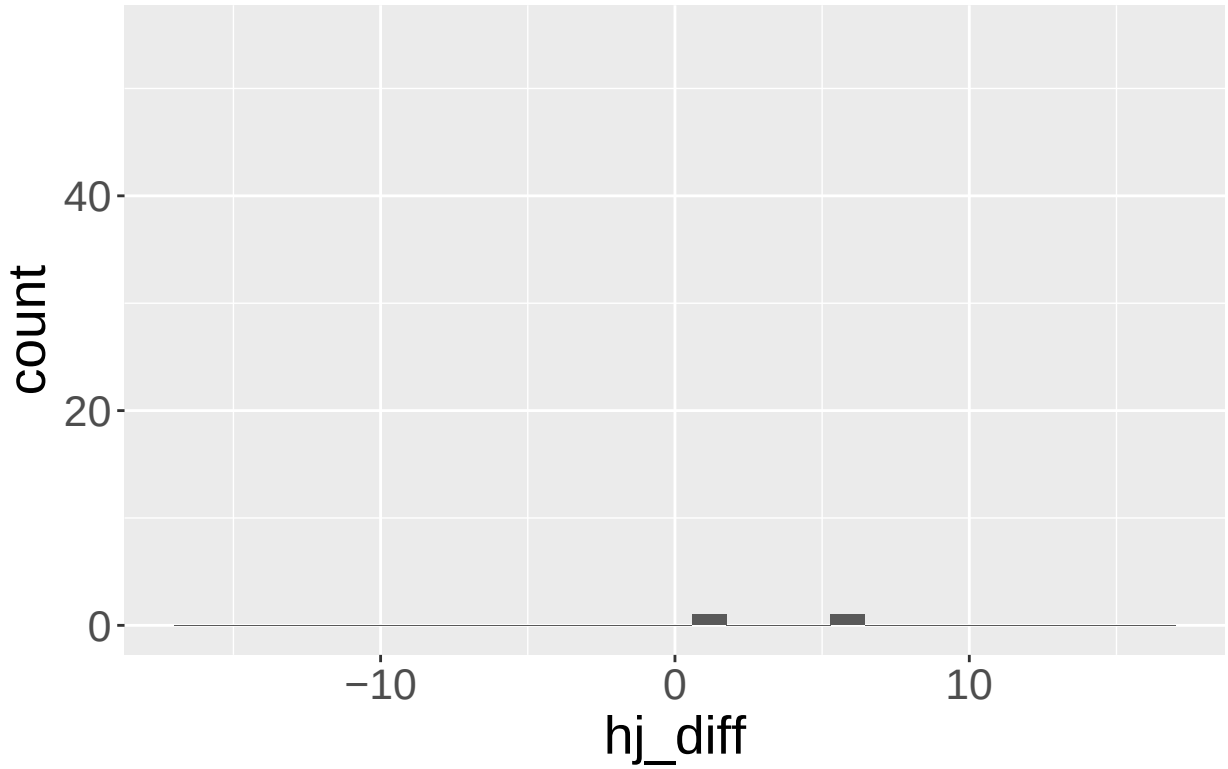
```
##
## [[31]]
```


Distribution of differences for NOR
count
40
20
0
−10
0
10
hj_diff

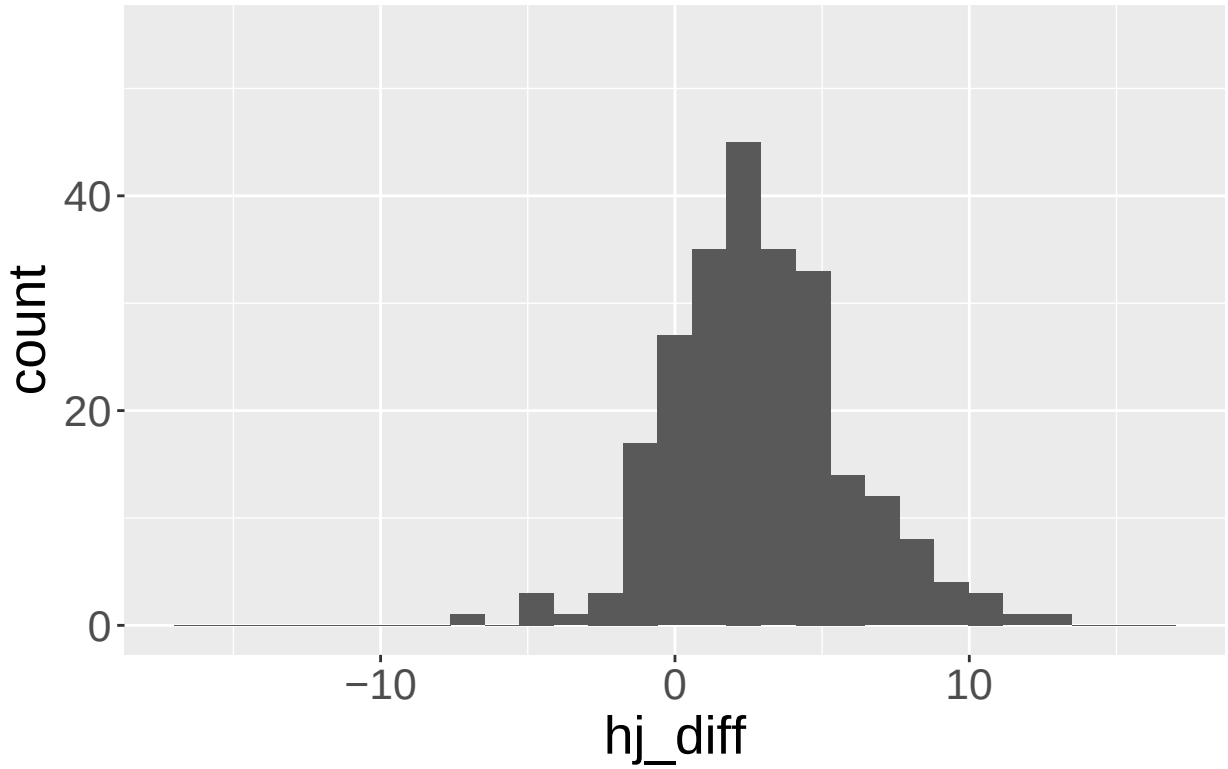
```
##
## [[32]]
```


Distribution of differences for POL
count
40
20
0
−10
0
10
hj_diff

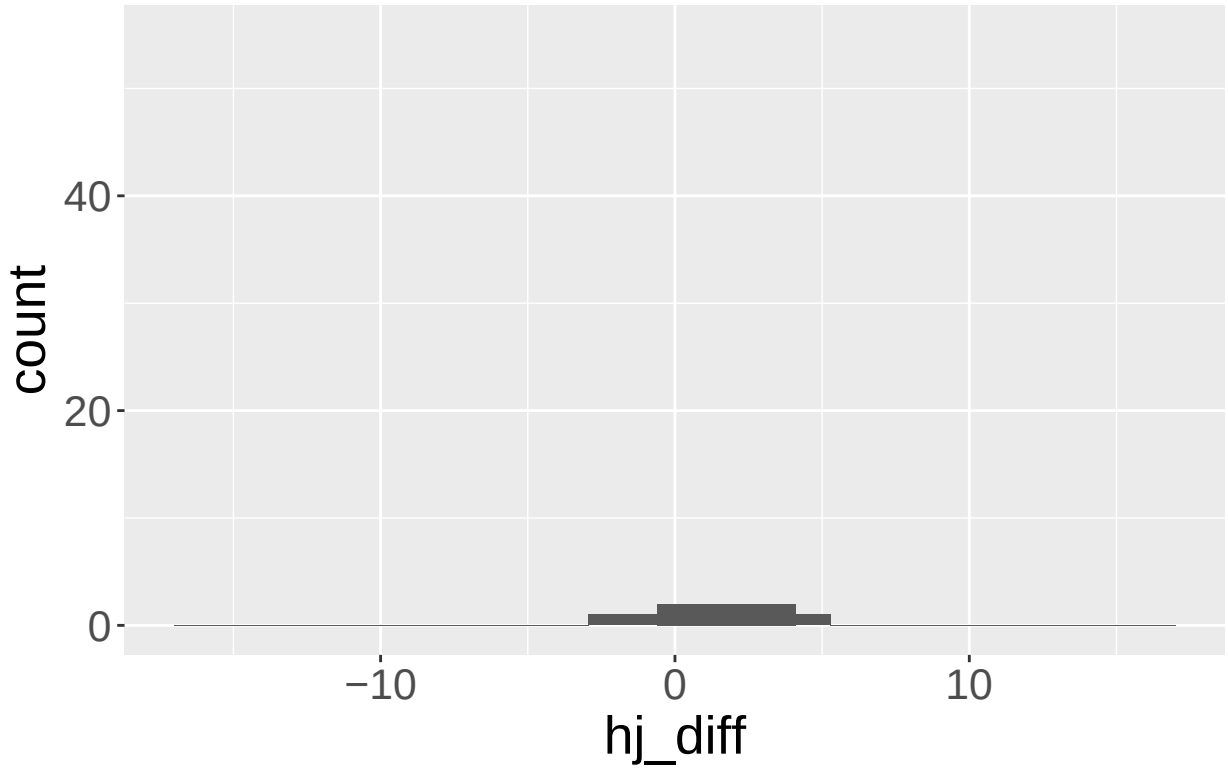
```
##
## [[33]]
```



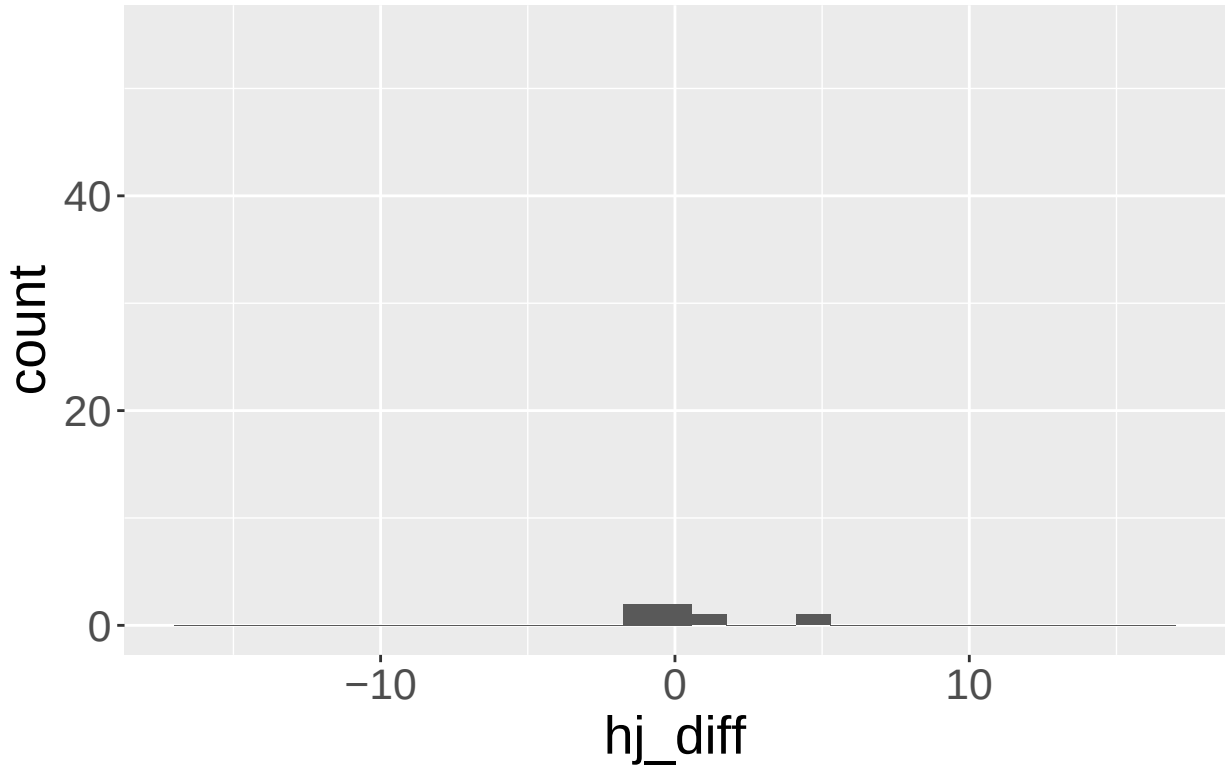

```
##
## [[34]]

## Warning: Removed 1 rows containing non-finite values (‘stat_bin()‘).
```


Distribution of differences for RUS
count
40
20
0
−10
0
10
hj_diff

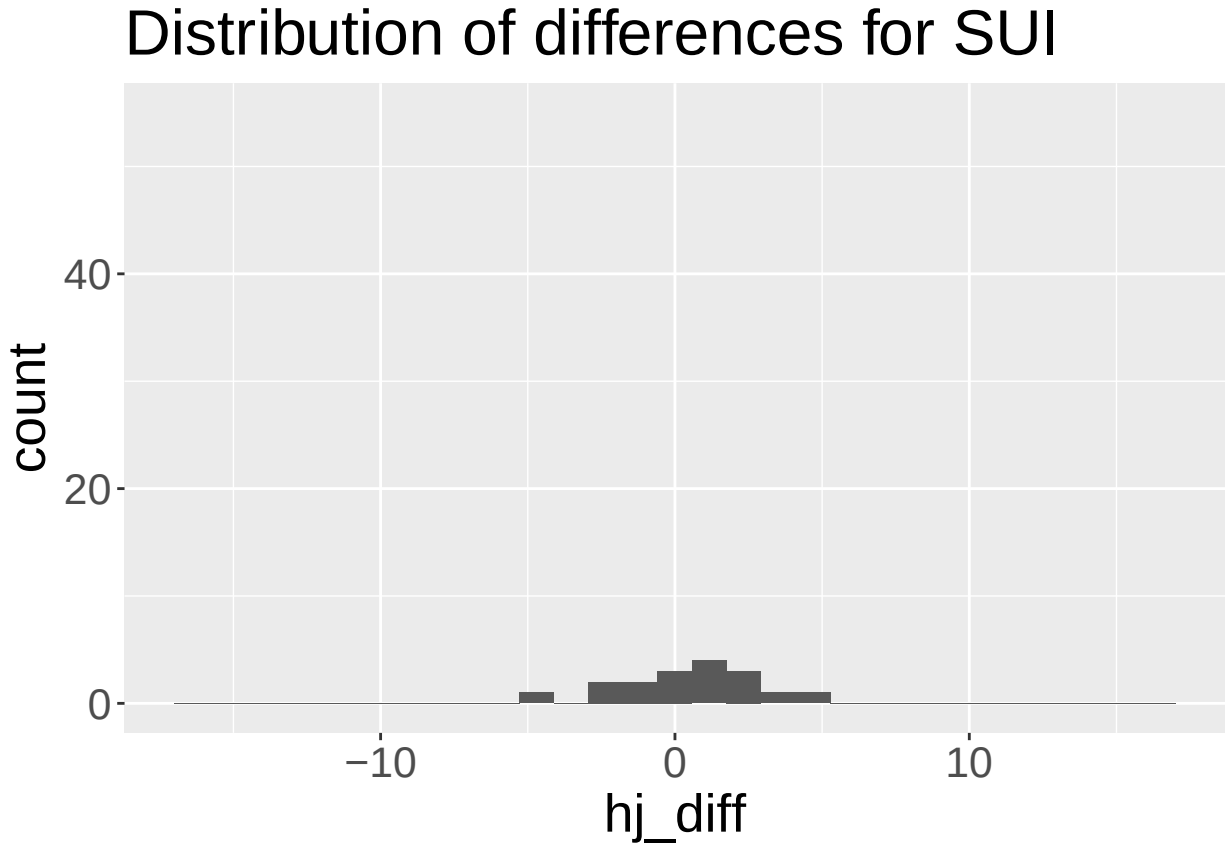
```
##
## [[35]]
```


Distribution of differences for SLO
count
40
20
0
−10
0
10
hj_diff

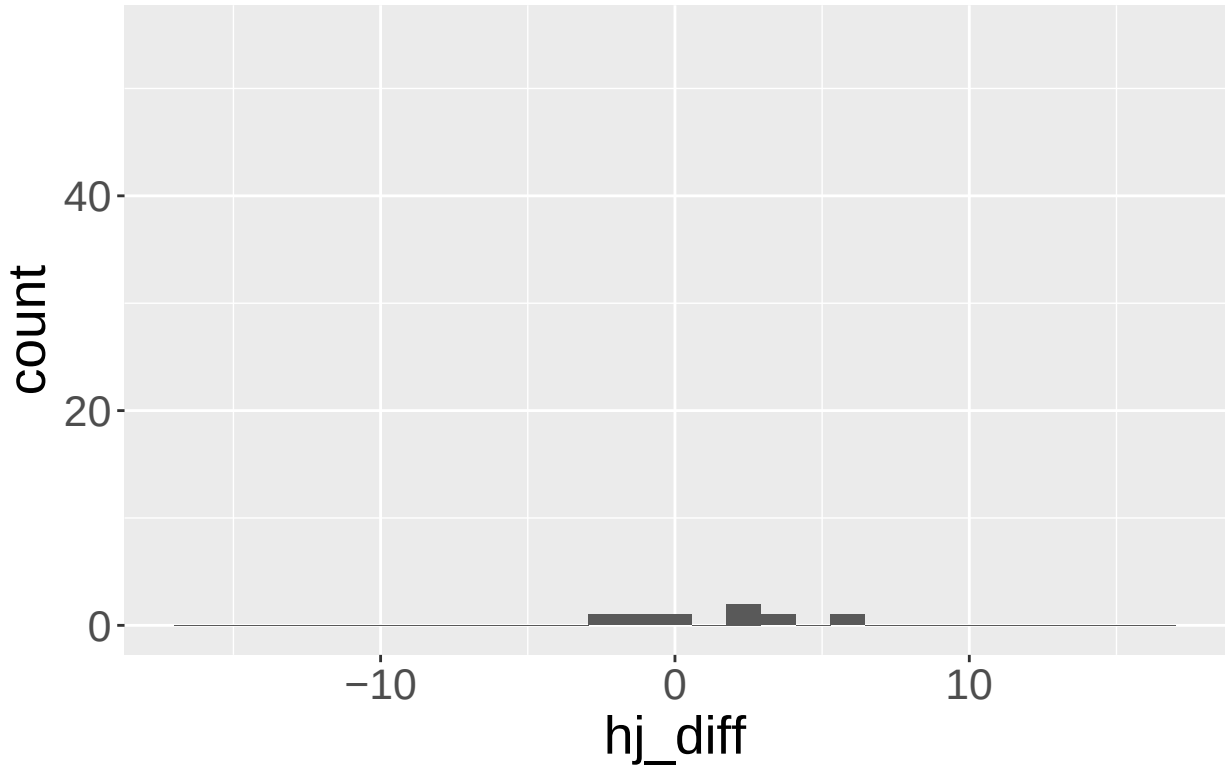
```
##
## [[36]]
```


Distribution of differences for SRB
count
40
20
0
−10
0
10
hj_diff

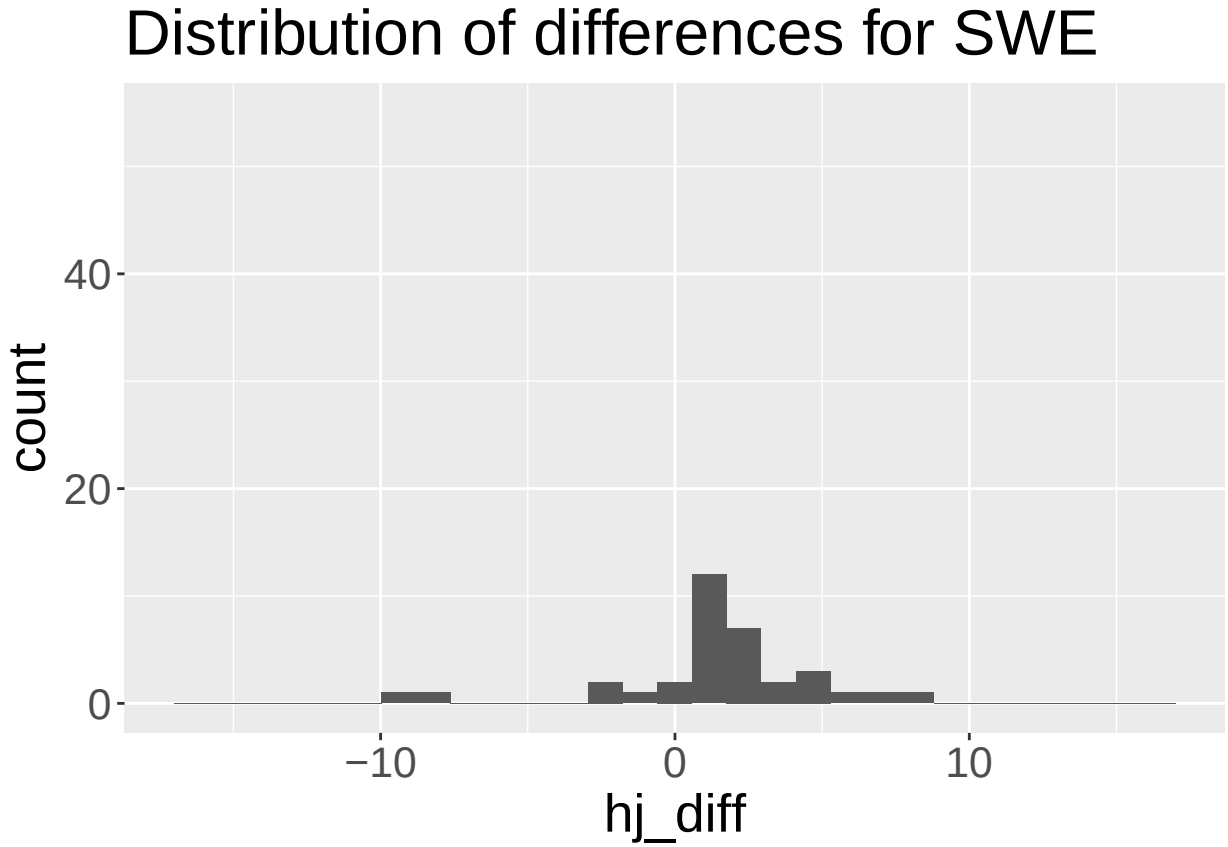
```
##
## [[37]]
```


Distribution of differences for SUI
count
40
20
0
−10
0
10
hj_diff

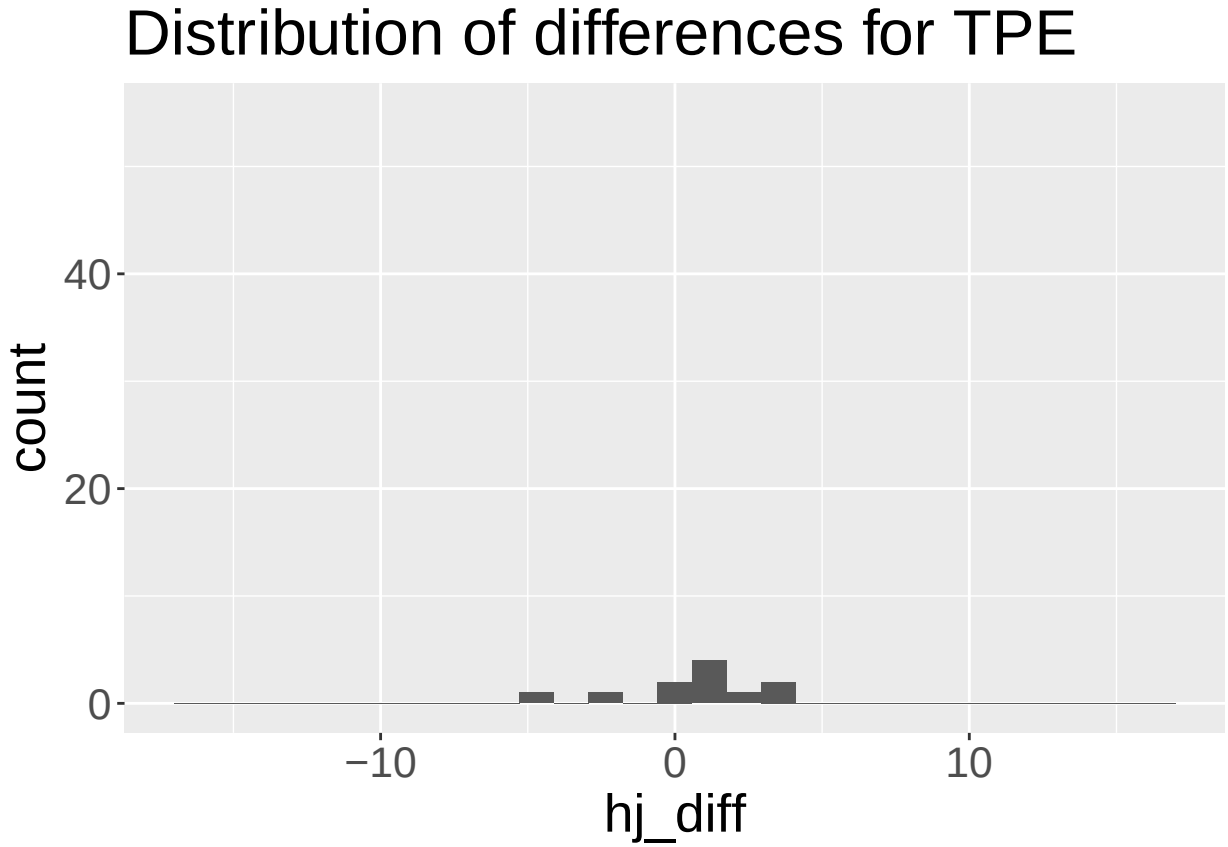
```
##
## [[38]]
```


Distribution of differences for SVK
count
40
20
0
−10
0
10
hj_diff

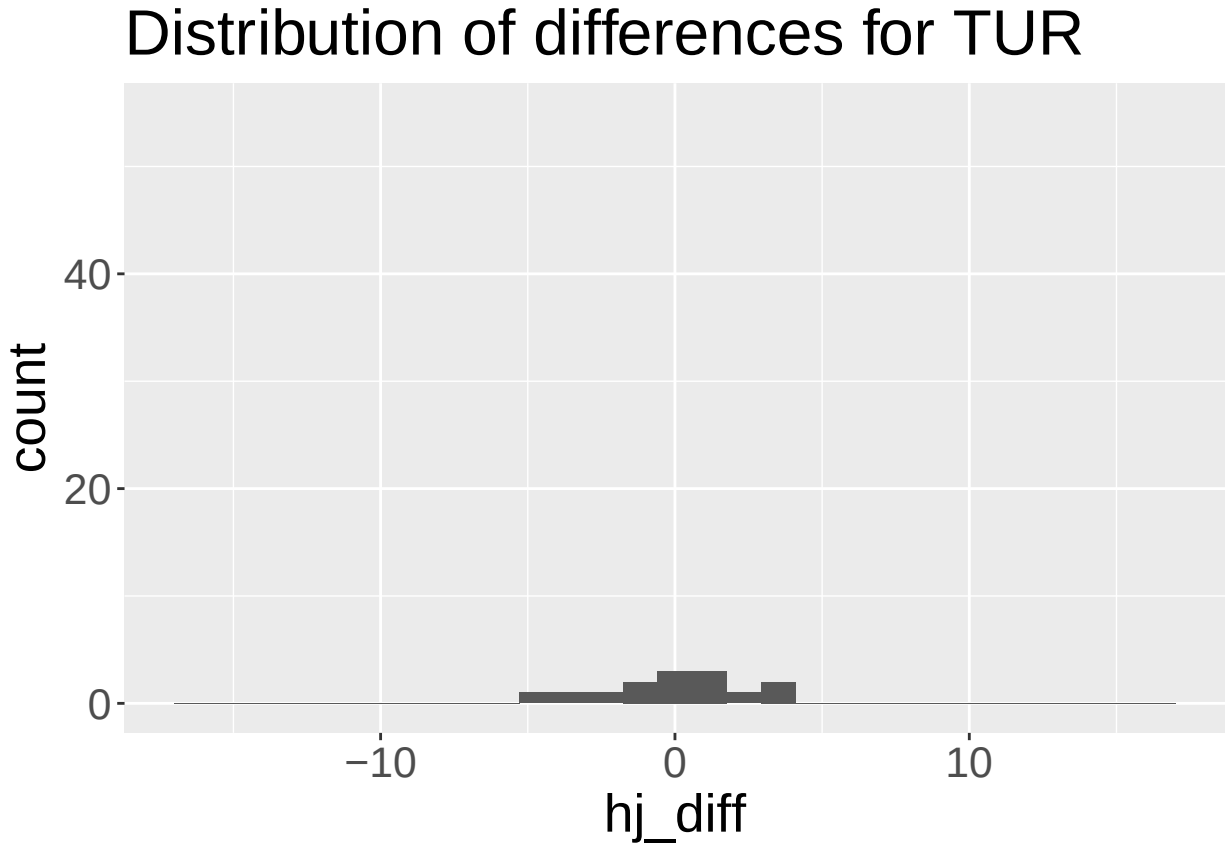
```
##
## [[39]]
```


Distribution of differences for SWE
count
40
20
0
−10
0
10
hj_diff

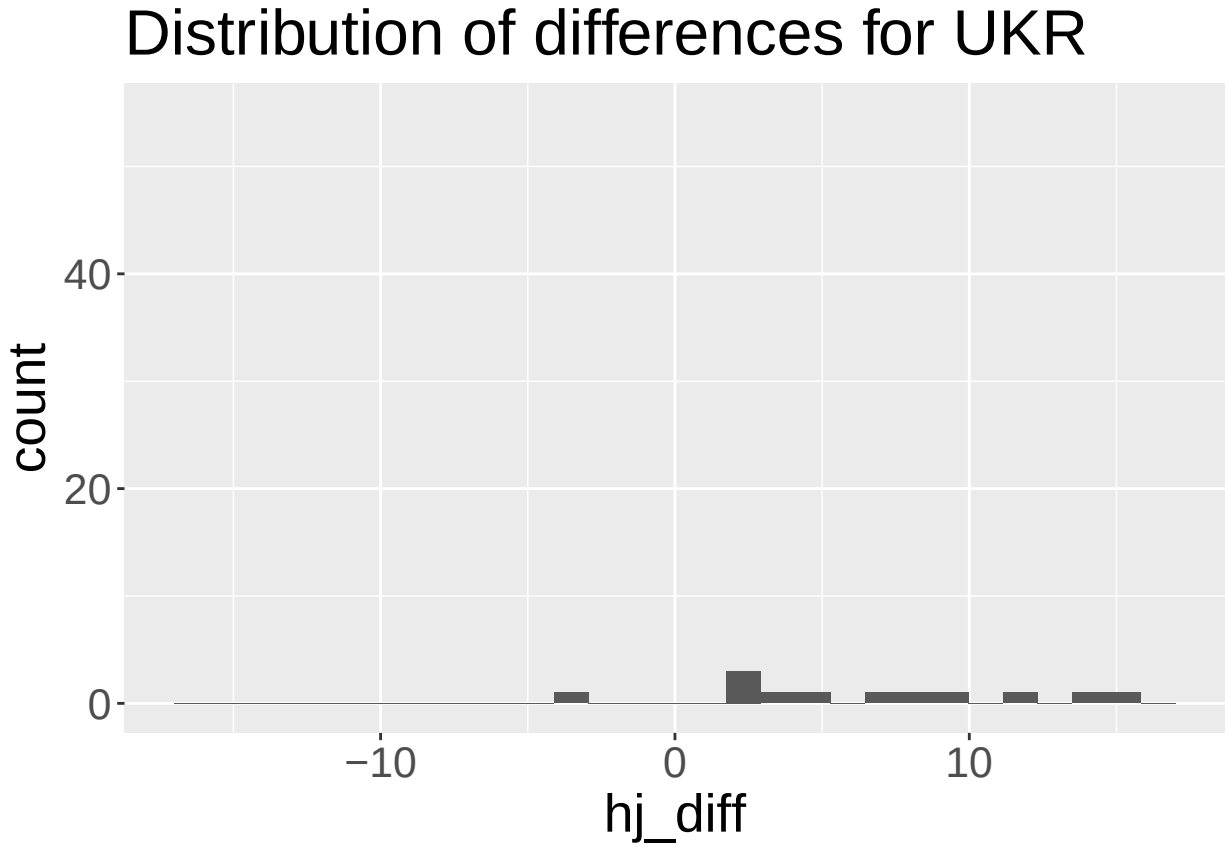
```
##
## [[40]]
```


Distribution of differences for TPE
count
40
20
0
−10
0
10
hj_diff

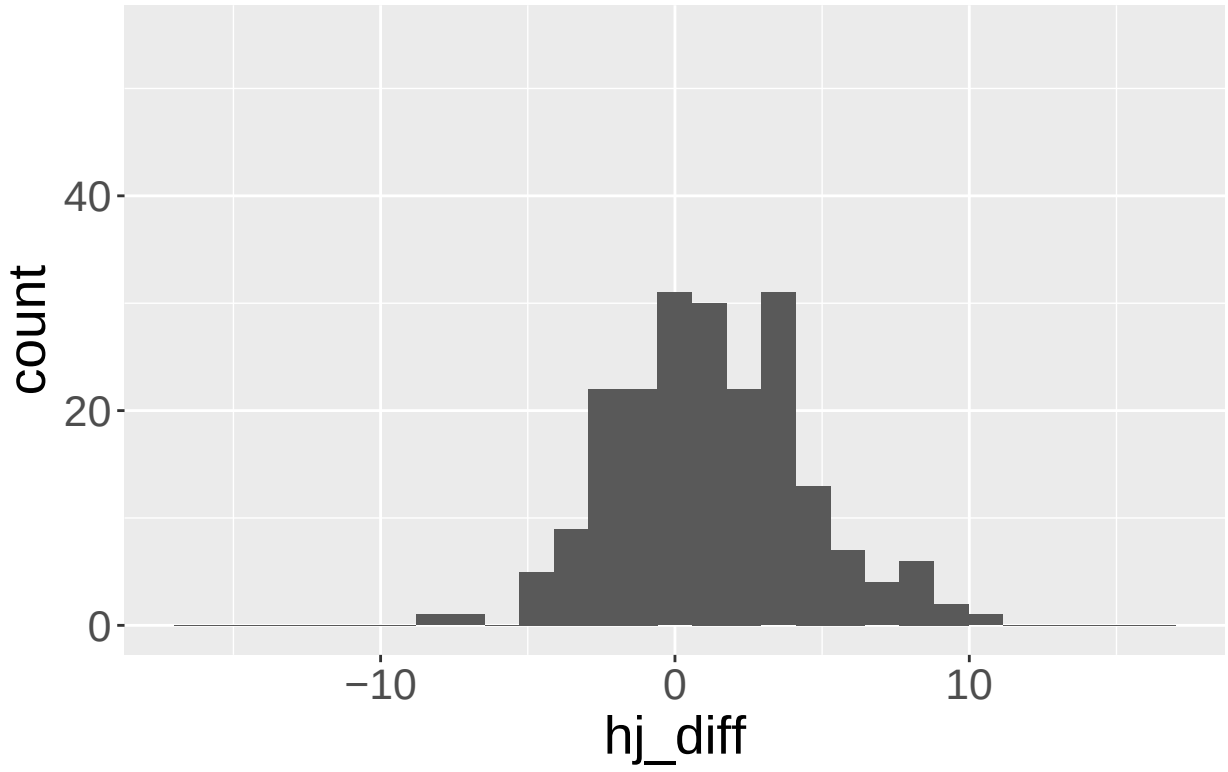
```
##
## [[41]]
```


Distribution of differences for TUR
count
40
20
0
−10
0
10
hj_diff

```
##
## [[42]]
```


Distribution of differences for UKR
count
40
20
0
−10
0
10
hj_diff

```
##
## [[43]]
```




```
# Exploring outliers for Russia
russia <- scores %>% filter(country == "RUS")
russia[russia$hj_diff %in% boxplot.stats(russia$hj_diff)$out,] %>% arrange(desc(hj_diff))
```

```
##                      event year country   home     away  hj_diff discipline
## 1    Golden Spin of Zagreb 2019     RUS 171.73 153.9917 17.73833       Mens
## 2  GP Gran Premio d'Italia 2021     RUS 157.11 144.7538 12.35625       Mens
## 3   European Championships 2022     RUS 197.58 186.3413 11.23875       Mens
## 4            GP NHK Trophy 2019     RUS 154.00 142.9425 11.05750       Mens
## 5            GP NHK Trophy 2019     RUS 159.99 149.0300 10.96000       Mens
## 6        GP Rostelecom Cup 2021     RUS 189.72 178.9387 10.78125       Mens
## 7      World Championships 2021     RUS 148.50 152.9988 -4.49875     Womens
## 8   European Championships 2019     RUS 137.01 141.5250 -4.51500     Womens
## 9        GP Intx de France 2019     RUS  59.09  63.9125 -4.82250       Mens
## 10 GP Gran Premio d'Italia 2021     RUS 148.42 155.3250 -6.90500     Womens
##    segment
## 1       fp
## 2       fp
## 3       fp
## 4       fp
## 5       fp
## 6       fp
## 7       fp
## 8       fp
## 9       sp
## 10      fp
```

```r
# Exploring outliers for all singles data
scores[scores$hj_diff %in% boxplot.stats(scores$hj_diff)$out,] %>% arrange(desc(hj_diff))
```

```
##                      event year country   home      away    hj_diff discipline
## 1    Golden Spin of Zagreb 2019     RUS 171.73 153.99167  17.738333       Mens
## 2                Warsaw Cup 2021     UKR 140.26 124.80000  15.460000       Mens
## 3          Grand Prix Final 2019     CHN 174.65 159.76625  14.883750       Mens
## 4           Four Continents 2019     JPN 145.82 130.98750  14.832500       Mens
## 5          Lombardia Trophy 2019     CHN 178.73 164.84167  13.888333       Mens
## 6   European Championships 2019     UKR 123.91 110.20875  13.701250       Mens
## 7         Nebelhorn Trophy 2021     BUL 113.68 100.20286  13.477143       Mens
## 8         GP Skate America 2019     CHN 162.46 149.33375  13.126250       Mens
## 9  GP Gran Premio d'Italia 2021     CHN 156.27 143.27875  12.991250       Mens
## 10 GP Gran Premio d'Italia 2021     RUS 157.11 144.75375  12.356250       Mens
## 11          Four Continents 2020     KOR 186.48 174.19875  12.281250       Mens
## 12   Golden Spin of Zagreb 2018     ITA  93.48  81.34000  12.140000       Mens
## 13        Nebelhorn Trophy 2021     AUT 140.36 128.38571  11.974286       Mens
## 14           GP NHK Trophy 2018     KOR 132.76 120.87250  11.887500       Mens
## 15        Nebelhorn Trophy 2021     UKR 126.49 114.96250  11.527500     Womens
## 16        Lombardia Trophy 2019     GEO 156.66 145.19667  11.463333       Mens
## 17       GP Rostelecom Cup 2018     GEO 168.83 157.41625  11.413750       Mens
## 18  European Championships 2022     RUS 197.58 186.34125  11.238750       Mens
## 19   Golden Spin of Zagreb 2018     GER 124.58 113.40667  11.173333       Mens
## 20               Warsaw Cup 2019     CZE 106.34  95.17500  11.165000       Mens
## 21               Warsaw Cup 2021     GER 133.77 122.66333  11.106667     Womens
## 22           GP NHK Trophy 2019     RUS 154.00 142.94250  11.057500       Mens
## 23           GP NHK Trophy 2019     JPN 160.92 149.91375  11.006250       Mens
## 24           GP NHK Trophy 2019     RUS 159.99 149.03000  10.960000       Mens
## 25       GP Rostelecom Cup 2021     RUS 189.72 178.93875  10.781250       Mens
## 26               Warsaw Cup 2021     GEO 102.34  91.60667  10.733333     Womens
## 27        Lombardia Trophy 2021     FRA 136.16 125.53667  10.623333       Mens
## 28       GP Intx de France 2018     FRA 159.93 149.33500  10.595000       Mens
## 29        Lombardia Trophy 2021     HUN  74.70  64.13167  10.568333     Womens
## 30           GP NHK Trophy 2019     ISR 145.01 134.55000  10.460000       Mens
## 31        GP Skate America 2021     FRA 159.26 148.85000  10.410000       Mens
## 32       GP Intx de France 2019     USA 167.65 157.54125  10.108750       Mens
## 33   Golden Spin of Zagreb 2021     FRA 167.34 157.48500   9.855000       Mens
## 34 GP Gran Premio d'Italia 2021     JPN 169.60 159.76000   9.840000       Mens
## 35         GP Skate Canada 2019     KOR 124.82 115.01750   9.802500     Womens
## 36  European Championships 2019     ESP 173.84 180.45875  -6.618750       Mens
## 37          Four Continents 2020     USA 119.52 126.14857  -6.628571     Womens
## 38 GP Gran Premio d'Italia 2021     RUS 148.42 155.32500  -6.905000     Womens
## 39    Olympic Winter Games 2022     CHN 174.06 181.03625  -6.976250       Mens
## 40          Four Continents 2020     CAN 128.06 135.38875  -7.328750       Mens
## 41  European Championships 2020     GER 143.09 150.49000  -7.400000       Mens
## 42          Four Continents 2019     CHN 104.82 112.28250  -7.462500       Mens
## 43     World Championships 2021     GBR  54.51  62.25125  -7.741250       Mens
## 44  European Championships 2020     GEO 156.55 164.30625  -7.756250       Mens
## 45          Four Continents 2020     USA 139.83 147.64714  -7.817143     Womens
## 46        Nebelhorn Trophy 2019     BUL 109.80 117.62667  -7.826667     Womens
## 47        Nebelhorn Trophy 2019     SWE 124.22 132.07500  -7.855000       Mens
## 48  European Championships 2022     AZE 153.81 162.06125  -8.251250       Mens
## 49  European Championships 2022     ITA 103.59 112.04500  -8.455000     Womens
```

```
## 50   Golden Spin of Zagreb 2018     ISR 111.55 120.31500  -8.765000       Mens
## 51         Four Continents 2022     KOR 136.25 145.05000  -8.800000       Mens
## 52     World Championships 2022     ITA 161.11 170.29500  -9.185000       Mens
## 53         GP Skate Canada 2021     CAN 116.17 125.47500  -9.305000     Womens
## 54     World Championships 2021     SWE 108.23 117.61000  -9.380000       Mens
## 55   Golden Spin of Zagreb 2018     KAZ  69.09  78.83833  -9.748333     Womens
## 56              Warsaw Cup 2019     POL  60.76  76.89500 -16.135000       Mens
## 57   Golden Spin of Zagreb 2021     CAN 122.21 139.19167 -16.981667       Mens
##    segment
## 1       fp
## 2       fp
## 3       fp
## 4       fp
## 5       fp
## 6       fp
## 7       fp
## 8       fp
## 9       fp
## 10      fp
## 11      fp
## 12      sp
## 13      fp
## 14      fp
## 15      fp
## 16      fp
## 17      fp
## 18      fp
## 19      fp
## 20      fp
## 21      fp
## 22      fp
## 23      fp
## 24      fp
## 25      fp
## 26      fp
## 27      fp
## 28      fp
## 29      fp
## 30      fp
## 31      fp
## 32      fp
## 33      fp
## 34      fp
## 35      fp
## 36      fp
## 37      fp
## 38      fp
## 39      fp
## 40      fp
## 41      fp
## 42      fp
## 43      sp
## 44      fp
## 45      fp
```

```
## 46      fp
## 47      fp
## 48      fp
## 49      fp
## 50      fp
## 51      fp
## 52      fp
## 53      fp
## 54      fp
## 55      fp
## 56      fp
## 57      fp
```

```
# Testing by event (for all singles data)
by_event <- scores %>% group_by(event, year) %>%
  summarize(mean_diff = mean(hj_diff, na.rm = TRUE),
            st_dev = sd(hj_diff, na.rm = TRUE), n()) %>% arrange(desc(mean_diff))
```

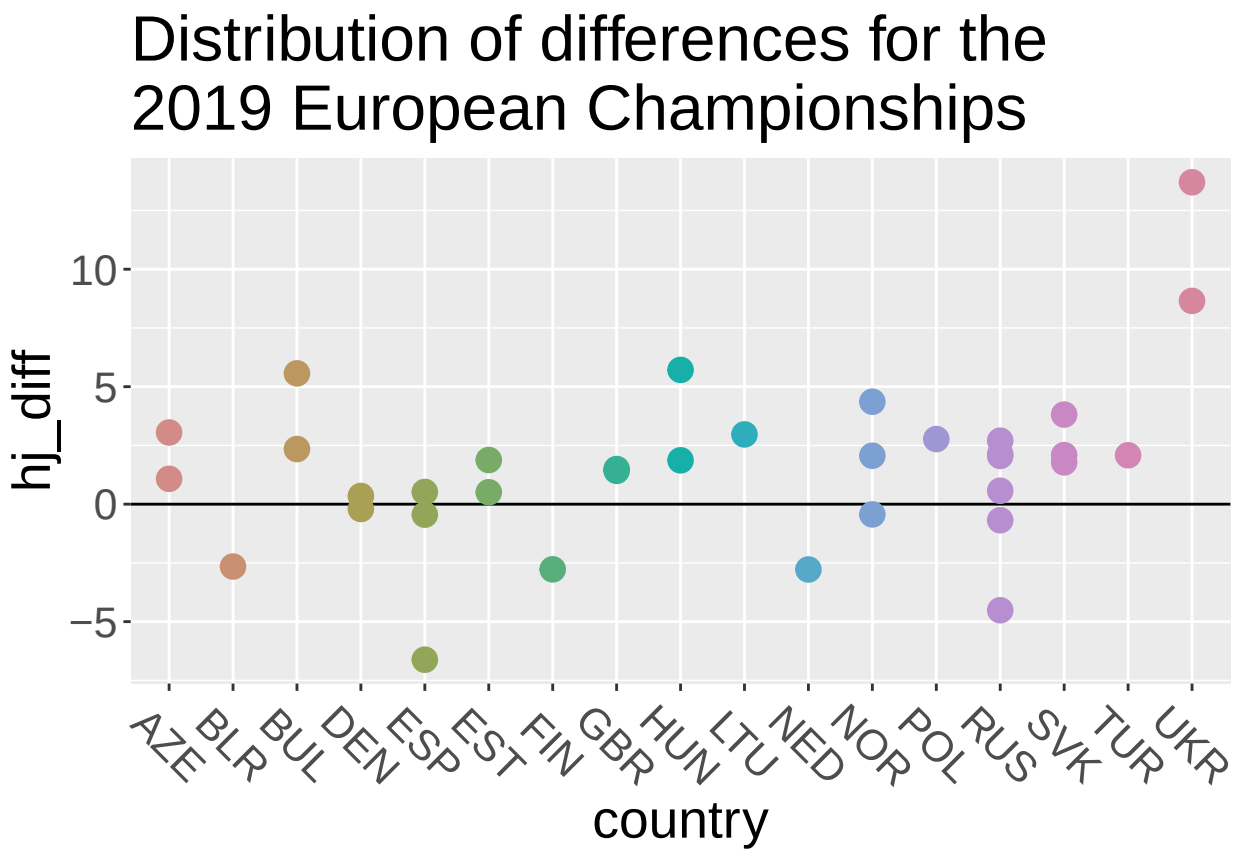
```
## `summarise()` has grouped output by 'event'. You can override using the
## `.groups` argument.
```

```
by_event
```

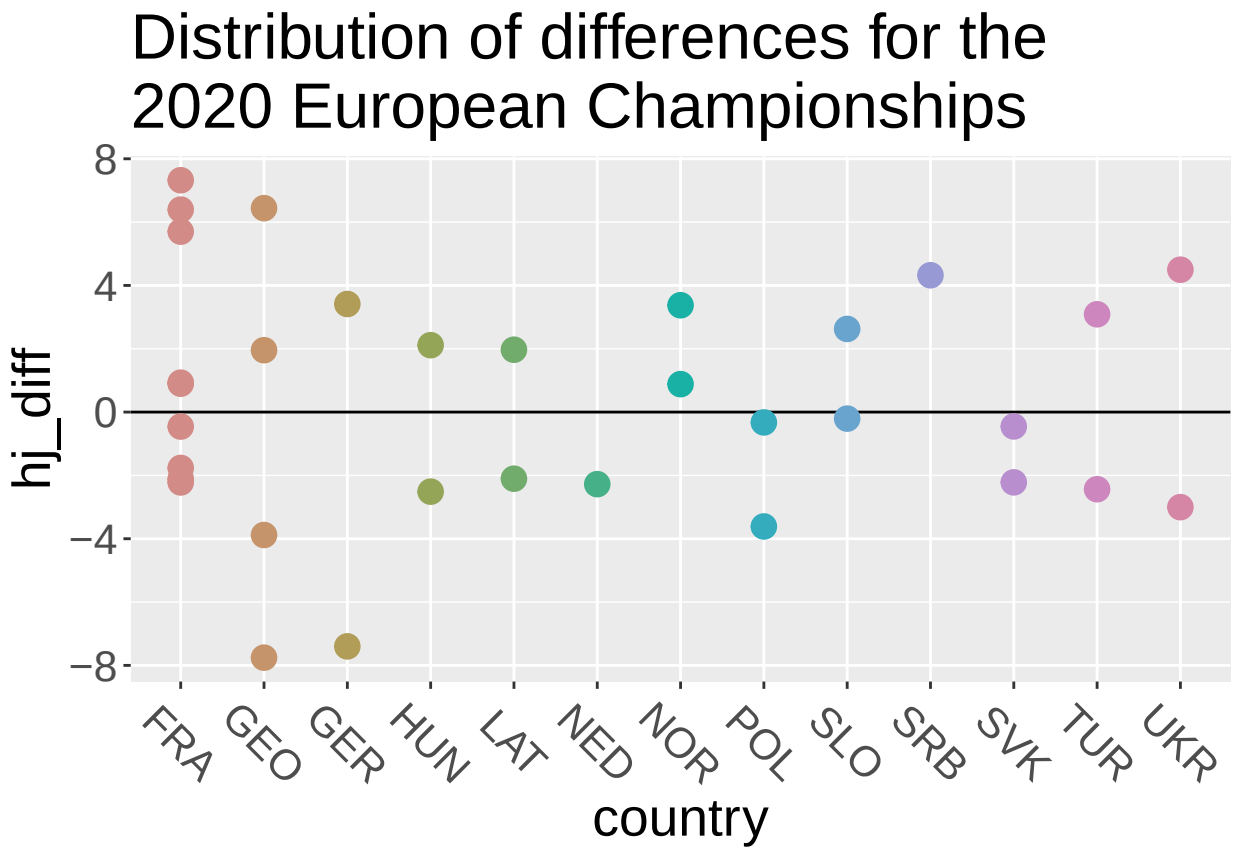
```
## # A tibble: 41 x 5
## # Groups:   event [18]
##    event               year mean_diff st_dev `n()`
##    <chr>              <int>     <dbl>  <dbl> <int>
##  1 GP NHK Trophy       2019      3.57   3.94    48
##  2 Lombardia Trophy    2019      3.27   4.44    30
##  3 Grand Prix Final    2019      3.19   3.73    24
##  4 GP NHK Trophy       2018      2.95   3.46    46
##  5 Olympic Team Event  2022      2.81   3.20    11
##  6 Lombardia Trophy    2018      2.77   2.82    40
##  7 Nebelhorn Trophy    2021      2.68   3.92    40
##  8 Lombardia Trophy    2021      2.63   3.11    45
##  9 GP Rostelecom Cup   2019      2.60   3.15    40
## 10 GP Intx de France   2018      2.48   2.88    43
## # i 31 more rows
```

```
charts <- scores %>% group_by(event, year) %>% group_map(.f = ~ ggplot(.x,
      aes(x= country, y= hj_diff)) + geom_hline(yintercept = 0, col = 'black') +
        geom_point(aes(color = country), size= 4, show.legend = FALSE) +
        ggtitle(paste0("Distribution of differences for the \n",
                       .y$year, " ", .y$event)) + scale_color_hue(c = 50) +
theme(text = element_text(size = 20),
          axis.text.x = element_text(angle = -45, vjust = 0.5, hjust=0.5)))
charts
```

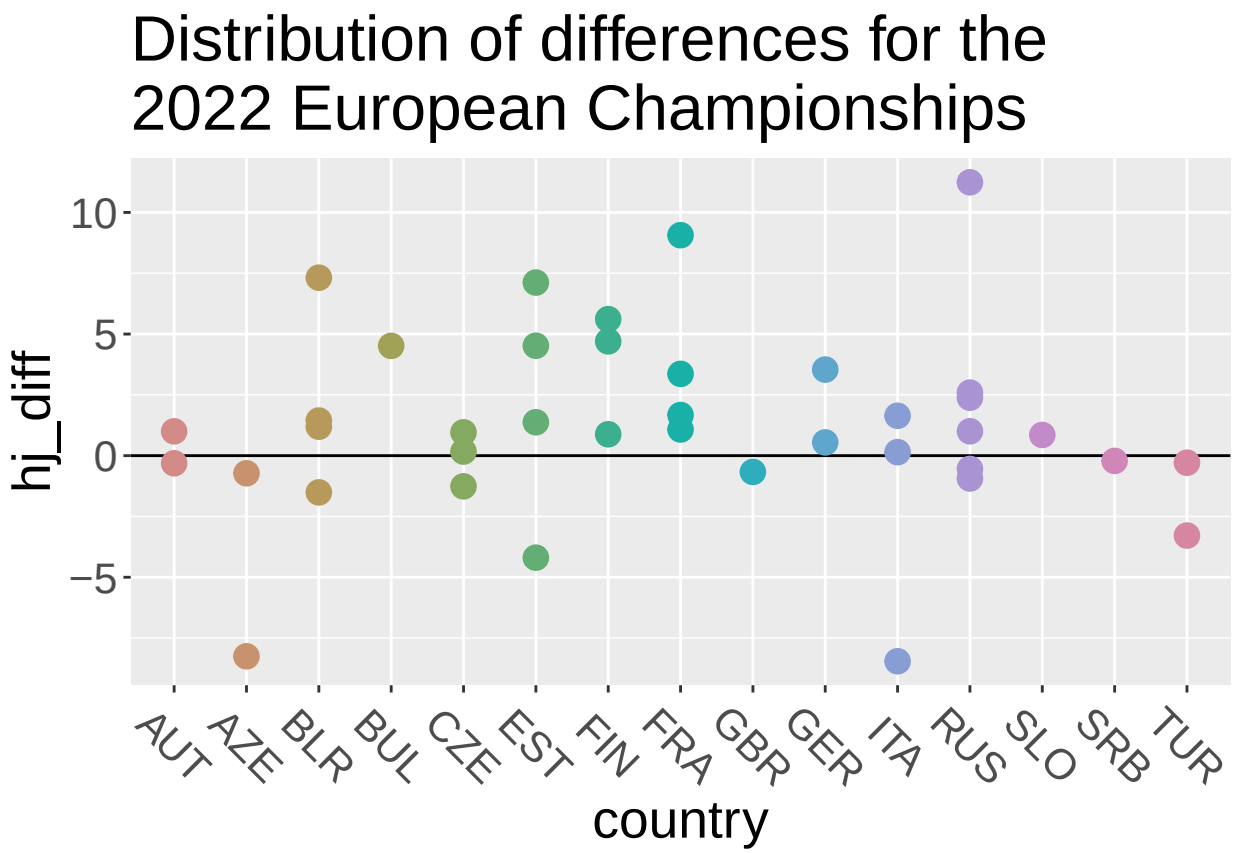
```
## [[1]]
```


Distribution of differences for the 2019 European Championships
hj_diff
10
5
0
−5
AZE
BLR
BUL
DEN
ESP
EST
FIN
GBR
HUN
LTU
NED
NOR
POL
RUS
SVK
TUR
UKR
country

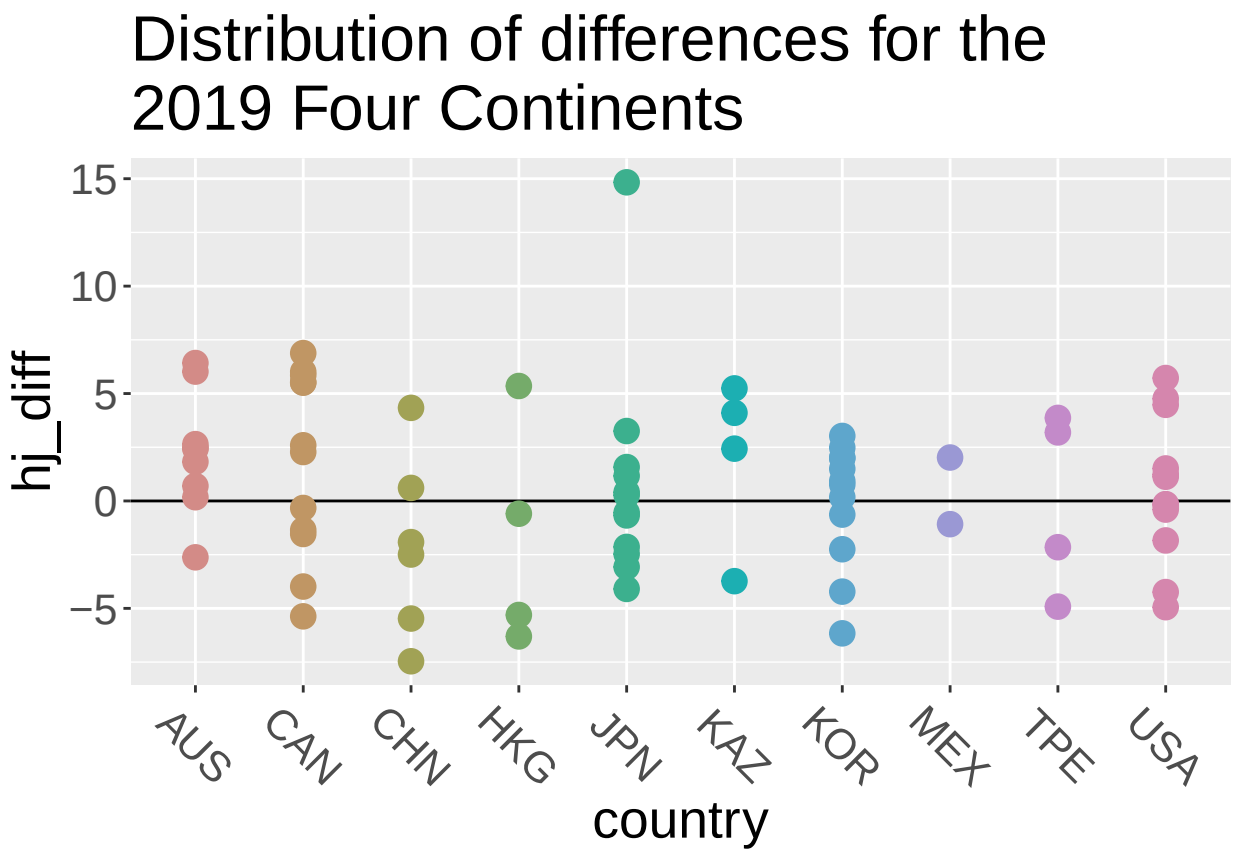
```
##
## [[2]]
```


Distribution of differences for the 2020 European Championships
hj_diff
8
4
0
−4
−8
FRA
GEO
GER
HUN
LAT
NED
NOR
POL
SLO
SRB
SVK
TUR
UKR
country

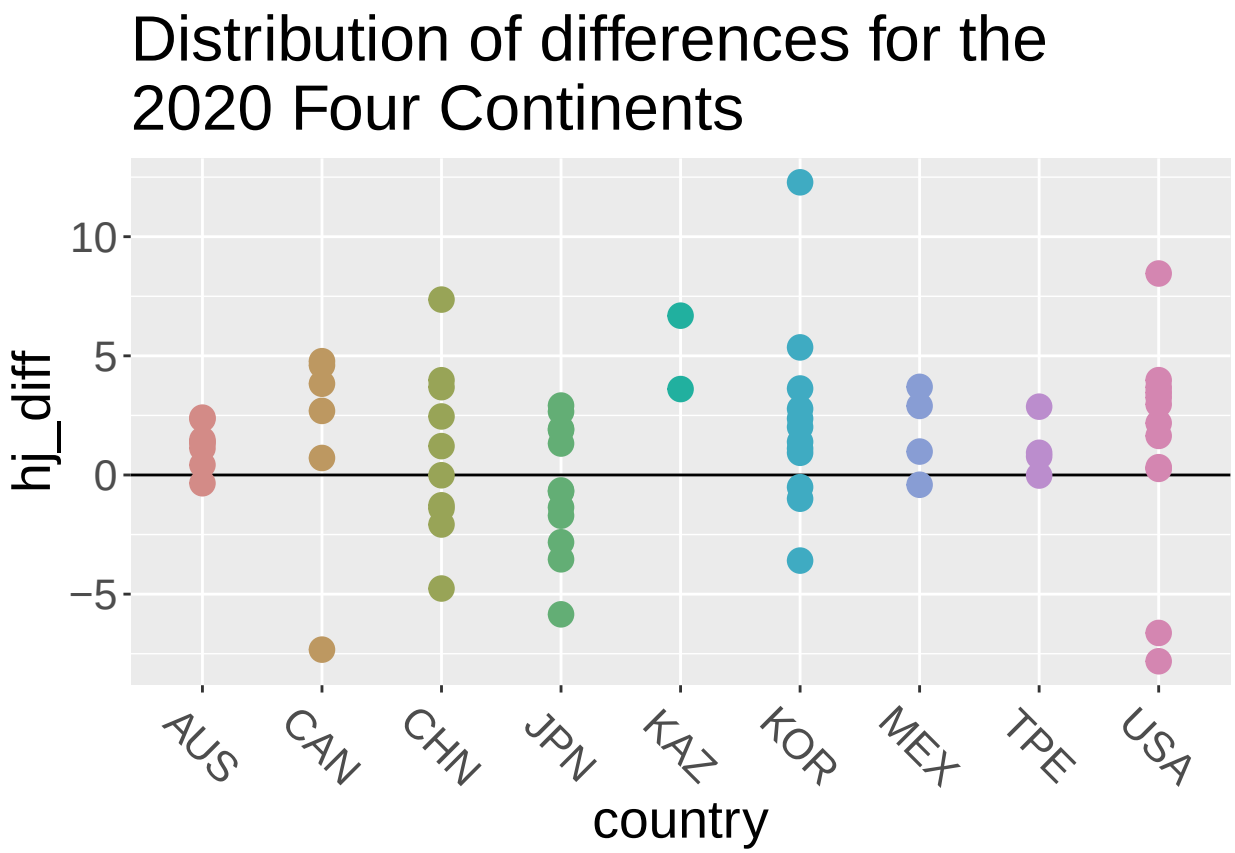
```
##
## [[3]]
```


Distribution of differences for the 2022 European Championships
hj_diff
10
5
0
−5
AUT
AZE
BLR
BUL
CZE
EST
FIN
FRA
GBR
GER
ITA
RUS
SLO
SRB
TUR
country

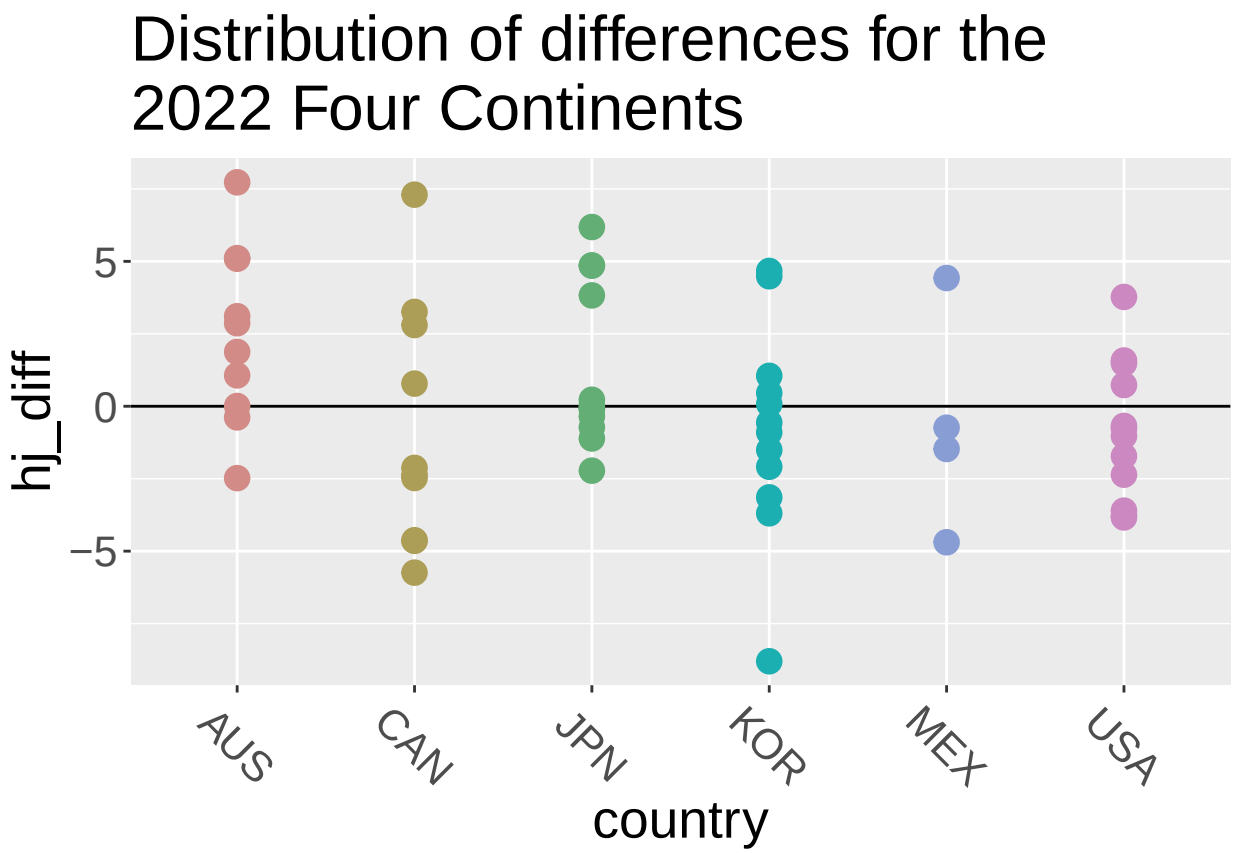
```
##
## [[4]]
```


Distribution of differences for the 2019 Four Continents
hj_diff
15
10
5
0
−5
AUS
CAN
CHN
HKG
JPN
KAZ
KOR
MEX
TPE
USA
country

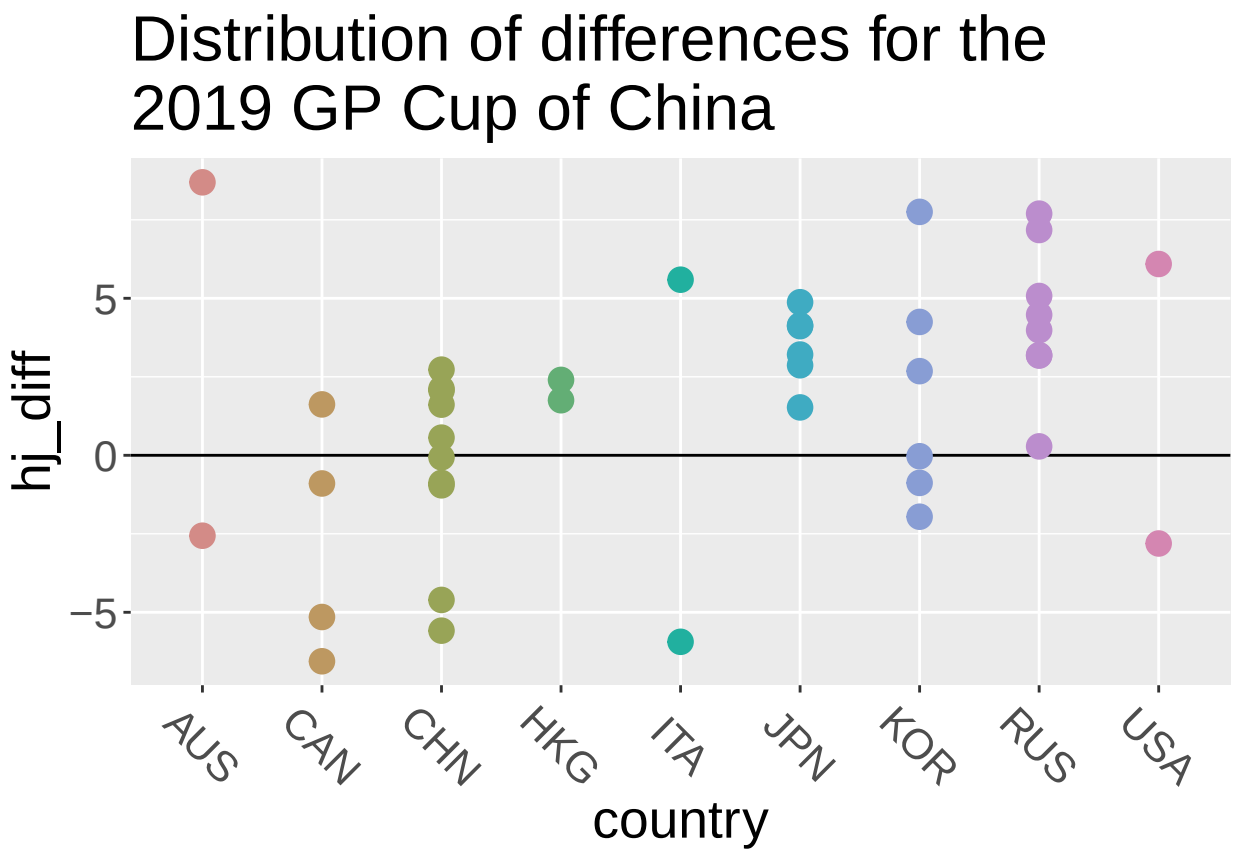
```
##
## [[5]]
```


Distribution of differences for the 2020 Four Continents
hj_diff
10
5
0
−5
AUS
CAN
CHN
JPN
KAZ
KOR
MEX
TPE
USA
country

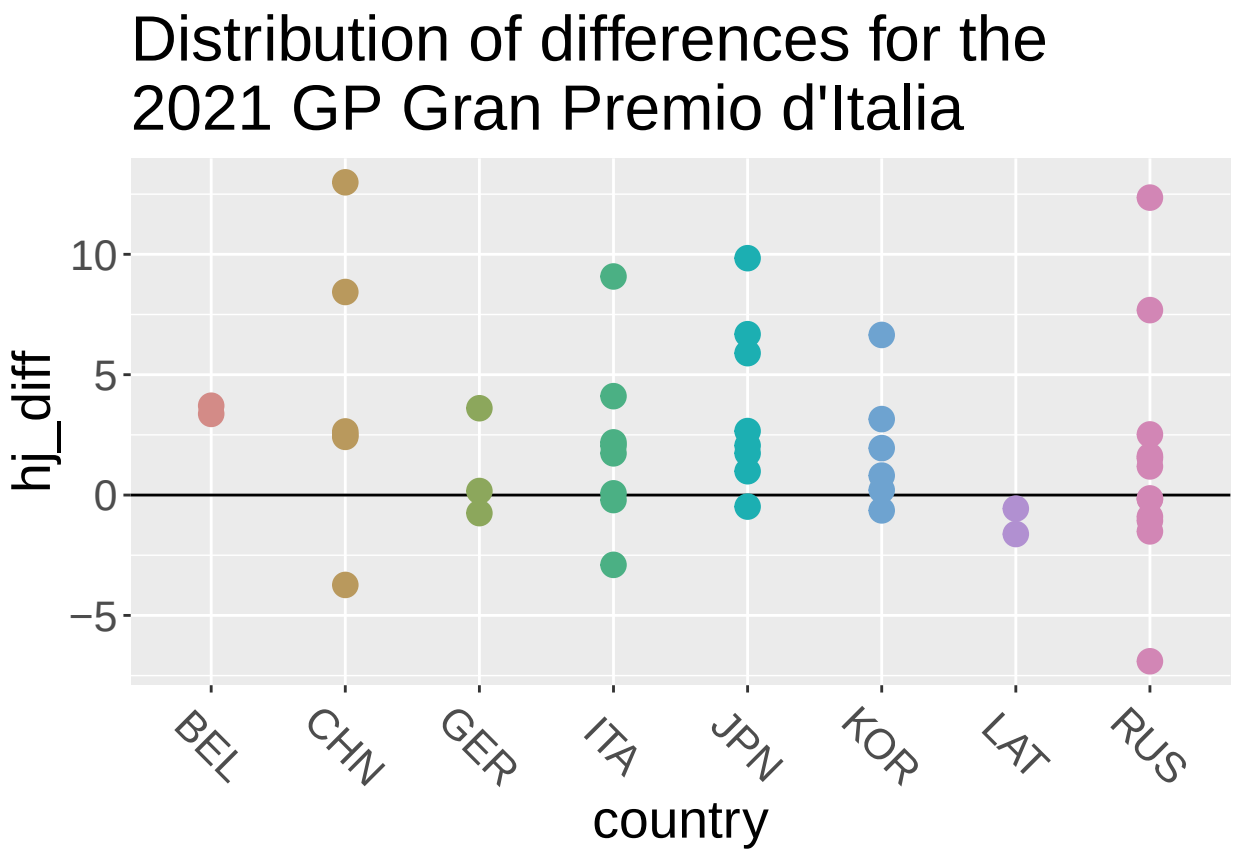
```
##
## [[6]]
```


Distribution of differences for the 2022 Four Continents
hj_diff
5
0
−5
AUS
CAN
JPN
KOR
MEX
USA
country

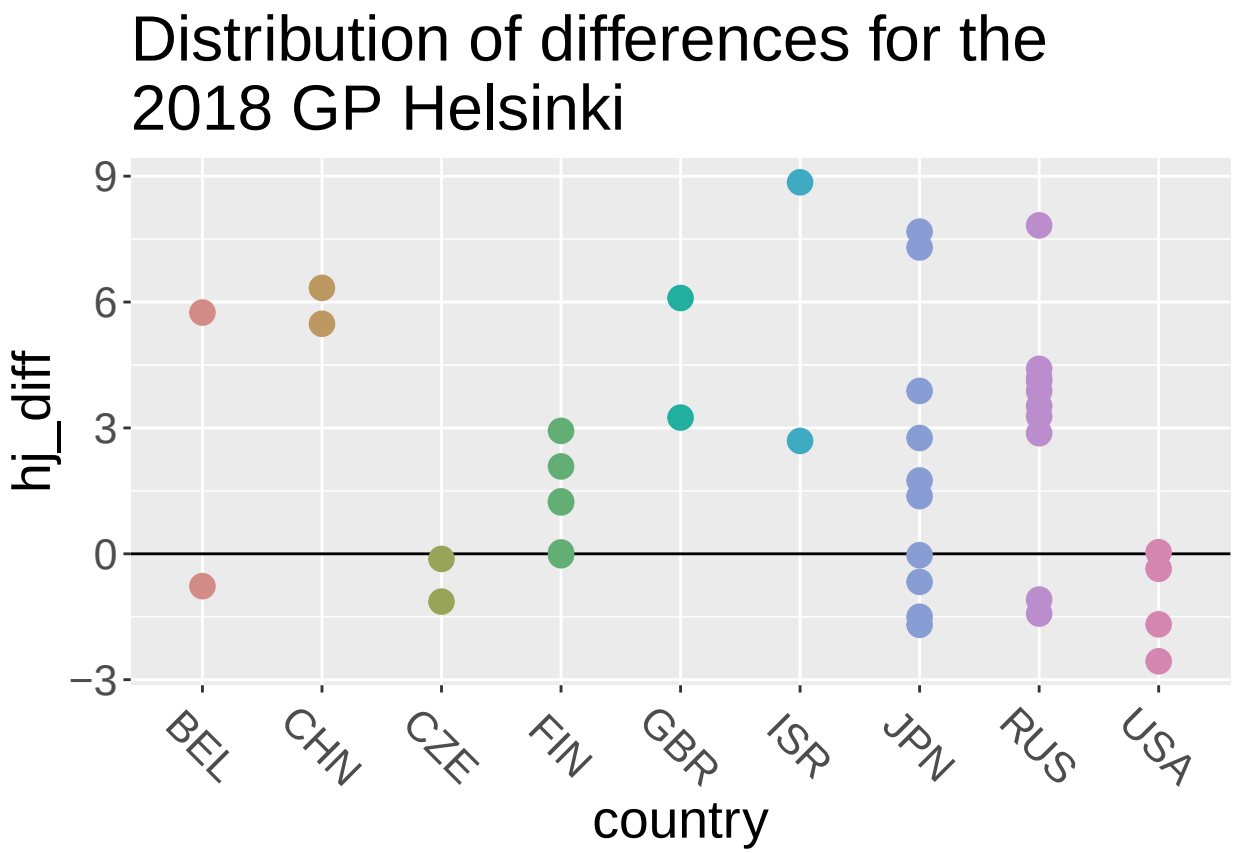
```
##
## [[7]]
```


Distribution of differences for the 2019 GP Cup of China
hj_diff
5
0
−5
AUS
CAN
CHN
HKG
ITA
JPN
KOR
RUS
USA
country

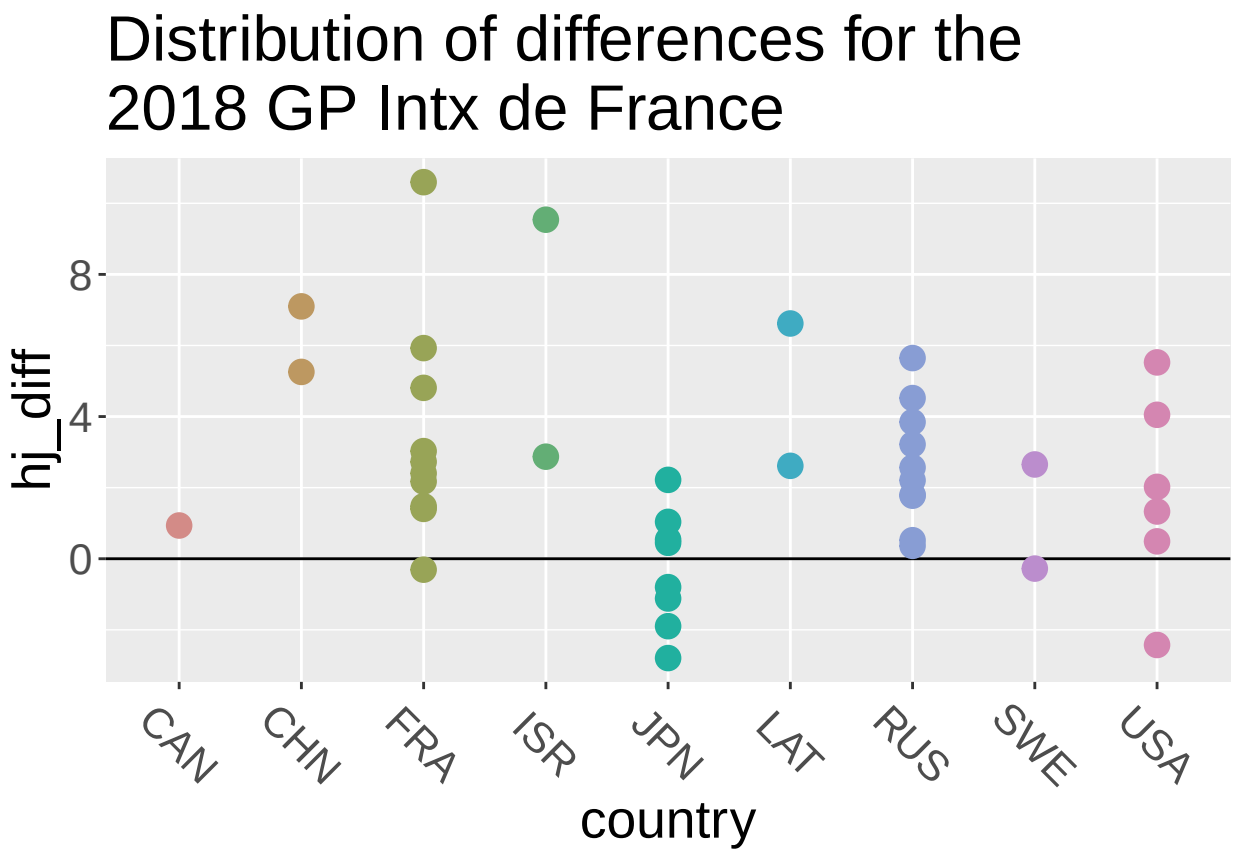
```
##
## [[8]]
```


Distribution of differences for the
2021 GP Gran Premio d'Italia
hj_diff
10
5
0
−5
BEL
CHN
GER
ITA
JPN
KOR
LAT
RUS
country

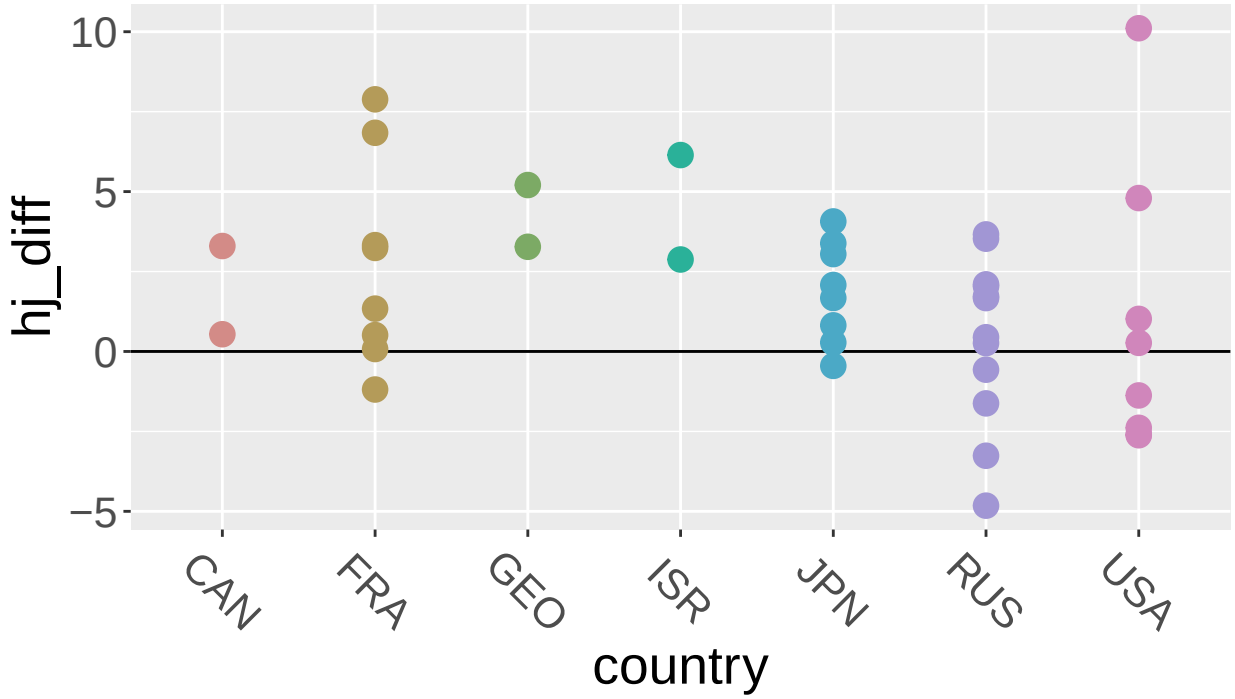
```
##
## [[9]]
```


Distribution of differences for the 2018 GP Helsinki
hj_diff
9
6
3
0
−3
BEL
CHN
CZE
FIN
GBR
ISR
JPN
RUS
USA
country

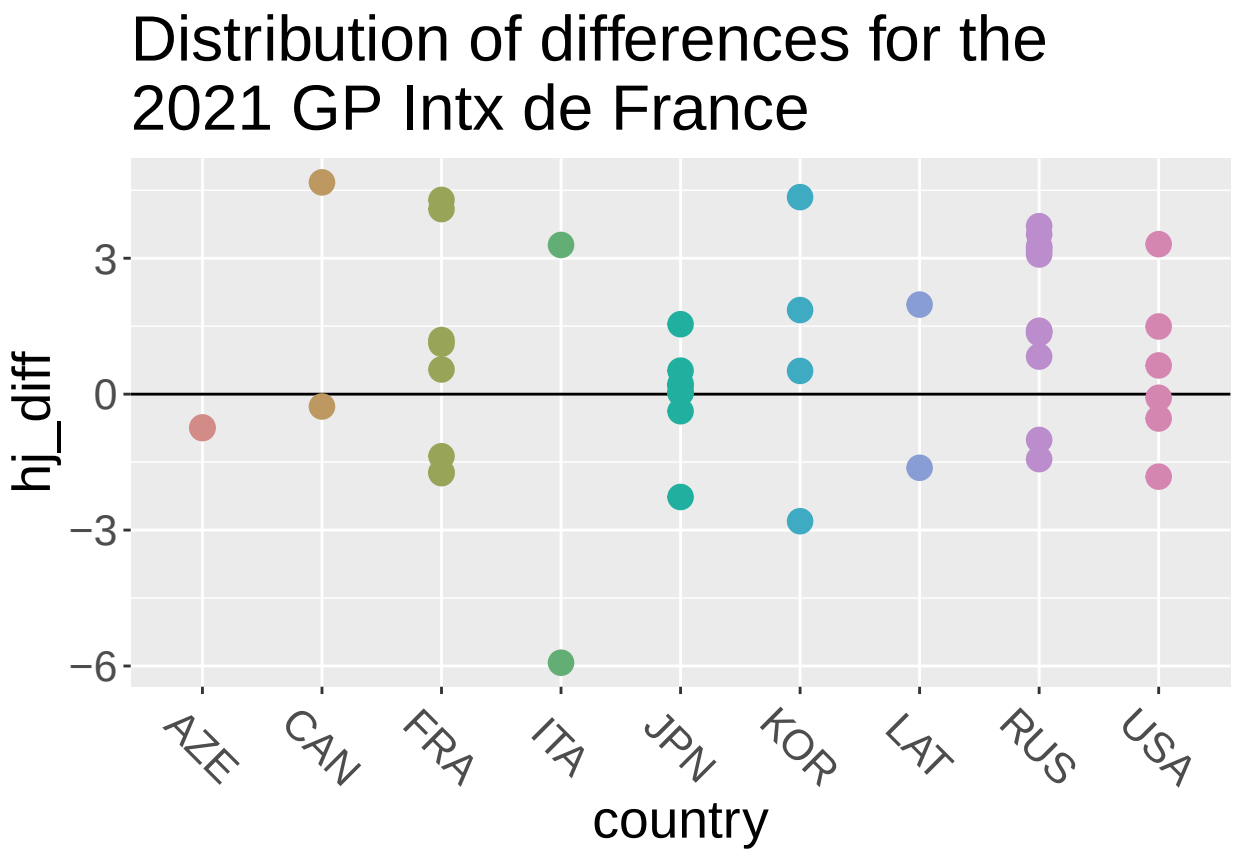
```
##
## [[10]]
```


Distribution of differences for the 2018 GP Intx de France
hj_diff
8
4
0
CAN
CHN
FRA
ISR
JPN
LAT
RUS
SWE
USA
country

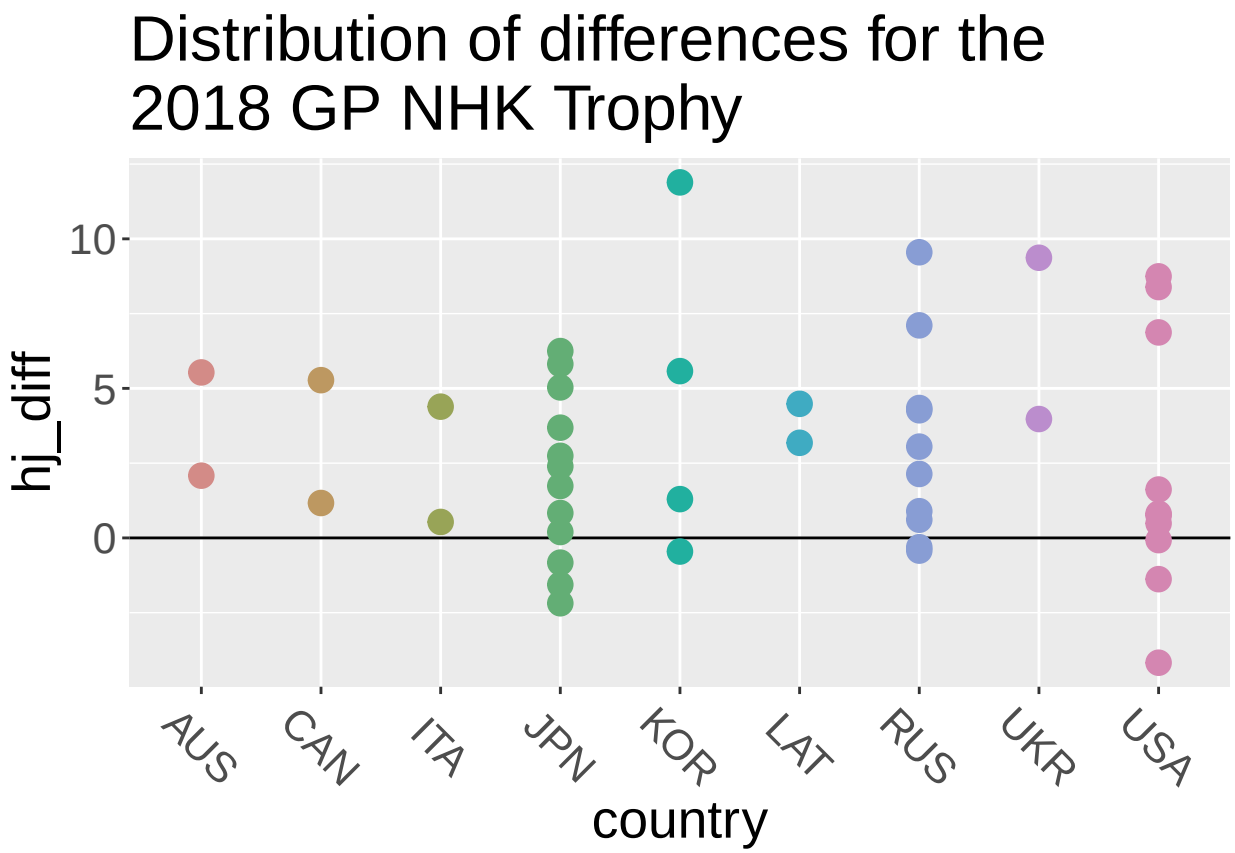
```
##
## [[11]]
```


Distribution of differences for the 2019 GP Intx de France
hj_diff
10
5
0
−5
CAN
FRA
GEO
ISR
JPN
RUS
USA
country

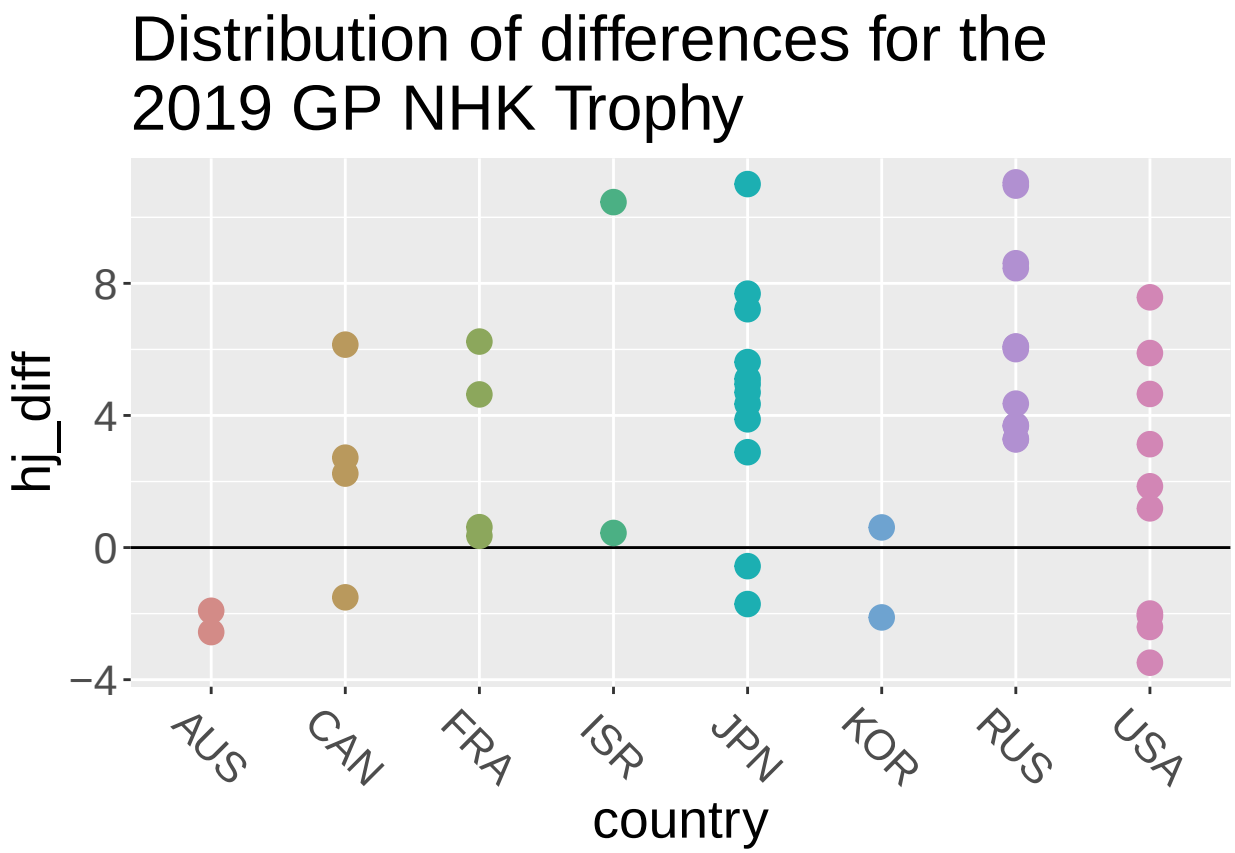
```
##
## [[12]]
```


Distribution of differences for the 2021 GP Intx de France
hj_diff
3
0
−3
−6
AZE
CAN
FRA
ITA
JPN
KOR
LAT
RUS
USA
country

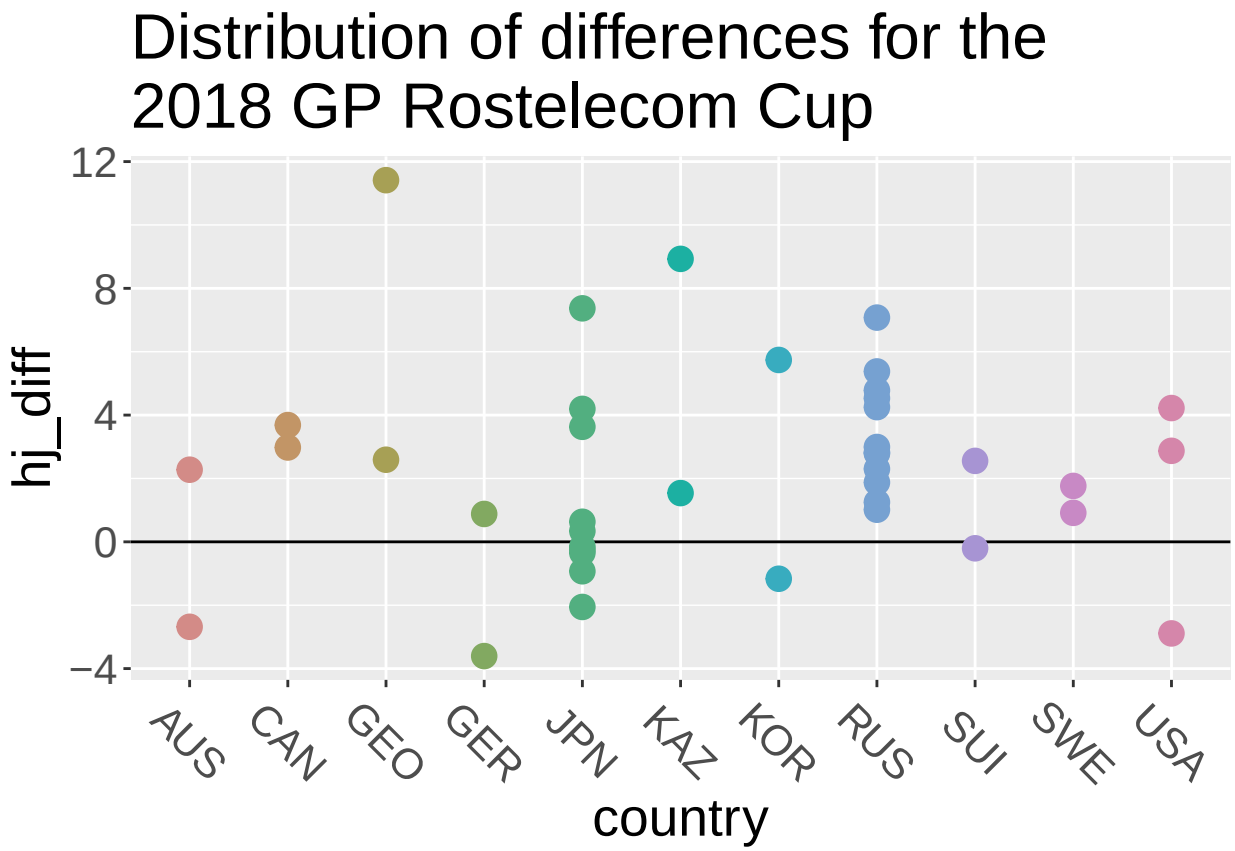
```
##
## [[13]]
```


Distribution of differences for the 2018 GP NHK Trophy
hj_diff
10
5
0
AUS
CAN
ITA
JPN
KOR
LAT
RUS
UKR
USA
country

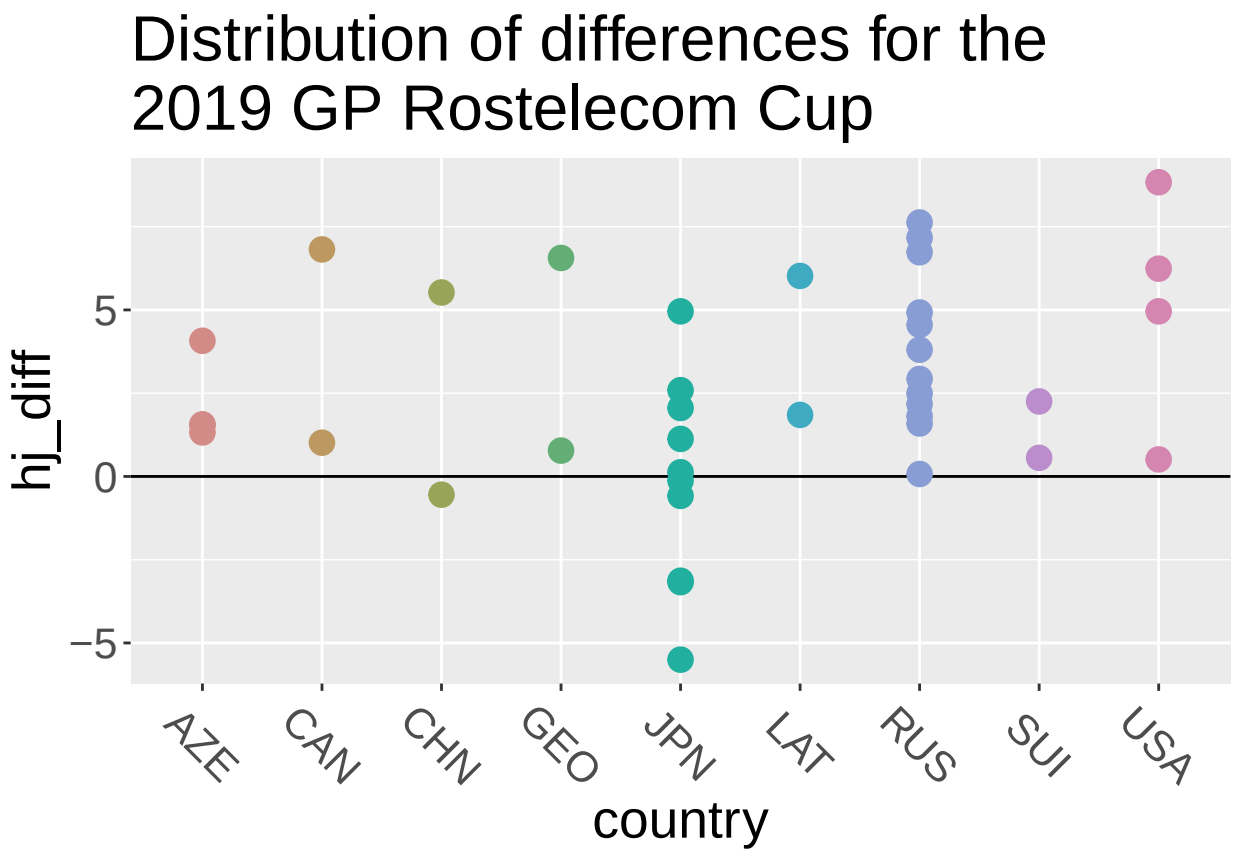
```
##
## [[14]]
```


Distribution of differences for the 2019 GP NHK Trophy
hj_diff
8
4
0
−4
AUS
CAN
FRA
ISR
JPN
KOR
RUS
USA
country

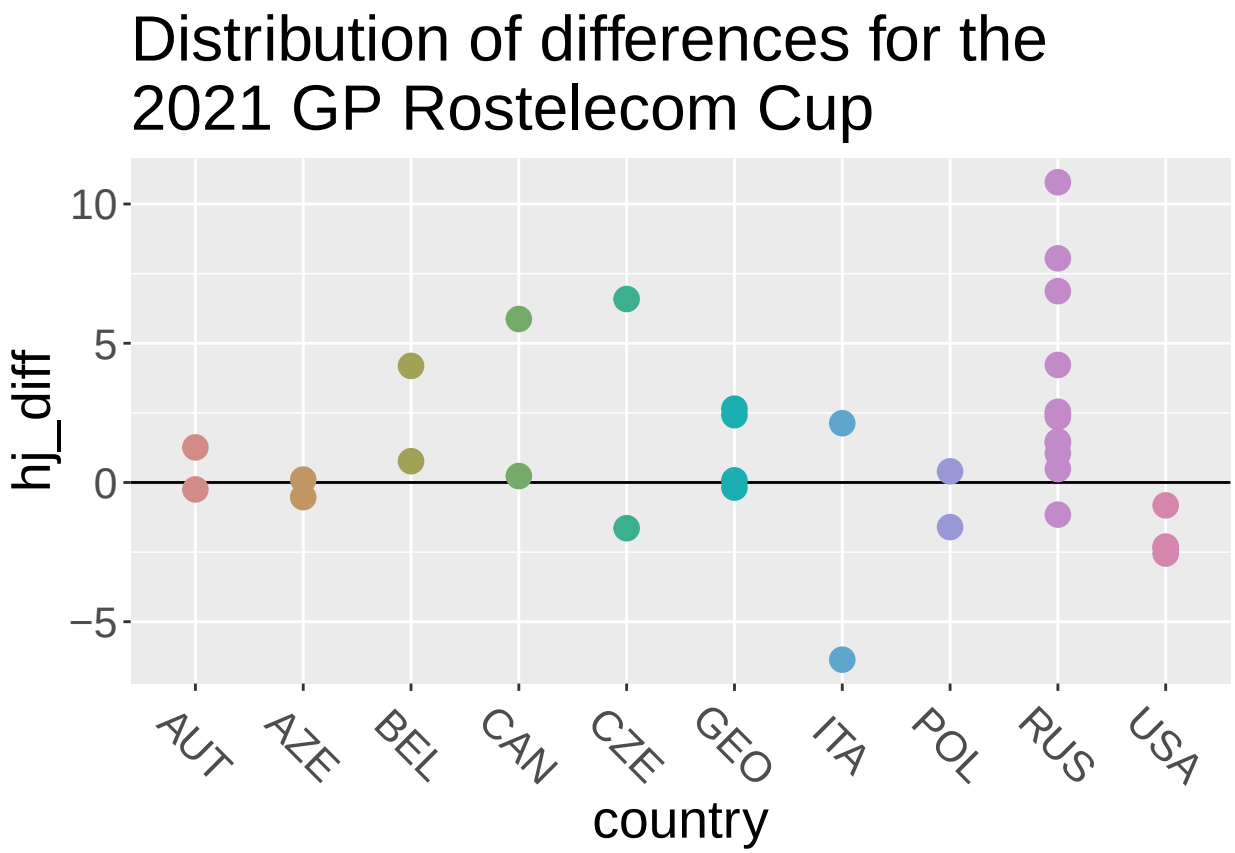
```
##
## [[15]]
```


Distribution of differences for the 2018 GP Rostelecom Cup
hj_diff
12
8
4
0
−4
AUS
CAN
GEO
GER
JPN
KAZ
KOR
RUS
SUI
SWE
USA
country

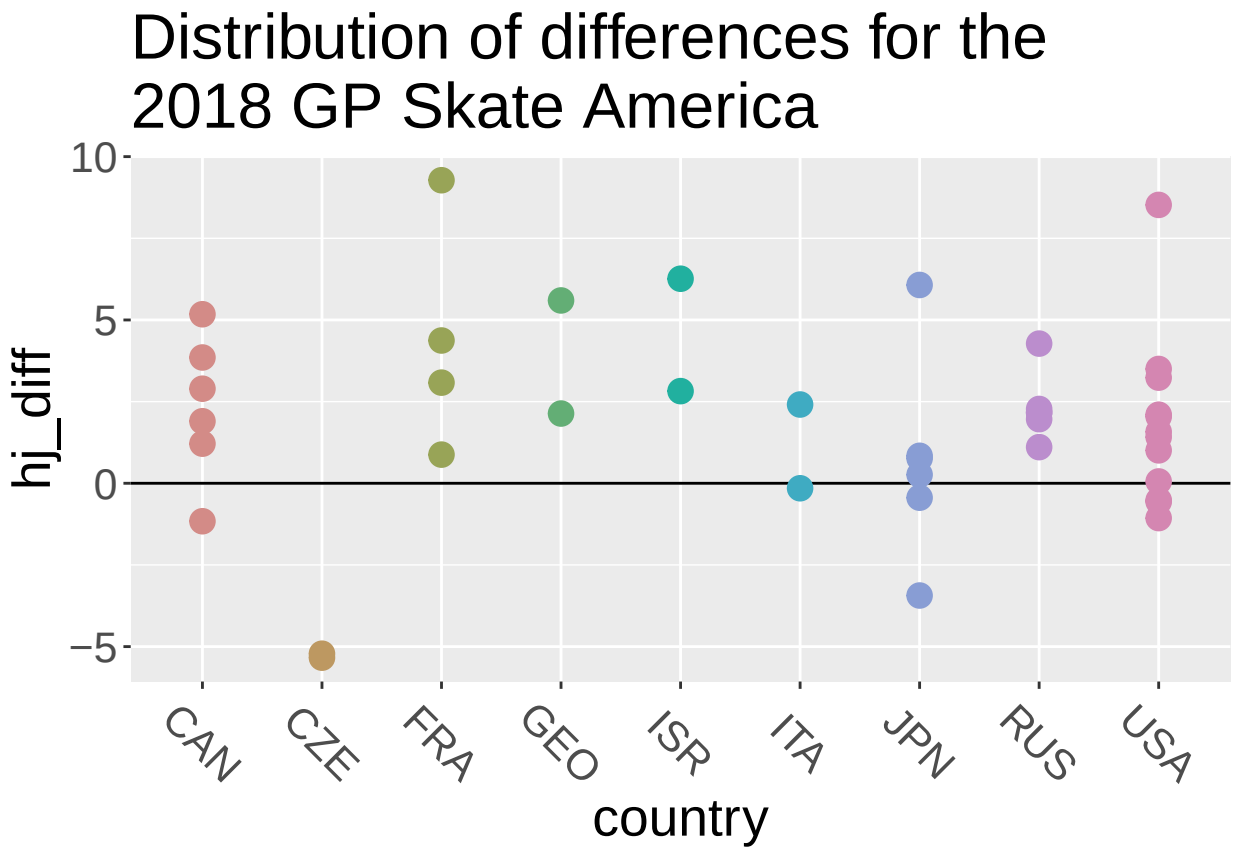
```
##
## [[16]]
```


Distribution of differences for the 2019 GP Rostelecom Cup
hj_diff
5
0
−5
AZE
CAN
CHN
GEO
JPN
LAT
RUS
SUI
USA
country

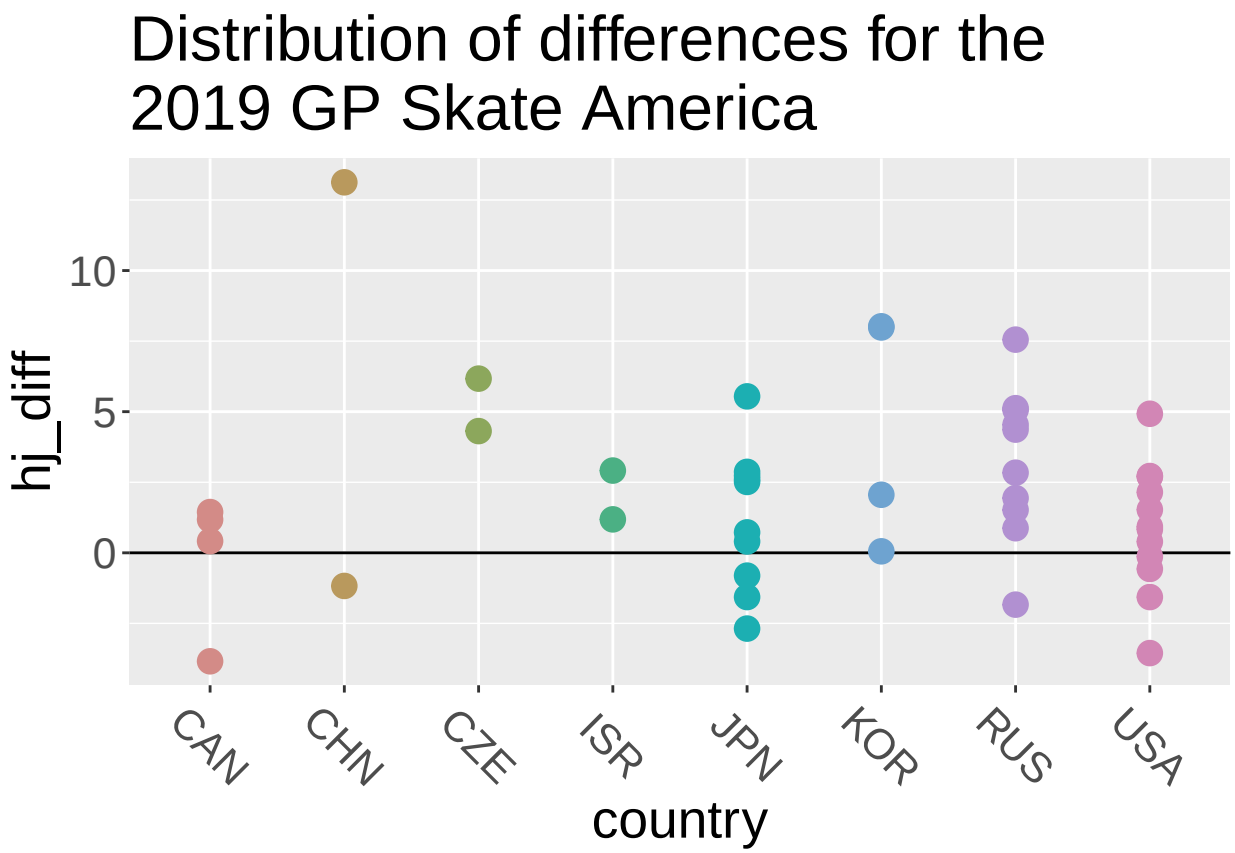
```
##
## [[17]]
```


Distribution of differences for the 2021 GP Rostelecom Cup
hj_diff
10
5
0
−5
AUT
AZE
BEL
CAN
CZE
GEO
ITA
POL
RUS
USA
country

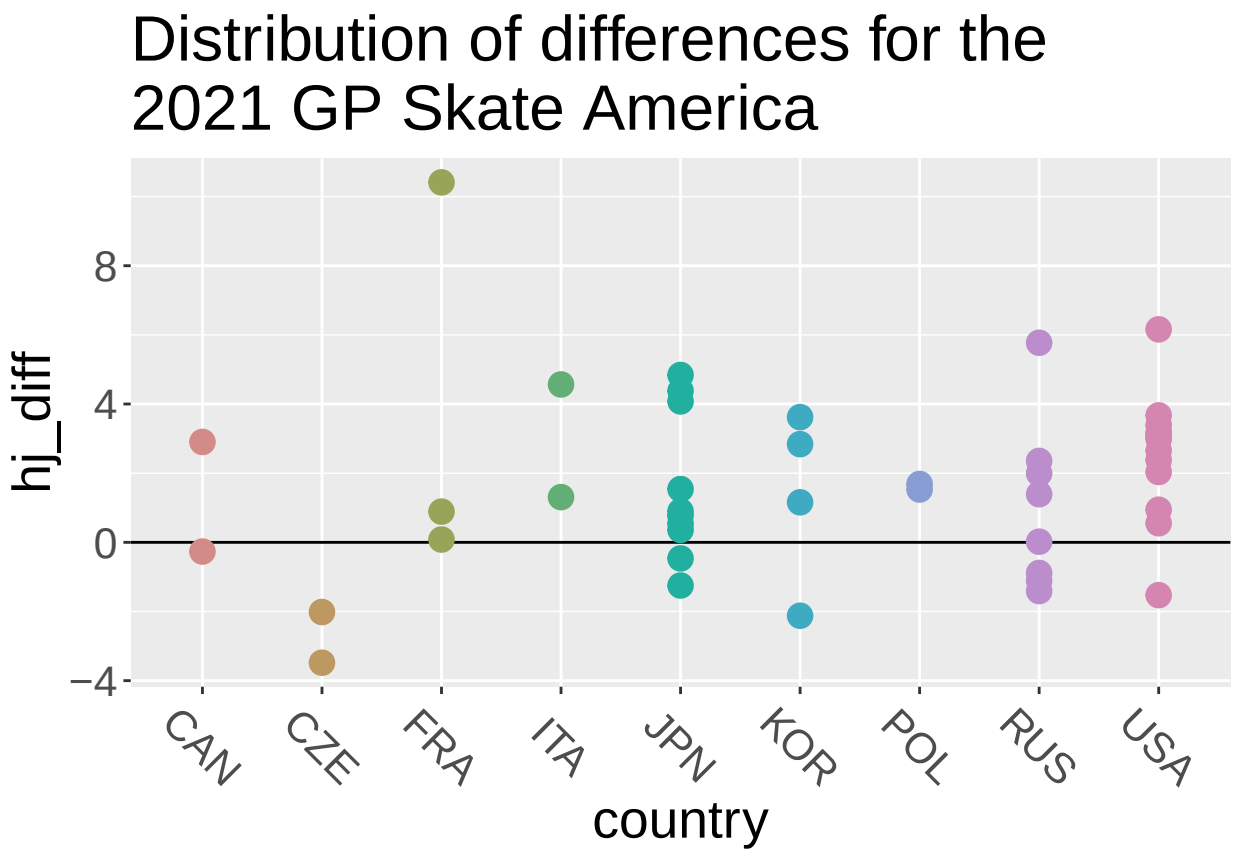
```
##
## [[18]]
```


Distribution of differences for the 2018 GP Skate America
hj_diff
10
5
0
−5
CAN
CZE
FRA
GEO
ISR
ITA
JPN
RUS
USA
country

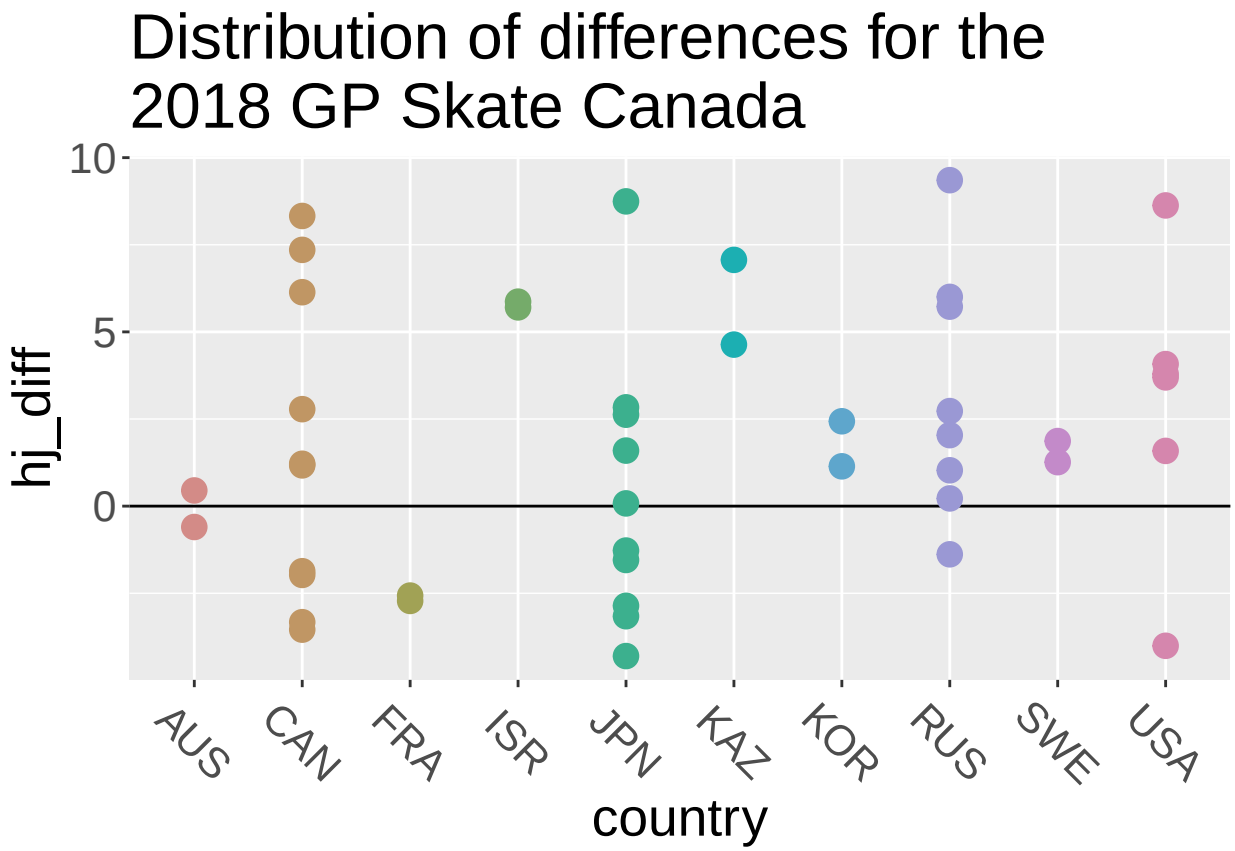
```
##
## [[19]]
```


Distribution of differences for the 2019 GP Skate America
hj_diff
10
5
0
CAN
CHN
CZE
ISR
JPN
KOR
RUS
USA
country

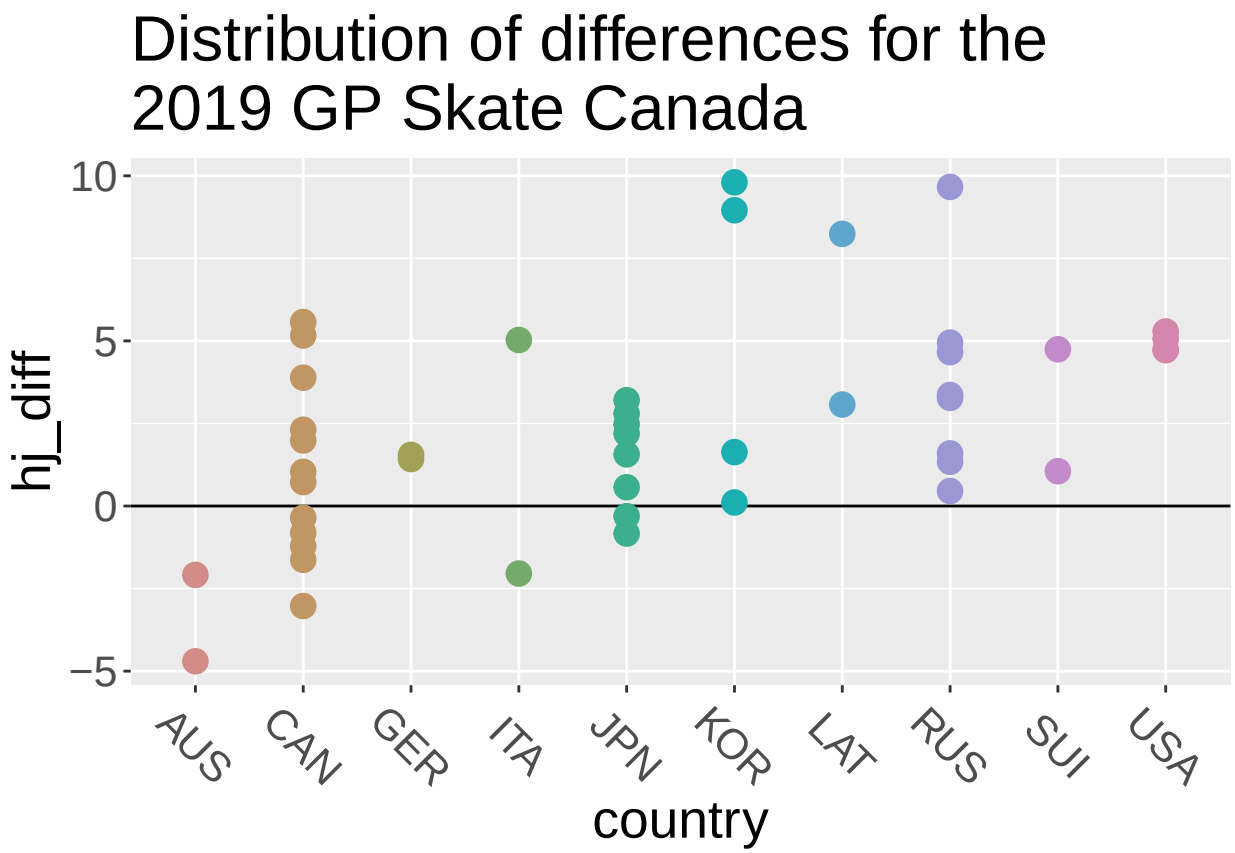
```
##
## [[20]]
```


Distribution of differences for the 2021 GP Skate America
hj_diff
8
4
0
−4
CAN
CZE
FRA
ITA
JPN
KOR
POL
RUS
USA
country

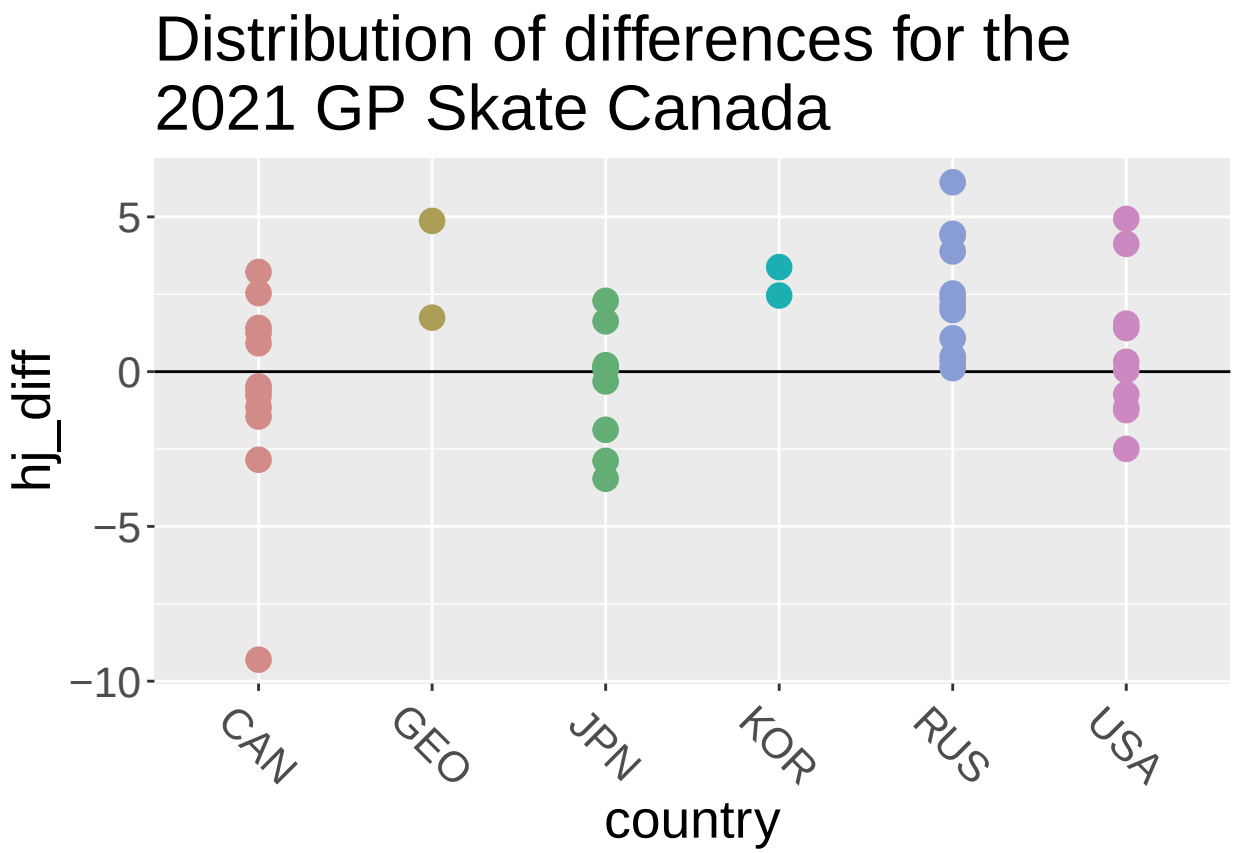
```
##
## [[21]]
```


Distribution of differences for the 2018 GP Skate Canada
hj_diff
10
5
0
AUS
CAN
FRA
ISR
JPN
KAZ
KOR
RUS
SWE
USA
country

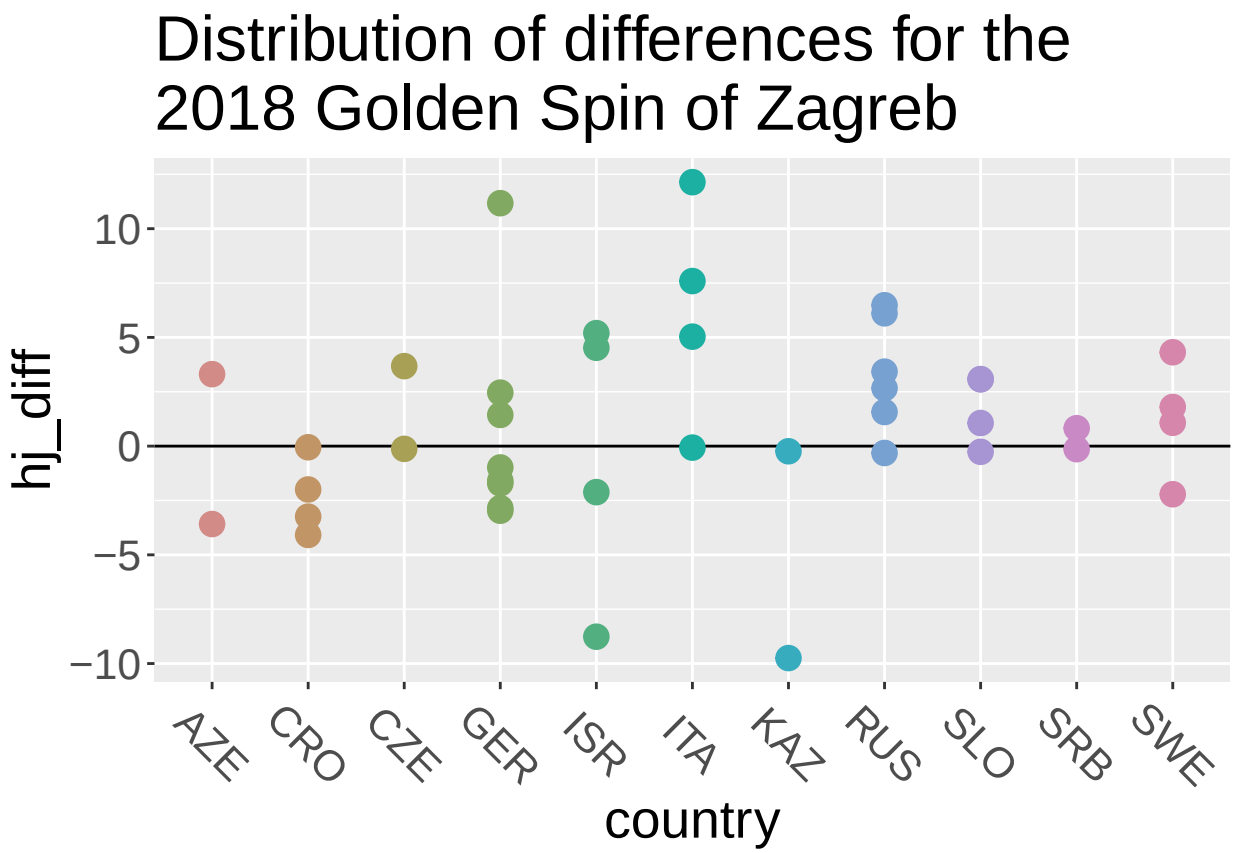
```
##
## [[22]]
```


Distribution of differences for the 2019 GP Skate Canada
hj_diff
10
5
0
−5
AUS
CAN
GER
ITA
JPN
KOR
LAT
RUS
SUI
USA
country

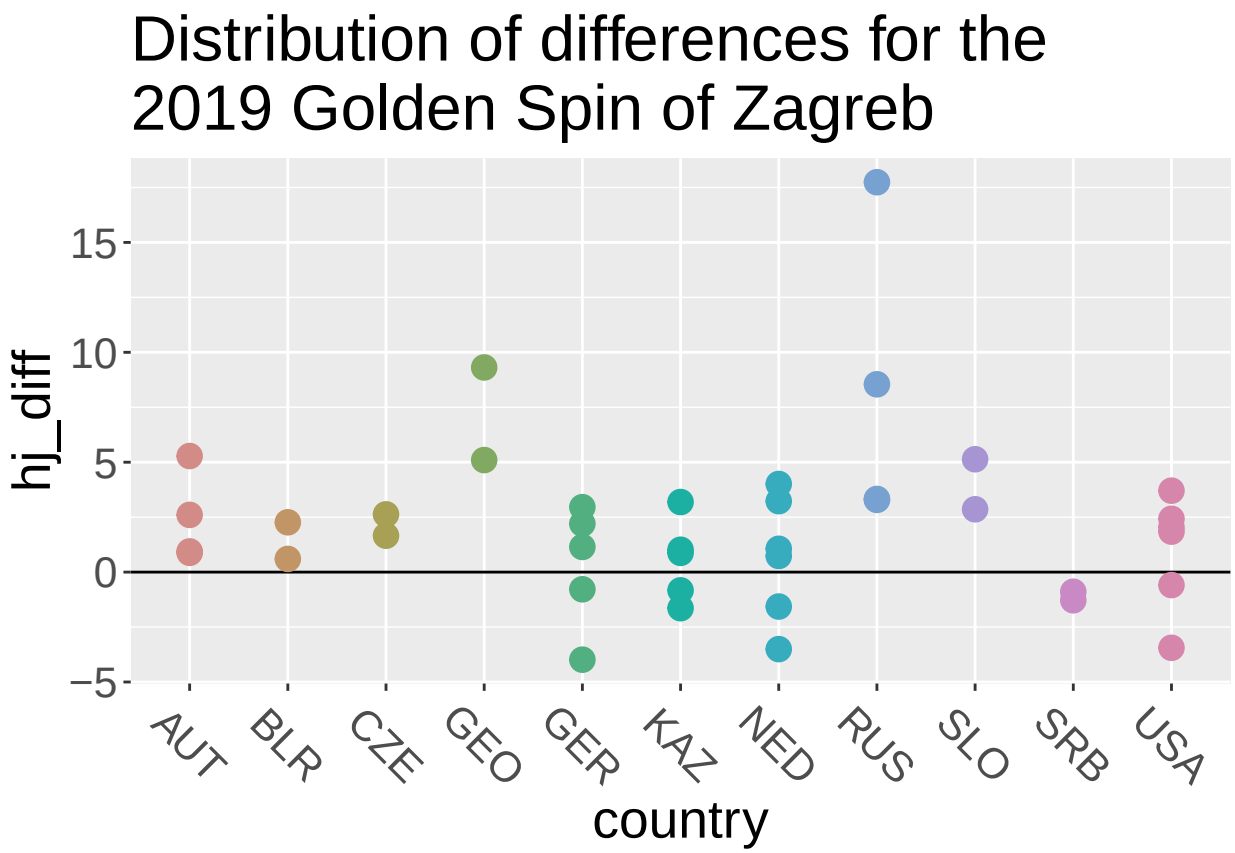
```
##
## [[23]]
```


Distribution of differences for the 2021 GP Skate Canada
hj_diff
5
0
−5
−10
CAN
GEO
JPN
KOR
RUS
USA
country

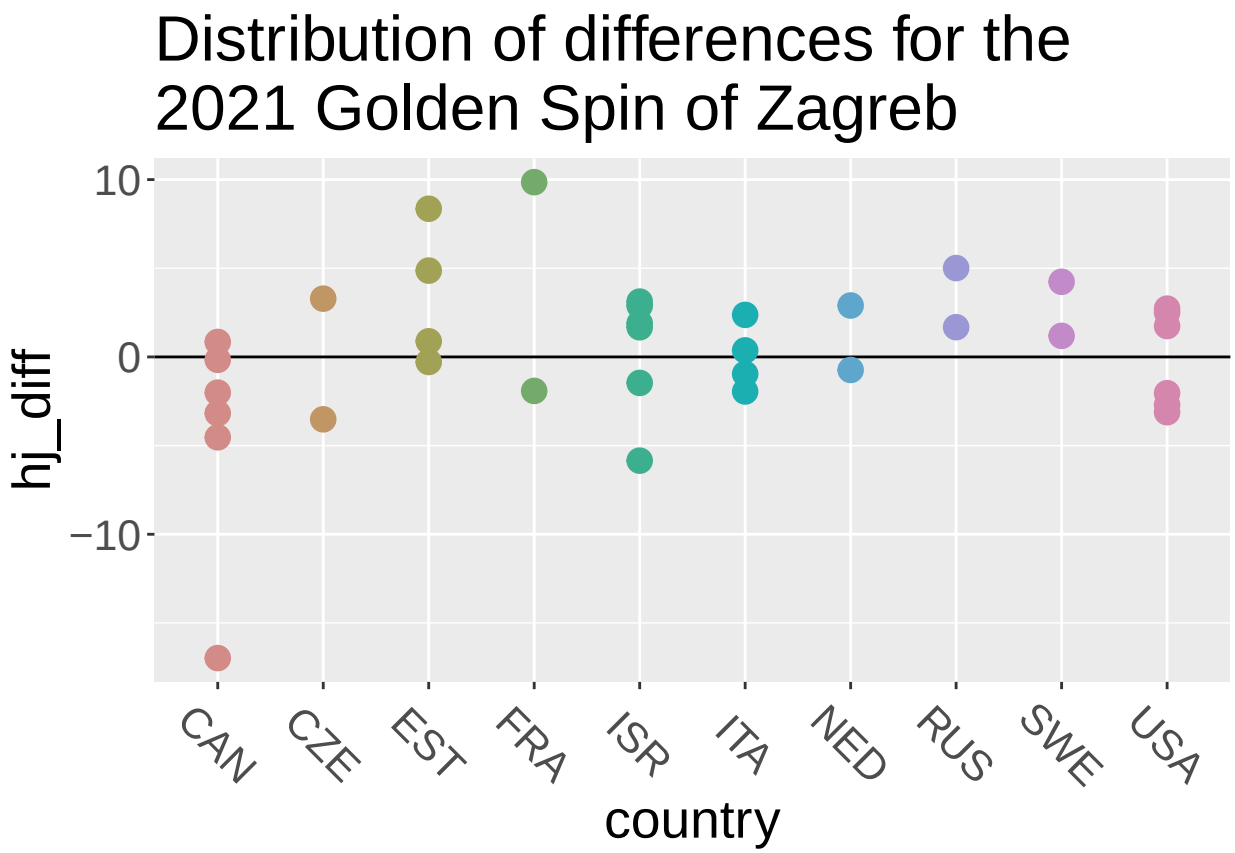
```
##
## [[24]]
```


Distribution of differences for the 2018 Golden Spin of Zagreb
hj_diff
10
5
0
−5
−10
AZE
CRO
CZE
GER
ISR
ITA
KAZ
RUS
SLO
SRB
SWE
country

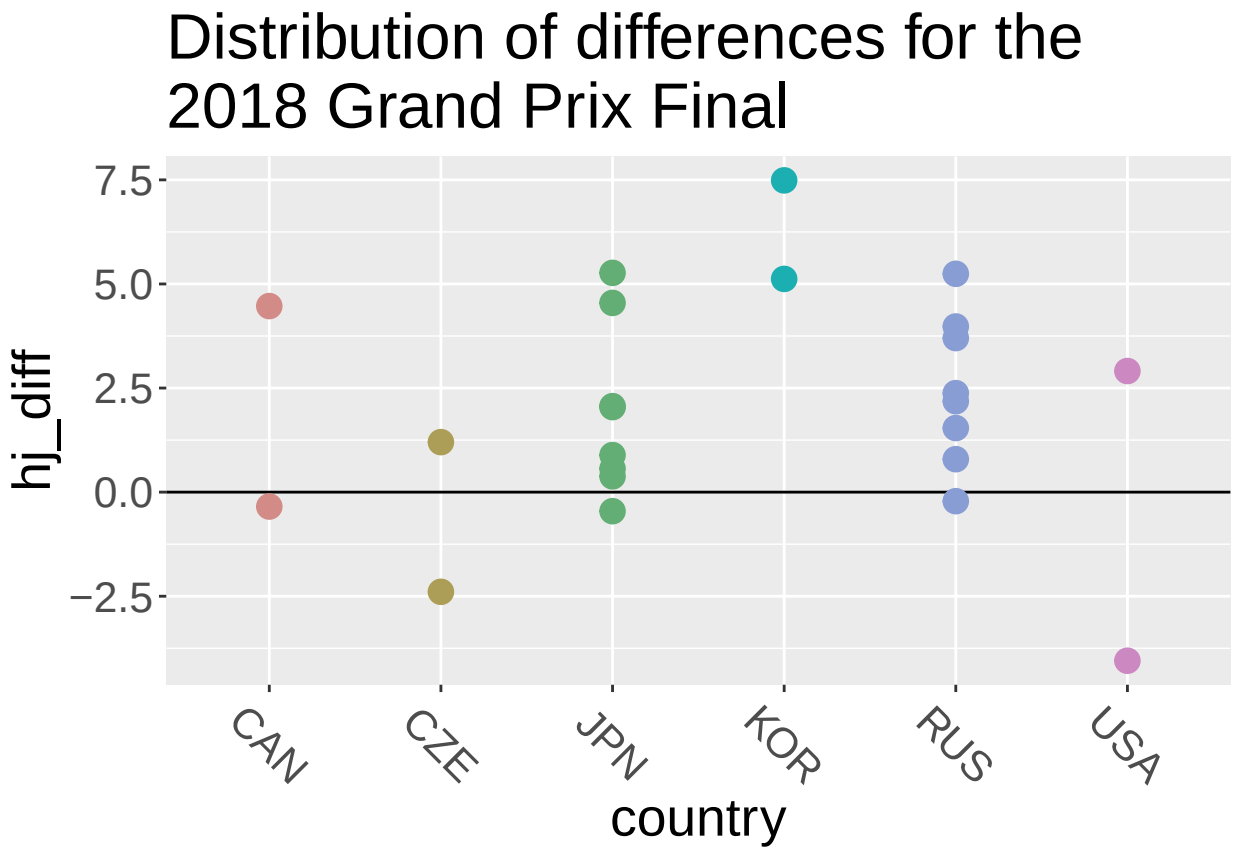
```
##
## [[25]]
```


Distribution of differences for the 2019 Golden Spin of Zagreb
hj_diff
15
10
5
0
−5
AUT
BLR
CZE
GEO
GER
KAZ
NED
RUS
SLO
SRB
USA
country

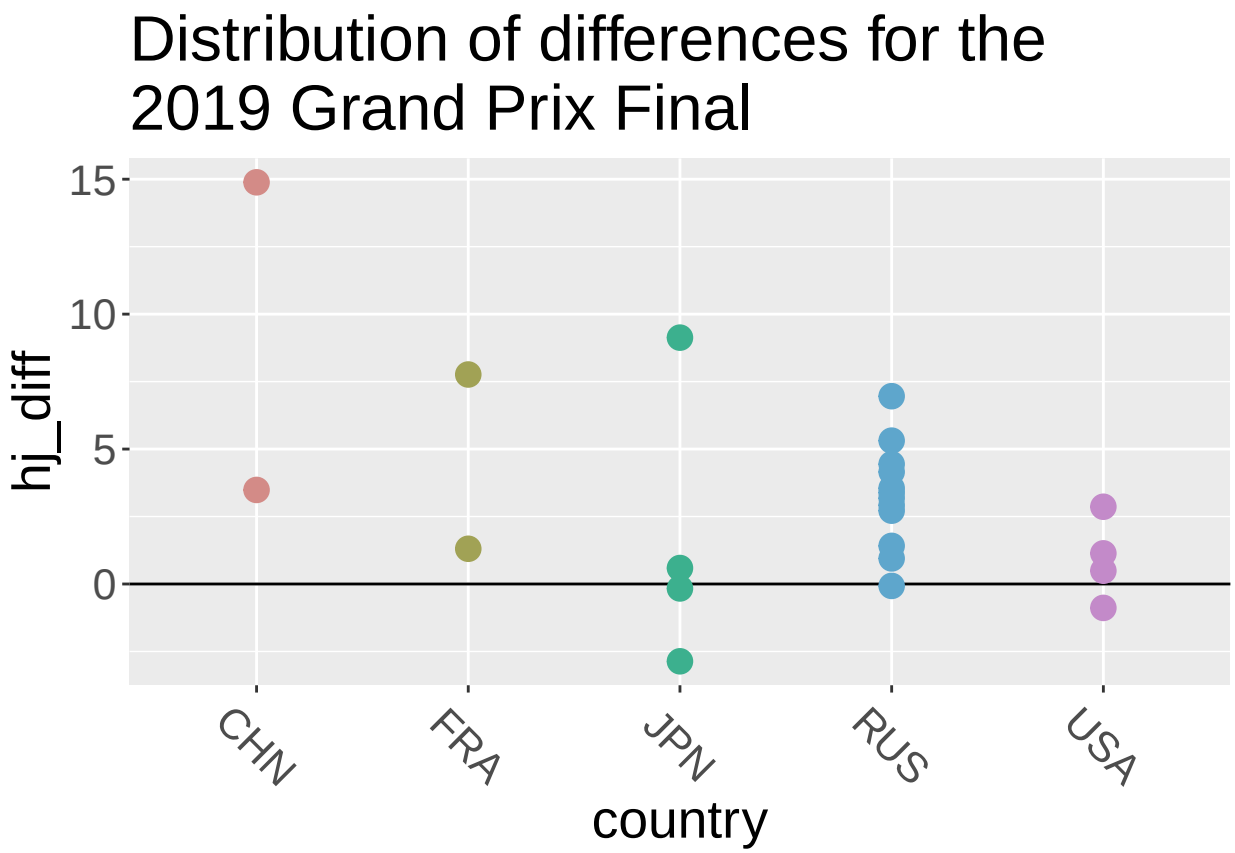
```
##
## [[26]]
```


Distribution of differences for the 2021 Golden Spin of Zagreb
hj_diff
10
0
−10
CAN
CZE
EST
FRA
ISR
ITA
NED
RUS
SWE
USA
country

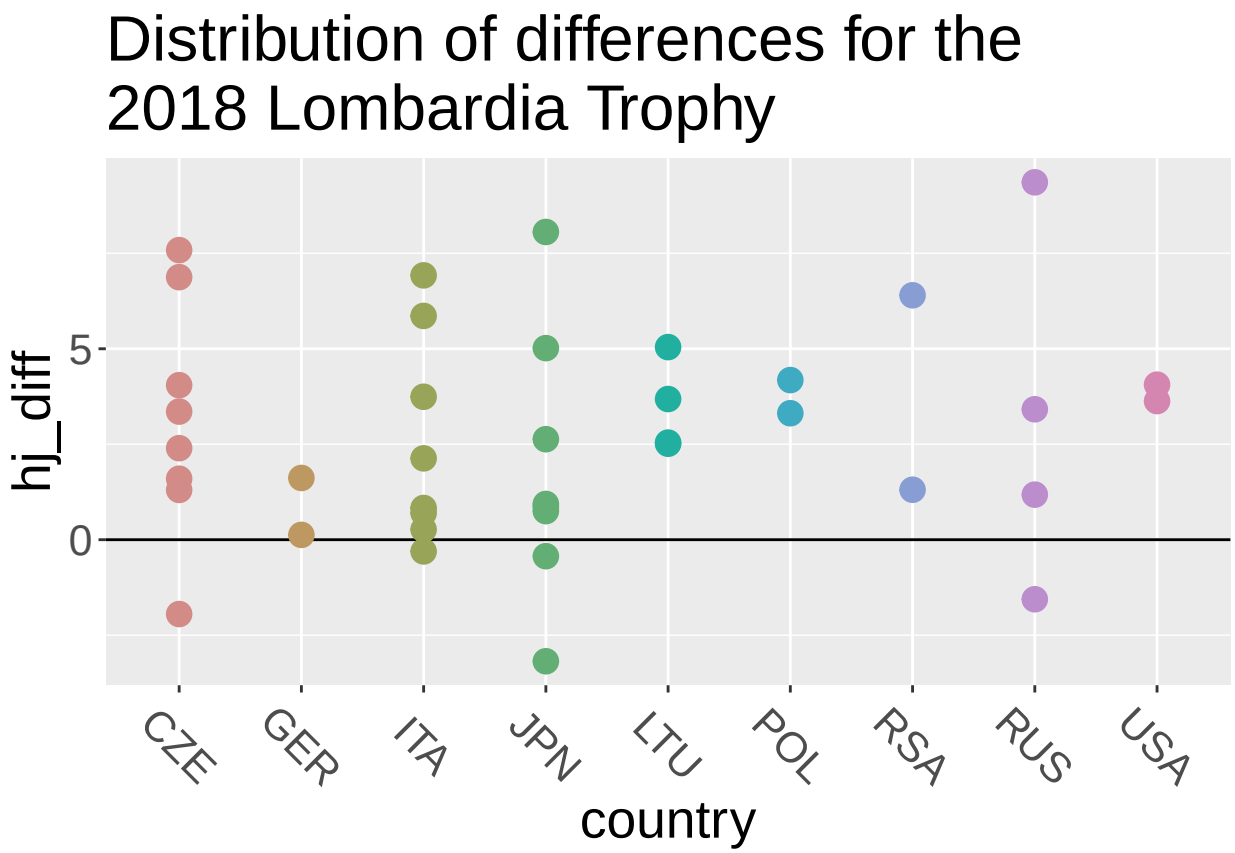
```
##
## [[27]]
```


Distribution of differences for the 2018 Grand Prix Final
hj_diff
7.5
5.0
2.5
0.0
−2.5
CAN
CZE
JPN
KOR
RUS
USA
country

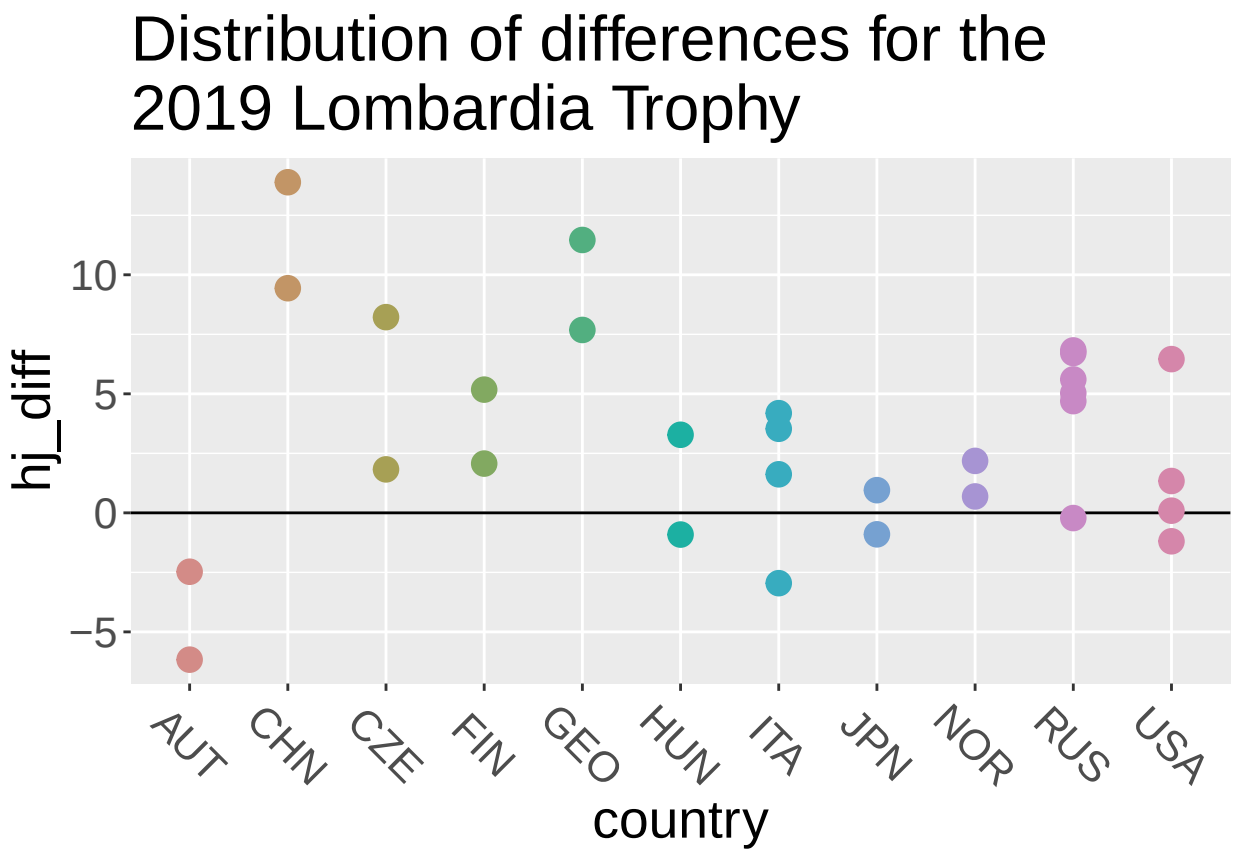
```
##
## [[28]]
```


Distribution of differences for the 2019 Grand Prix Final
hj_diff
15
10
5
0
CHN
FRA
JPN
RUS
USA
country

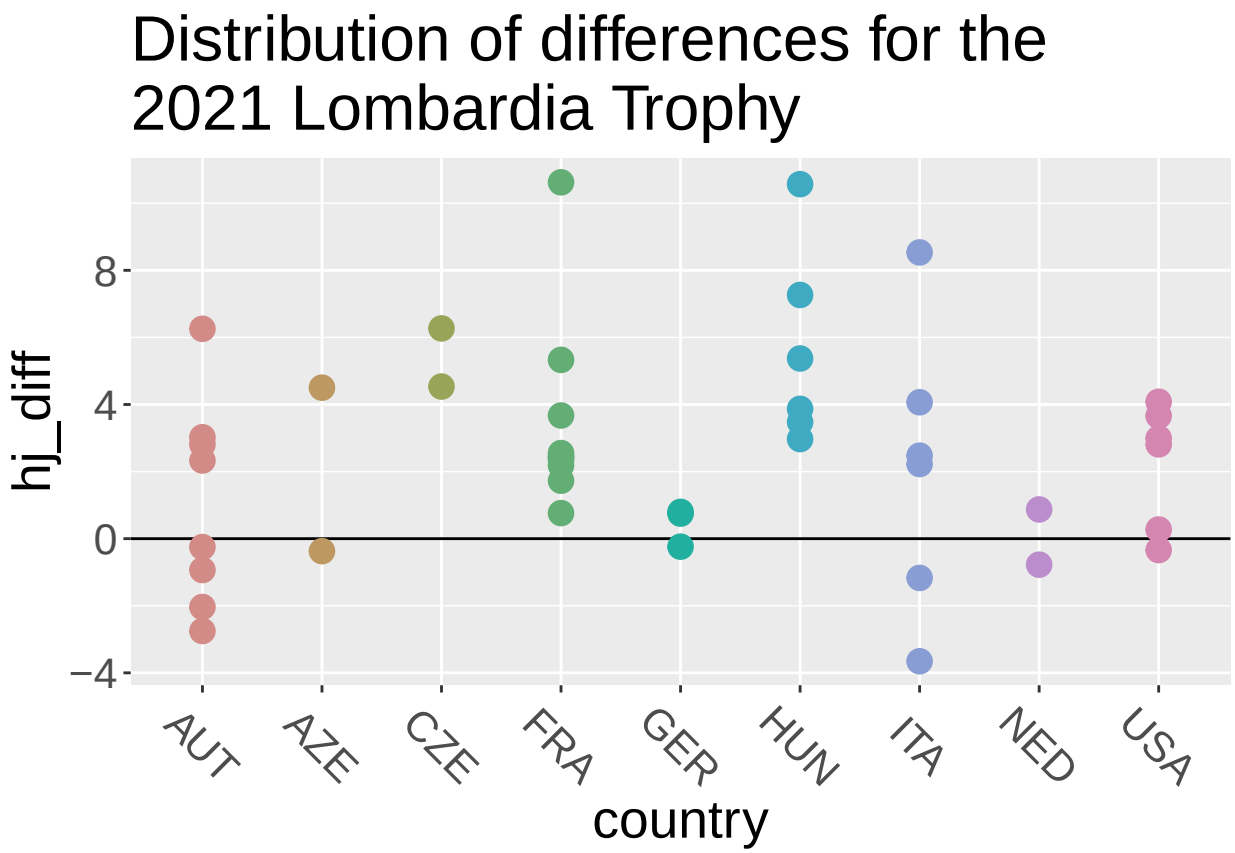
```
##
## [[29]]
```


Distribution of differences for the 2018 Lombardia Trophy
hj_diff
5
0
CZE
GER
ITA
JPN
LTU
POL
RSA
RUS
USA
country

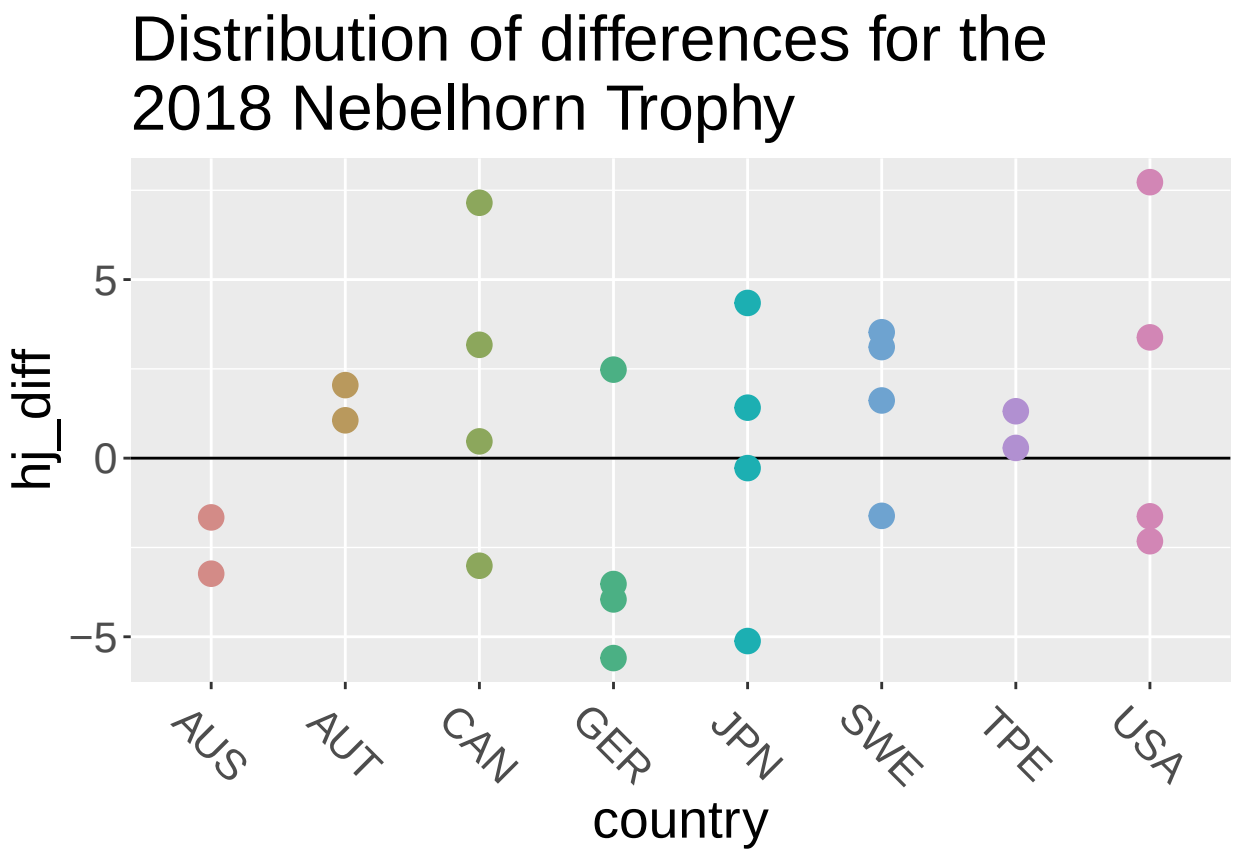
```
##
## [[30]]
```


Distribution of differences for the 2019 Lombardia Trophy
hj_diff
10
5
0
−5
AUT
CHN
CZE
FIN
GEO
HUN
ITA
JPN
NOR
RUS
USA
country

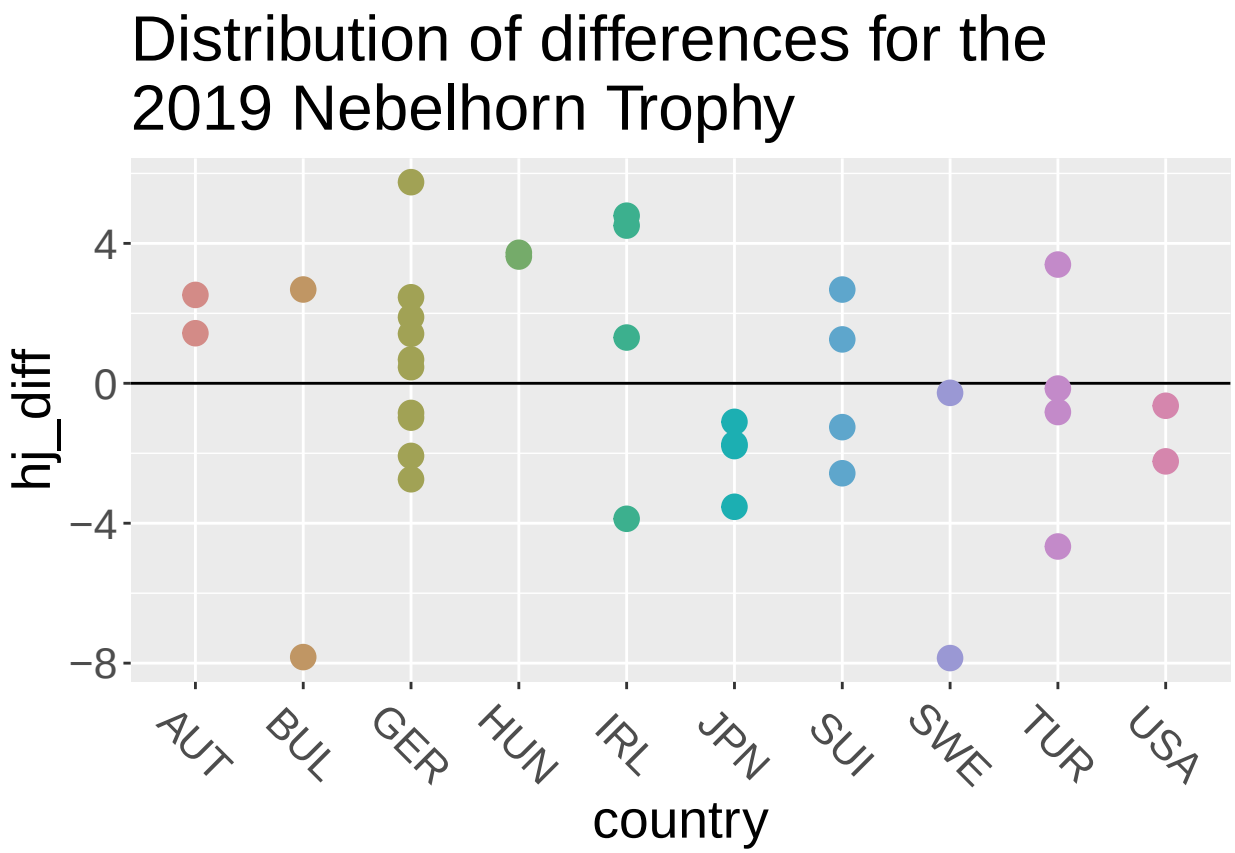
```
##
## [[31]]
```


Distribution of differences for the 2021 Lombardia Trophy
hj_diff
8
4
0
−4
AUT
AZE
CZE
FRA
GER
HUN
ITA
NED
USA
country

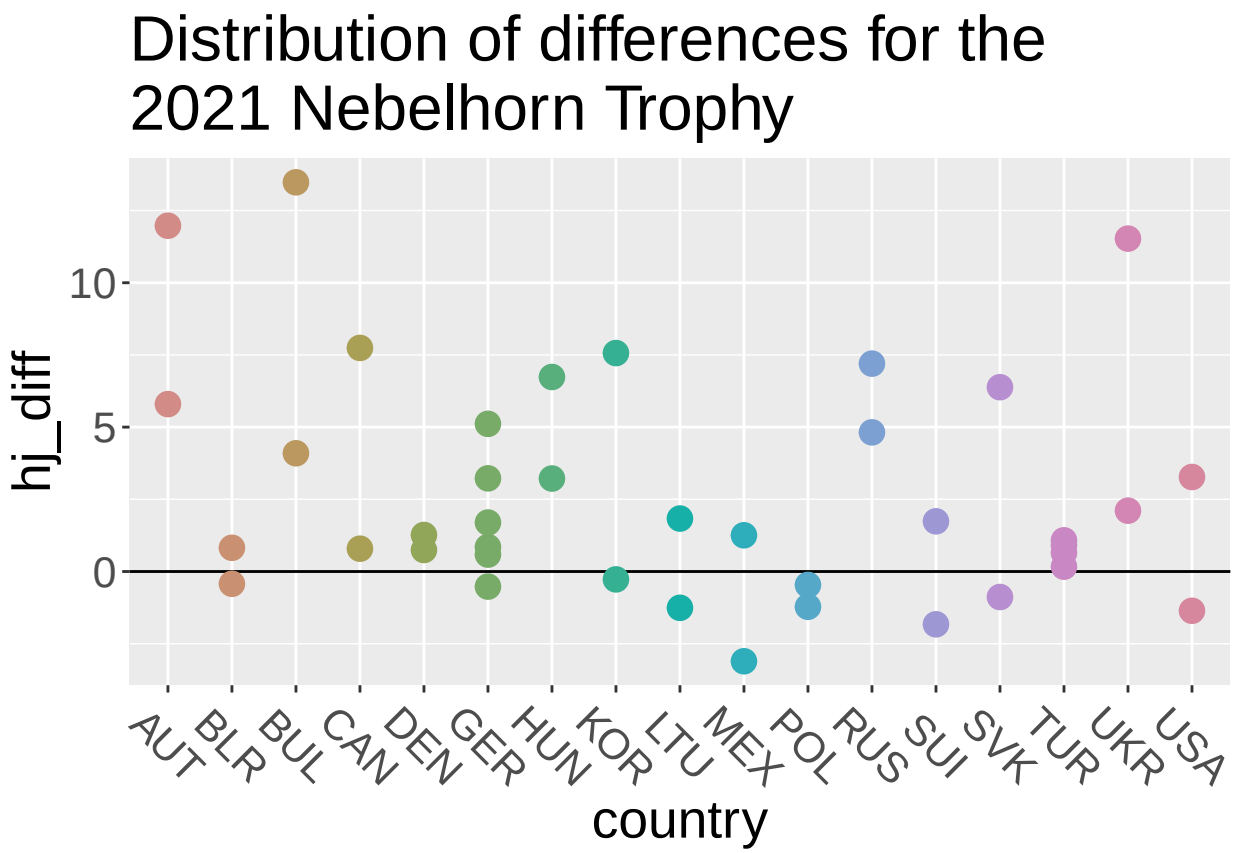
```
##
## [[32]]
```


Distribution of differences for the 2018 Nebelhorn Trophy
hj_diff
5
0
−5
AUS
AUT
CAN
GER
JPN
SWE
TPE
USA
country

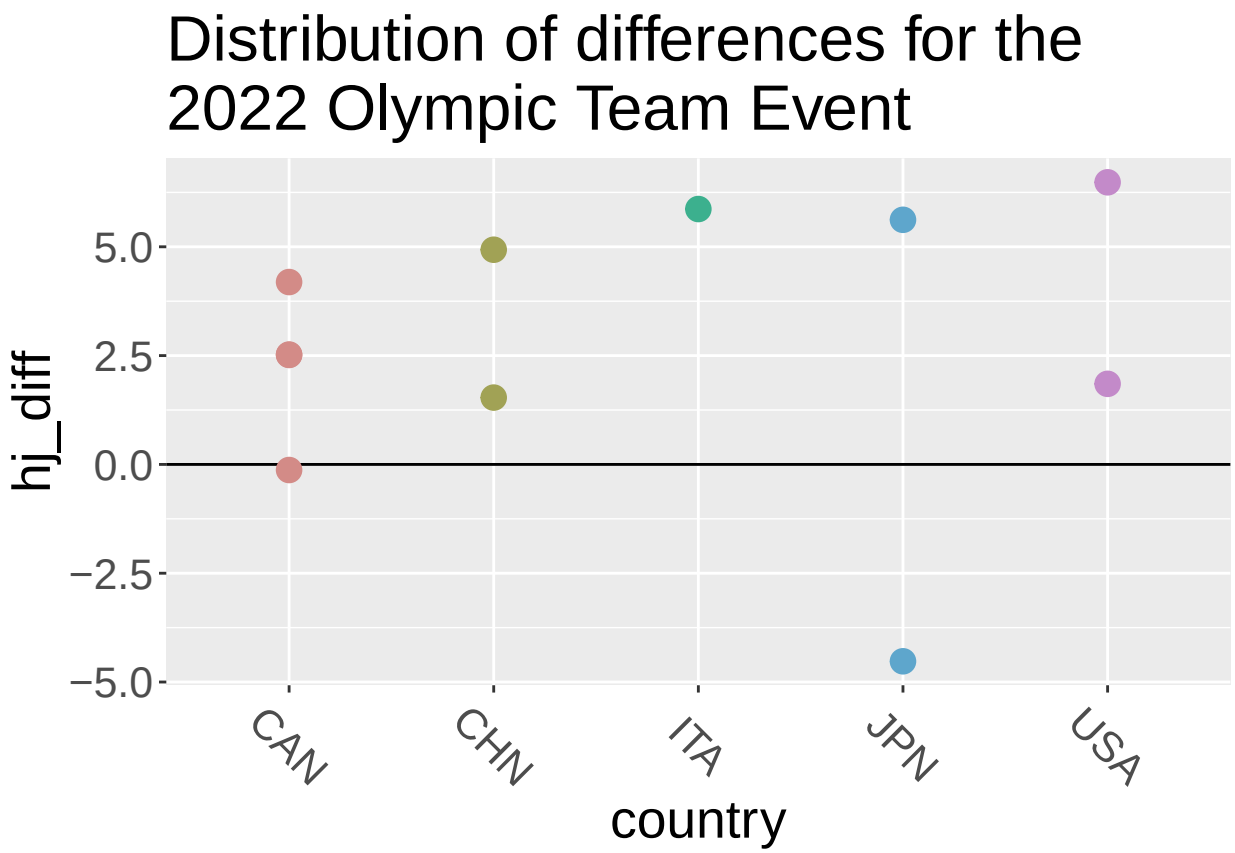
```
##
## [[33]]
```


Distribution of differences for the 2019 Nebelhorn Trophy
hj_diff
4
0
−4
−8
AUT
BUL
GER
HUN
IRL
JPN
SUI
SWE
TUR
USA
country

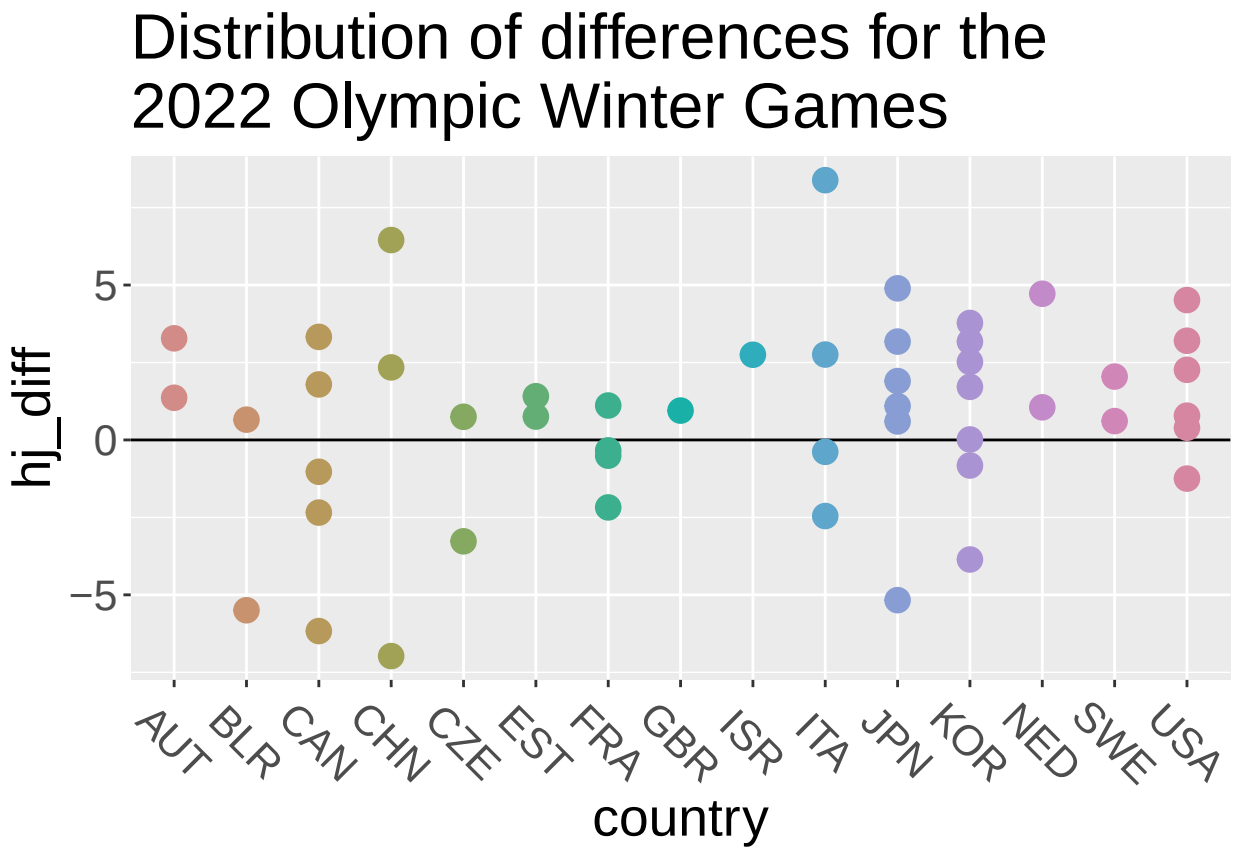
```
##
## [[34]]
```


Distribution of differences for the 2021 Nebelhorn Trophy
hj_diff
10
5
0
AUT
BLR
BUL
CAN
DEN
GER
HUN
KOR
LTU
MEX
POL
RUS
SUI
SVK
TUR
UKR
USA
country

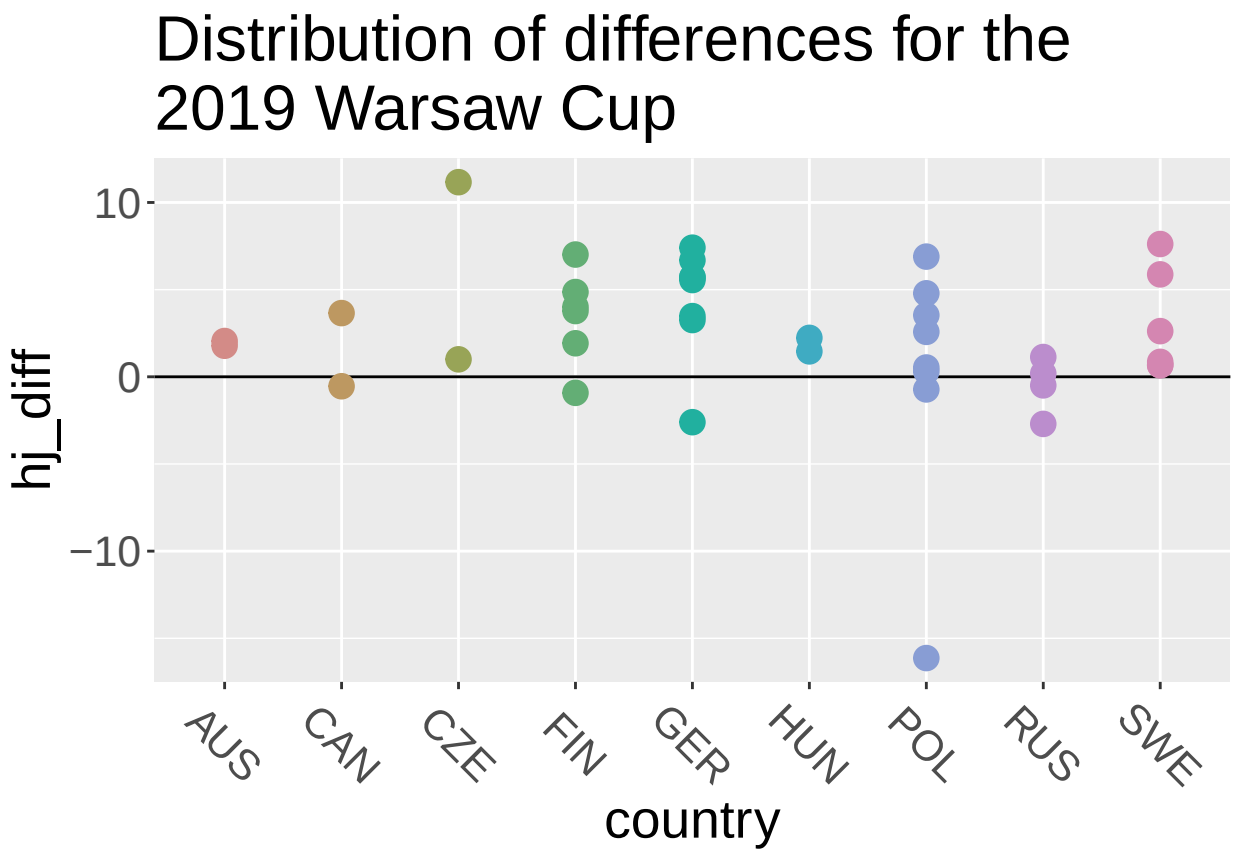
```
##
## [[35]]
```


Distribution of differences for the 2022 Olympic Team Event
hj_diff
5.0
2.5
0.0
−2.5
−5.0
CAN
CHN
ITA
JPN
USA
country

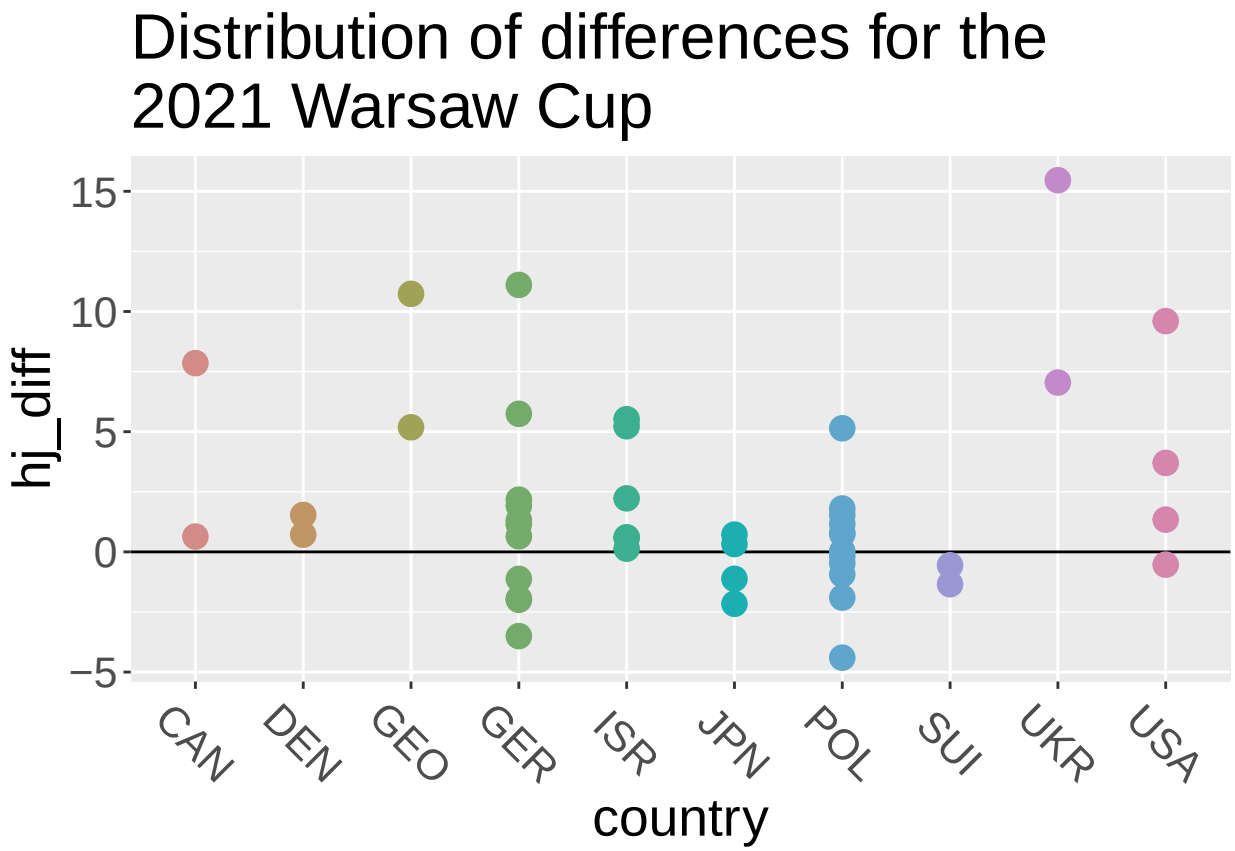
```
##
## [[36]]
```


Distribution of differences for the 2022 Olympic Winter Games
hj_diff
5
0
−5
AUT
BLR
CAN
CHN
CZE
EST
FRA
GBR
ISR
ITA
JPN
KOR
NED
SWE
USA
country

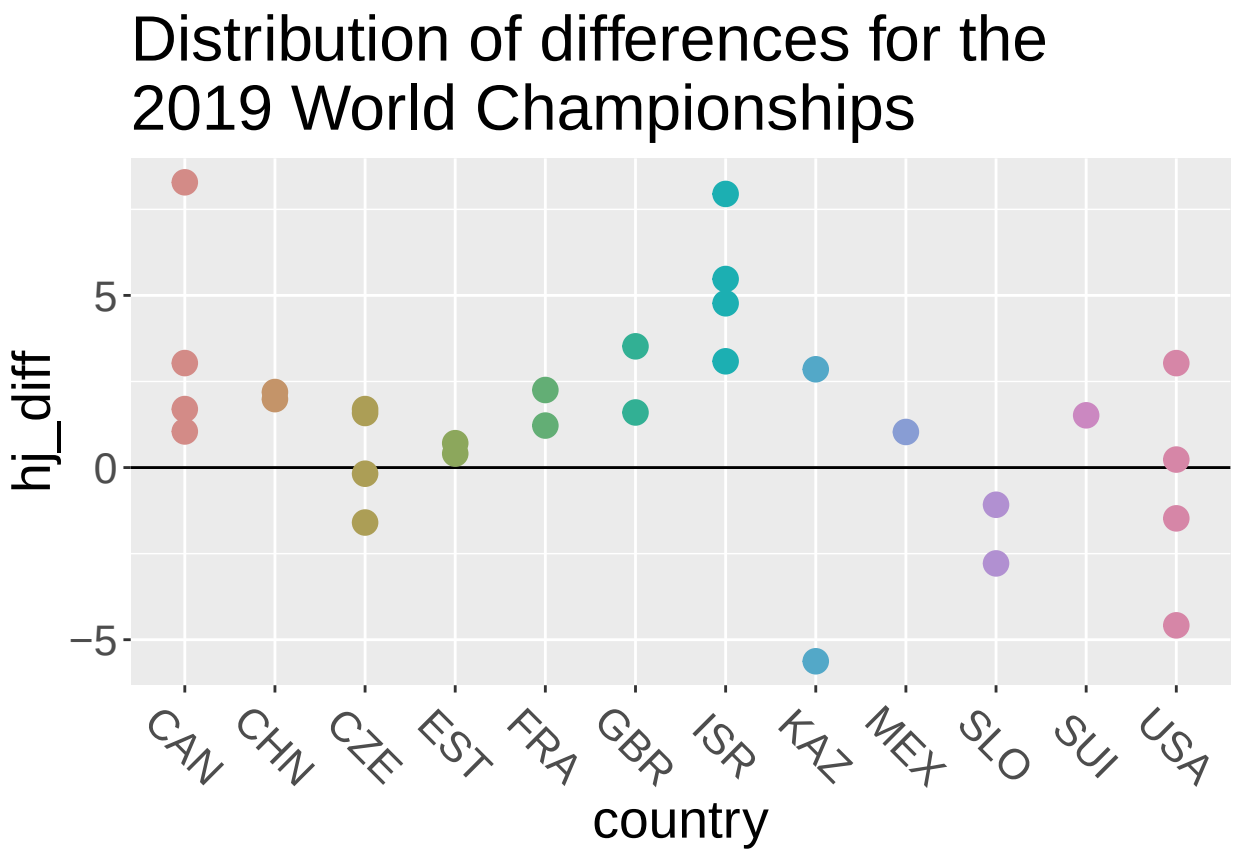
```
##
## [[37]]
```


Distribution of differences for the 2019 Warsaw Cup
hj_diff
10
0
−10
AUS
CAN
CZE
FIN
GER
HUN
POL
RUS
SWE
country

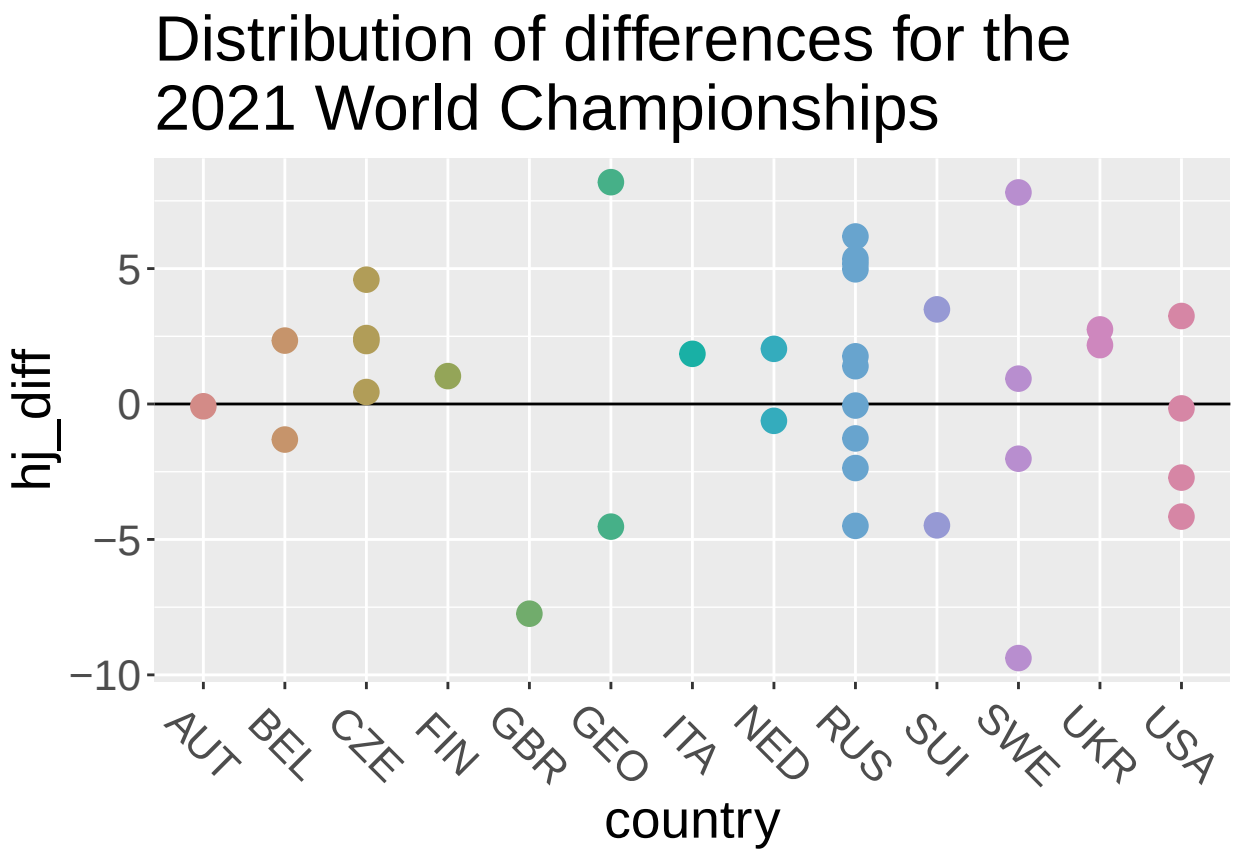
```
##
## [[38]]
```


Distribution of differences for the 2021 Warsaw Cup
hj_diff
15
10
5
0
−5
CAN
DEN
GEO
GER
ISR
JPN
POL
SUI
UKR
USA
country

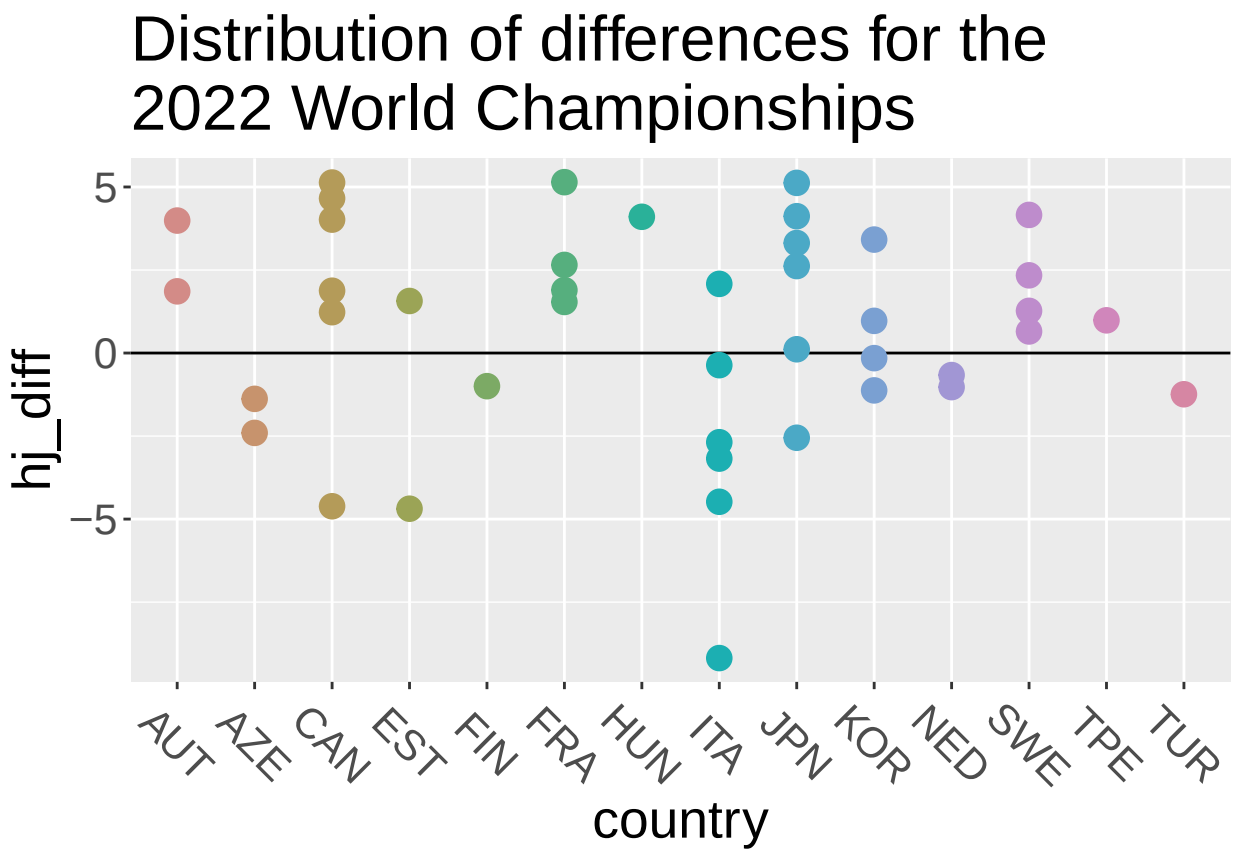
```
##
## [[39]]
```


Distribution of differences for the 2019 World Championships
hj_diff
5
0
−5
CAN
CHN
CZE
EST
FRA
GBR
ISR
KAZ
MEX
SLO
SUI
USA
country

```
##
## [[40]]
```


Distribution of differences for the 2021 World Championships
hj_diff
5
0
−5
−10
AUT
BEL
CZE
FIN
GBR
GEO
ITA
NED
RUS
SUI
SWE
UKR
USA
country

```
##
## [[41]]
```




```
# Functions to get home and away scores for each judge on the panel of an event

# Non-paired permutation test function
new_perm <- function(home, away) {
  n <- length(home)
  all <- c(home, away)
  mean <- mean(home) - mean(away)
  diff <- replicate(10000, {

    # Randomly sample n scores
    home_perm <- sample(all, size = n, replace = FALSE)
    # Remaining unsampled go into other list
    away_perm <- setdiff(all, home_perm)

    mean_diff <- mean(home_perm) - mean(away_perm)
})
  # Determine which hypothesis to test
    if (mean > 0) {
    hypothesis <- "hA = true mean is greater than 0 (overscoring)"
    pval <- mean(diff > mean)
  } else if (mean <= 0) {
    hypothesis <- "hA = true mean is less than 0 (underscoring)"
    pval <- mean(diff <= mean)
  }

  return(list("Permutation test", pval))
```

```
}

# Get the home and away scores for a judge
analyze_judge <- function(segment, judge_num){

  #Gets the difference from the total score (not panel mean)
  bool = segment[,judge_num] == segment[,20]
  home <- segment[,judge_num+9][bool] - segment[,19][bool]
  away <- segment[,judge_num+9][!bool] - segment[,19][!bool]

  return(list(paste0("j_",judge_num), segment[,judge_num][1], home, away))
}

# Run tests on a judge's scores
test_list <- function(judge_scores){

  home <- judge_scores[[3]]
  away <- judge_scores[[4]]

  if (length(home) != 0){
    if (mean(home)-mean(away) > 0){
    wilcox <- wilcox.test(home, away, alternative = "greater")
    }
    else {
    wilcox <- wilcox.test(home, away, alternative = "less")
    }
    perm <- new_perm(home, away)
  }
  else {
    wilcox <- "No home scores to test"
    perm <- "No home scores to test"
  }

  return(list(judge_scores[[1]], judge_scores[[2]], wilcox, perm, c("diff in means", mean(home) -
                                                    mean(away))))
}

# Run tests for each judge on the panel
get_results <- function(segment){

  segment <- segment[c("j1_nat", "j2_nat", "j3_nat", "j4_nat", "j5_nat", "j6_nat",
             "j7_nat", "j8_nat", "j9_nat","j1_total", "j2_total", "j3_total", "j4_total", "j5_total", "

  results <- list()

  for (judge in 1:9) {
    results[[judge]] <- analyze_judge(segment, judge)
  }

  return(list("Individual Judge Analysis", lapply(results, test_list)))
}
```

```r
# Functions to analyze home judge bias by event and segment

run_test <- function(segment) {
  shared_nat <- segment %>% filter(j1_nat == nationality | j2_nat == nationality
                                   | j3_nat == nationality |
                                     j4_nat == nationality |
                                     j5_nat == nationality |
                                     j6_nat == nationality |
                                     j7_nat == nationality |
                                     j8_nat == nationality |
                                     j9_nat == nationality )

  n_obs <- nrow(shared_nat)

  judge_nats <- shared_nat[c("j1_nat", "j2_nat", "j3_nat", "j4_nat", "j5_nat",
                             "j6_nat", "j7_nat", "j8_nat", "j9_nat","j1_total",
                             "j2_total", "j3_total", "j4_total", "j5_total",
                             "j6_total", "j7_total", "j8_total", "j9_total",
                             "nationality")]

  panel_scores <- shared_nat[c("j1_total", "j2_total", "j3_total", "j4_total",
                               "j5_total", "j6_total", "j7_total", "j8_total",
                               "j9_total")]

  home_judge <- apply(judge_nats, 1, find_home)
  home_judge <- as.numeric(unlist(home_judge))

  panel_scores["home"] = home_judge

  panel_mean <- apply(panel_scores, 1, find_mean)

  # Data frame for the differences between the home judge and mean of the others
  diffs <- data.frame(diff = home_judge - panel_mean)
  # solely for visualization purposes
  diffs$index <- 1:nrow(diffs)
  diffs$sign <- ifelse(diffs$diff > 0, "positive", "negative")

  # mean difference for all singles observations
  mean_diffs <- mean(diffs$diff, na.rm = TRUE)

  st_dev <- sd(diffs$diff, na.rm = TRUE)

  # Decide which hypothesis to use for wilcoxon test
  if (mean_diffs > 0) {
    w_test <- wilcox.test(home_judge, panel_mean, paired = TRUE, alternative = "greater")
  } else if (mean_diffs <= 0) {
    w_test <- wilcox.test(home_judge, panel_mean, paired = TRUE, alternative = "less")
  }

  # Paired Permutation test
  perm_test <- paired_perm(diffs, n_obs, mean_diffs, segment$event_name[1],
                           segment$event_year[1], paste0("from panel mean, ",
                          segment$discipline[1]), segment$segment[1])
```

```
  # Confidence interval for true mean difference
  confidence <- boot(diffs, n_obs, segment$event_name[1], segment$event_year[1],
                     paste0("from total, ", segment$discipline[1]),
                     segment$segment[1])

  # Histogram with each observed difference
  h1 <- ggplot(diffs, aes(x= index, y=diff)) + geom_col(aes(fill = sign)) +
    xlab("Observation") + ylab("Difference") +
    ggtitle(paste0("HJ score vs. Panel Mean for ", segment$discipline[1], " ",
                   segment$segment[1], " at ", segment$event_year[1], " ",
                   segment$event_name[1])) +
    scale_x_continuous(breaks = seq(0, max(diffs$index), 1))

  output <- list(c(segment$discipline[1], segment$segment[1], "# of Obs.",
                   n_obs, "Standard Deviation of Observations", st_dev), w_test,
                 c("Permuation Test p-value", perm_test),
                 c("Bootstrap Confidence Interval",
                   confidence[c(1,2)], "MOE", as.numeric(confidence[3])/2),
                 h1, get_results(segment))

  return(output)
}
```

```
analyze_event <- function(name, year) {

  # Filter for specific event only
  event <- skating %>%
    filter(event_year == year & event_name == name)

  # Filter for distinct skater/judge country matches
  filtered <- event %>% filter(j1_nat == nationality | j2_nat == nationality
                                   | j3_nat == nationality |
                                     j4_nat == nationality |
                                     j5_nat == nationality |
                                     j6_nat == nationality |
                                     j7_nat == nationality |
                                     j8_nat == nationality |
                                     j9_nat == nationality ) %>%
    filter(discipline == "Mens" | discipline == "Womens") %>%
    distinct(skater, .keep_all = TRUE)

  nats <- as.data.frame(table(filtered$nationality)) %>%
    rename(Nationality = Var1)

  # Histogram for frequencies of home judge occurrences on the panel
  h1 <- ggplot(nats, aes(x = Nationality, y = Freq)) +
    geom_bar(stat = "identity", aes(fill = Nationality)) +
    scale_y_continuous(breaks = seq(0, max(nats$Freq), 2), limits = c(0,6)) +
    scale_fill_hue(c = 50) + theme(legend.position="none") +
    ggtitle(paste0("Home Judge Occurrences for \n", year, " ", name)) +
    theme(text = element_text(size = 20),
          axis.text.x = element_text(angle = -45, vjust = 0.5, hjust=0.5))
```

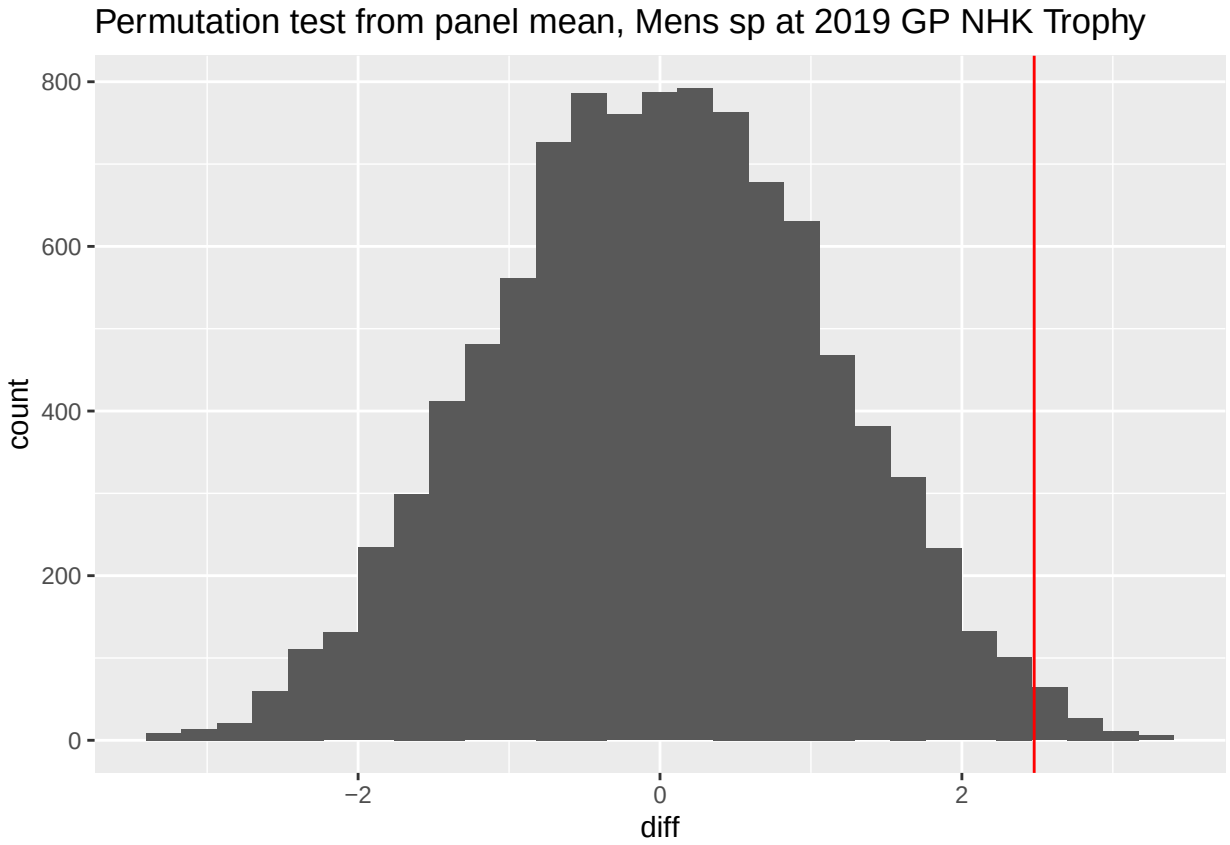
```
  # Separate into the four segments
  mens_sp <- event %>%
    filter(discipline == "Mens", segment == "sp")
  womens_sp <- event %>%
    filter(discipline == "Womens", segment == "sp")
  mens_fp <- event %>%
    filter(discipline == "Mens", segment == "fp")
  womens_fp <- event %>%
    filter(discipline == "Womens", segment == "fp")

  segments <- list(mens_sp,womens_sp,mens_fp,womens_fp)

  return(list(paste0("Results for ", year, " ", name),
              lapply(segments, run_test), h1))
}
```

```
results <- analyze_event("GP NHK Trophy", "2019")
```

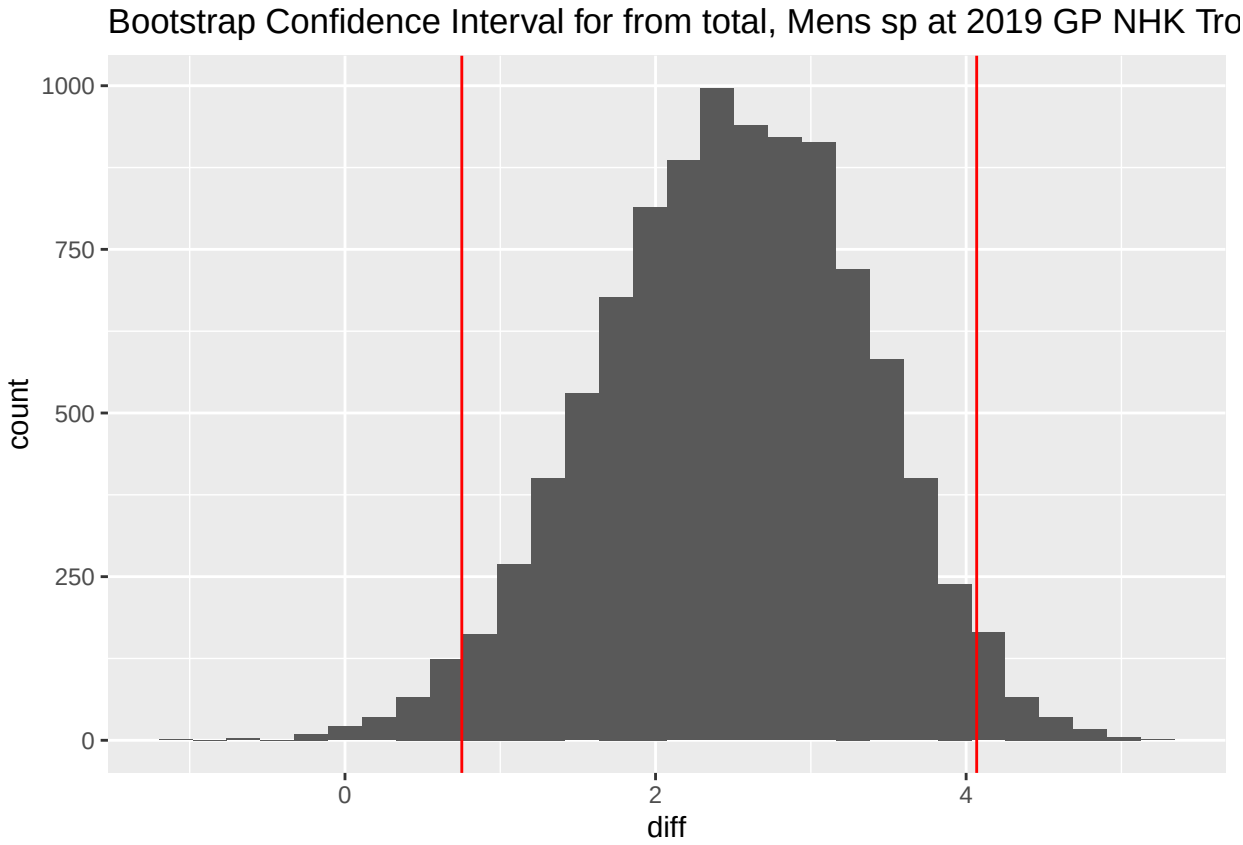
```
## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties
```

```
results
```

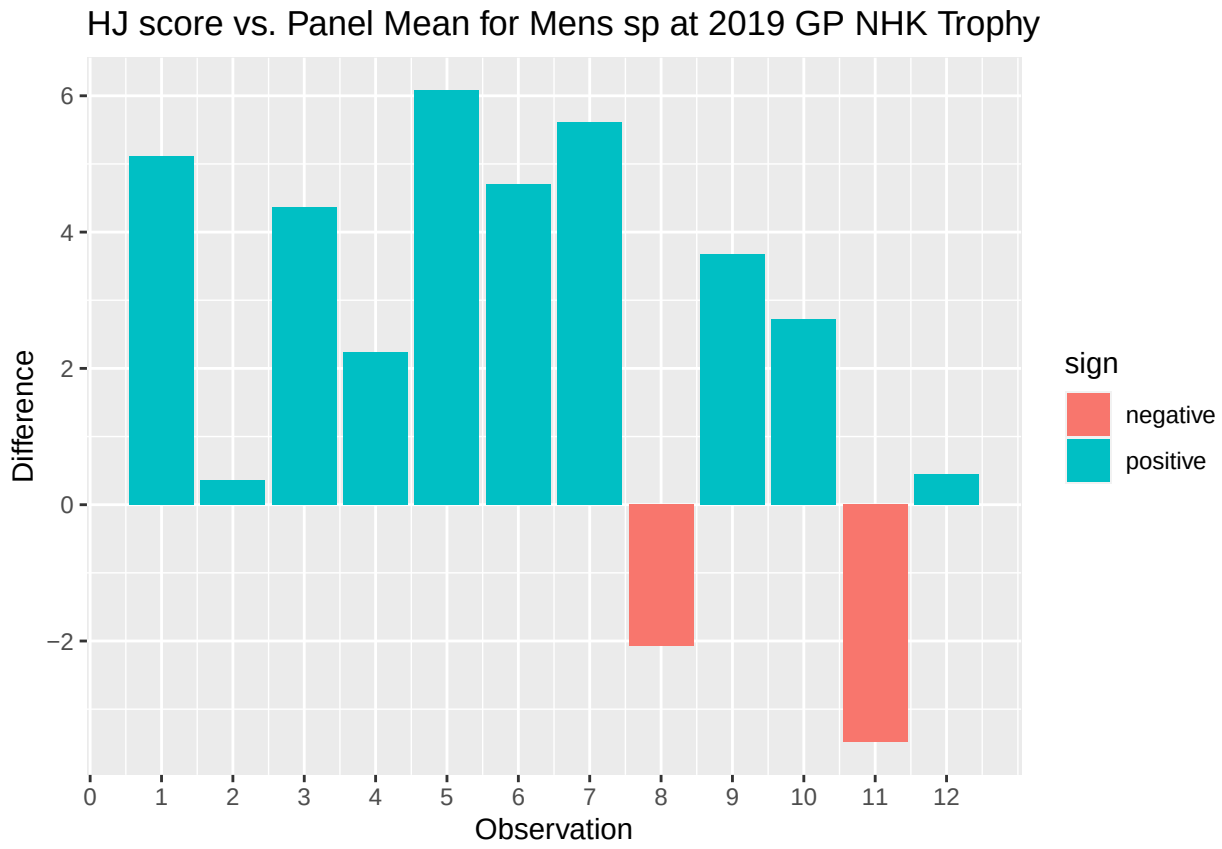
```
## [[1]]
## [1] "Results for 2019 GP NHK Trophy"
##
## [[2]]
## [[2]][[1]]
## [[2]][[1]][[1]]
## [1] "Mens"                                "sp"
## [3] "# of Obs."                           "12"
## [5] "Standard Deviation of Observations" "3.08513135279767"
##
## [[2]][[1]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 69, p-value = 0.008057
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[3]]
## [[2]][[1]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[1]][[3]][[2]]
```




```
##
## [[2]][[1]][[3]][[3]]
## [1] 0.0102
##
## [[2]][[1]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[1]][[4]]
## [[2]][[1]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[1]][[4]][[2]]
```




```
##
## [[2]][[1]][[4]][[3]]
## [1] 0.7522891 4.0679896
##
## [[2]][[1]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[1]][[4]][[5]]
## [1] 1.65785
##
##
## [[2]][[1]][[5]]
```




```
##
## [[2]][[1]][[6]]
## [[2]][[1]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[1]][[6]][[2]]
## [[2]][[1]][[6]][[2]][[1]]
## [[2]][[1]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[1]][[6]][[2]][[1]][[2]]
## [1] "AUS"
##
## [[2]][[1]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[1]][[6]][[2]][[2]]
## [[2]][[1]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

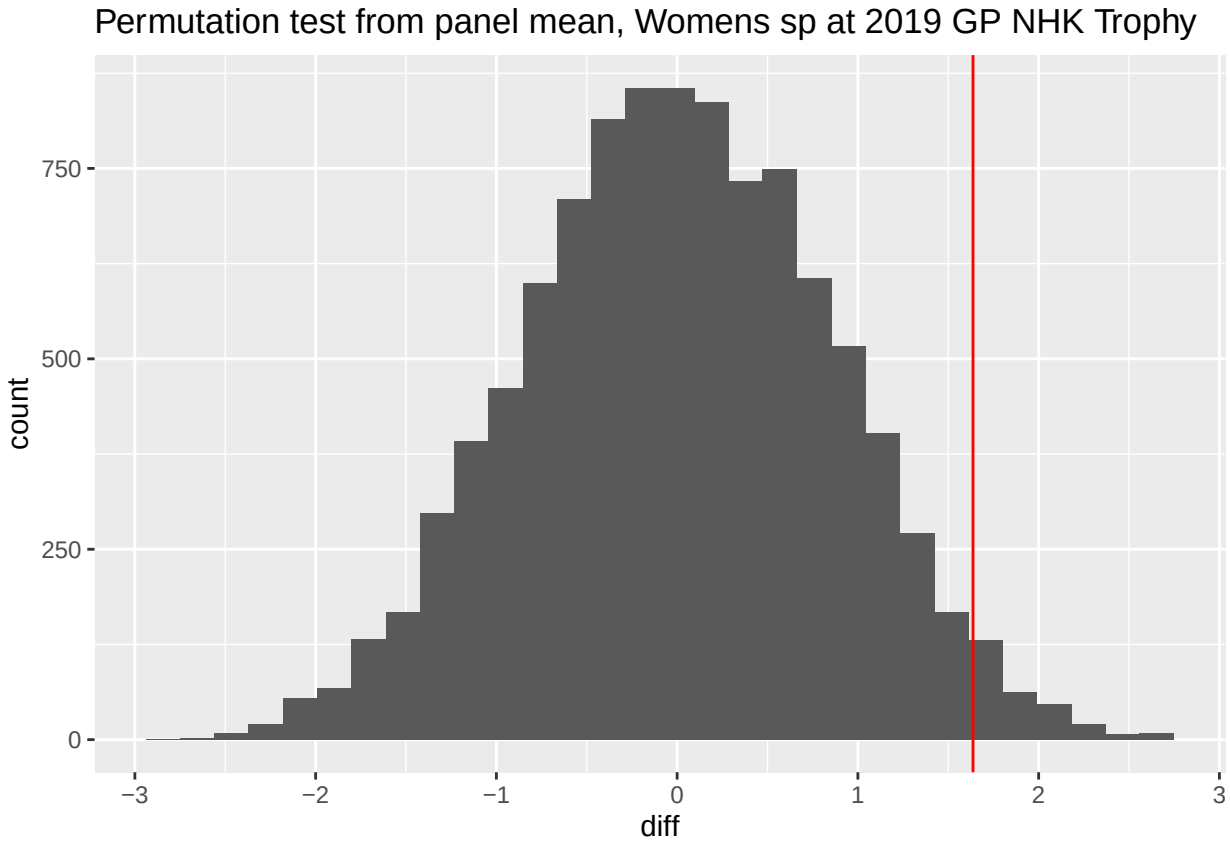
```
##
## [[2]][[1]][[6]][[2]][[2]][[2]]
## [1] "ISR"
##
## [[2]][[1]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 6, p-value = 0.5833
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[1]][[6]][[2]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.587
##
##
## [[2]][[1]][[6]][[2]][[2]][[5]]
## [1] "diff in means"      "-0.209999999999998"
##
##
## [[2]][[1]][[6]][[2]][[3]]
## [[2]][[1]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[1]][[6]][[2]][[3]][[2]]
## [1] "RUS"
##
## [[2]][[1]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 19, p-value = 0.1864
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[3]][[4]]
## [[2]][[1]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.1917
##
##
## [[2]][[1]][[6]][[2]][[3]][[5]]
## [1] "diff in means"    "1.24222222222222"
##
##
## [[2]][[1]][[6]][[2]][[4]]
```

```
## [[2]][[1]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[1]][[6]][[2]][[4]][[2]]
## [1] "USA"
##
## [[2]][[1]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 5, p-value = 0.1818
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[1]][[6]][[2]][[4]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.1944
##
##
## [[2]][[1]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "-1.62000000000001"
##
##
## [[2]][[1]][[6]][[2]][[5]]
## [[2]][[1]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[1]][[6]][[2]][[5]][[2]]
## [1] "CAN"
##
## [[2]][[1]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 20, p-value = 0.01515
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[5]][[4]]
## [[2]][[1]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[5]][[4]][[2]]
## [1] 0
##
##
## [[2]][[1]][[6]][[2]][[5]][[5]]
## [1] "diff in means" "3.099"
##
```

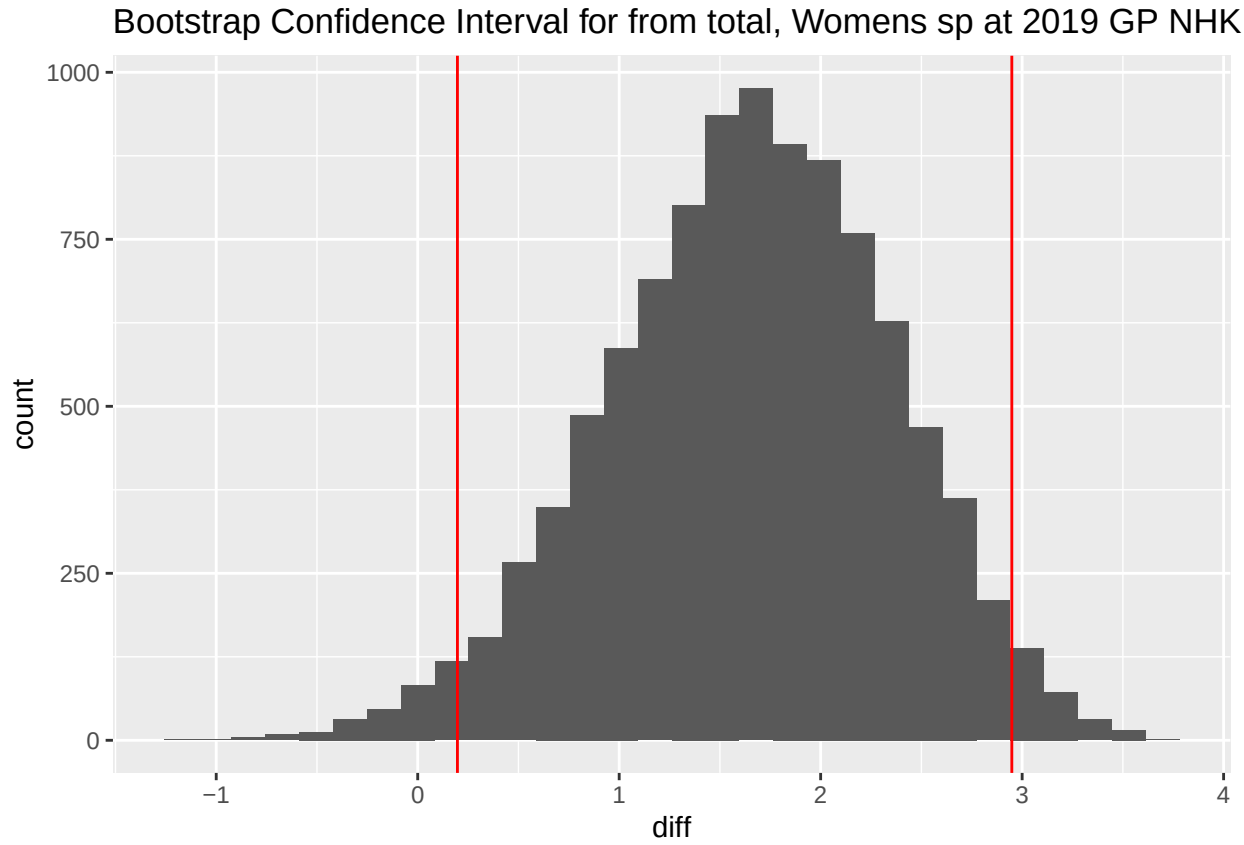
```
##
## [[2]][[1]][[6]][[2]][[6]]
## [[2]][[1]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[1]][[6]][[2]][[6]][[2]]
## [1] "GER"
##
## [[2]][[1]][[6]][[2]][[6]][[3]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[6]][[4]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[6]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[1]][[6]][[2]][[7]]
## [[2]][[1]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[1]][[6]][[2]][[7]][[2]]
## [1] "JPN"
##
## [[2]][[1]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 27, p-value = 0.004545
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[7]][[4]]
## [[2]][[1]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[7]][[4]][[2]]
## [1] 0
##
##
## [[2]][[1]][[6]][[2]][[7]][[5]]
## [1] "diff in means" "3.38"
##
##
## [[2]][[1]][[6]][[2]][[8]]
## [[2]][[1]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[1]][[6]][[2]][[8]][[2]]
## [1] "ITA"
##
## [[2]][[1]][[6]][[2]][[8]][[3]]
```

```
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[8]][[4]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[8]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[1]][[6]][[2]][[9]]
## [[2]][[1]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[1]][[6]][[2]][[9]][[2]]
## [1] "FRA"
##
## [[2]][[1]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 8, p-value = 0.3333
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[9]][[4]]
## [[2]][[1]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.2521
##
##
## [[2]][[1]][[6]][[2]][[9]][[5]]
## [1] "diff in means"    "1.79818181818182"
##
##
##
##
##
## [[2]][[2]]
## [[2]][[2]][[1]]
## [1] "Womens"                             "sp"
## [3] "# of Obs."                          "12"
## [5] "Standard Deviation of Observations" "2.55790771987754"
##
## [[2]][[2]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 66, p-value = 0.01709
## alternative hypothesis: true location shift is greater than 0
##
```

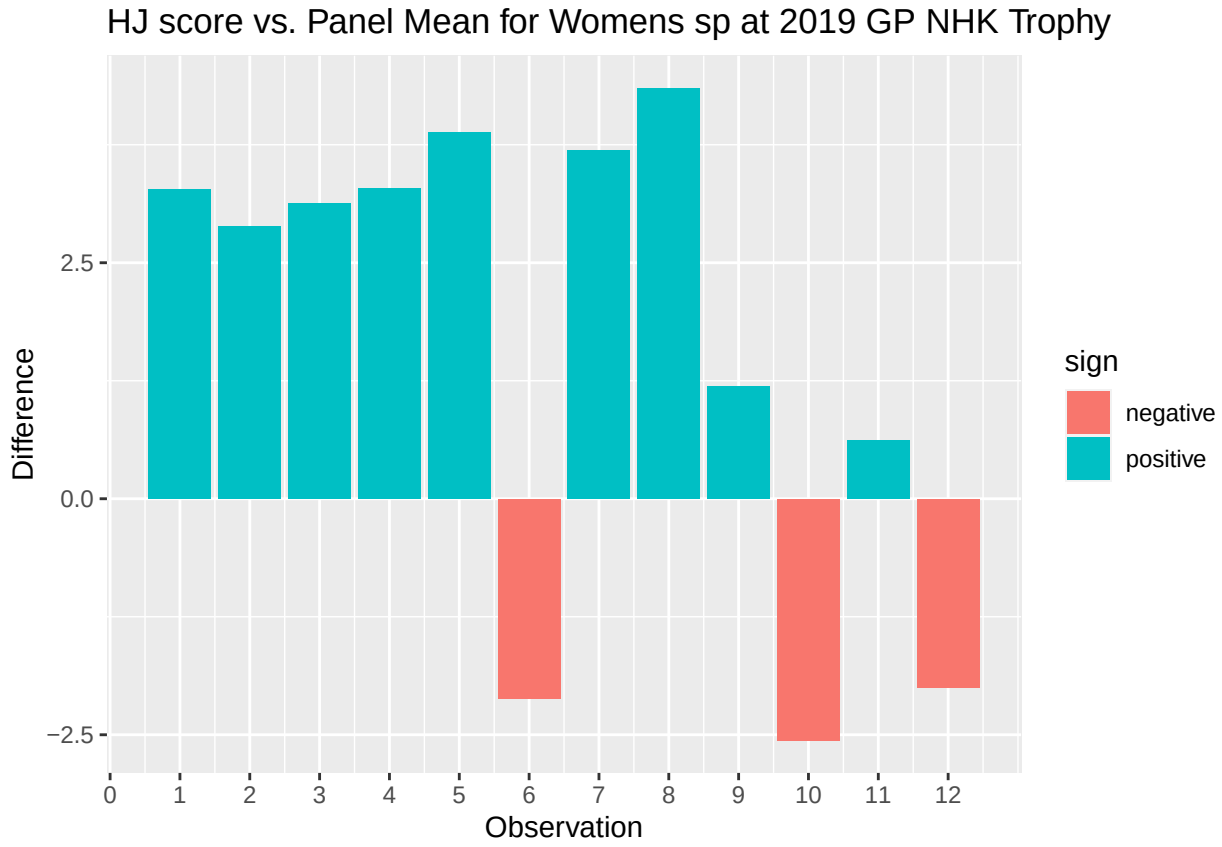
```
##
## [[2]][[2]][[3]]
## [[2]][[2]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[2]][[3]][[2]]
```




```
##
## [[2]][[2]][[3]][[3]]
## [1] 0.0257
##
## [[2]][[2]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[2]][[4]]
## [[2]][[2]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[2]][[4]][[2]]
```




```
##
## [[2]][[2]][[4]][[3]]
## [1] 0.1970547 2.9488568
##
## [[2]][[2]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[2]][[4]][[5]]
## [1] 1.375901
##
##
## [[2]][[2]][[5]]
```




```
##
## [[2]][[2]][[6]]
## [[2]][[2]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[2]][[6]][[2]]
## [[2]][[2]][[6]][[2]][[1]]
## [[2]][[2]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[2]][[6]][[2]][[1]][[2]]
## [1] "CAN"
##
## [[2]][[2]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[2]][[6]][[2]][[2]]
## [[2]][[2]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

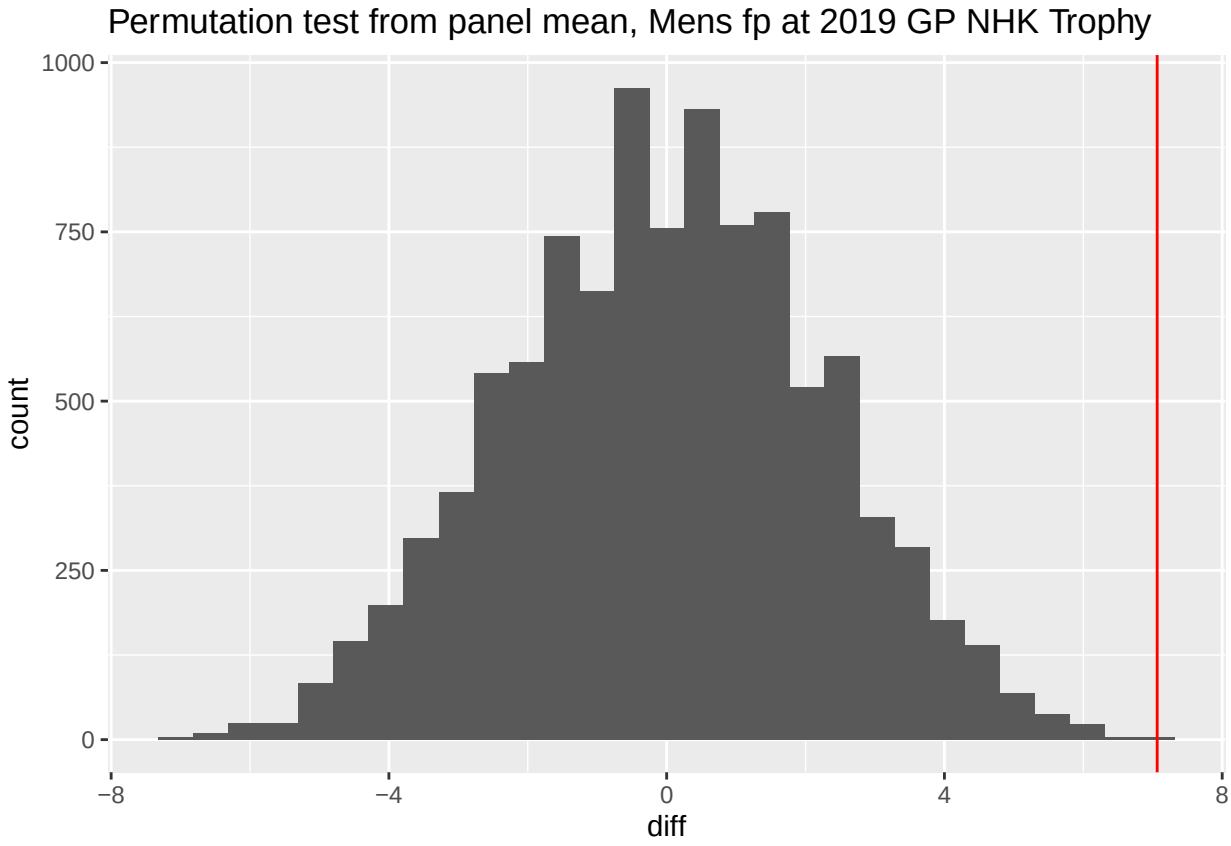
```
##
## [[2]][[2]][[6]][[2]][[2]][[2]]
## [1] "JPN"
##
## [[2]][[2]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 23, p-value = 0.05
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[2]][[4]]
## [[2]][[2]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.0602
##
##
## [[2]][[2]][[6]][[2]][[2]][[5]]
## [1] "diff in means"    "1.69222222222222"
##
##
## [[2]][[2]][[6]][[2]][[3]]
## [[2]][[2]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[2]][[6]][[2]][[3]][[2]]
## [1] "AUS"
##
## [[2]][[2]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 4, p-value = 0.4167
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[2]][[6]][[2]][[3]][[4]]
## [[2]][[2]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.4184
##
##
## [[2]][[2]][[6]][[2]][[3]][[5]]
## [1] "diff in means"      "-0.667272727272726"
##
##
## [[2]][[2]][[6]][[2]][[4]]
```

```
## [[2]][[2]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[2]][[6]][[2]][[4]][[2]]
## [1] "USA"
##
## [[2]][[2]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 17, p-value = 0.3
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[4]][[4]]
## [[2]][[2]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.3064
##
##
## [[2]][[2]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "0.866666666666669"
##
##
## [[2]][[2]][[6]][[2]][[5]]
## [[2]][[2]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[2]][[6]][[2]][[5]][[2]]
## [1] "RUS"
##
## [[2]][[2]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 27, p-value = 0.004545
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[5]][[4]]
## [[2]][[2]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[5]][[4]][[2]]
## [1] 0
##
##
## [[2]][[2]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "2.83222222222222"
##
```

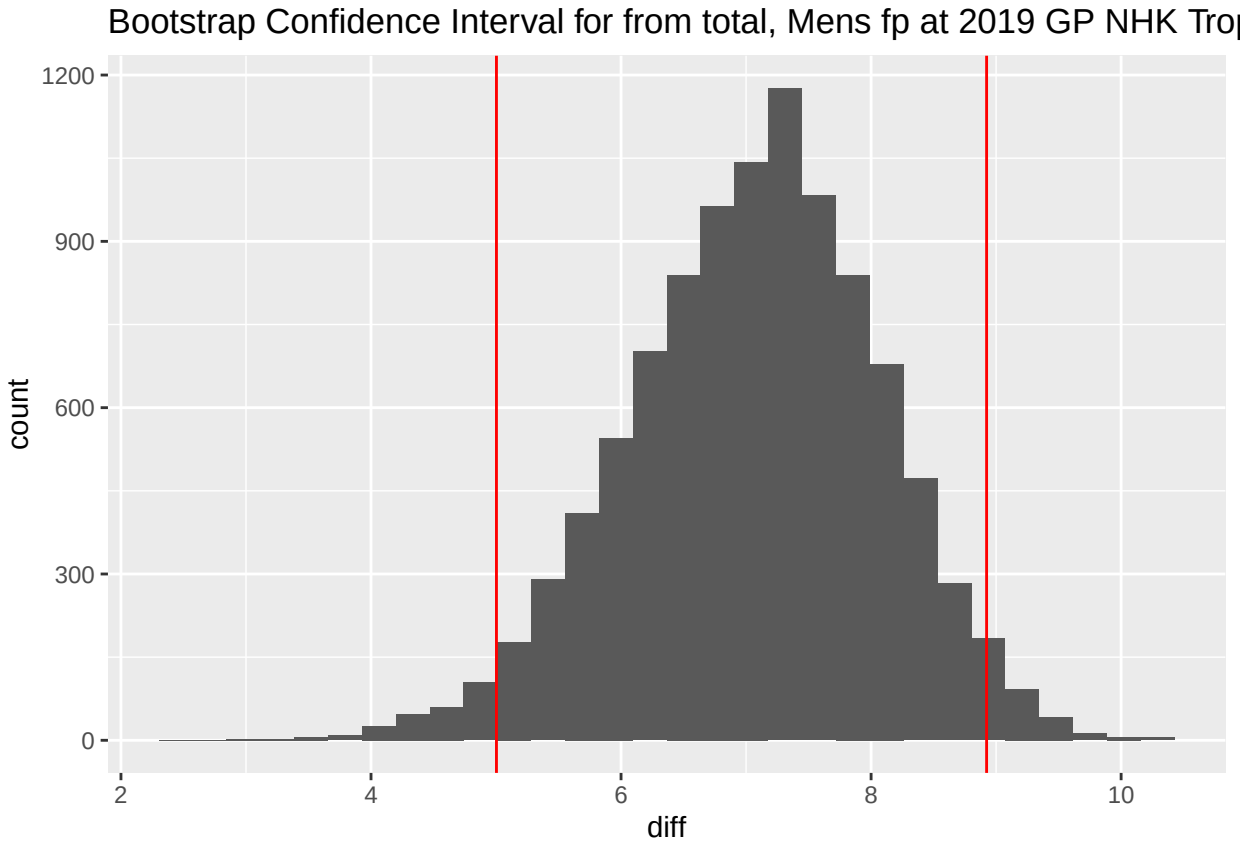
```
##
## [[2]][[2]][[6]][[2]][[6]]
## [[2]][[2]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[2]][[6]][[2]][[6]][[2]]
## [1] "CHN"
##
## [[2]][[2]][[6]][[2]][[6]][[3]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[6]][[4]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[6]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[2]][[6]][[2]][[7]]
## [[2]][[2]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[2]][[6]][[2]][[7]][[2]]
## [1] "FRA"
##
## [[2]][[2]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 10, p-value = 0.1667
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[7]][[4]]
## [[2]][[2]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.0898
##
##
## [[2]][[2]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "2.22181818181818"
##
##
## [[2]][[2]][[6]][[2]][[8]]
## [[2]][[2]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[2]][[6]][[2]][[8]][[2]]
## [1] "FIN"
##
## [[2]][[2]][[6]][[2]][[8]][[3]]
```

```
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[8]][[4]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[8]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[2]][[6]][[2]][[9]]
## [[2]][[2]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[2]][[6]][[2]][[9]][[2]]
## [1] "KOR"
##
## [[2]][[2]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 1, p-value = 0.1667
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[2]][[6]][[2]][[9]][[4]]
## [[2]][[2]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.1696
##
##
## [[2]][[2]][[6]][[2]][[9]][[5]]
## [1] "diff in means" "-1.18"
##
##
##
##
##
## [[2]][[3]]
## [[2]][[3]][[1]]
## [1] "Mens"                                "fp"
## [3] "# of Obs."                           "12"
## [5] "Standard Deviation of Observations" "3.62916953910403"
##
## [[2]][[3]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 77, p-value = 0.0004883
## alternative hypothesis: true location shift is greater than 0
##
```

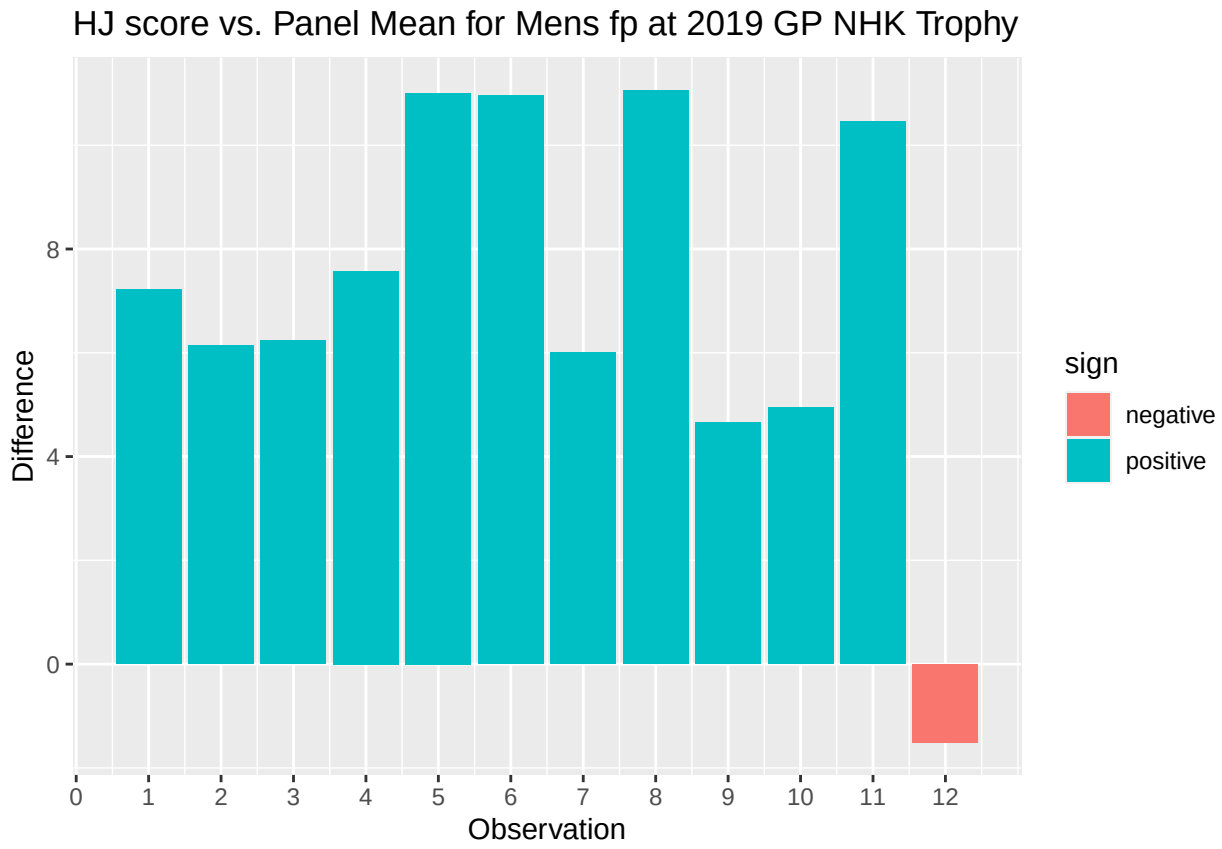
```
##
## [[2]][[3]][[3]]
## [[2]][[3]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[3]][[3]][[2]]
```




```
##
## [[2]][[3]][[3]][[3]]
## [1] 3e-04
##
## [[2]][[3]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[3]][[4]]
## [[2]][[3]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[3]][[4]][[2]]
```




```
##
## [[2]][[3]][[4]][[3]]
## [1] 5.003477 8.924010
##
## [[2]][[3]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[3]][[4]][[5]]
## [1] 1.960267
##
##
## [[2]][[3]][[5]]
```




```
##
## [[2]][[3]][[6]]
## [[2]][[3]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[3]][[6]][[2]]
## [[2]][[3]][[6]][[2]][[1]]
## [[2]][[3]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[3]][[6]][[2]][[1]][[2]]
## [1] "AUS"
##
## [[2]][[3]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[2]]
## [[2]][[3]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

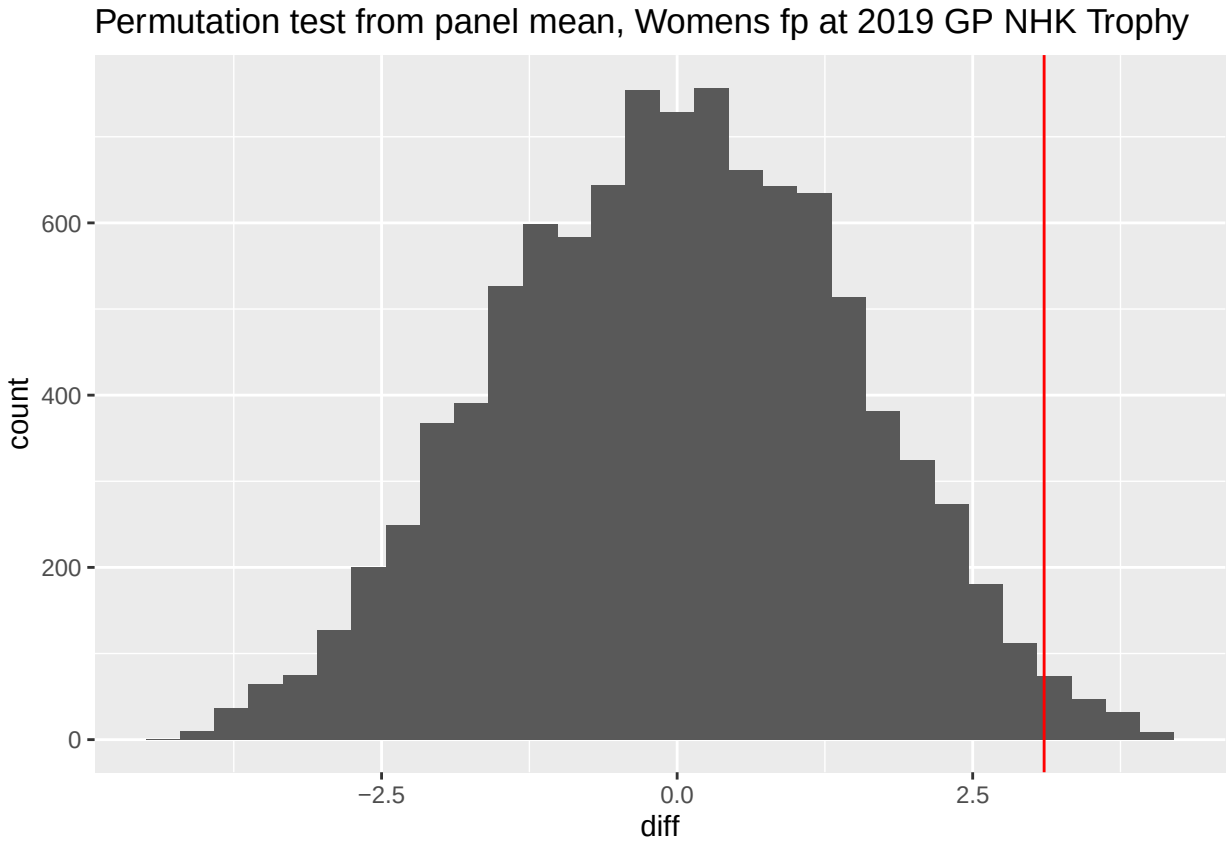
```
##
## [[2]][[3]][[6]][[2]][[2]][[2]]
## [1] "ISR"
##
## [[2]][[3]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 11, p-value = 0.08333
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[2]][[4]]
## [[2]][[3]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[2]][[4]][[2]]
## [1] 0
##
##
## [[2]][[3]][[6]][[2]][[2]][[5]]
## [1] "diff in means"   "7.0590909090909"
##
##
## [[2]][[3]][[6]][[2]][[3]]
## [[2]][[3]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[3]][[6]][[2]][[3]][[2]]
## [1] "RUS"
##
## [[2]][[3]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 21, p-value = 0.1045
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[3]][[4]]
## [[2]][[3]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.1031
##
##
## [[2]][[3]][[6]][[2]][[3]][[5]]
## [1] "diff in means"    "3.62555555555556"
##
##
## [[2]][[3]][[6]][[2]][[4]]
```

```
## [[2]][[3]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[3]][[6]][[2]][[4]][[2]]
## [1] "USA"
##
## [[2]][[3]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 18, p-value = 0.06061
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[4]][[4]]
## [[2]][[3]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.0774
##
##
## [[2]][[3]][[6]][[2]][[4]][[5]]
## [1] "diff in means" "7.069"
##
##
## [[2]][[3]][[6]][[2]][[5]]
## [[2]][[3]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[3]][[6]][[2]][[5]][[2]]
## [1] "CAN"
##
## [[2]][[3]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 15, p-value = 0.1818
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[5]][[4]]
## [[2]][[3]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.132
##
##
## [[2]][[3]][[6]][[2]][[5]][[5]]
## [1] "diff in means" "4.399"
##
```

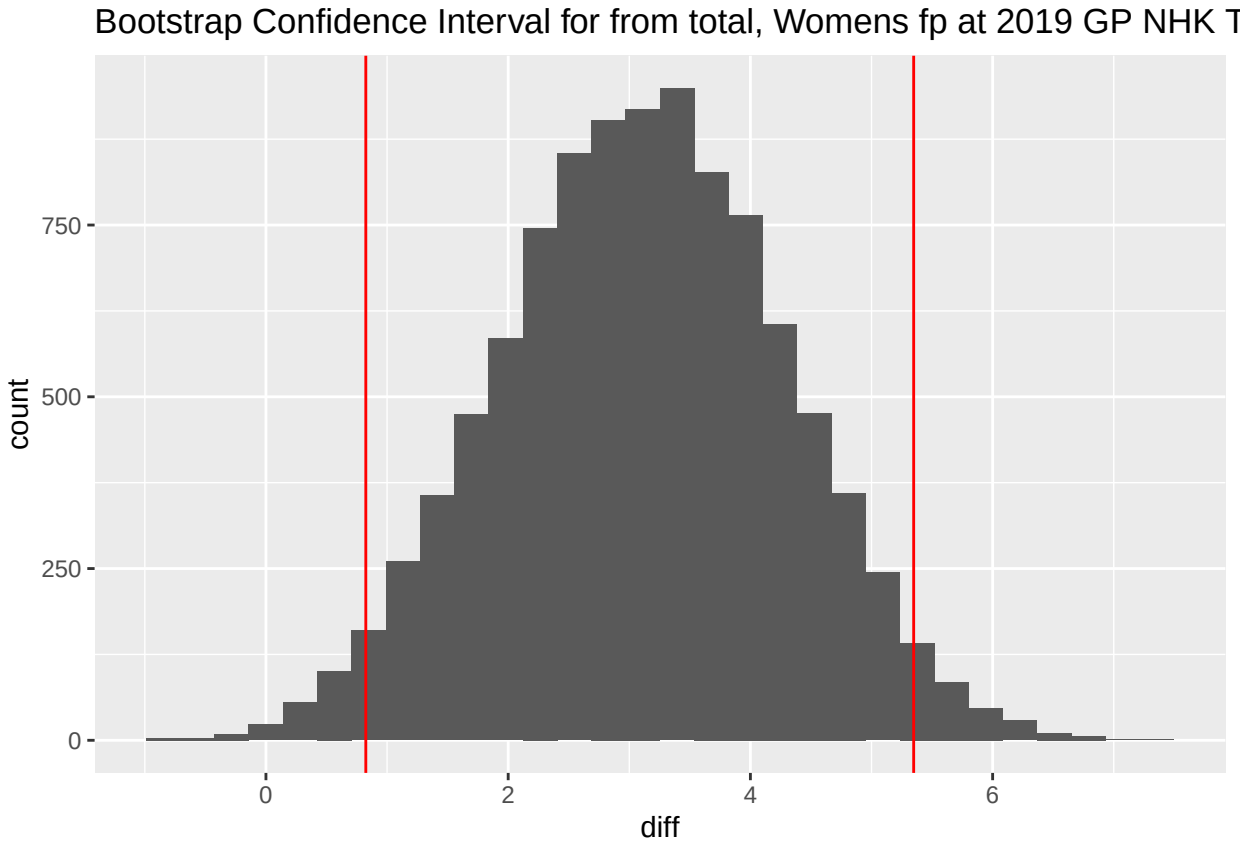
```
##
## [[2]][[3]][[6]][[2]][[6]]
## [[2]][[3]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[3]][[6]][[2]][[6]][[2]]
## [1] "GER"
##
## [[2]][[3]][[6]][[2]][[6]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[6]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[6]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[7]]
## [[2]][[3]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[3]][[6]][[2]][[7]][[2]]
## [1] "JPN"
##
## [[2]][[3]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 27, p-value = 0.004545
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[7]][[4]]
## [[2]][[3]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[7]][[4]][[2]]
## [1] 0
##
##
## [[2]][[3]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "6.87888888888889"
##
##
## [[2]][[3]][[6]][[2]][[8]]
## [[2]][[3]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[3]][[6]][[2]][[8]][[2]]
## [1] "ITA"
##
## [[2]][[3]][[6]][[2]][[8]][[3]]
```

```
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[8]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[8]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[9]]
## [[2]][[3]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[3]][[6]][[2]][[9]][[2]]
## [1] "FRA"
##
## [[2]][[3]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 11, p-value = 0.08333
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[9]][[4]]
## [[2]][[3]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[9]][[4]][[2]]
## [1] 0
##
##
## [[2]][[3]][[6]][[2]][[9]][[5]]
## [1] "diff in means"    "8.74818181818181"
##
##
##
##
##
## [[2]][[4]]
## [[2]][[4]][[1]]
## [1] "Womens"                             "fp"
## [3] "# of Obs."                          "12"
## [5] "Standard Deviation of Observations" "4.25277223950653"
##
## [[2]][[4]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 63, p-value = 0.03198
## alternative hypothesis: true location shift is greater than 0
##
```

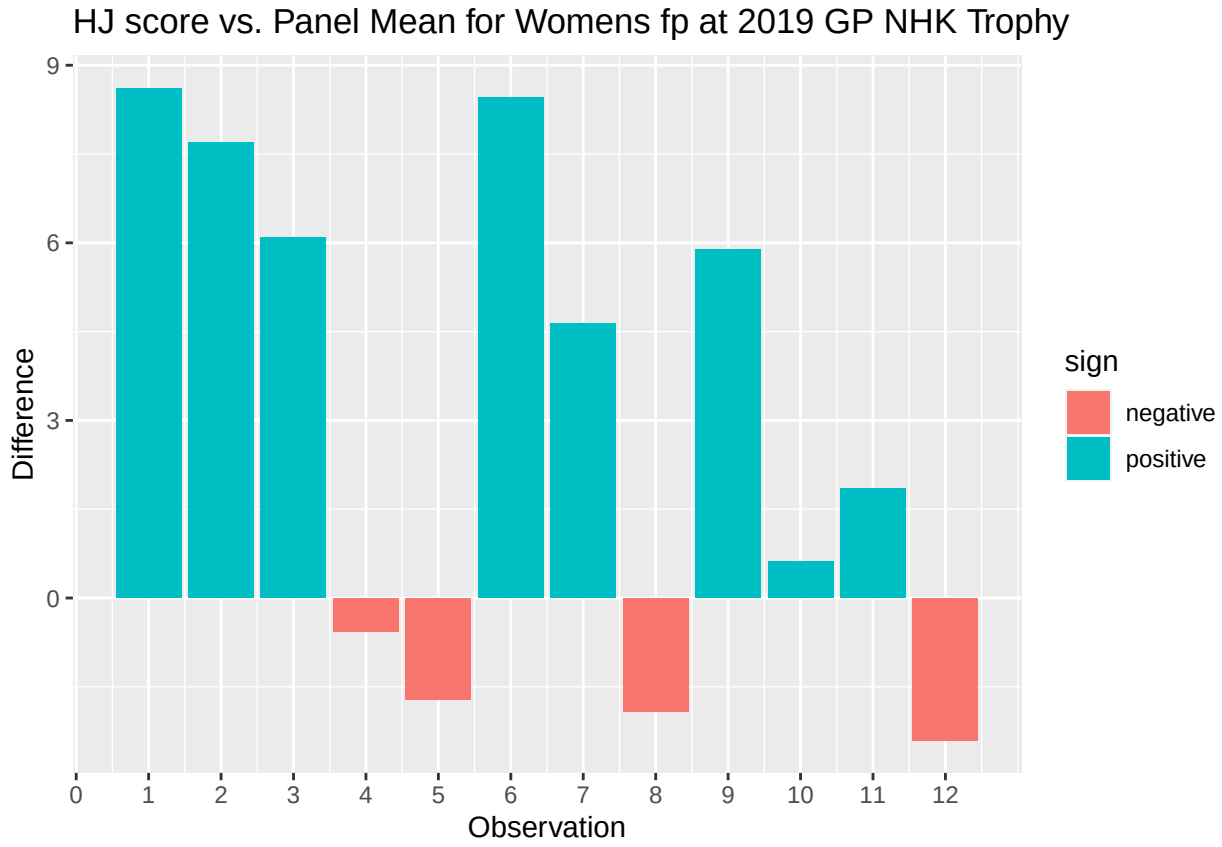
```
##
## [[2]][[4]][[3]]
## [[2]][[4]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[4]][[3]][[2]]
```




```
##
## [[2]][[4]][[3]][[3]]
## [1] 0.0142
##
## [[2]][[4]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[4]][[4]]
## [[2]][[4]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[4]][[4]][[2]]
```




```
##
## [[2]][[4]][[4]][[3]]
## [1] 0.8245156 5.3480703
##
## [[2]][[4]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[4]][[4]][[5]]
## [1] 2.261777
##
##
## [[2]][[4]][[5]]
```



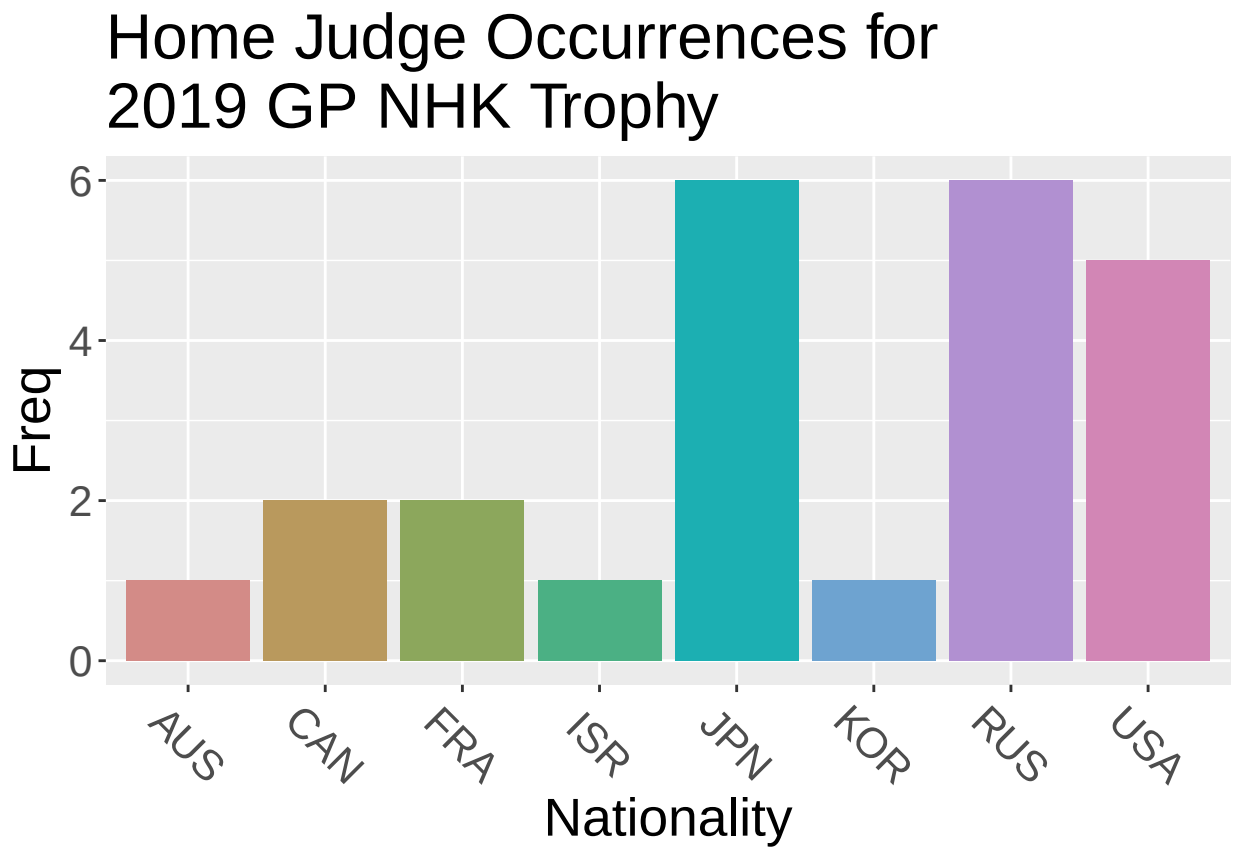

```
##
## [[2]][[4]][[6]]
## [[2]][[4]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[4]][[6]][[2]]
## [[2]][[4]][[6]][[2]][[1]]
## [[2]][[4]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[4]][[6]][[2]][[1]][[2]]
## [1] "CAN"
##
## [[2]][[4]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[2]]
## [[2]][[4]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

```
##
## [[2]][[4]][[6]][[2]][[2]][[2]]
## [1] "JPN"
##
## [[2]][[4]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 25, p-value = 0.01818
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[2]][[4]]
## [[2]][[4]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.0425
##
##
## [[2]][[4]][[6]][[2]][[2]][[5]]
## [1] "diff in means"    "4.36555555555556"
##
##
## [[2]][[4]][[6]][[2]][[3]]
## [[2]][[4]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[4]][[6]][[2]][[3]][[2]]
## [1] "AUS"
##
## [[2]][[4]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 6, p-value = 0.5
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[3]][[4]]
## [[2]][[4]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.4177
##
##
## [[2]][[4]][[6]][[2]][[3]][[5]]
## [1] "diff in means"    "0.14818181818182"
##
##
## [[2]][[4]][[6]][[2]][[4]]
```

```
## [[2]][[4]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[4]][[6]][[2]][[4]][[2]]
## [1] "USA"
##
## [[2]][[4]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 16, p-value = 0.3636
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[4]][[4]]
## [[2]][[4]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.3454
##
##
## [[2]][[4]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "0.747777777777781"
##
##
## [[2]][[4]][[6]][[2]][[5]]
## [[2]][[4]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[4]][[6]][[2]][[5]][[2]]
## [1] "RUS"
##
## [[2]][[4]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 25, p-value = 0.01818
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[5]][[4]]
## [[2]][[4]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.0103
##
##
## [[2]][[4]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "3.47444444444444"
##
```

```
##
## [[2]][[4]][[6]][[2]][[6]]
## [[2]][[4]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[4]][[6]][[2]][[6]][[2]]
## [1] "CHN"
##
## [[2]][[4]][[6]][[2]][[6]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[6]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[6]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[7]]
## [[2]][[4]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[4]][[6]][[2]][[7]][[2]]
## [1] "FRA"
##
## [[2]][[4]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 11, p-value = 0.08333
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[7]][[4]]
## [[2]][[4]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[7]][[4]][[2]]
## [1] 0
##
##
## [[2]][[4]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "4.61454545454547"
##
##
## [[2]][[4]][[6]][[2]][[8]]
## [[2]][[4]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[4]][[6]][[2]][[8]][[2]]
## [1] "FIN"
##
## [[2]][[4]][[6]][[2]][[8]][[3]]
```

```
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[8]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[8]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[9]]
## [[2]][[4]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[4]][[6]][[2]][[9]][[2]]
## [1] "KOR"
##
## [[2]][[4]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 7.5, p-value = 0.3317
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[9]][[4]]
## [[2]][[4]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.4173
##
##
## [[2]][[4]][[6]][[2]][[9]][[5]]
## [1] "diff in means"   "1.3309090909091"
##
##
##
##
##
##
## [[3]]
```

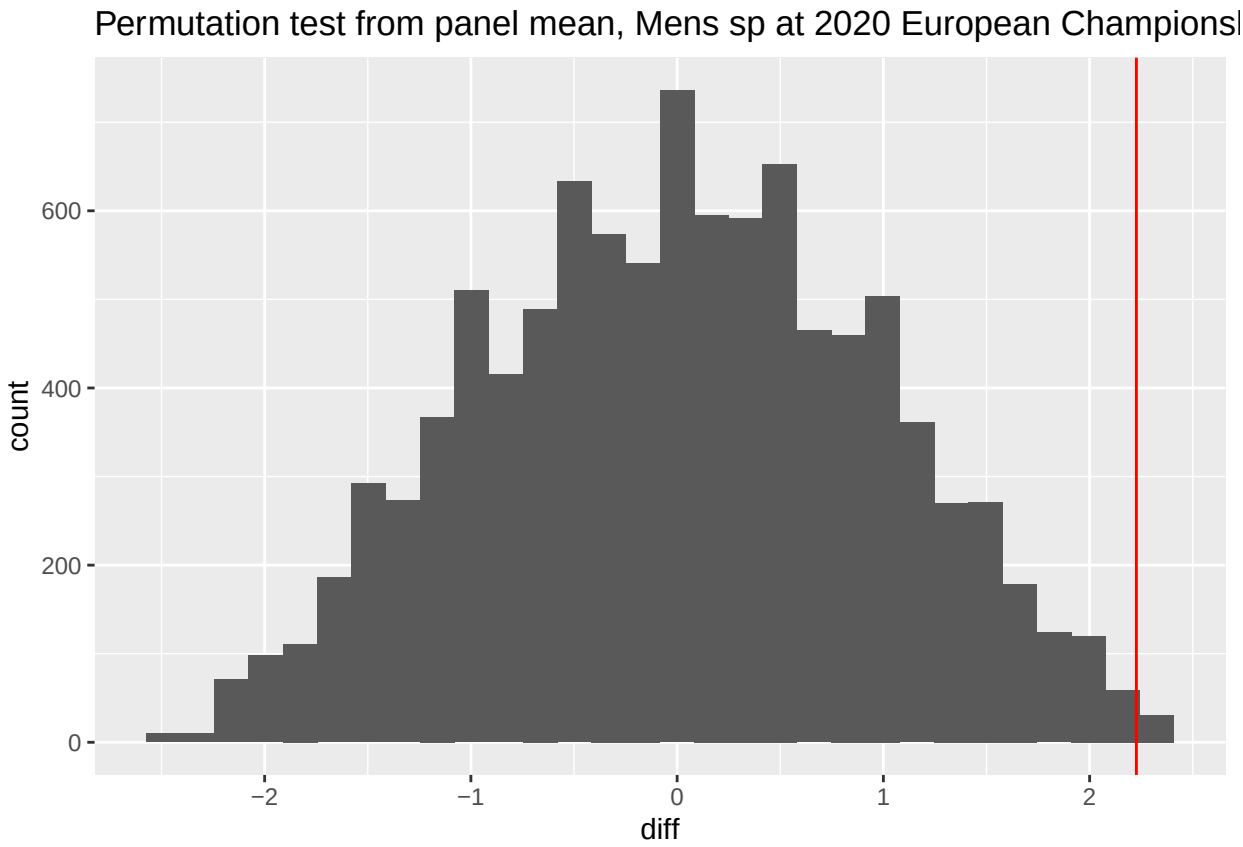



```
results <- analyze_event("European Championships", "2020")
```

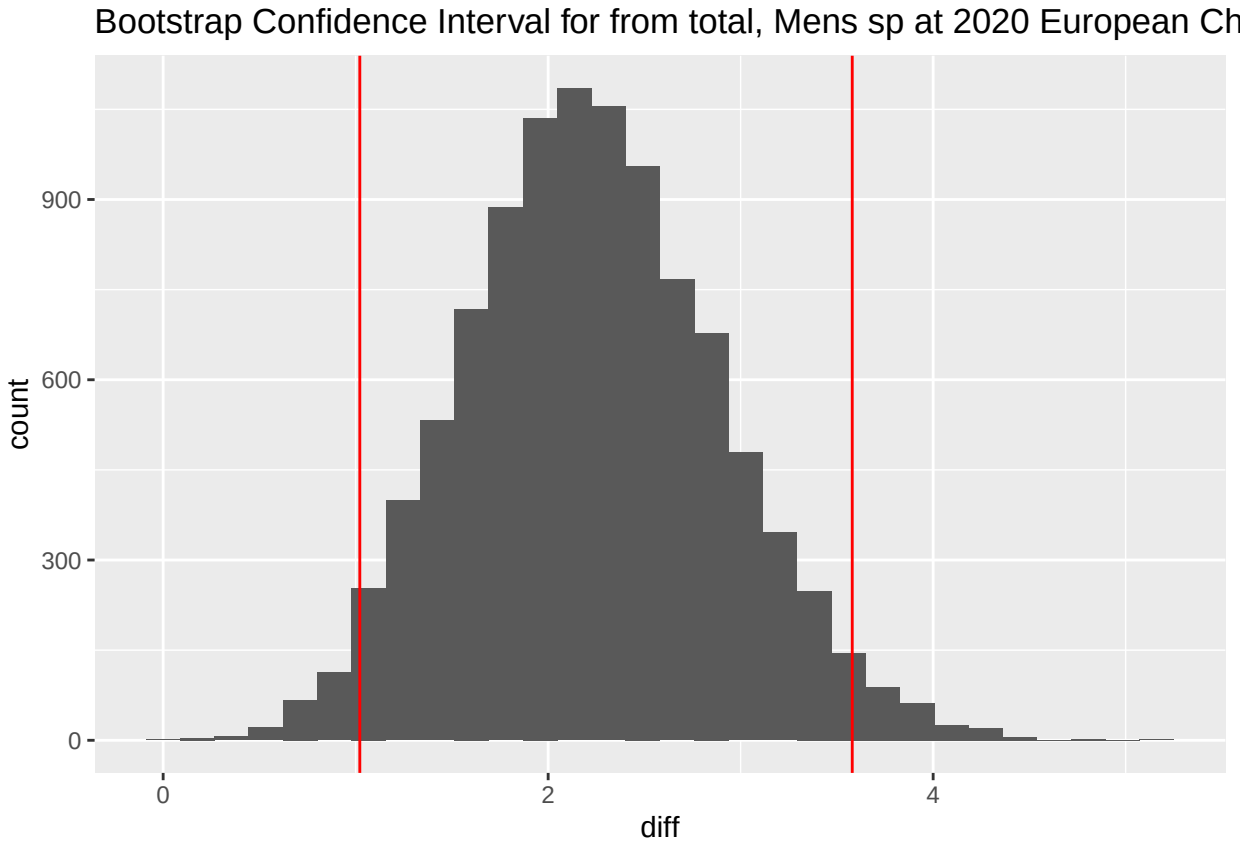
```
## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties
```

```
results
```

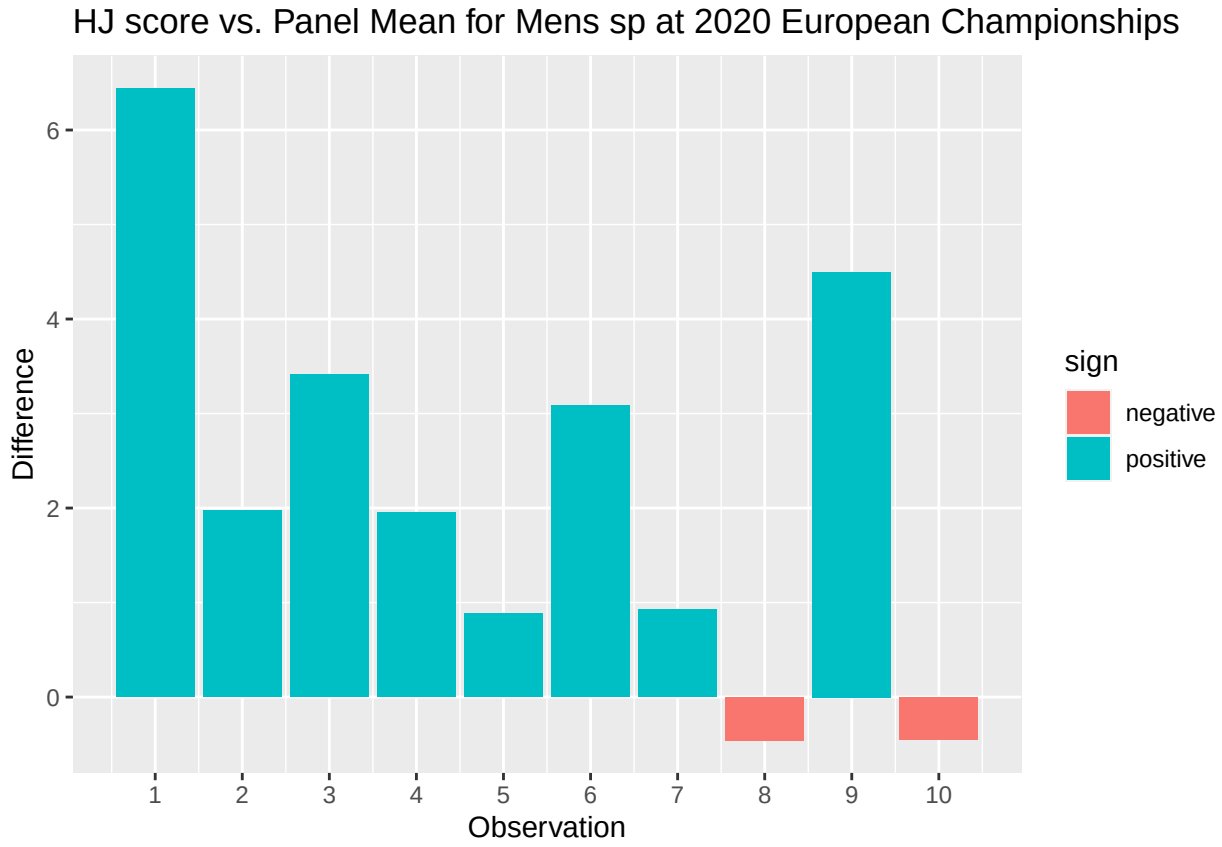
```
## [[1]]
## [1] "Results for 2020 European Championships"
##
## [[2]]
## [[2]][[1]]
## [[2]][[1]][[1]]
## [1] "Mens"                                "sp"
## [3] "# of Obs."                           "10"
## [5] "Standard Deviation of Observations" "2.18807232195627"
##
## [[2]][[1]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 52, p-value = 0.004883
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[3]]
## [[2]][[1]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[1]][[3]][[2]]
```




```
##
## [[2]][[1]][[3]][[3]]
## [1] 0.0037
##
## [[2]][[1]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[1]][[4]]
## [[2]][[1]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[1]][[4]][[2]]
```




```
##
## [[2]][[1]][[4]][[3]]
## [1] 1.021622 3.579656
##
## [[2]][[1]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[1]][[4]][[5]]
## [1] 1.279017
##
##
## [[2]][[1]][[5]]
```




```
##
## [[2]][[1]][[6]]
## [[2]][[1]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[1]][[6]][[2]]
## [[2]][[1]][[6]][[2]][[1]]
## [[2]][[1]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[1]][[6]][[2]][[1]][[2]]
## [1] "GEO"
##
## [[2]][[1]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 61, p-value = 0.02017
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[1]][[4]]
## [[2]][[1]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

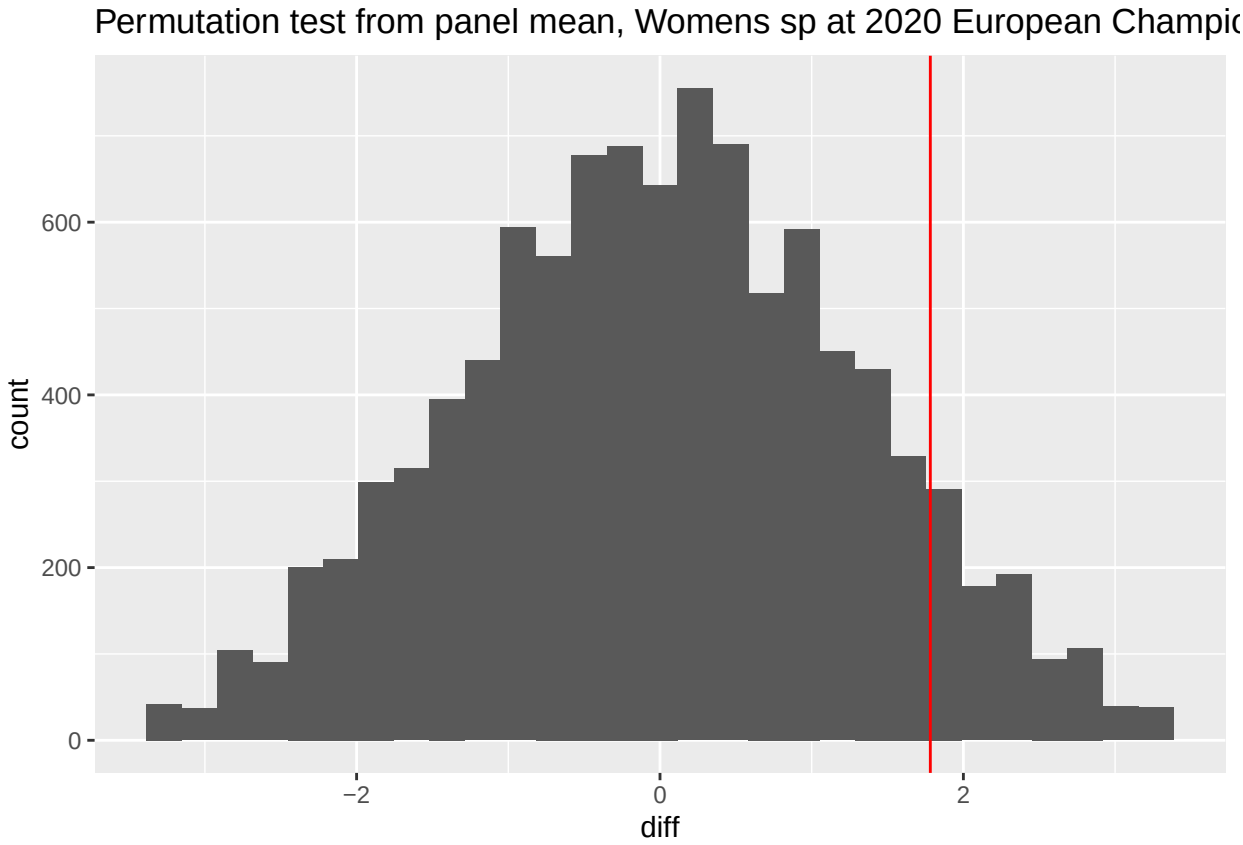
```
## [[2]][[1]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.0075
##
##
## [[2]][[1]][[6]][[2]][[1]][[5]]
## [1] "diff in means"    "4.29151515151516"
##
##
## [[2]][[1]][[6]][[2]][[2]]
## [[2]][[1]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[1]][[6]][[2]][[2]][[2]]
## [1] "TUR"
##
## [[2]][[1]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 24, p-value = 0.3143
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.2832
##
##
## [[2]][[1]][[6]][[2]][[2]][[5]]
## [1] "diff in means"   "1.4264705882353"
##
##
## [[2]][[1]][[6]][[2]][[3]]
## [[2]][[1]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[1]][[6]][[2]][[3]][[2]]
## [1] "NOR"
##
## [[2]][[1]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 22, p-value = 0.3714
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[3]][[4]]
## [[2]][[1]][[6]][[2]][[3]][[4]][[1]]
```

```
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.3436
##
##
## [[2]][[1]][[6]][[2]][[3]][[5]]
## [1] "diff in means"    "1.38705882352942"
##
##
## [[2]][[1]][[6]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[1]][[6]][[2]][[4]][[2]]
## [1] "LAT"
##
## [[2]][[1]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 29, p-value = 0.1714
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[4]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.1429
##
##
## [[2]][[1]][[6]][[2]][[4]][[5]]
## [1] "diff in means"    "1.87705882352942"
##
##
## [[2]][[1]][[6]][[2]][[5]]
## [[2]][[1]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[1]][[6]][[2]][[5]][[2]]
## [1] "UKR"
##
## [[2]][[1]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 34, p-value = 0.02857
## alternative hypothesis: true location shift is greater than 0
##
##
```

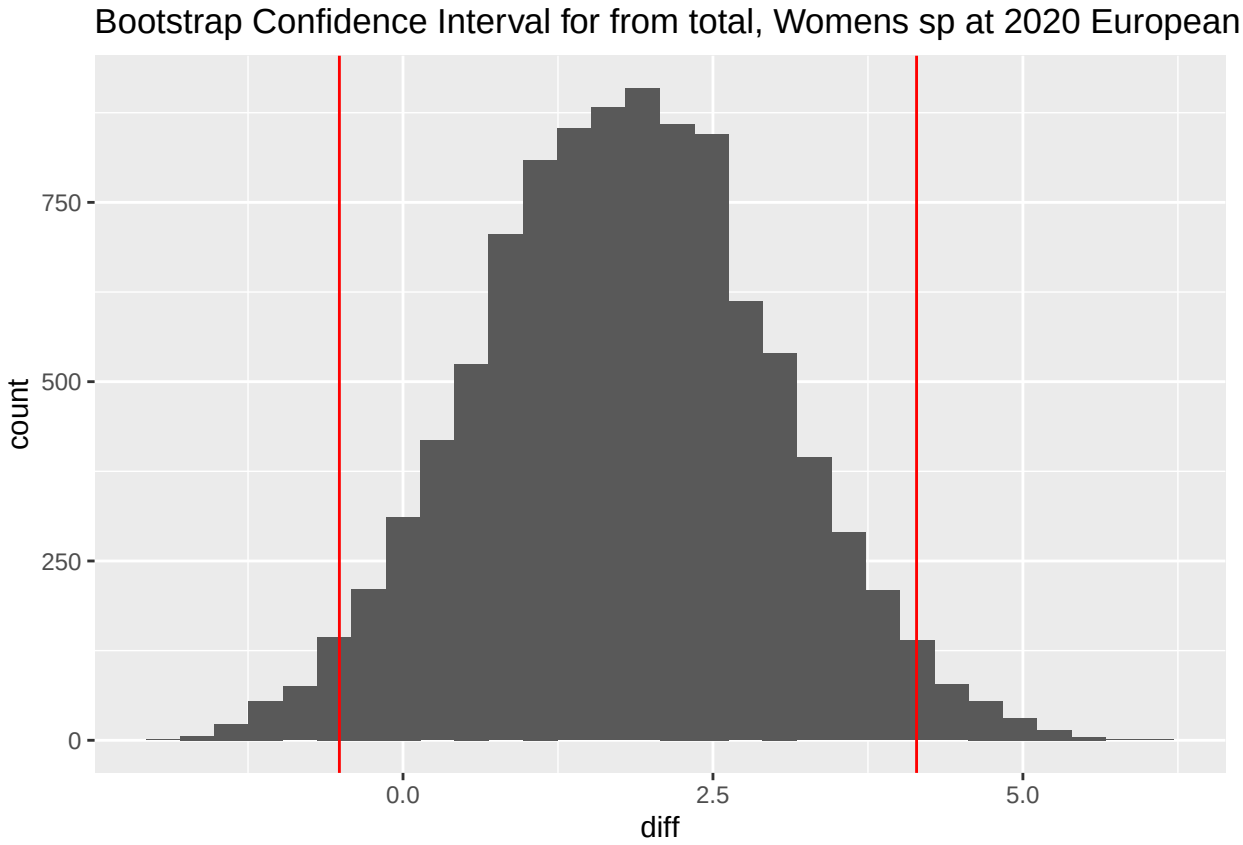
```
## [[2]][[1]][[6]][[2]][[5]][[4]]
## [[2]][[1]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[5]][[4]][[2]]
## [1] 0
##
##
## [[2]][[1]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "4.47911764705882"
##
##
## [[2]][[1]][[6]][[2]][[6]]
## [[2]][[1]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[1]][[6]][[2]][[6]][[2]]
## [1] "SVK"
##
## [[2]][[1]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 13, p-value = 0.3645
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[1]][[6]][[2]][[6]][[4]]
## [[2]][[1]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[6]][[4]][[2]]
## [1] 0.3818
##
##
## [[2]][[1]][[6]][[2]][[6]][[5]]
## [1] "diff in means"      "-0.344705882352941"
##
##
## [[2]][[1]][[6]][[2]][[7]]
## [[2]][[1]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[1]][[6]][[2]][[7]][[2]]
## [1] "ESP"
##
## [[2]][[1]][[6]][[2]][[7]][[3]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[7]][[4]]
## [1] "No home scores to test"
##
## [[2]][[1]][[6]][[2]][[7]][[5]]
```

```
## [1] "diff in means" "NaN"
##
##
## [[2]][[1]][[6]][[2]][[8]]
## [[2]][[1]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[1]][[6]][[2]][[8]][[2]]
## [1] "FRA"
##
## [[2]][[1]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 35, p-value = 0.5697
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[1]][[6]][[2]][[8]][[4]]
## [[2]][[1]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.4736
##
##
## [[2]][[1]][[6]][[2]][[8]][[5]]
## [1] "diff in means"      "-0.213787878787881"
##
##
## [[2]][[1]][[6]][[2]][[9]]
## [[2]][[1]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[1]][[6]][[2]][[9]][[2]]
## [1] "GER"
##
## [[2]][[1]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 31, p-value = 0.09065
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[9]][[4]]
## [[2]][[1]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.1735
##
```

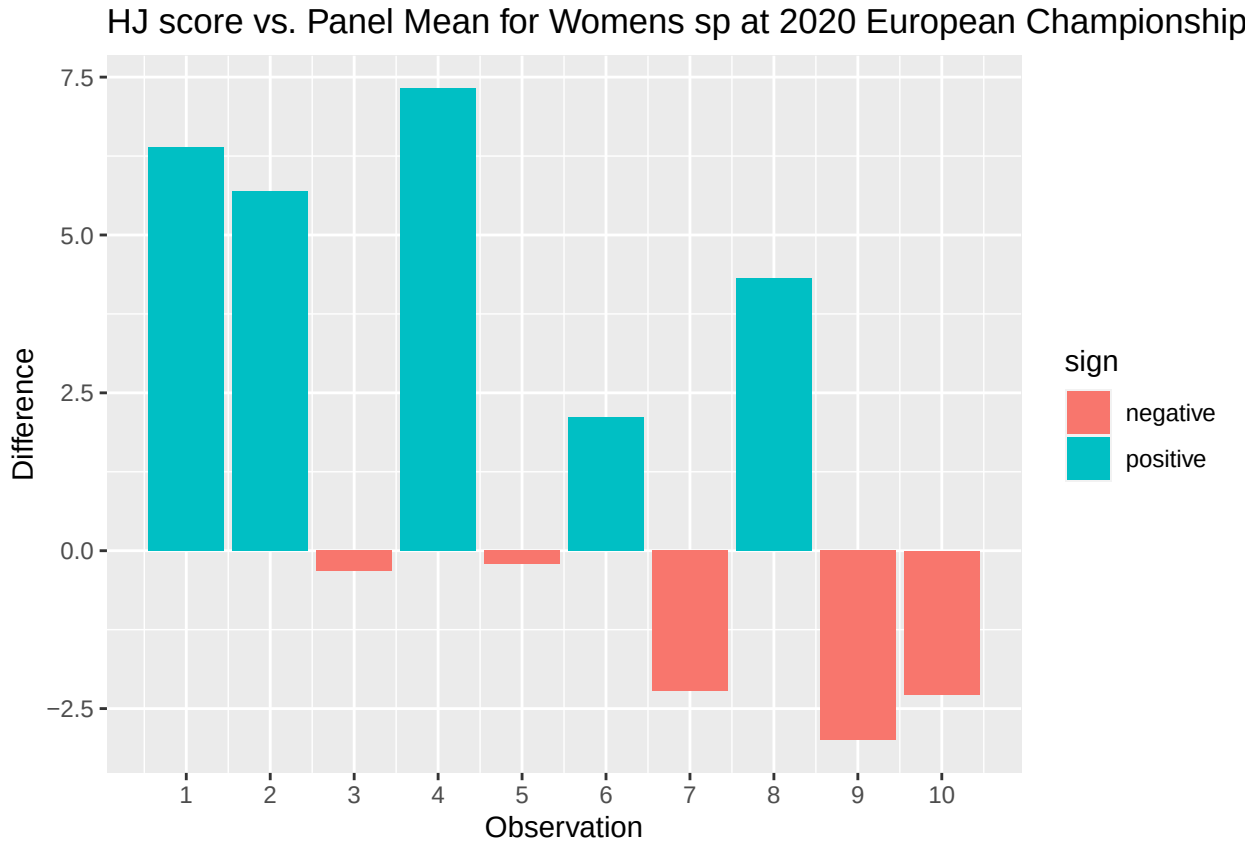
```
##
## [[2]][[1]][[6]][[2]][[9]][[5]]
## [1] "diff in means"   "2.4764705882353"
##
##
##
##
##
## [[2]][[2]]
## [[2]][[2]][[1]]
## [1] "Womens"                              "sp"
## [3] "# of Obs."                           "10"
## [5] "Standard Deviation of Observations" "3.9109687365579"
##
## [[2]][[2]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 37, p-value = 0.1875
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[3]]
## [[2]][[2]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[2]][[3]][[2]]
```




```
##
## [[2]][[2]][[3]][[3]]
## [1] 0.0914
##
## [[2]][[2]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[2]][[4]]
## [[2]][[2]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[2]][[4]][[2]]
```




```
##
## [[2]][[2]][[4]][[3]]
## [1] -0.5131563  4.1424156
##
## [[2]][[2]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[2]][[4]][[5]]
## [1] 2.327786
##
##
## [[2]][[2]][[5]]
```




```
##
## [[2]][[2]][[6]]
## [[2]][[2]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[2]][[6]][[2]]
## [[2]][[2]][[6]][[2]][[1]]
## [[2]][[2]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[2]][[6]][[2]][[1]][[2]]
## [1] "HUN"
##
## [[2]][[2]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 34, p-value = 0.07328
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[1]][[4]]
## [[2]][[2]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

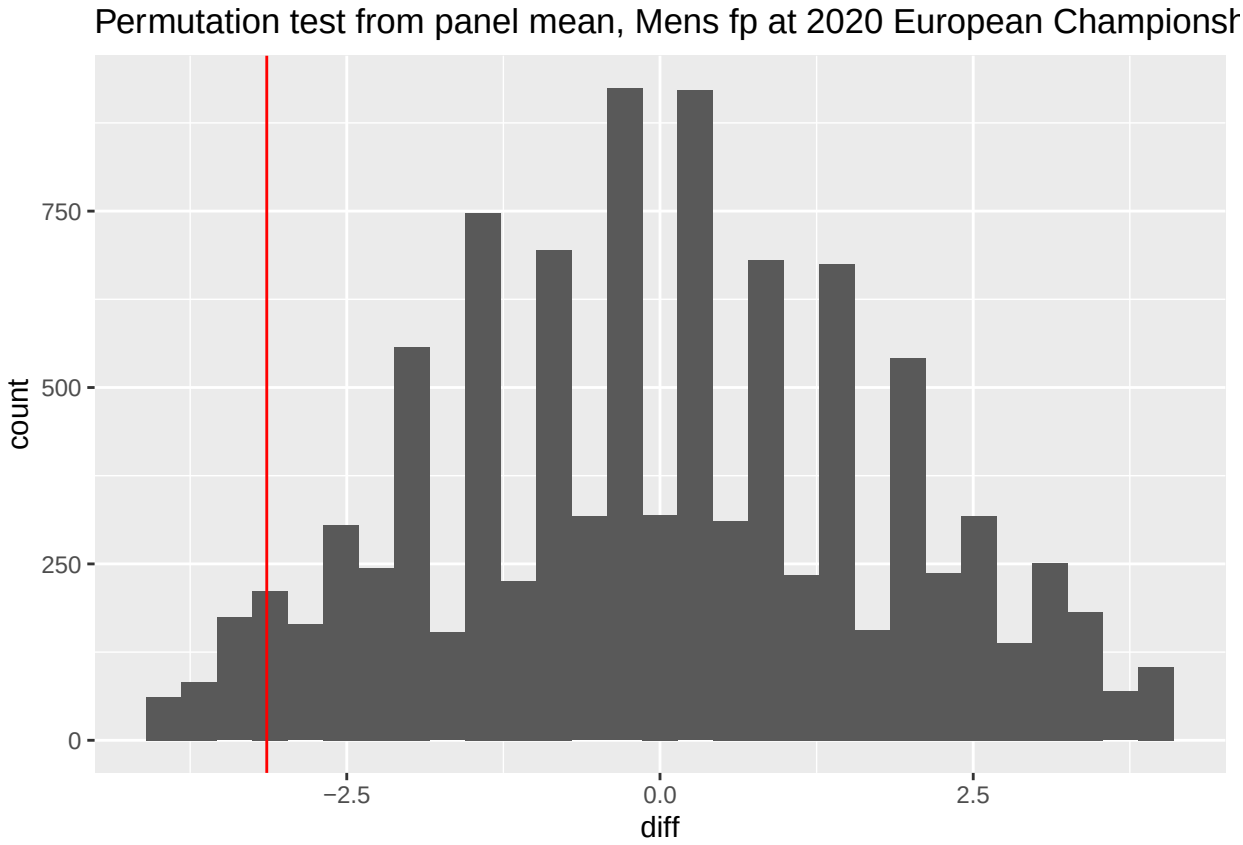
```
## [[2]][[2]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.0797
##
##
## [[2]][[2]][[6]][[2]][[1]][[5]]
## [1] "diff in means"    "3.18055555555556"
##
##
## [[2]][[2]][[6]][[2]][[2]]
## [[2]][[2]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[2]][[6]][[2]][[2]][[2]]
## [1] "NED"
##
## [[2]][[2]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 17, p-value = 0.4813
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[2]][[6]][[2]][[2]][[4]]
## [[2]][[2]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.4587
##
##
## [[2]][[2]][[6]][[2]][[2]][[5]]
## [1] "diff in means"        "-0.00805555555555637"
##
##
## [[2]][[2]][[6]][[2]][[3]]
## [[2]][[2]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[2]][[6]][[2]][[3]][[2]]
## [1] "SVK"
##
## [[2]][[2]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 10, p-value = 0.2973
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[2]][[6]][[2]][[3]][[4]]
## [[2]][[2]][[6]][[2]][[3]][[4]][[1]]
```

```
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.2901
##
##
## [[2]][[2]][[6]][[2]][[3]][[5]]
## [1] "diff in means"      "-0.958333333333338"
##
##
## [[2]][[2]][[6]][[2]][[4]]
## [[2]][[2]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[2]][[6]][[2]][[4]][[2]]
## [1] "ROU"
##
## [[2]][[2]][[6]][[2]][[4]][[3]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[4]][[4]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[4]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[2]][[6]][[2]][[5]]
## [[2]][[2]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[2]][[6]][[2]][[5]][[2]]
## [1] "SLO"
##
## [[2]][[2]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 20, p-value = 0.4595
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[5]][[4]]
## [[2]][[2]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.4347
##
##
## [[2]][[2]][[6]][[2]][[5]][[5]]
## [1] "diff in means"     "0.390277777777779"
##
```

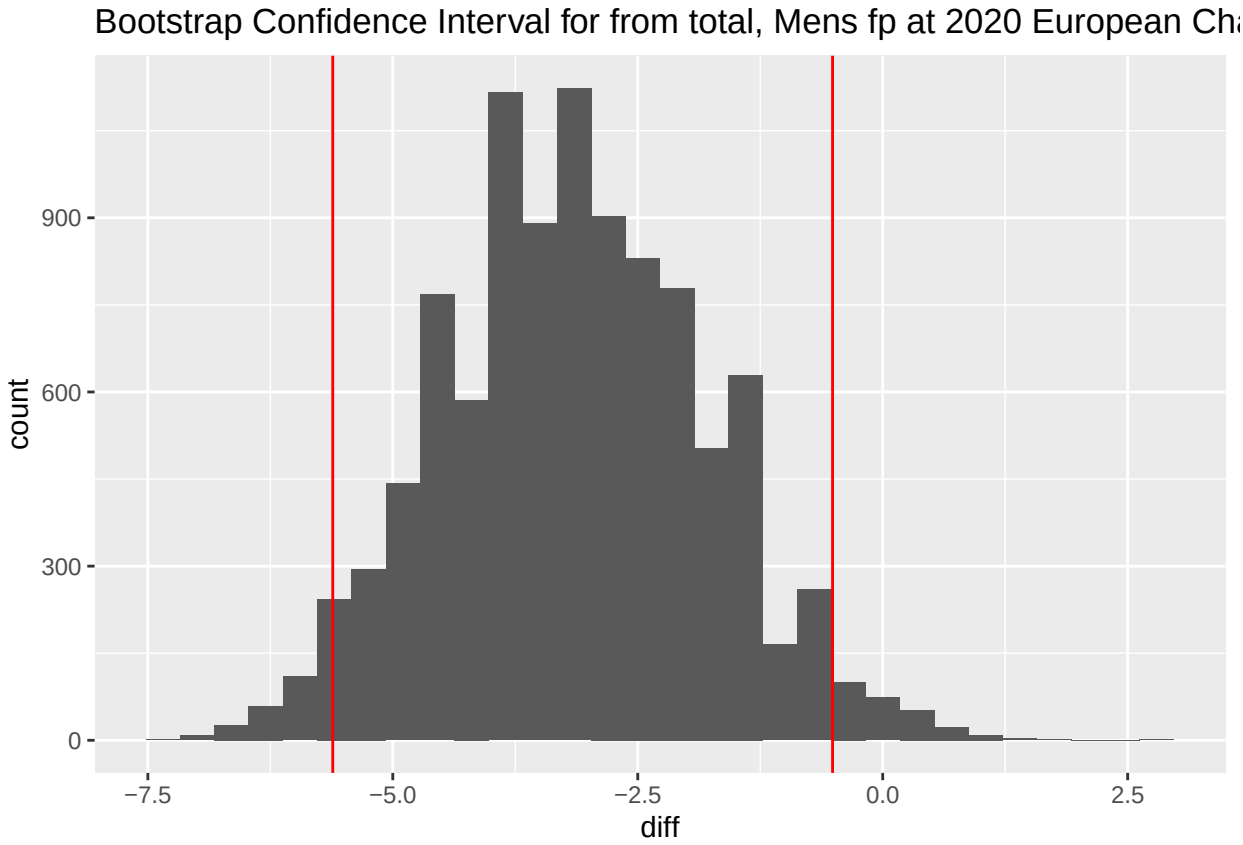
```
##
## [[2]][[2]][[6]][[2]][[6]]
## [[2]][[2]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[2]][[6]][[2]][[6]][[2]]
## [1] "UKR"
##
## [[2]][[2]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 1, p-value = 0.06111
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[2]][[6]][[2]][[6]][[4]]
## [[2]][[2]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[6]][[4]][[2]]
## [1] 0.0548
##
##
## [[2]][[2]][[6]][[2]][[6]][[5]]
## [1] "diff in means"     "-2.75916666666667"
##
##
## [[2]][[2]][[6]][[2]][[7]]
## [[2]][[2]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[2]][[6]][[2]][[7]][[2]]
## [1] "FRA"
##
## [[2]][[2]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 96, p-value = 0.00296
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[7]][[4]]
## [[2]][[2]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.0052
##
##
## [[2]][[2]][[6]][[2]][[7]][[5]]
```

```
## [1] "diff in means"    "3.90725490196078"
##
##
## [[2]][[2]][[6]][[2]][[8]]
## [[2]][[2]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[2]][[6]][[2]][[8]][[2]]
## [1] "POL"
##
## [[2]][[2]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 21, p-value = 0.4324
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[8]][[4]]
## [[2]][[2]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.4128
##
##
## [[2]][[2]][[6]][[2]][[8]][[5]]
## [1] "diff in means"     "0.366666666666665"
##
##
## [[2]][[2]][[6]][[2]][[9]]
## [[2]][[2]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[2]][[6]][[2]][[9]][[2]]
## [1] "SRB"
##
## [[2]][[2]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 35, p-value = 0.06111
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[9]][[4]]
## [[2]][[2]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.0528
##
```

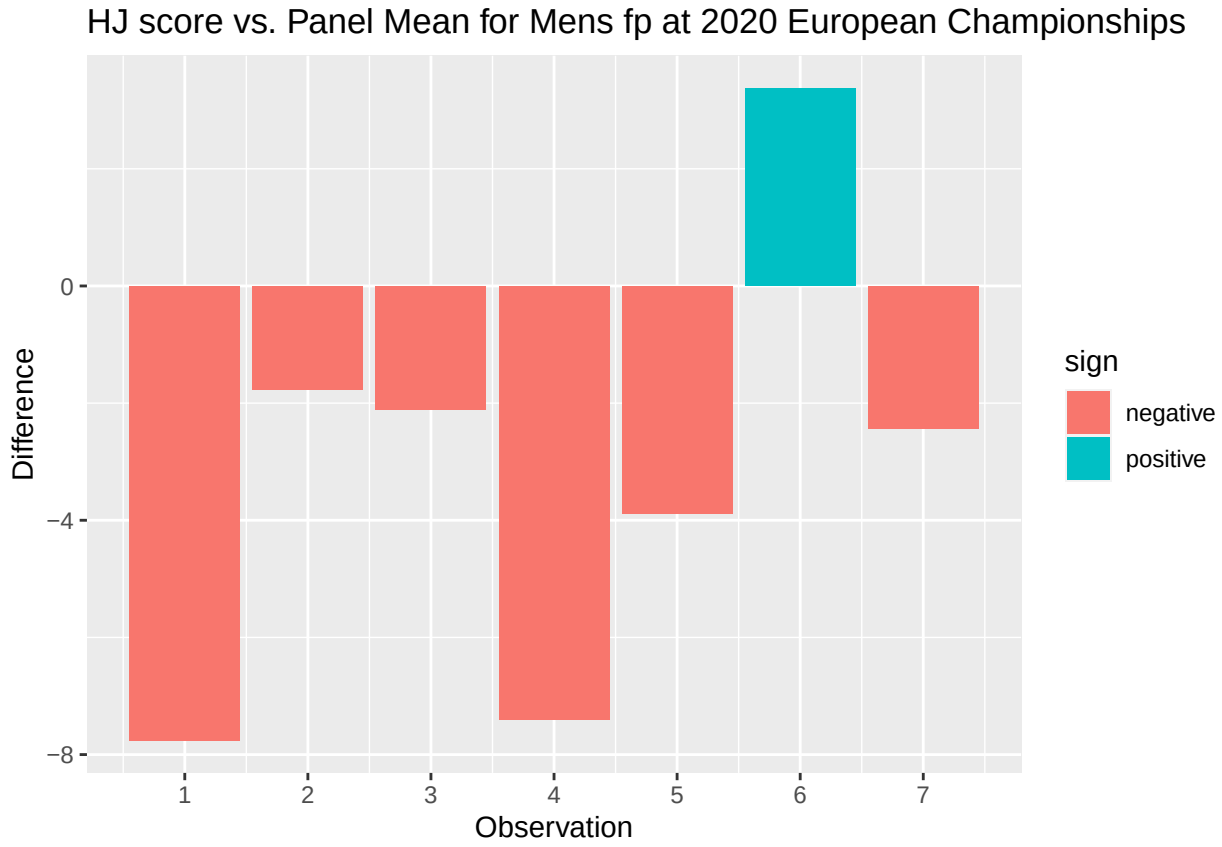
```
##
## [[2]][[2]][[6]][[2]][[9]][[5]]
## [1] "diff in means"    "3.71694444444445"
##
##
##
##
##
## [[2]][[3]]
## [[2]][[3]][[1]]
## [1] "Mens"                                "fp"
## [3] "# of Obs."                           "7"
## [5] "Standard Deviation of Observations" "3.78375328393521"
##
## [[2]][[3]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 4, p-value = 0.05469
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[3]]
## [[2]][[3]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[3]][[3]][[2]]
```




```
##
## [[2]][[3]][[3]][[3]]
## [1] 0.0392
##
## [[2]][[3]][[3]][[4]]
## [1] "hA = true mean is less than 0 (underscoring)"
##
##
## [[2]][[3]][[4]]
## [[2]][[3]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[3]][[4]][[2]]
```




```
##
## [[2]][[3]][[4]][[3]]
## [1] -5.6128571 -0.5117857
##
## [[2]][[3]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[3]][[4]][[5]]
## [1] 2.550536
##
##
## [[2]][[3]][[5]]
```




```
##
## [[2]][[3]][[6]]
## [[2]][[3]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[3]][[6]][[2]]
## [[2]][[3]][[6]][[2]][[1]]
## [[2]][[3]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[3]][[6]][[2]][[1]][[2]]
## [1] "GEO"
##
## [[2]][[3]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 9, p-value = 0.0958
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[1]][[4]]
## [[2]][[3]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

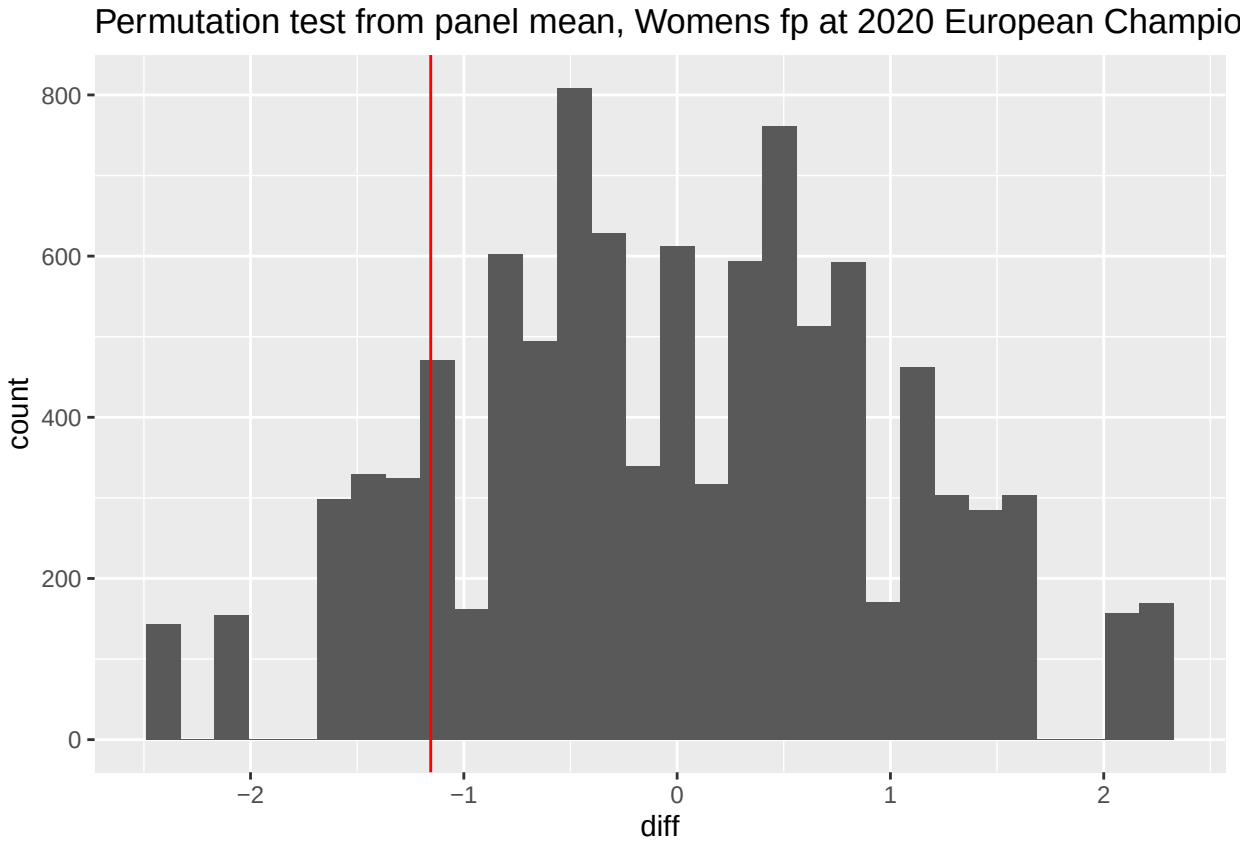
```
## [[2]][[3]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.133
##
##
## [[2]][[3]][[6]][[2]][[1]][[5]]
## [1] "diff in means"     "-3.04045454545454"
##
##
## [[2]][[3]][[6]][[2]][[2]]
## [[2]][[3]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[3]][[6]][[2]][[2]][[2]]
## [1] "TUR"
##
## [[2]][[3]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 8, p-value = 0.375
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[2]][[4]]
## [[2]][[3]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.3694
##
##
## [[2]][[3]][[6]][[2]][[2]][[5]]
## [1] "diff in means"      "-0.975217391304346"
##
##
## [[2]][[3]][[6]][[2]][[3]]
## [[2]][[3]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[3]][[6]][[2]][[3]][[2]]
## [1] "NOR"
##
## [[2]][[3]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 10, p-value = 0.4583
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[3]][[4]]
## [[2]][[3]][[6]][[2]][[3]][[4]][[1]]
```

```
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.4556
##
##
## [[2]][[3]][[6]][[2]][[3]][[5]]
## [1] "diff in means"      "-0.397826086956524"
##
##
## [[2]][[3]][[6]][[2]][[4]]
## [[2]][[3]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[3]][[6]][[2]][[4]][[2]]
## [1] "LAT"
##
## [[2]][[3]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 5, p-value = 0.25
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[4]][[4]]
## [[2]][[3]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.2472
##
##
## [[2]][[3]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "-1.87304347826087"
##
##
## [[2]][[3]][[6]][[2]][[5]]
## [[2]][[3]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[3]][[6]][[2]][[5]][[2]]
## [1] "UKR"
##
## [[2]][[3]][[6]][[2]][[5]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[5]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[5]][[5]]
## [1] "diff in means" "NaN"
##
```

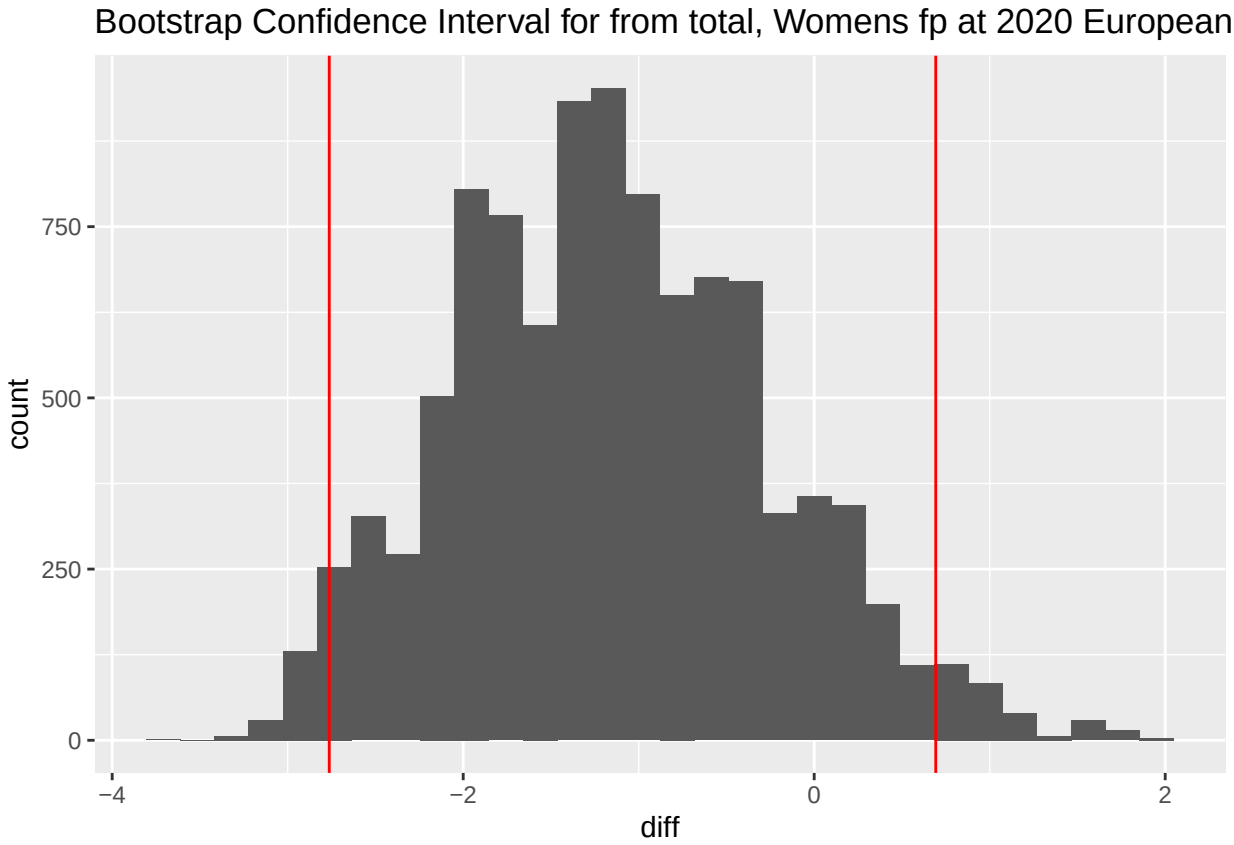
```
##
## [[2]][[3]][[6]][[2]][[6]]
## [[2]][[3]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[3]][[6]][[2]][[6]][[2]]
## [1] "SVK"
##
## [[2]][[3]][[6]][[2]][[6]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[6]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[6]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[7]]
## [[2]][[3]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[3]][[6]][[2]][[7]][[2]]
## [1] "ESP"
##
## [[2]][[3]][[6]][[2]][[7]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[7]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[7]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[8]]
## [[2]][[3]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[3]][[6]][[2]][[8]][[2]]
## [1] "FRA"
##
## [[2]][[3]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 10, p-value = 0.4583
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[8]][[4]]
## [[2]][[3]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
```

```
##
## [[2]][[3]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.46
##
##
## [[2]][[3]][[6]][[2]][[8]][[5]]
## [1] "diff in means"     "-0.87304347826089"
##
##
## [[2]][[3]][[6]][[2]][[9]]
## [[2]][[3]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[3]][[6]][[2]][[9]][[2]]
## [1] "GER"
##
## [[2]][[3]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 4, p-value = 0.2083
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[9]][[4]]
## [[2]][[3]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.2084
##
##
## [[2]][[3]][[6]][[2]][[9]][[5]]
## [1] "diff in means"     "-6.73217391304347"
##
##
##
##
##
## [[2]][[4]]
## [[2]][[4]][[1]]
## [1] "Womens"                            "fp"
## [3] "# of Obs."                         "6"
## [5] "Standard Deviation of Observations" "2.38461834166742"
##
## [[2]][[4]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 6, p-value = 0.2188
## alternative hypothesis: true location shift is less than 0
##
```

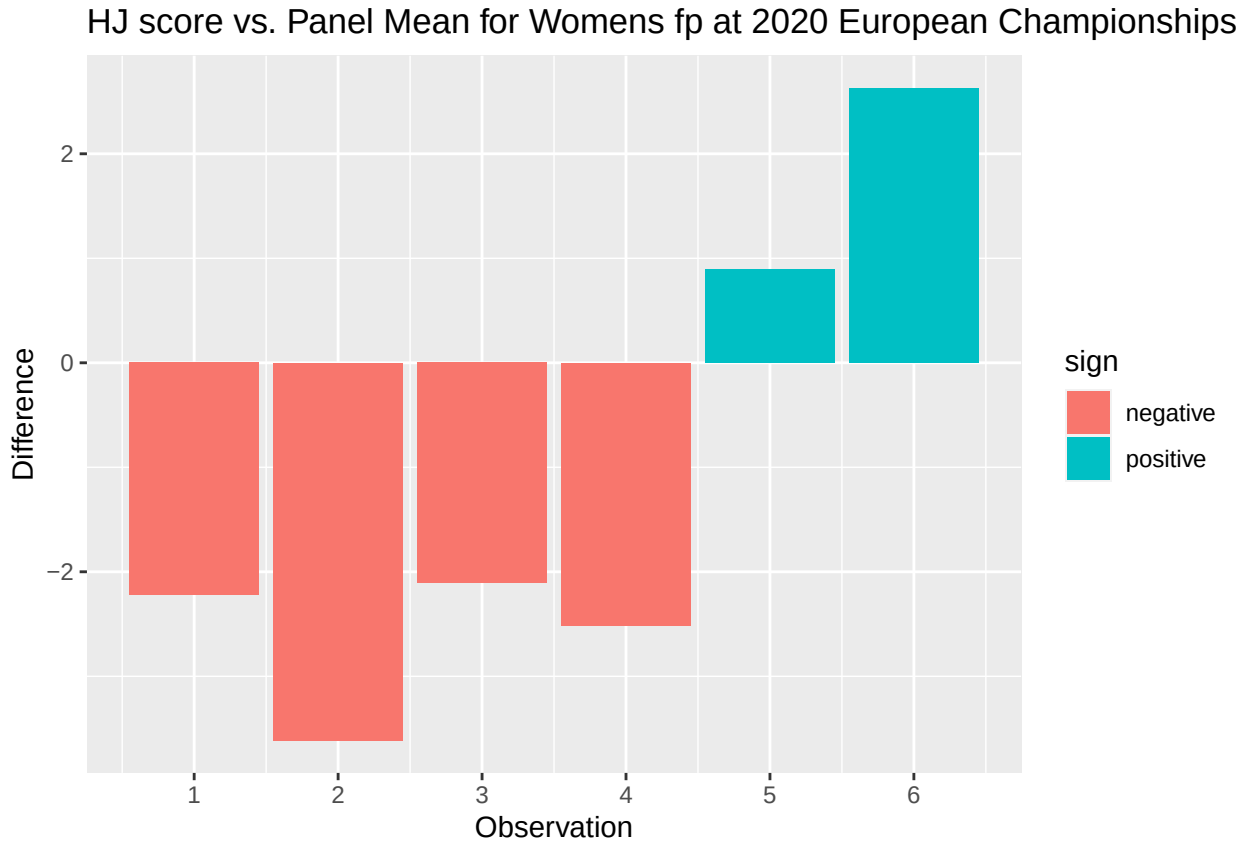
```
##
## [[2]][[4]][[3]]
## [[2]][[4]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[4]][[3]][[2]]
```




```
##
## [[2]][[4]][[3]][[3]]
## [1] 0.1576
##
## [[2]][[4]][[3]][[4]]
## [1] "hA = true mean is less than 0 (underscoring)"
##
##
## [[2]][[4]][[4]]
## [[2]][[4]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[4]][[4]][[2]]
```




```
##
## [[2]][[4]][[4]][[3]]
## [1] -2.7631250  0.6927083
##
## [[2]][[4]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[4]][[4]][[5]]
## [1] 1.727917
##
##
## [[2]][[4]][[5]]
```



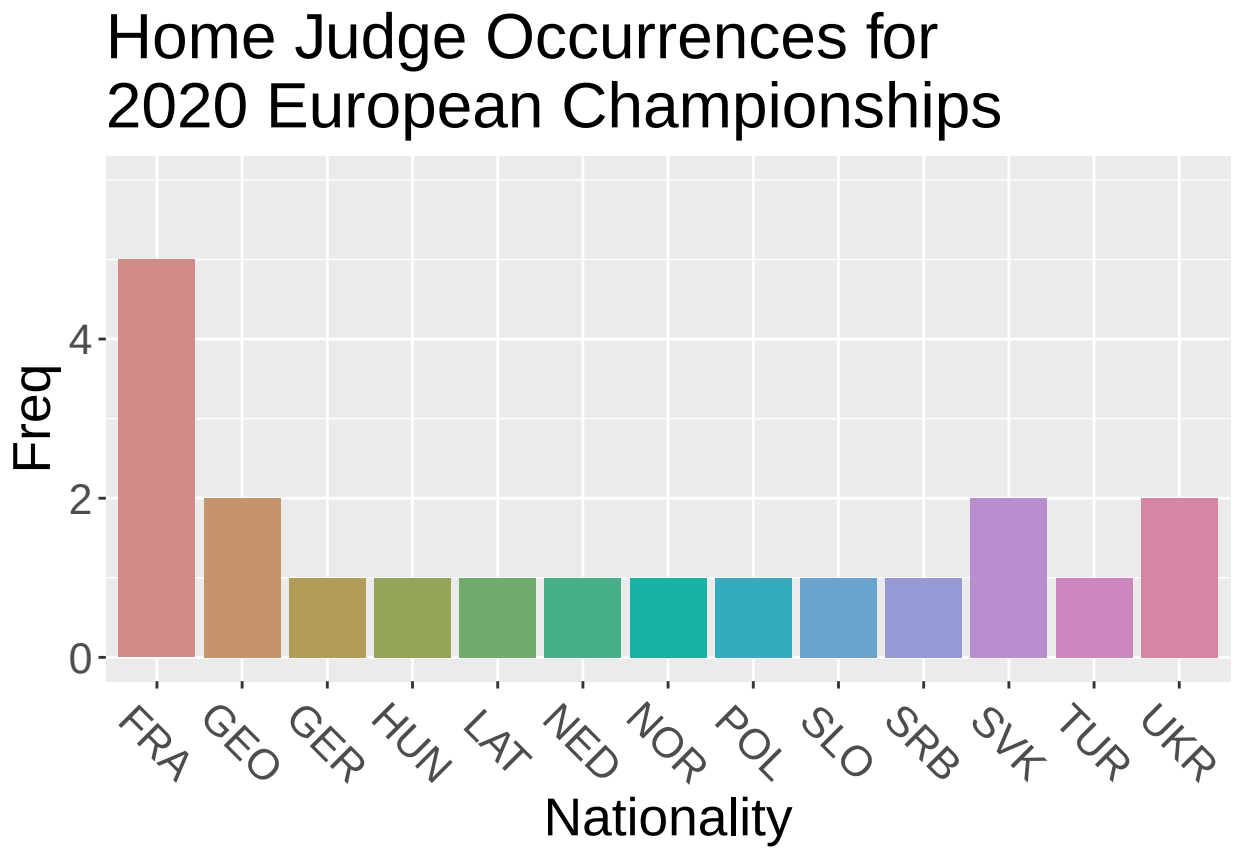

```
##
## [[2]][[4]][[6]]
## [[2]][[4]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[4]][[6]][[2]]
## [[2]][[4]][[6]][[2]][[1]]
## [[2]][[4]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[4]][[6]][[2]][[1]][[2]]
## [1] "HUN"
##
## [[2]][[4]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 2, p-value = 0.125
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[1]][[4]]
## [[2]][[4]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

```
## [[2]][[4]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.1222
##
##
## [[2]][[4]][[6]][[2]][[1]][[5]]
## [1] "diff in means"     "-3.43000000000001"
##
##
## [[2]][[4]][[6]][[2]][[2]]
## [[2]][[4]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[4]][[6]][[2]][[2]][[2]]
## [1] "NED"
##
## [[2]][[4]][[6]][[2]][[2]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[2]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[2]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[3]]
## [[2]][[4]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[4]][[6]][[2]][[3]][[2]]
## [1] "SVK"
##
## [[2]][[4]][[6]][[2]][[3]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[3]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[3]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[4]]
## [[2]][[4]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[4]][[6]][[2]][[4]][[2]]
## [1] "ROU"
##
## [[2]][[4]][[6]][[2]][[4]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[4]][[4]]
## [1] "No home scores to test"
```

```
##
## [[2]][[4]][[6]][[2]][[4]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[5]]
## [[2]][[4]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[4]][[6]][[2]][[5]][[2]]
## [1] "SLO"
##
## [[2]][[4]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 19, p-value = 0.2083
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[5]][[4]]
## [[2]][[4]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.1646
##
##
## [[2]][[4]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "3.02043478260869"
##
##
## [[2]][[4]][[6]][[2]][[6]]
## [[2]][[4]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[4]][[6]][[2]][[6]][[2]]
## [1] "UKR"
##
## [[2]][[4]][[6]][[2]][[6]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[6]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[6]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[7]]
## [[2]][[4]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
```

```
## [[2]][[4]][[6]][[2]][[7]][[2]]
## [1] "FRA"
##
## [[2]][[4]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 19, p-value = 0.1551
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[7]][[4]]
## [[2]][[4]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.1443
##
##
## [[2]][[4]][[6]][[2]][[7]][[5]]
## [1] "diff in means"     "-1.56285714285714"
##
##
## [[2]][[4]][[6]][[2]][[8]]
## [[2]][[4]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[4]][[6]][[2]][[8]][[2]]
## [1] "POL"
##
## [[2]][[4]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 6, p-value = 0.2917
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[8]][[4]]
## [[2]][[4]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.2827
##
##
## [[2]][[4]][[6]][[2]][[8]][[5]]
## [1] "diff in means"     "-1.98956521739131"
##
##
## [[2]][[4]][[6]][[2]][[9]]
## [[2]][[4]][[6]][[2]][[9]][[1]]
```

```
## [1] "j_9"
##
## [[2]][[4]][[6]][[2]][[9]][[2]]
## [1] "SRB"
##
## [[2]][[4]][[6]][[2]][[9]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[9]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[9]][[5]]
## [1] "diff in means" "NaN"
##
##
##
##
##
##
## [[3]]
```



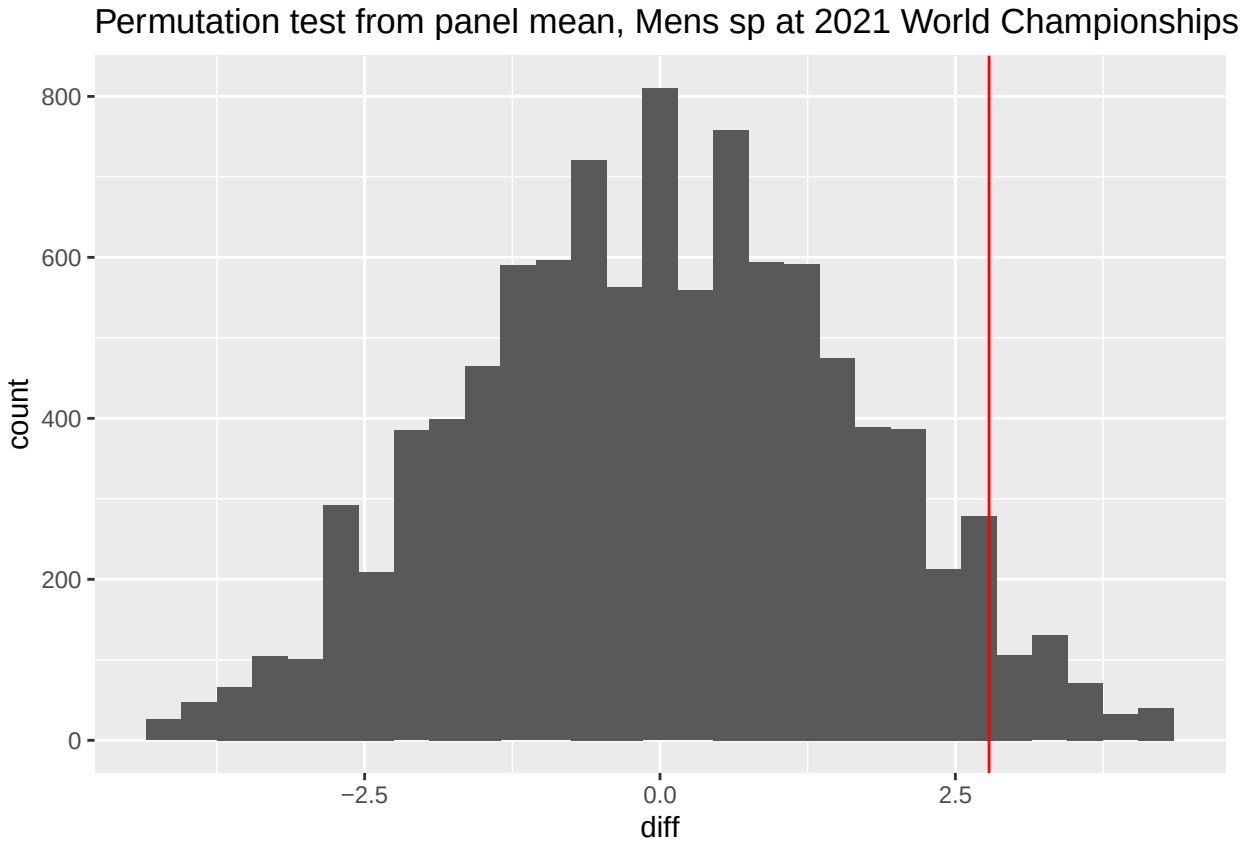

```
results <- analyze_event("World Championships", "2021")
```

```
## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties
```

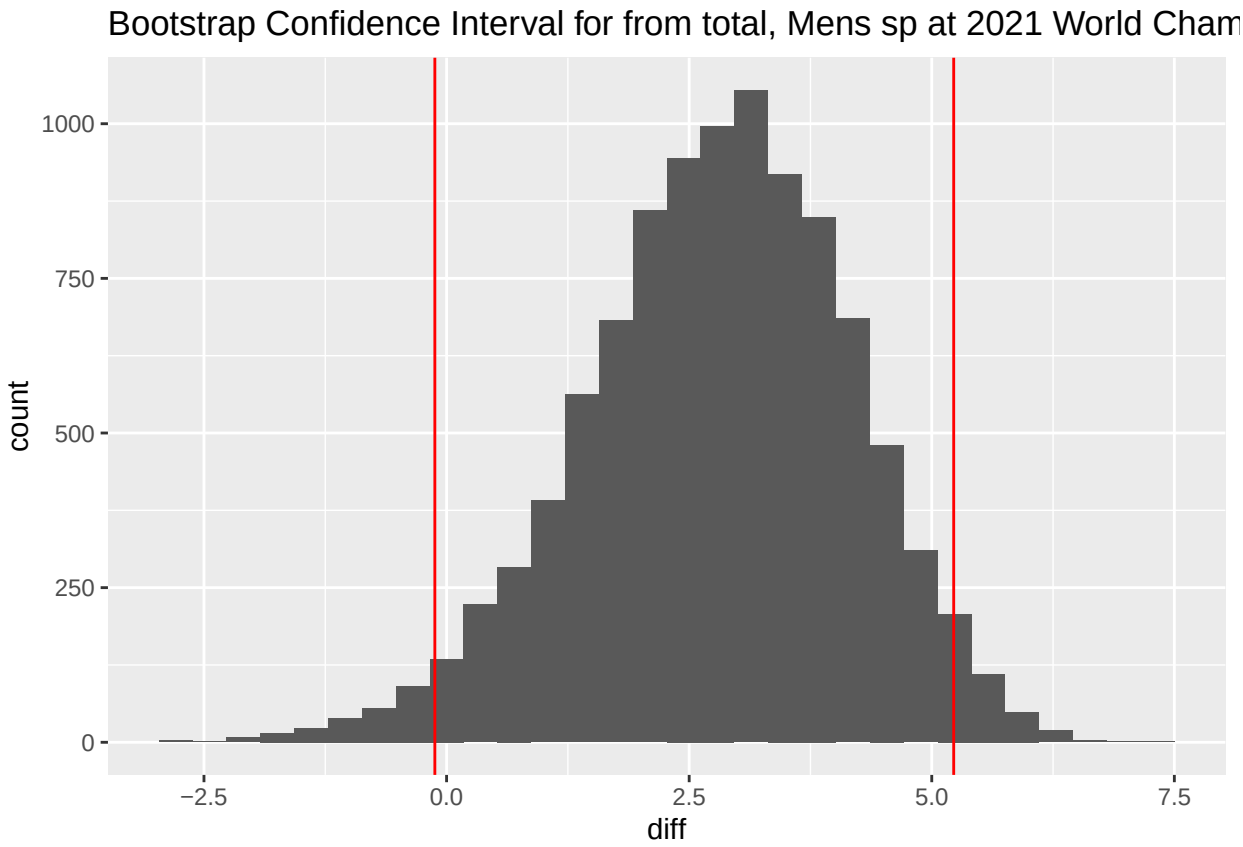
```
## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties
```

```
results
```

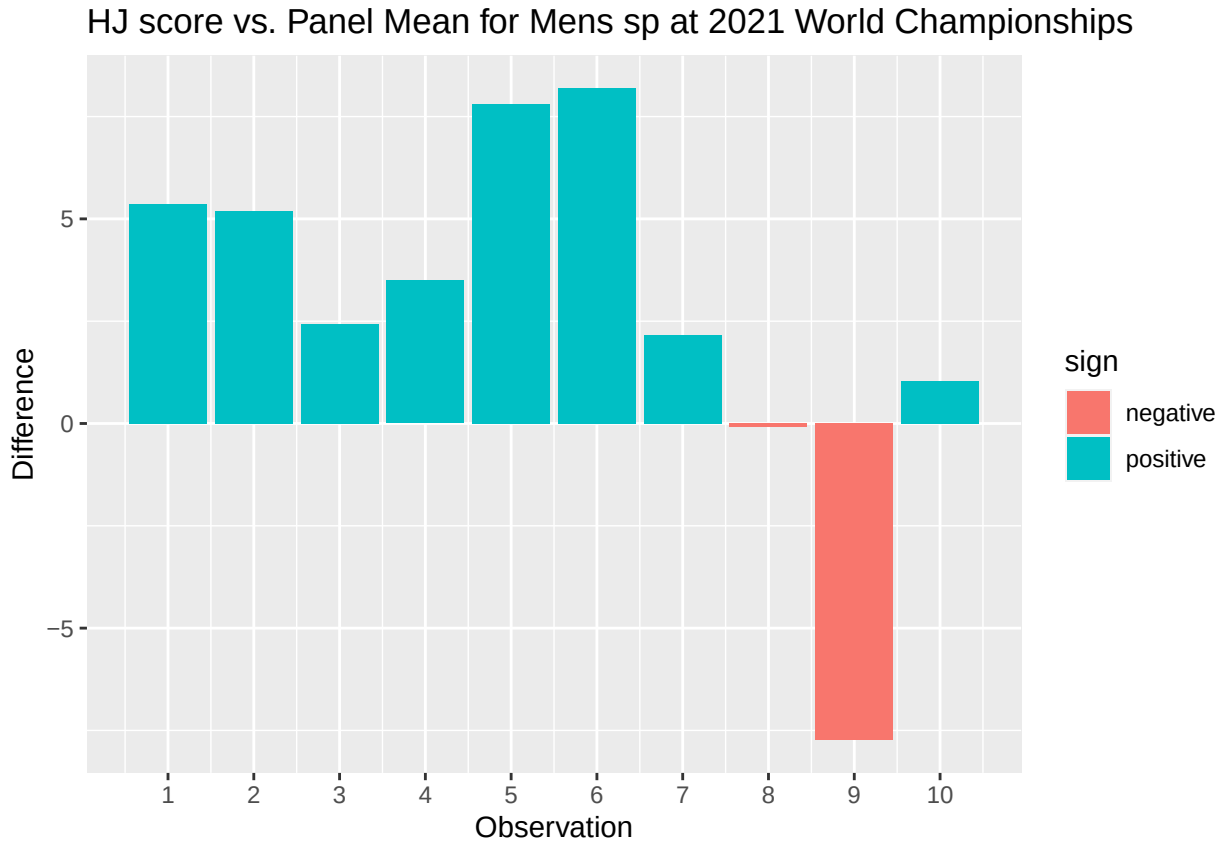
```
## [[1]]
## [1] "Results for 2021 World Championships"
##
## [[2]]
## [[2]][[1]]
## [[2]][[1]][[1]]
## [1] "Mens"                                "sp"
## [3] "# of Obs."                           "10"
## [5] "Standard Deviation of Observations" "4.59442200489113"
##
## [[2]][[1]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 46, p-value = 0.03223
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[3]]
## [[2]][[1]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[1]][[3]][[2]]
```




```
##
## [[2]][[1]][[3]][[3]]
## [1] 0.0435
##
## [[2]][[1]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[1]][[4]]
## [[2]][[1]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[1]][[4]][[2]]
```




```
##
## [[2]][[1]][[4]][[3]]
## [1] -0.1207687  5.2262219
##
## [[2]][[1]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[1]][[4]][[5]]
## [1] 2.673495
##
##
## [[2]][[1]][[5]]
```




```
##
## [[2]][[1]][[6]]
## [[2]][[1]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[1]][[6]][[2]]
## [[2]][[1]][[6]][[2]][[1]]
## [[2]][[1]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[1]][[6]][[2]][[1]][[2]]
## [1] "GBR"
##
## [[2]][[1]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 8, p-value = 0.2727
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[1]][[6]][[2]][[1]][[4]]
## [[2]][[1]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

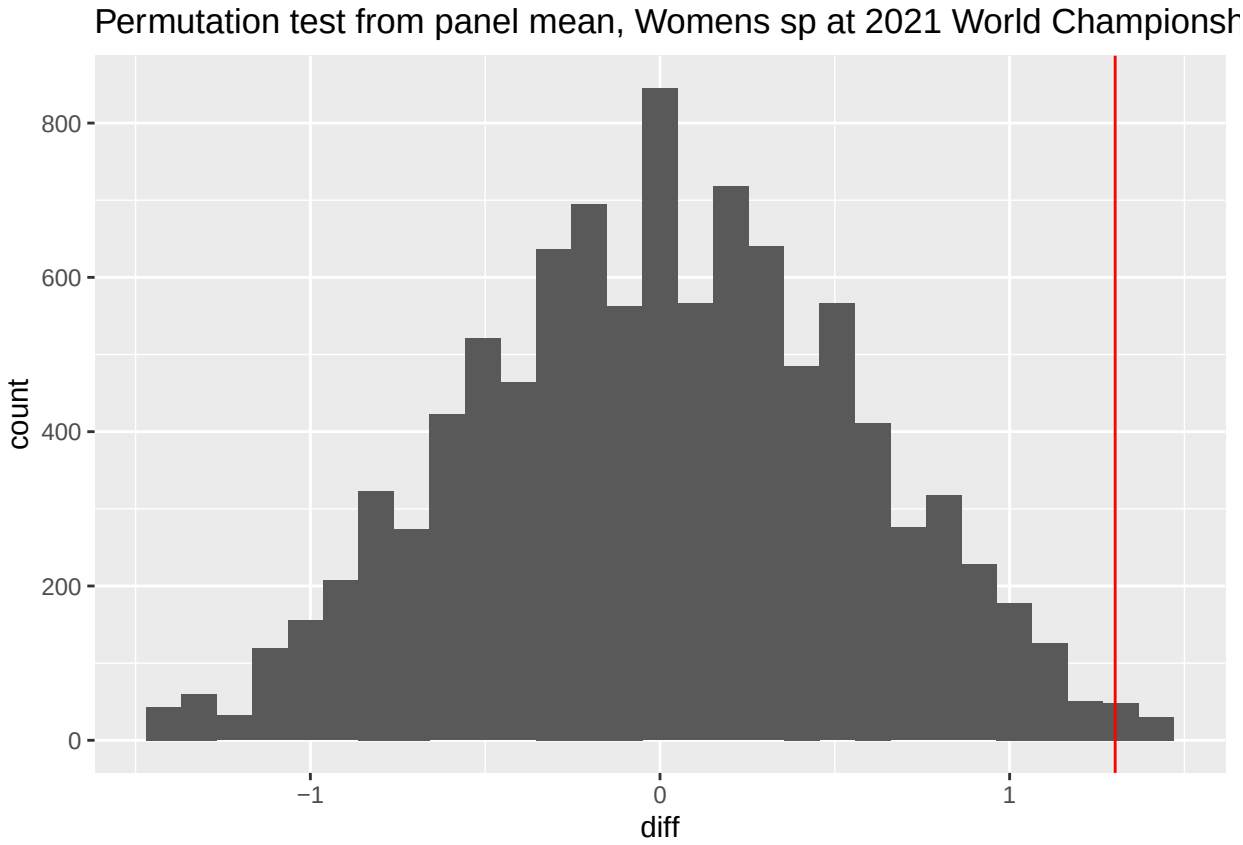
```
## [[2]][[1]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.2769
##
##
## [[2]][[1]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "-1.2853125"
##
##
## [[2]][[1]][[6]][[2]][[2]]
## [[2]][[1]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[1]][[6]][[2]][[2]][[2]]
## [1] "AUT"
##
## [[2]][[1]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 29, p-value = 0.1212
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.0945
##
##
## [[2]][[1]][[6]][[2]][[2]][[5]]
## [1] "diff in means" "2.7875"
##
##
## [[2]][[1]][[6]][[2]][[3]]
## [[2]][[1]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[1]][[6]][[2]][[3]][[2]]
## [1] "UKR"
##
## [[2]][[1]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 17, p-value = 0.4848
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[3]][[4]]
## [[2]][[1]][[6]][[2]][[3]][[4]][[1]]
```

```
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.4541
##
##
## [[2]][[1]][[6]][[2]][[3]][[5]]
## [1] "diff in means"      "0.0193749999999933"
##
##
## [[2]][[1]][[6]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[1]][[6]][[2]][[4]][[2]]
## [1] "FIN"
##
## [[2]][[1]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 20, p-value = 0.3566
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[4]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.3976
##
##
## [[2]][[1]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "0.860624999999997"
##
##
## [[2]][[1]][[6]][[2]][[5]]
## [[2]][[1]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[1]][[6]][[2]][[5]][[2]]
## [1] "GEO"
##
## [[2]][[1]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 32, p-value = 0.0303
## alternative hypothesis: true location shift is greater than 0
##
##
```

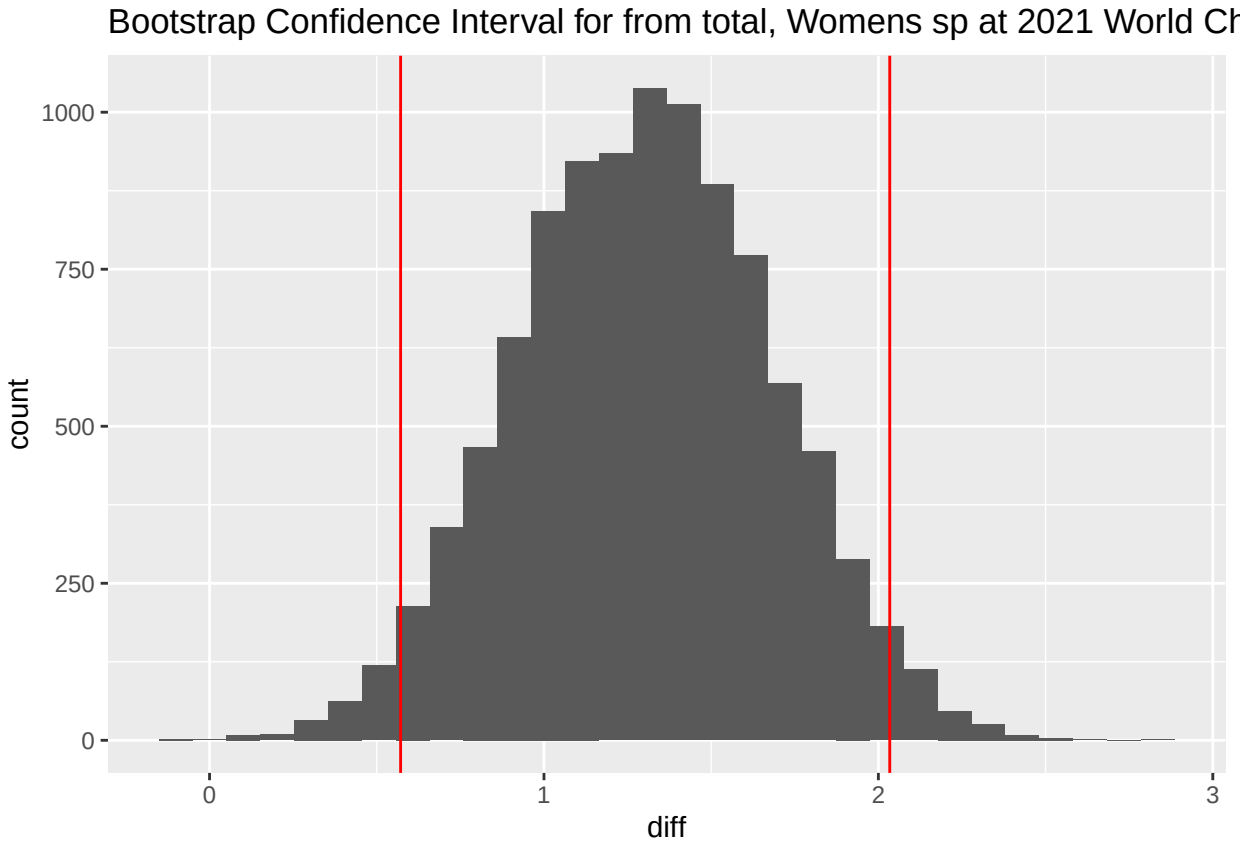
```
## [[2]][[1]][[6]][[2]][[5]][[4]]
## [[2]][[1]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[5]][[4]][[2]]
## [1] 0
##
##
## [[2]][[1]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "7.81281250000001"
##
##
## [[2]][[1]][[6]][[2]][[6]]
## [[2]][[1]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[1]][[6]][[2]][[6]][[2]]
## [1] "SWE"
##
## [[2]][[1]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 32, p-value = 0.05175
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[6]][[4]]
## [[2]][[1]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[6]][[4]][[2]]
## [1] 0
##
##
## [[2]][[1]][[6]][[2]][[6]][[5]]
## [1] "diff in means"    "6.92343749999999"
##
##
## [[2]][[1]][[6]][[2]][[7]]
## [[2]][[1]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[1]][[6]][[2]][[7]][[2]]
## [1] "SUI"
##
## [[2]][[1]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 21, p-value = 0.3636
## alternative hypothesis: true location shift is greater than 0
```

```
##
##
## [[2]][[1]][[6]][[2]][[7]][[4]]
## [[2]][[1]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.3439
##
##
## [[2]][[1]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "1.11656250000001"
##
##
## [[2]][[1]][[6]][[2]][[8]]
## [[2]][[1]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[1]][[6]][[2]][[8]][[2]]
## [1] "RUS"
##
## [[2]][[1]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 58, p-value = 0.02277
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[8]][[4]]
## [[2]][[1]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.0085
##
##
## [[2]][[1]][[6]][[2]][[8]][[5]]
## [1] "diff in means"    "2.73193548387097"
##
##
## [[2]][[1]][[6]][[2]][[9]]
## [[2]][[1]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[1]][[6]][[2]][[9]][[2]]
## [1] "CZE"
##
## [[2]][[1]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
```

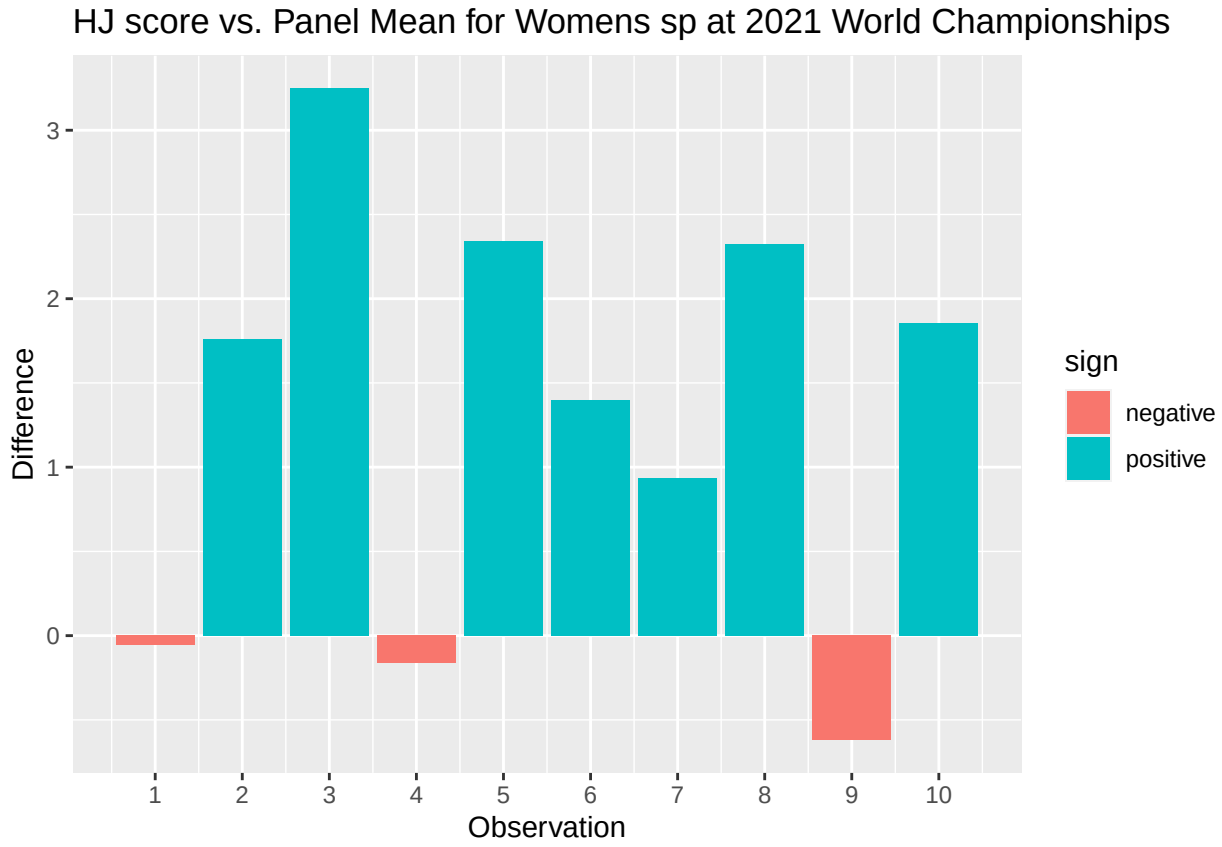
```
## W = 17, p-value = 0.4848
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[9]][[4]]
## [[2]][[1]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.4591
##
##
## [[2]][[1]][[6]][[2]][[9]][[5]]
## [1] "diff in means"     "0.170312499999992"
##
##
##
##
##
## [[2]][[2]]
## [[2]][[2]][[1]]
## [1] "Womens"                            "sp"
## [3] "# of Obs."                         "10"
## [5] "Standard Deviation of Observations" "1.2589536619418"
##
## [[2]][[2]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 49, p-value = 0.01367
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[3]]
## [[2]][[2]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[2]][[3]][[2]]
```




```
##
## [[2]][[2]][[3]][[3]]
## [1] 0.0052
##
## [[2]][[2]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[2]][[4]]
## [[2]][[2]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[2]][[4]][[2]]
```




```
##
## [[2]][[2]][[4]][[3]]
## [1] 0.5713469 2.0340000
##
## [[2]][[2]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[2]][[4]][[5]]
## [1] 0.7313266
##
##
## [[2]][[2]][[5]]
```




```
##
## [[2]][[2]][[6]]
## [[2]][[2]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[2]][[6]][[2]]
## [[2]][[2]][[6]][[2]][[1]]
## [[2]][[2]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[2]][[6]][[2]][[1]][[2]]
## [1] "SVK"
##
## [[2]][[2]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[2]][[6]][[2]][[2]]
## [[2]][[2]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

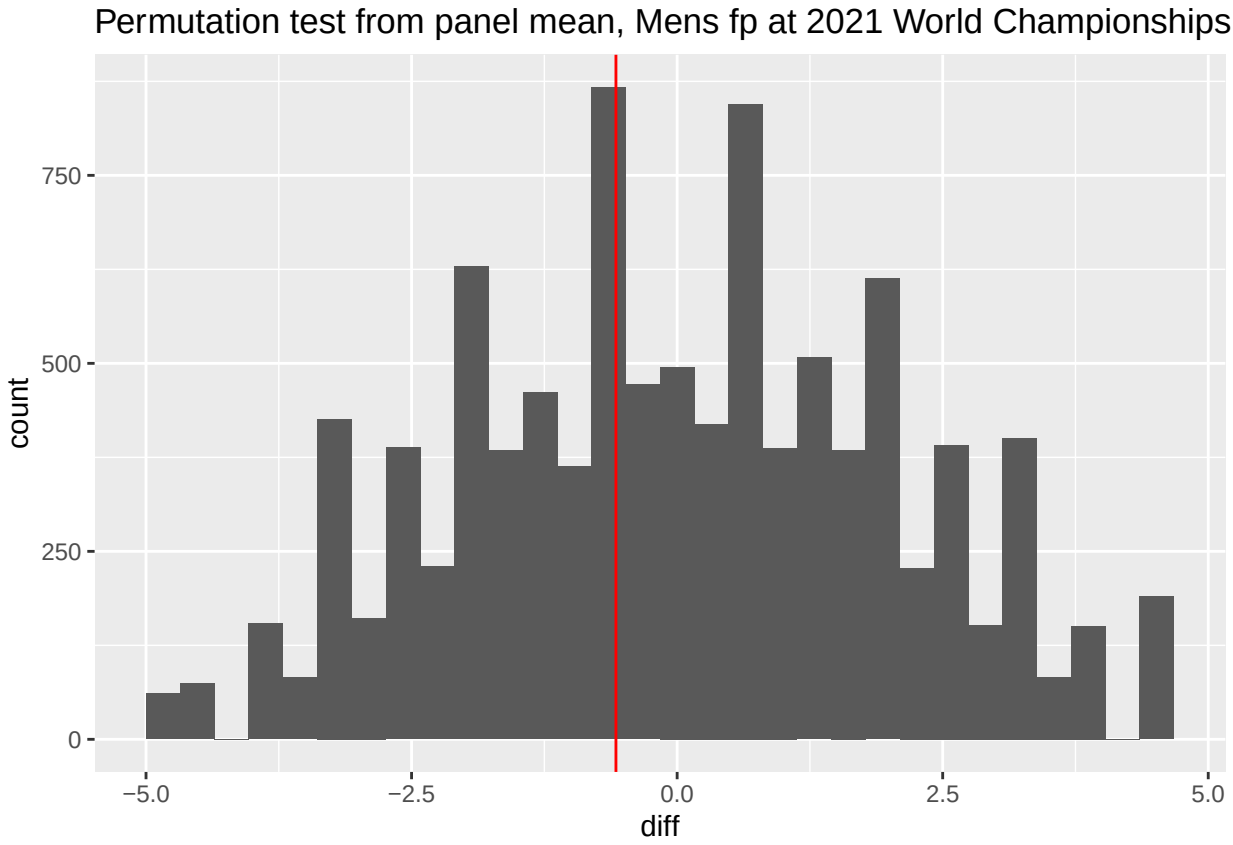
```
##
## [[2]][[2]][[6]][[2]][[2]][[2]]
## [1] "BEL"
##
## [[2]][[2]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 29, p-value = 0.1627
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[2]][[4]]
## [[2]][[2]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.1873
##
##
## [[2]][[2]][[6]][[2]][[2]][[5]]
## [1] "diff in means"    "1.55833333333334"
##
##
## [[2]][[2]][[6]][[2]][[3]]
## [[2]][[2]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[2]][[6]][[2]][[3]][[2]]
## [1] "USA"
##
## [[2]][[2]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 53, p-value = 0.1351
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[3]][[4]]
## [[2]][[2]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.1385
##
##
## [[2]][[2]][[6]][[2]][[3]][[5]]
## [1] "diff in means"    "1.66785714285714"
##
##
## [[2]][[2]][[6]][[2]][[4]]
```

```
## [[2]][[2]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[2]][[6]][[2]][[4]][[2]]
## [1] "FRA"
##
## [[2]][[2]][[6]][[2]][[4]][[3]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[4]][[4]]
## [1] "No home scores to test"
##
## [[2]][[2]][[6]][[2]][[4]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[2]][[6]][[2]][[5]]
## [[2]][[2]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[2]][[6]][[2]][[5]][[2]]
## [1] "ITA"
##
## [[2]][[2]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 35, p-value = 0.05405
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[5]][[4]]
## [[2]][[2]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.0251
##
##
## [[2]][[2]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "2.52972222222222"
##
##
## [[2]][[2]][[6]][[2]][[6]]
## [[2]][[2]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[2]][[6]][[2]][[6]][[2]]
## [1] "CZE"
##
## [[2]][[2]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum exact test
```

```
##
## data:  home and away
## W = 36, p-value = 0.02703
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[6]][[4]]
## [[2]][[2]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[6]][[4]][[2]]
## [1] 0
##
##
## [[2]][[2]][[6]][[2]][[6]][[5]]
## [1] "diff in means"    "2.64166666666667"
##
##
## [[2]][[2]][[6]][[2]][[7]]
## [[2]][[2]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[2]][[6]][[2]][[7]][[2]]
## [1] "SWE"
##
## [[2]][[2]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 27, p-value = 0.213
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[7]][[4]]
## [[2]][[2]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.2673
##
##
## [[2]][[2]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "1.19083333333334"
##
##
## [[2]][[2]][[6]][[2]][[8]]
## [[2]][[2]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[2]][[6]][[2]][[8]][[2]]
## [1] "RUS"
##
## [[2]][[2]][[6]][[2]][[8]][[3]]
```

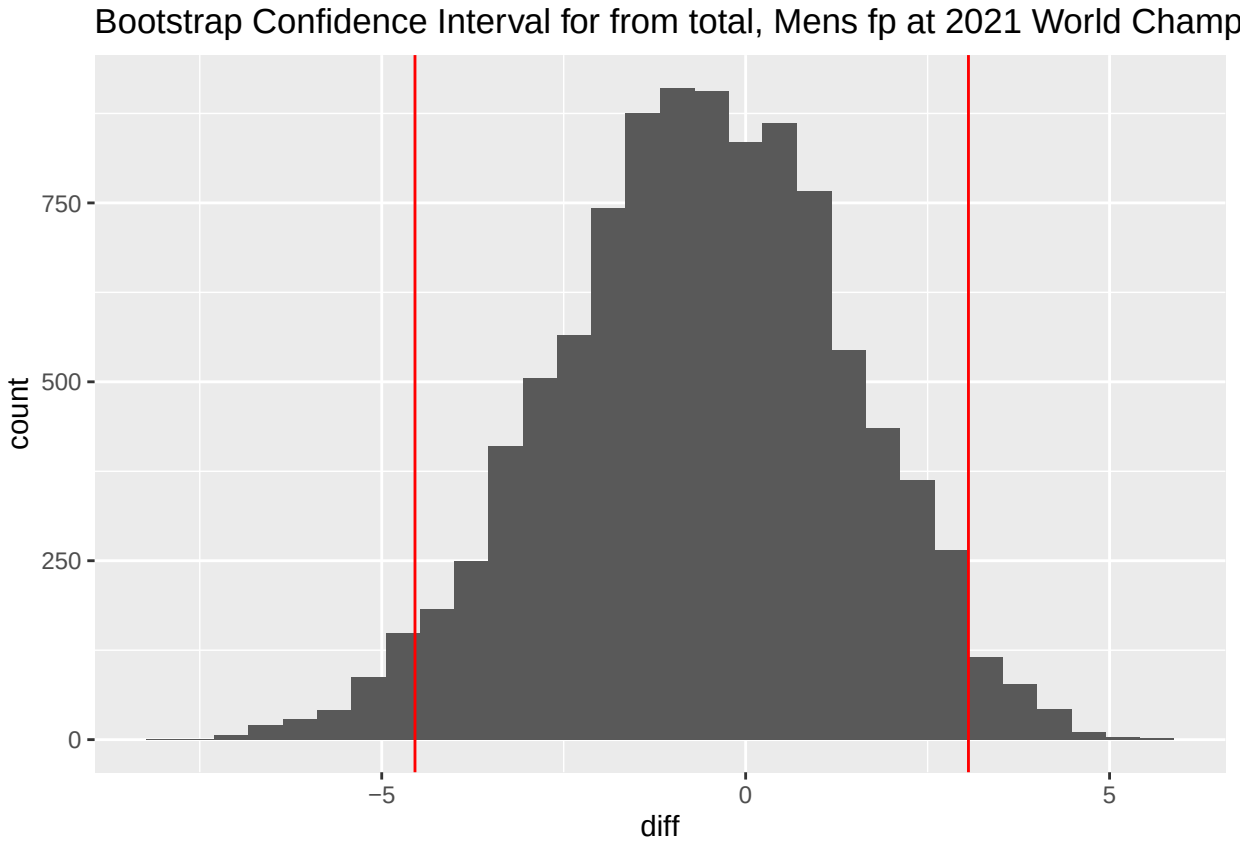
```
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 63, p-value = 0.271
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[8]][[4]]
## [[2]][[2]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.2484
##
##
## [[2]][[2]][[6]][[2]][[8]][[5]]
## [1] "diff in means"     "0.670588235294117"
##
##
## [[2]][[2]][[6]][[2]][[9]]
## [[2]][[2]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[2]][[6]][[2]][[9]][[2]]
## [1] "NED"
##
## [[2]][[2]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 15, p-value = 0.4324
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[2]][[6]][[2]][[9]][[4]]
## [[2]][[2]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.4259
##
##
## [[2]][[2]][[6]][[2]][[9]][[5]]
## [1] "diff in means"      "-0.895555555555553"
##
##
##
##
##
## [[2]][[3]]
## [[2]][[3]][[1]]
## [1] "Mens"                              "fp"
```

```
## [3] "# of Obs."                          "7"
## [5] "Standard Deviation of Observations" "5.73010236731256"
##
## [[2]][[3]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 14, p-value = 0.5313
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[3]]
## [[2]][[3]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[3]][[3]][[2]]
```

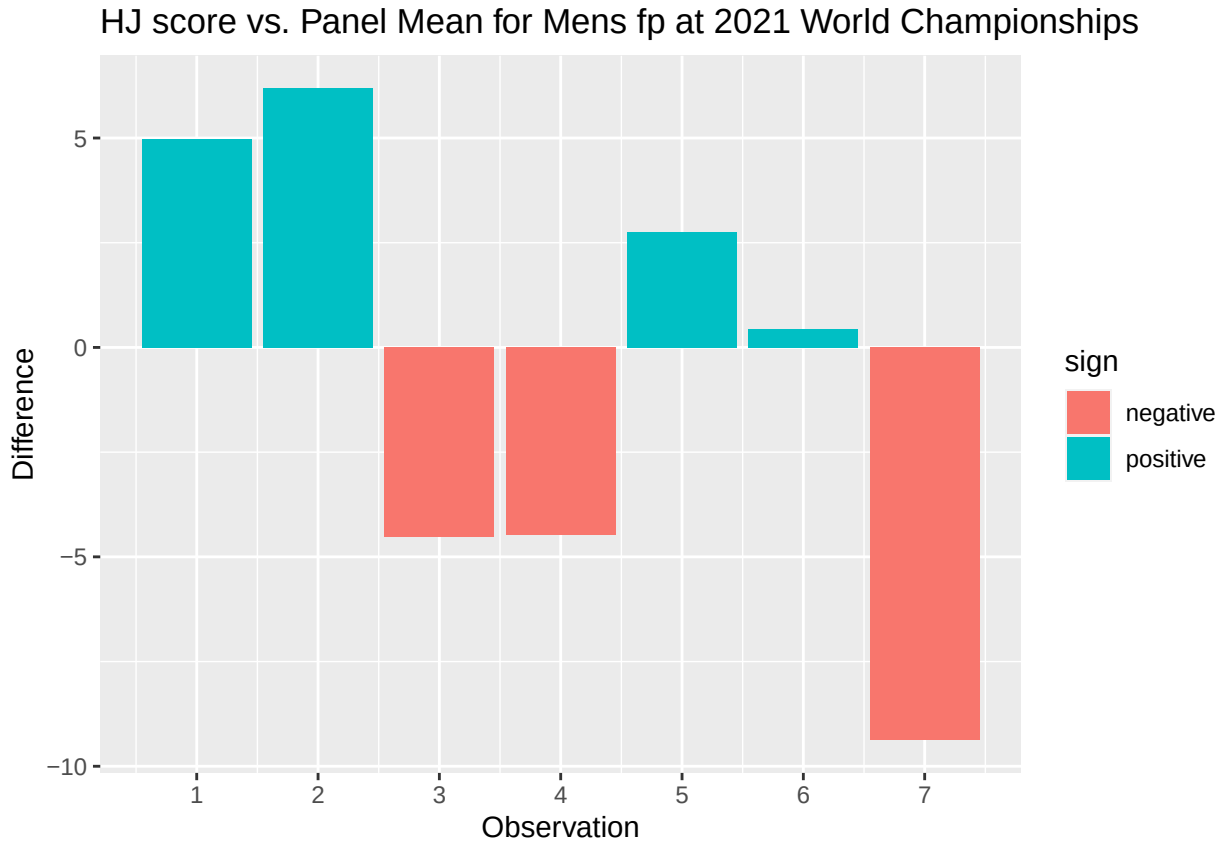



```
##
## [[2]][[3]][[3]][[3]]
## [1] 0.4211
##
## [[2]][[3]][[3]][[4]]
## [1] "hA = true mean is less than 0 (underscoring)"
##
```

```
##
## [[2]][[3]][[4]]
## [[2]][[3]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[3]][[4]][[2]]
```




```
##
## [[2]][[3]][[4]][[3]]
## [1] -4.543214  3.060893
##
## [[2]][[3]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[3]][[4]][[5]]
## [1] 3.802054
##
##
## [[2]][[3]][[5]]
```




```
##
## [[2]][[3]][[6]]
## [[2]][[3]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[3]][[6]][[2]]
## [[2]][[3]][[6]][[2]][[1]]
## [[2]][[3]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[3]][[6]][[2]][[1]][[2]]
## [1] "GBR"
##
## [[2]][[3]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[2]]
## [[2]][[3]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

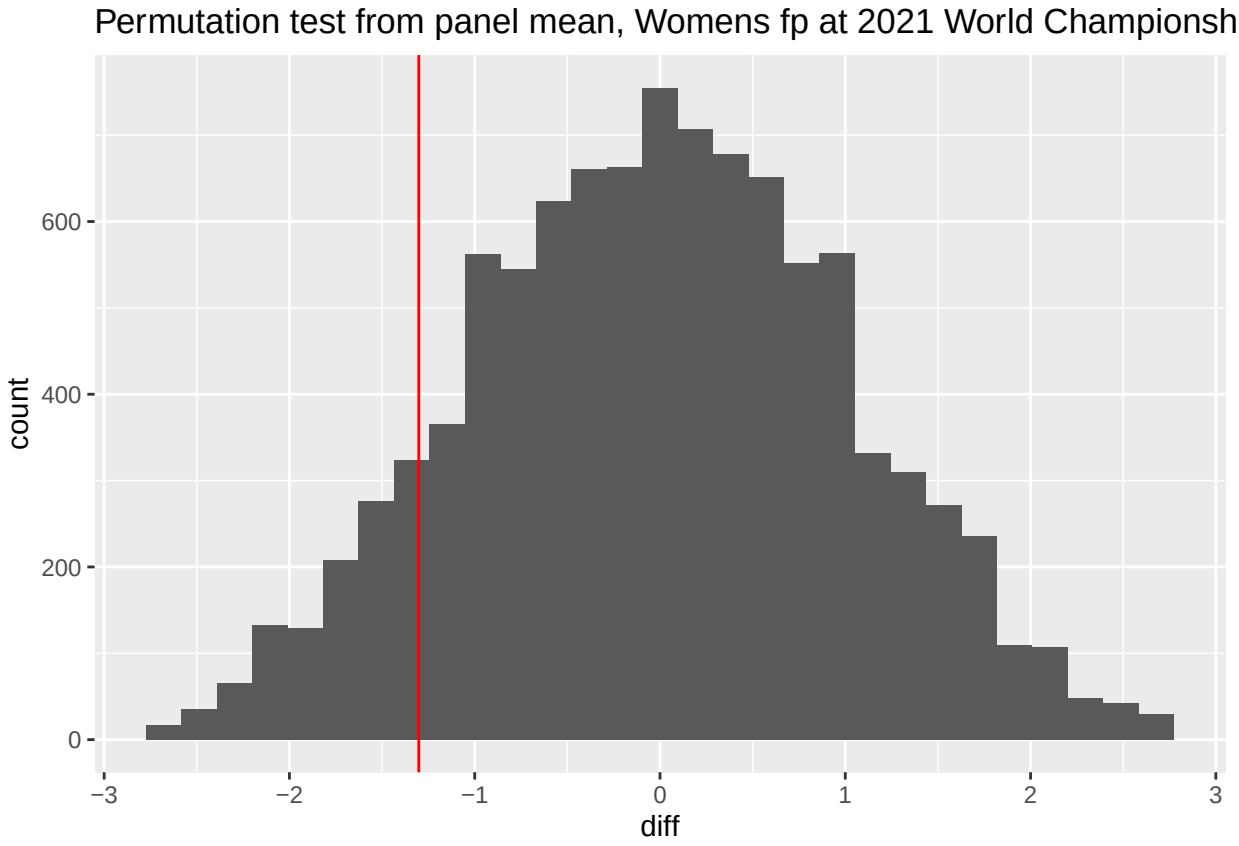
```
##
## [[2]][[3]][[6]][[2]][[2]][[2]]
## [1] "AUT"
##
## [[2]][[3]][[6]][[2]][[2]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[2]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[2]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[3]]
## [[2]][[3]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[3]][[6]][[2]][[3]][[2]]
## [1] "UKR"
##
## [[2]][[3]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 11, p-value = 0.5417
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[3]][[4]]
## [[2]][[3]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.5076
##
##
## [[2]][[3]][[6]][[2]][[3]][[5]]
## [1] "diff in means"      "0.0934782608695561"
##
##
## [[2]][[3]][[6]][[2]][[4]]
## [[2]][[3]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[3]][[6]][[2]][[4]][[2]]
## [1] "FIN"
##
## [[2]][[3]][[6]][[2]][[4]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[4]][[4]]
## [1] "No home scores to test"
```

```
##
## [[2]][[3]][[6]][[2]][[4]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[5]]
## [[2]][[3]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[3]][[6]][[2]][[5]][[2]]
## [1] "GEO"
##
## [[2]][[3]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 2, p-value = 0.125
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[5]][[4]]
## [[2]][[3]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.126
##
##
## [[2]][[3]][[6]][[2]][[5]][[5]]
## [1] "diff in means"     "-7.91347826086956"
##
##
## [[2]][[3]][[6]][[2]][[6]]
## [[2]][[3]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[3]][[6]][[2]][[6]][[2]]
## [1] "SWE"
##
## [[2]][[3]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 0, p-value = 0.04167
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[6]][[4]]
## [[2]][[3]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[6]][[4]][[2]]
```

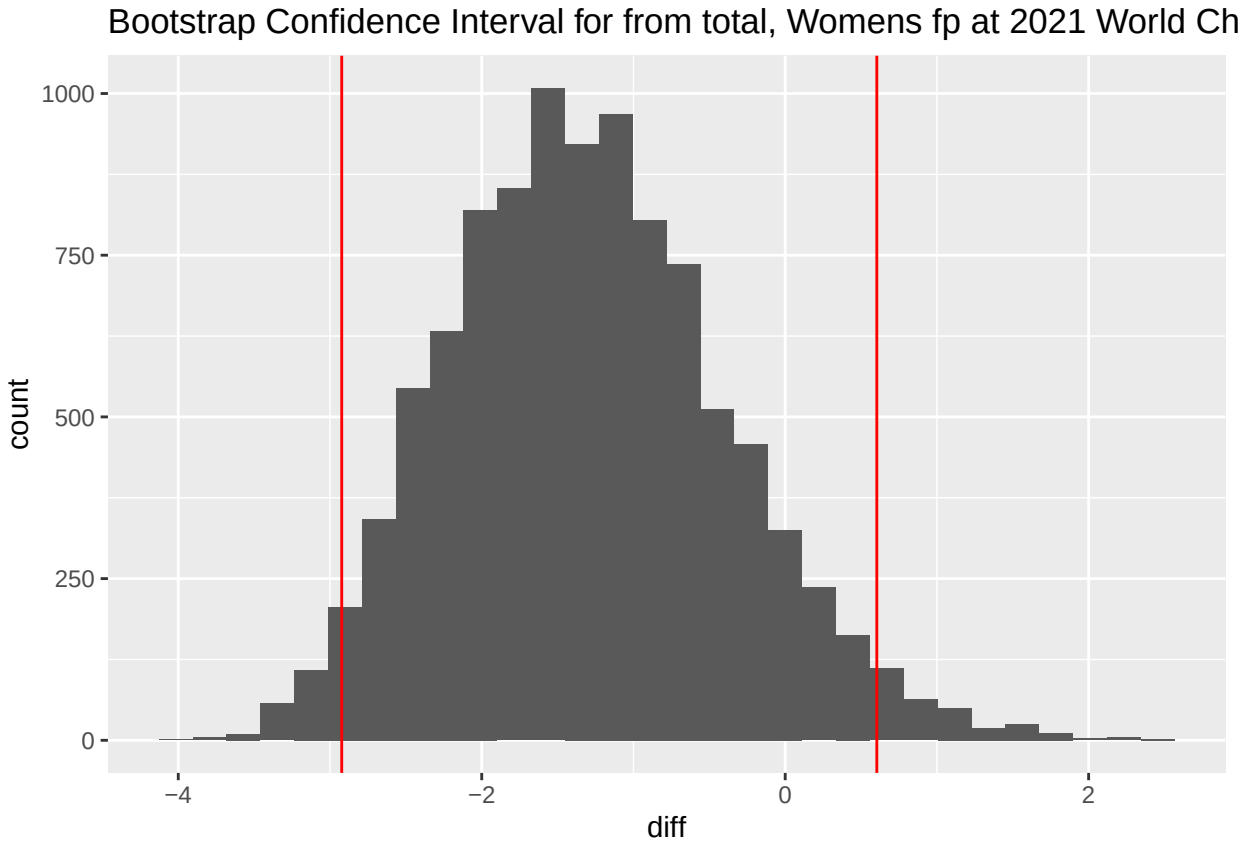
```
## [1] 0.0403
##
##
## [[2]][[3]][[6]][[2]][[6]][[5]]
## [1] "diff in means"     "-7.73434782608695"
##
##
## [[2]][[3]][[6]][[2]][[7]]
## [[2]][[3]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[3]][[6]][[2]][[7]][[2]]
## [1] "SUI"
##
## [[2]][[3]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 6, p-value = 0.2917
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[7]][[4]]
## [[2]][[3]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.29
##
##
## [[2]][[3]][[6]][[2]][[7]][[5]]
## [1] "diff in means"     "-3.09565217391305"
##
##
## [[2]][[3]][[6]][[2]][[8]]
## [[2]][[3]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[3]][[6]][[2]][[8]][[2]]
## [1] "RUS"
##
## [[2]][[3]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 40, p-value = 0.03261
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[8]][[4]]
## [[2]][[3]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
```

```
##
## [[2]][[3]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.0471
##
##
## [[2]][[3]][[6]][[2]][[8]][[5]]
## [1] "diff in means"    "4.70227272727272"
##
##
## [[2]][[3]][[6]][[2]][[9]]
## [[2]][[3]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[3]][[6]][[2]][[9]][[2]]
## [1] "CZE"
##
## [[2]][[3]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 23, p-value = 0.04167
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[9]][[4]]
## [[2]][[3]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[9]][[4]][[2]]
## [1] 0
##
##
## [[2]][[3]][[6]][[2]][[9]][[5]]
## [1] "diff in means"    "4.46173913043478"
##
##
##
##
##
## [[2]][[4]]
## [[2]][[4]][[1]]
## [1] "Womens"                             "fp"
## [3] "# of Obs."                          "9"
## [5] "Standard Deviation of Observations" "2.91290662397544"
##
## [[2]][[4]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 13, p-value = 0.1504
## alternative hypothesis: true location shift is less than 0
##
```

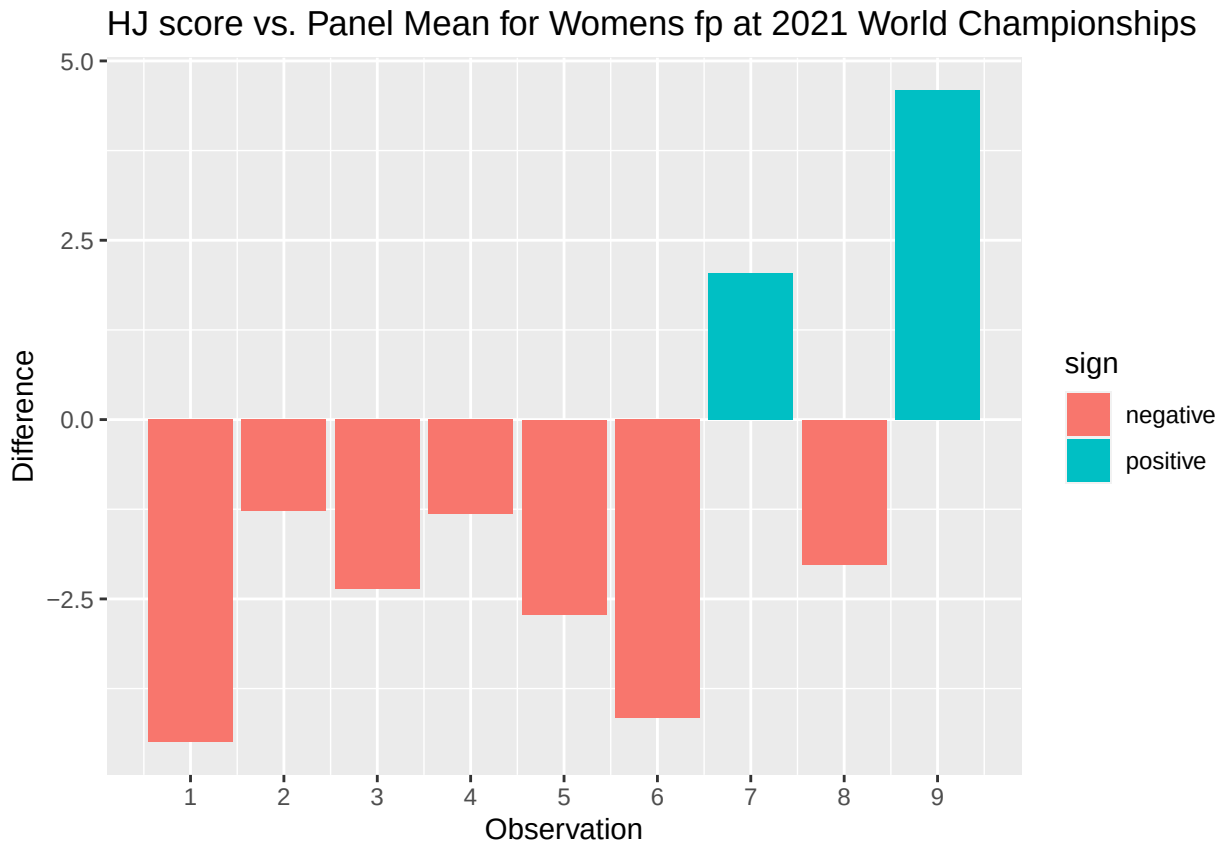
```
##
## [[2]][[4]][[3]]
## [[2]][[4]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[4]][[3]][[2]]
```




```
##
## [[2]][[4]][[3]][[3]]
## [1] 0.1084
##
## [[2]][[4]][[3]][[4]]
## [1] "hA = true mean is less than 0 (underscoring)"
##
##
## [[2]][[4]][[4]]
## [[2]][[4]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[4]][[4]][[2]]
```




```
##
## [[2]][[4]][[4]][[3]]
## [1] -2.9226458  0.6038889
##
## [[2]][[4]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[4]][[4]][[5]]
## [1] 1.763267
##
##
## [[2]][[4]][[5]]
```



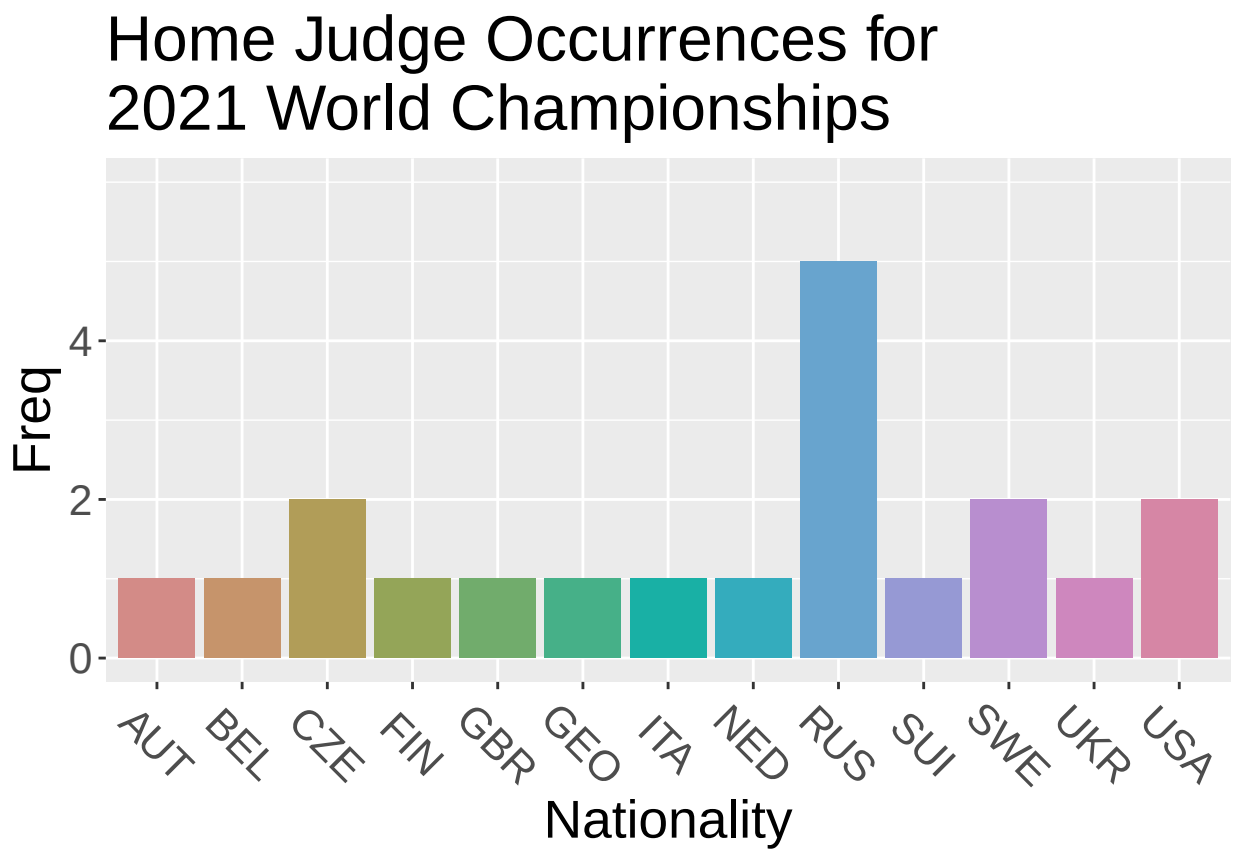

```
##
## [[2]][[4]][[6]]
## [[2]][[4]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[4]][[6]][[2]]
## [[2]][[4]][[6]][[2]][[1]]
## [[2]][[4]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[4]][[6]][[2]][[1]][[2]]
## [1] "SVK"
##
## [[2]][[4]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[2]]
## [[2]][[4]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

```
##
## [[2]][[4]][[6]][[2]][[2]][[2]]
## [1] "BEL"
##
## [[2]][[4]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 3, p-value = 0.1667
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[2]][[4]]
## [[2]][[4]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.1667
##
##
## [[2]][[4]][[6]][[2]][[2]][[5]]
## [1] "diff in means"     "-1.91347826086955"
##
##
## [[2]][[4]][[6]][[2]][[3]]
## [[2]][[4]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[4]][[6]][[2]][[3]][[2]]
## [1] "USA"
##
## [[2]][[4]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 19, p-value = 0.3986
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[3]][[4]]
## [[2]][[4]][[6]][[2]][[3]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.426
##
##
## [[2]][[4]][[6]][[2]][[3]][[5]]
## [1] "diff in means"     "-0.89454545454545"
##
##
## [[2]][[4]][[6]][[2]][[4]]
```

```
## [[2]][[4]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[4]][[6]][[2]][[4]][[2]]
## [1] "FRA"
##
## [[2]][[4]][[6]][[2]][[4]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[4]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[4]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[5]]
## [[2]][[4]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[4]][[6]][[2]][[5]][[2]]
## [1] "ITA"
##
## [[2]][[4]][[6]][[2]][[5]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[5]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[5]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[6]]
## [[2]][[4]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[4]][[6]][[2]][[6]][[2]]
## [1] "CZE"
##
## [[2]][[4]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 21, p-value = 0.125
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[6]][[4]]
## [[2]][[4]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[6]][[4]][[2]]
```

```
## [1] 0.0816
##
##
## [[2]][[4]][[6]][[2]][[6]][[5]]
## [1] "diff in means"    "2.91782608695652"
##
##
## [[2]][[4]][[6]][[2]][[7]]
## [[2]][[4]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[4]][[6]][[2]][[7]][[2]]
## [1] "SWE"
##
## [[2]][[4]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 6, p-value = 0.2917
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[7]][[4]]
## [[2]][[4]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.2934
##
##
## [[2]][[4]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "-1.7995652173913"
##
##
## [[2]][[4]][[6]][[2]][[8]]
## [[2]][[4]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[4]][[6]][[2]][[8]][[2]]
## [1] "RUS"
##
## [[2]][[4]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 14, p-value = 0.07263
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[8]][[4]]
## [[2]][[4]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
```

```
##
## [[2]][[4]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.1004
##
##
## [[2]][[4]][[6]][[2]][[8]][[5]]
## [1] "diff in means"     "-2.66761904761904"
##
##
## [[2]][[4]][[6]][[2]][[9]]
## [[2]][[4]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[4]][[6]][[2]][[9]][[2]]
## [1] "NED"
##
## [[2]][[4]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 14, p-value = 0.4167
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[9]][[4]]
## [[2]][[4]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.3774
##
##
## [[2]][[4]][[6]][[2]][[9]][[5]]
## [1] "diff in means"    "1.34304347826086"
##
##
##
##
##
##
## [[3]]
```



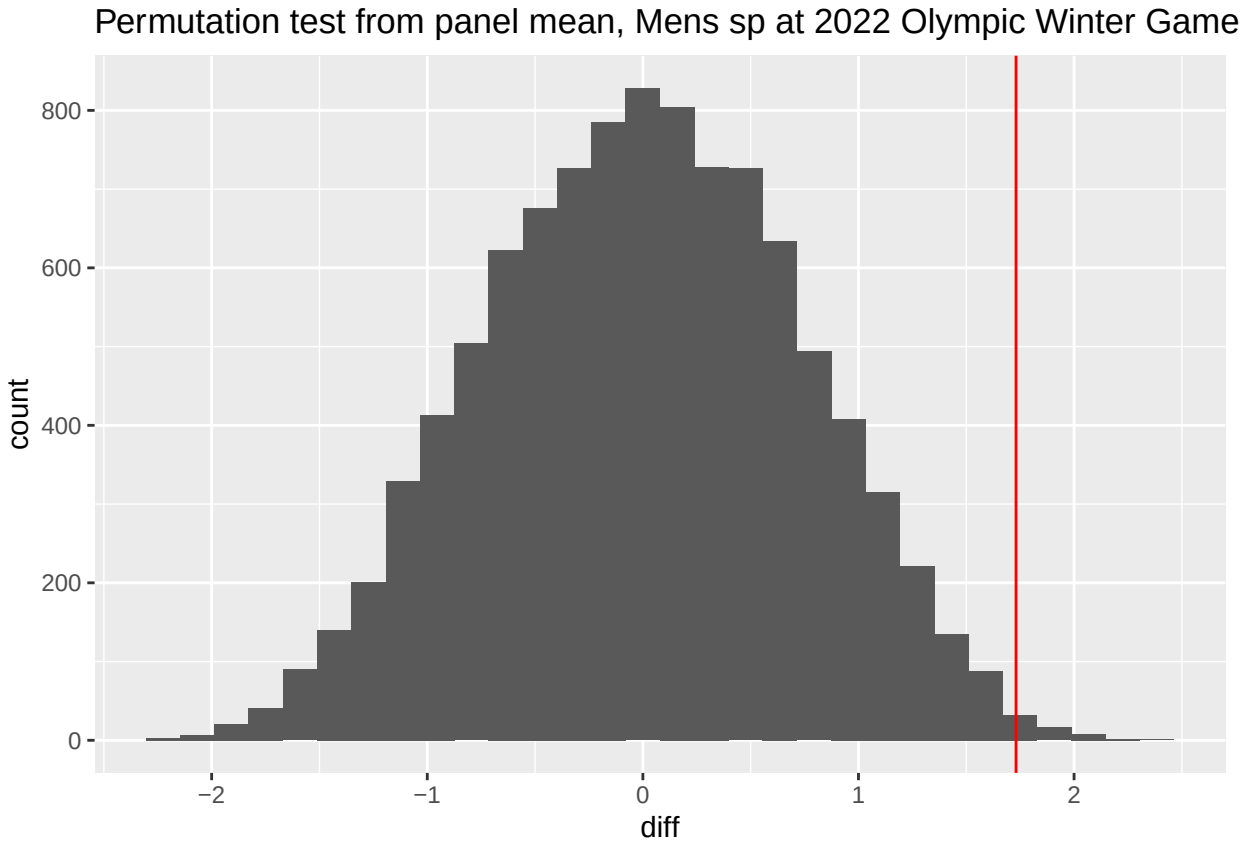

```
results <- analyze_event("Olympic Winter Games", "2022")
```

```
## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties
```

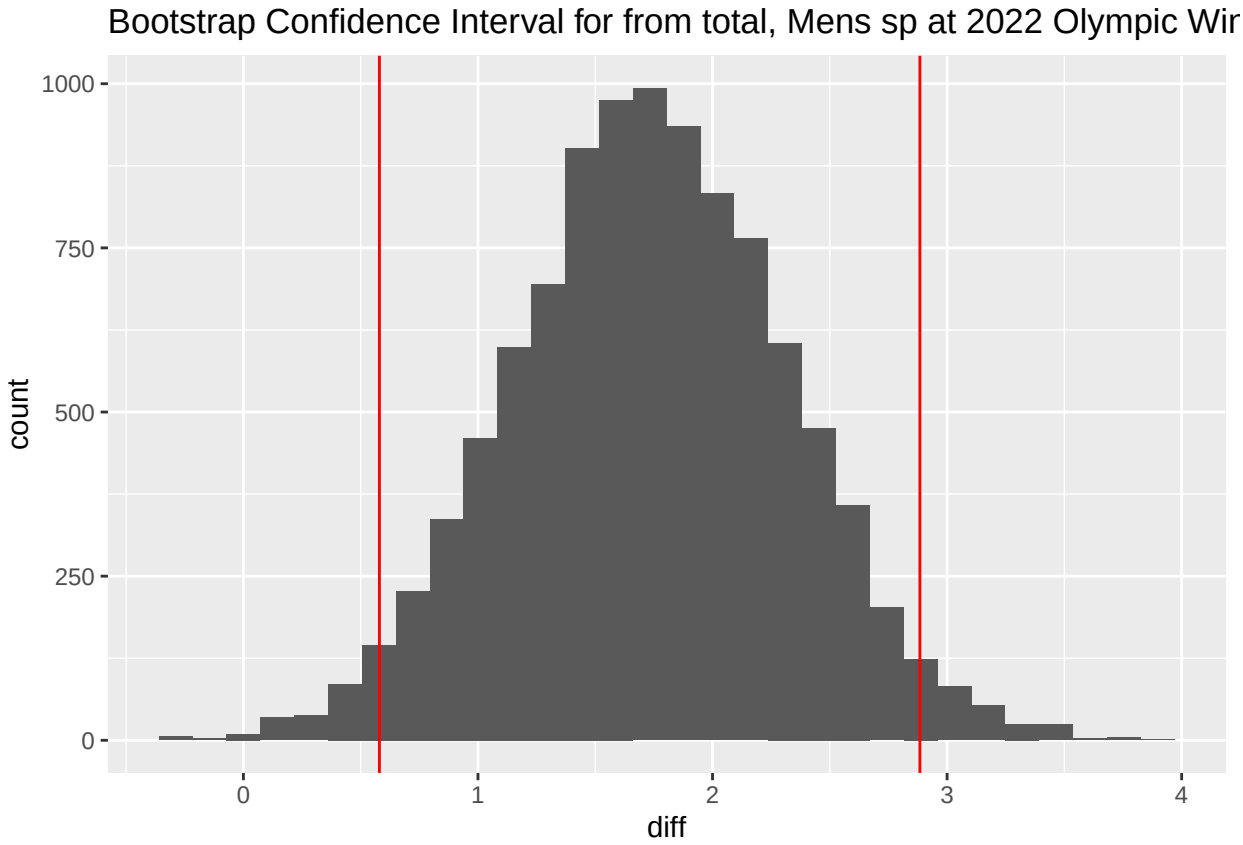
```
## Warning in wilcox.test.default(home, away, alternative = "greater"): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(home, away, alternative = "less"): cannot
## compute exact p-value with ties
```

```
results
```

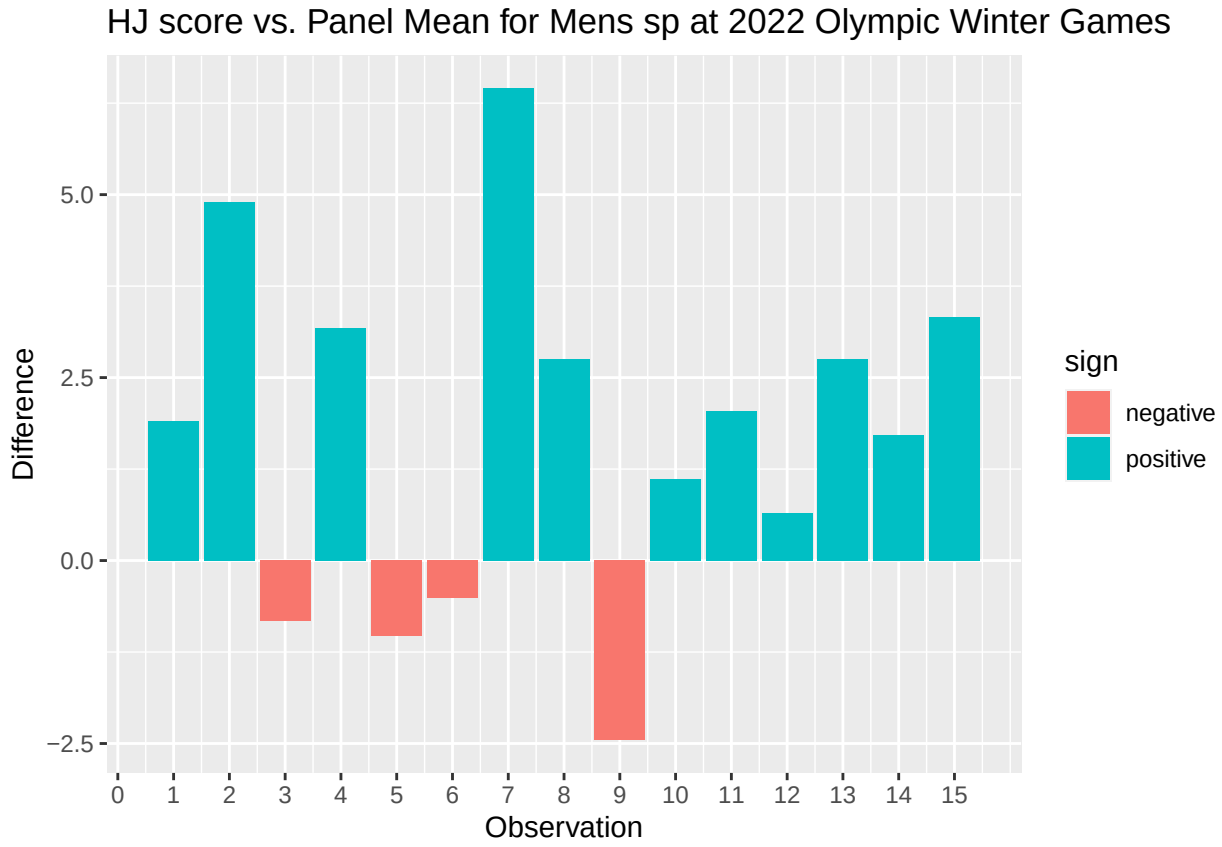
```
## [[1]]
## [1] "Results for 2022 Olympic Winter Games"
##
## [[2]]
## [[2]][[1]]
## [[2]][[1]][[1]]
## [1] "Mens"                                "sp"
## [3] "# of Obs."                           "15"
## [5] "Standard Deviation of Observations" "2.35084681108035"
##
## [[2]][[1]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 103, p-value = 0.006226
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[3]]
## [[2]][[1]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[1]][[3]][[2]]
```




```
##
## [[2]][[1]][[3]][[3]]
## [1] 0.0047
##
## [[2]][[1]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[1]][[4]]
## [[2]][[1]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[1]][[4]][[2]]
```




```
##
## [[2]][[1]][[4]][[3]]
## [1] 0.5798271 2.8840958
##
## [[2]][[1]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[1]][[4]][[5]]
## [1] 1.152134
##
##
## [[2]][[1]][[5]]
```




```
##
## [[2]][[1]][[6]]
## [[2]][[1]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[1]][[6]][[2]]
## [[2]][[1]][[6]][[2]][[1]]
## [[2]][[1]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[1]][[6]][[2]][[1]][[2]]
## [1] "ITA"
##
## [[2]][[1]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 34, p-value = 0.298
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[1]][[4]]
## [[2]][[1]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

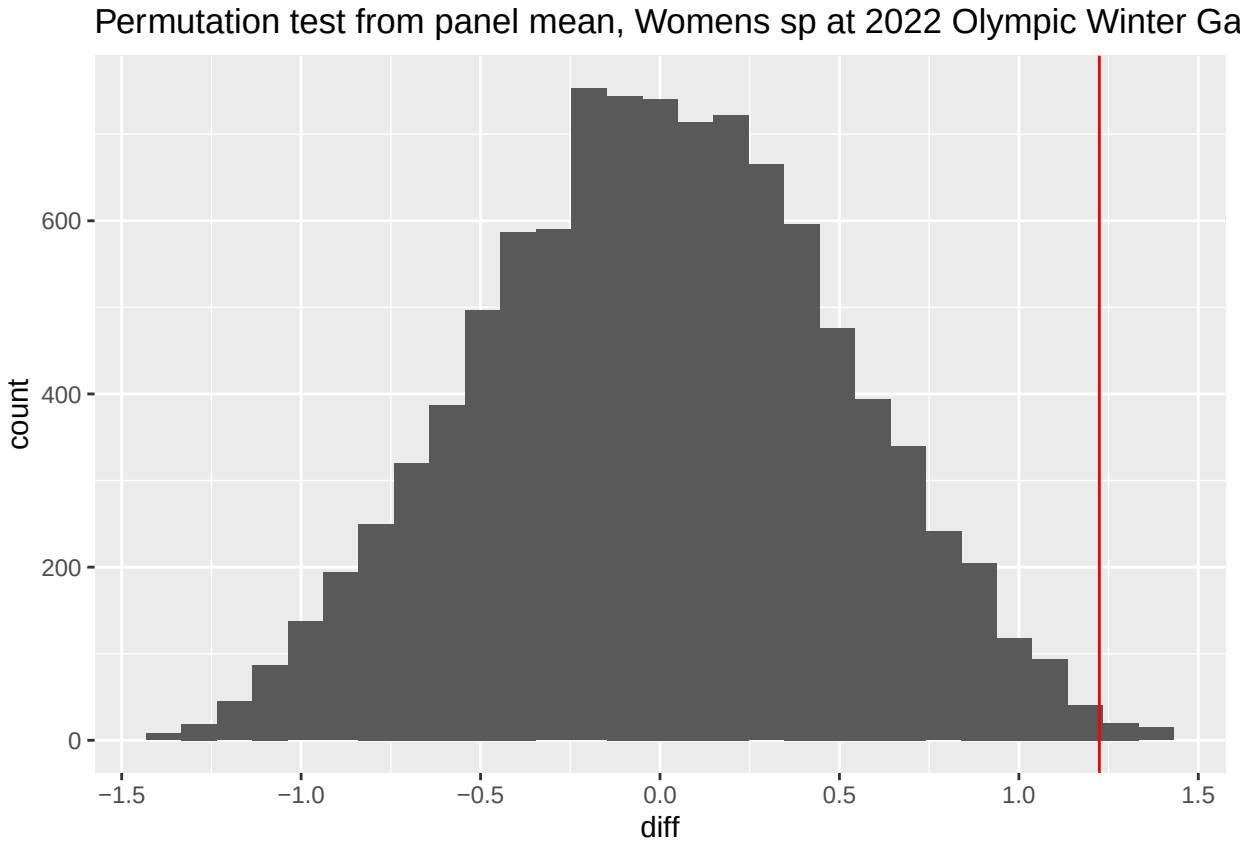
```
## [[2]][[1]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.2392
##
##
## [[2]][[1]][[6]][[2]][[1]][[5]]
## [1] "diff in means"     "0.945925925925926"
##
##
## [[2]][[1]][[6]][[2]][[2]]
## [[2]][[1]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[1]][[6]][[2]][[2]][[2]]
## [1] "CHN"
##
## [[2]][[1]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 28, p-value = 0.03448
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[2]][[4]][[2]]
## [1] 0
##
##
## [[2]][[1]][[6]][[2]][[2]][[5]]
## [1] "diff in means"    "4.69392857142857"
##
##
## [[2]][[1]][[6]][[2]][[3]]
## [[2]][[1]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[1]][[6]][[2]][[3]][[2]]
## [1] "ISR"
##
## [[2]][[1]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 27, p-value = 0.06897
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[3]][[4]]
## [[2]][[1]][[6]][[2]][[3]][[4]][[1]]
```

```
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.035
##
##
## [[2]][[1]][[6]][[2]][[3]][[5]]
## [1] "diff in means"   "4.2592857142857"
##
##
## [[2]][[1]][[6]][[2]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[1]][[6]][[2]][[4]][[2]]
## [1] "JPN"
##
## [[2]][[1]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 76, p-value = 0.001095
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[4]][[4]]
## [[2]][[1]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[4]][[4]][[2]]
## [1] 9e-04
##
##
## [[2]][[1]][[6]][[2]][[4]][[5]]
## [1] "diff in means"    "4.17833333333333"
##
##
## [[2]][[1]][[6]][[2]][[5]]
## [[2]][[1]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[1]][[6]][[2]][[5]][[2]]
## [1] "FRA"
##
## [[2]][[1]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 19, p-value = 0.2593
## alternative hypothesis: true location shift is less than 0
##
##
```

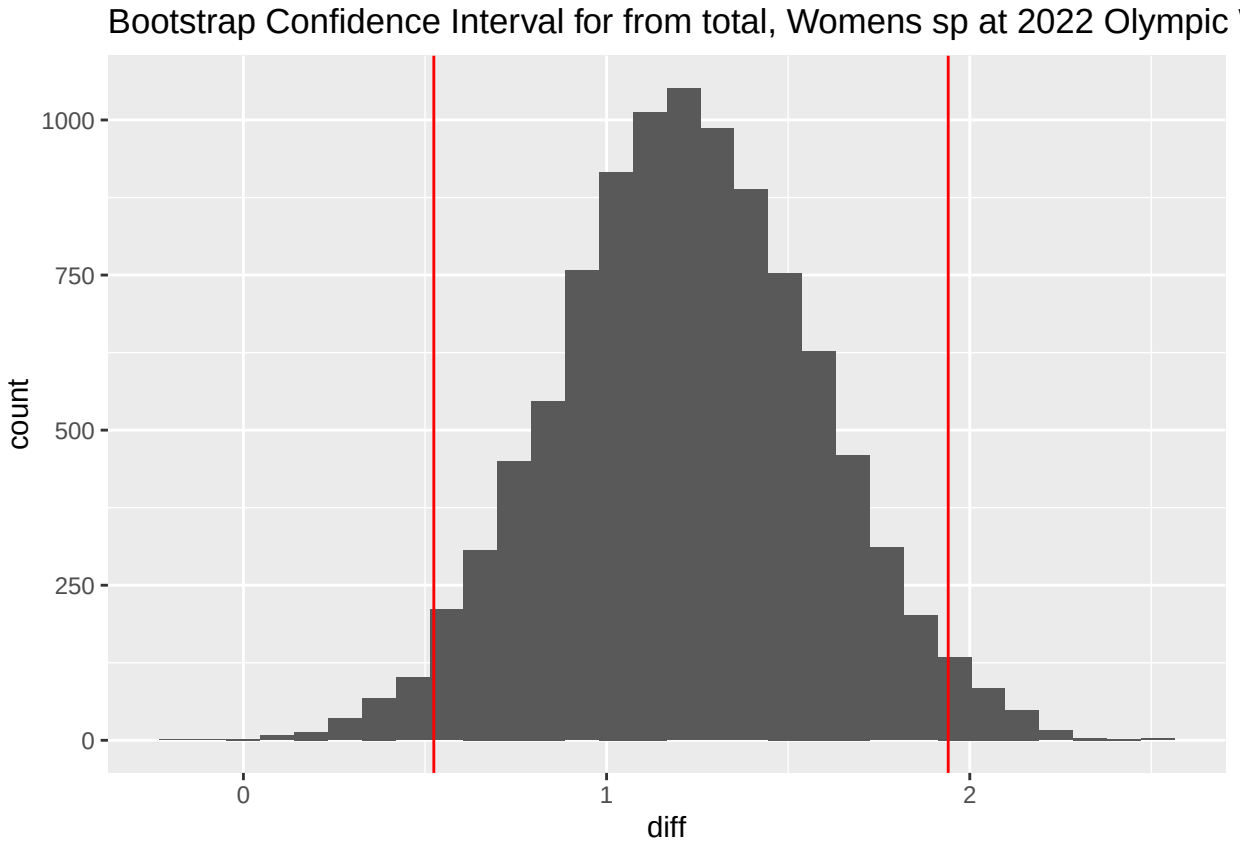
```
## [[2]][[1]][[6]][[2]][[5]][[4]]
## [[2]][[1]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.2906
##
##
## [[2]][[1]][[6]][[2]][[5]][[5]]
## [1] "diff in means"     "-1.06555555555555"
##
##
## [[2]][[1]][[6]][[2]][[6]]
## [[2]][[1]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[1]][[6]][[2]][[6]][[2]]
## [1] "KOR"
##
## [[2]][[1]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 46, p-value = 0.05564
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[6]][[4]]
## [[2]][[1]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[6]][[4]][[2]]
## [1] 0.0875
##
##
## [[2]][[1]][[6]][[2]][[6]][[5]]
## [1] "diff in means"    "1.89555555555555"
##
##
## [[2]][[1]][[6]][[2]][[7]]
## [[2]][[1]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[1]][[6]][[2]][[7]][[2]]
## [1] "BLR"
##
## [[2]][[1]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 14.5, p-value = 0.5
## alternative hypothesis: true location shift is greater than 0
```

```
##
##
## [[2]][[1]][[6]][[2]][[7]][[4]]
## [[2]][[1]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.4494
##
##
## [[2]][[1]][[6]][[2]][[7]][[5]]
## [1] "diff in means"    "0.48607142857143"
##
##
## [[2]][[1]][[6]][[2]][[8]]
## [[2]][[1]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[1]][[6]][[2]][[8]][[2]]
## [1] "SWE"
##
## [[2]][[1]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 22, p-value = 0.2414
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[1]][[6]][[2]][[8]][[4]]
## [[2]][[1]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.2064
##
##
## [[2]][[1]][[6]][[2]][[8]][[5]]
## [1] "diff in means"    "1.90214285714285"
##
##
## [[2]][[1]][[6]][[2]][[9]]
## [[2]][[1]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[1]][[6]][[2]][[9]][[2]]
## [1] "CAN"
##
## [[2]][[1]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
```

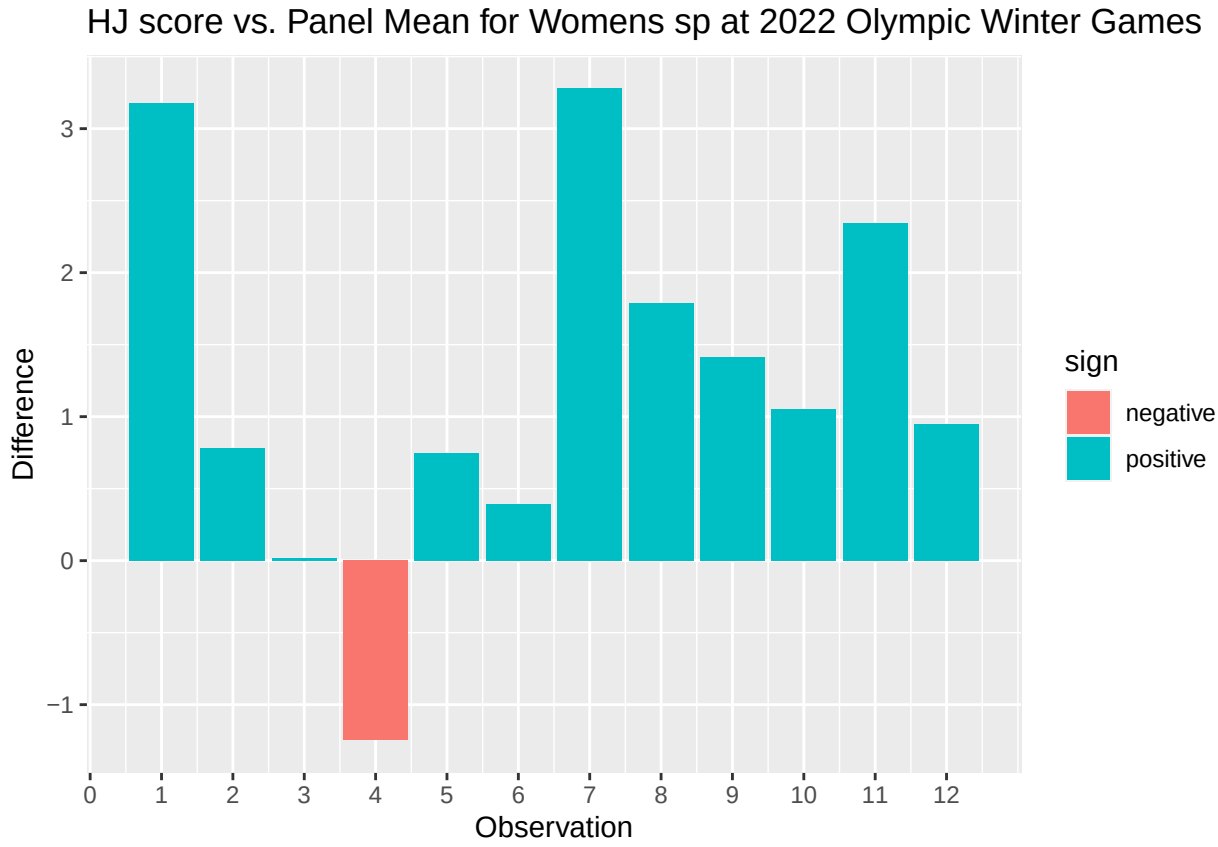
```
## W = 22, p-value = 0.3493
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[1]][[6]][[2]][[9]][[4]]
## [[2]][[1]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[1]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.3253
##
##
## [[2]][[1]][[6]][[2]][[9]][[5]]
## [1] "diff in means"      "-0.785370370370363"
##
##
##
##
##
## [[2]][[2]]
## [[2]][[2]][[1]]
## [1] "Womens"                            "sp"
## [3] "# of Obs."                         "12"
## [5] "Standard Deviation of Observations" "1.29401983992419"
##
## [[2]][[2]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 71, p-value = 0.004639
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[3]]
## [[2]][[2]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[2]][[3]][[2]]
```




```
##
## [[2]][[2]][[3]][[3]]
## [1] 0.0038
##
## [[2]][[2]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[2]][[4]]
## [[2]][[2]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[2]][[4]][[2]]
```




```
##
## [[2]][[2]][[4]][[3]]
## [1] 0.5243672 1.9405547
##
## [[2]][[2]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[2]][[4]][[5]]
## [1] 0.7080938
##
##
## [[2]][[2]][[5]]
```




```
##
## [[2]][[2]][[6]]
## [[2]][[2]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[2]][[6]][[2]]
## [[2]][[2]][[6]][[2]][[1]]
## [[2]][[2]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[2]][[6]][[2]][[1]][[2]]
## [1] "GBR"
##
## [[2]][[2]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 17, p-value = 0.4086
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[1]][[4]]
## [[2]][[2]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

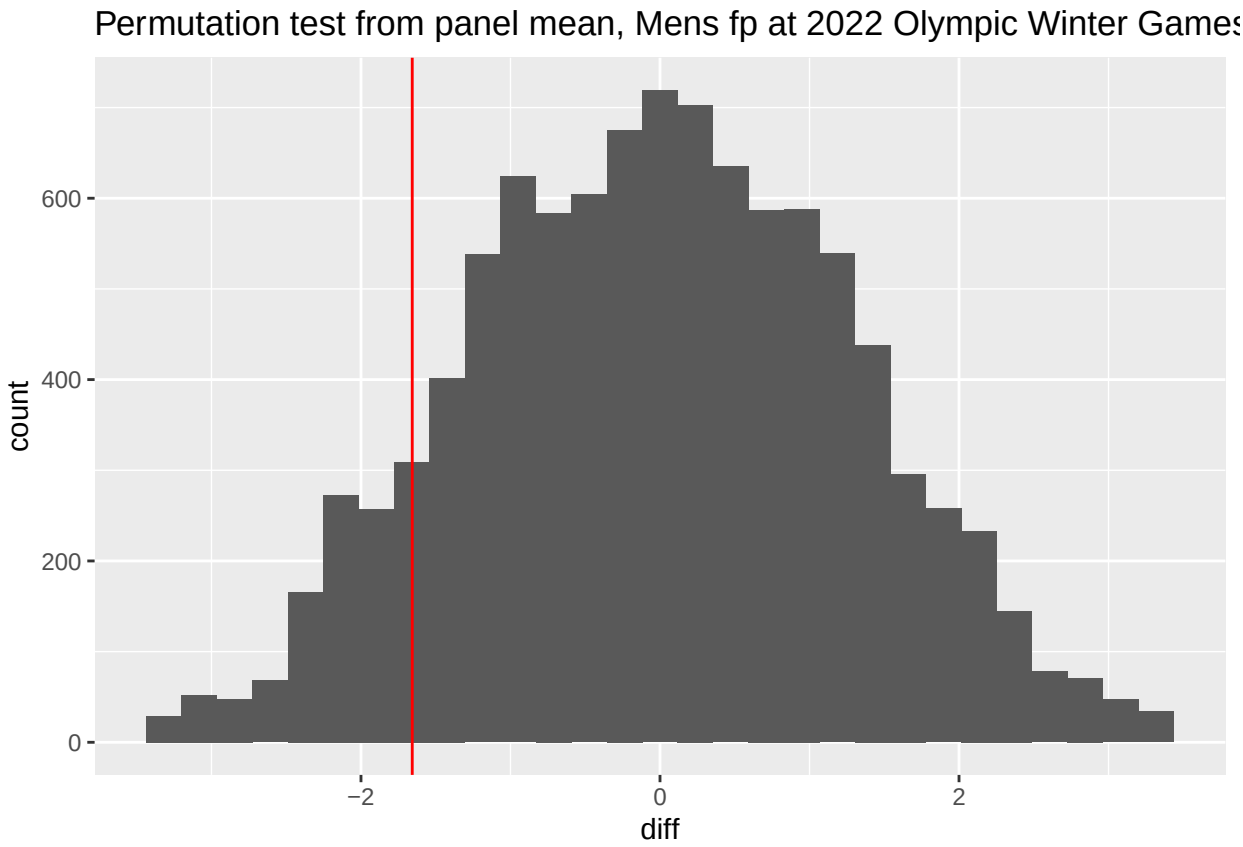
```
## [[2]][[2]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.3956
##
##
## [[2]][[2]][[6]][[2]][[1]][[5]]
## [1] "diff in means"     "0.286206896551728"
##
##
## [[2]][[2]][[6]][[2]][[2]]
## [[2]][[2]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[2]][[6]][[2]][[2]][[2]]
## [1] "NED"
##
## [[2]][[2]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 19, p-value = 0.322
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[2]][[4]]
## [[2]][[2]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.3599
##
##
## [[2]][[2]][[6]][[2]][[2]][[5]]
## [1] "diff in means"     "0.625862068965519"
##
##
## [[2]][[2]][[6]][[2]][[3]]
## [[2]][[2]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[2]][[6]][[2]][[3]][[2]]
## [1] "CHN"
##
## [[2]][[2]][[6]][[2]][[3]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 28, p-value = 0.06667
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[3]][[4]]
## [[2]][[2]][[6]][[2]][[3]][[4]][[1]]
```

```
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[3]][[4]][[2]]
## [1] 0.0349
##
##
## [[2]][[2]][[6]][[2]][[3]][[5]]
## [1] "diff in means"    "2.35724137931035"
##
##
## [[2]][[2]][[6]][[2]][[4]]
## [[2]][[2]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[2]][[6]][[2]][[4]][[2]]
## [1] "AUT"
##
## [[2]][[2]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 28, p-value = 0.06653
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[4]][[4]]
## [[2]][[2]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.0684
##
##
## [[2]][[2]][[6]][[2]][[4]][[5]]
## [1] "diff in means"    "2.76586206896552"
##
##
## [[2]][[2]][[6]][[2]][[5]]
## [[2]][[2]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[2]][[6]][[2]][[5]][[2]]
## [1] "CAN"
##
## [[2]][[2]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 27, p-value = 0.1
## alternative hypothesis: true location shift is greater than 0
##
##
```

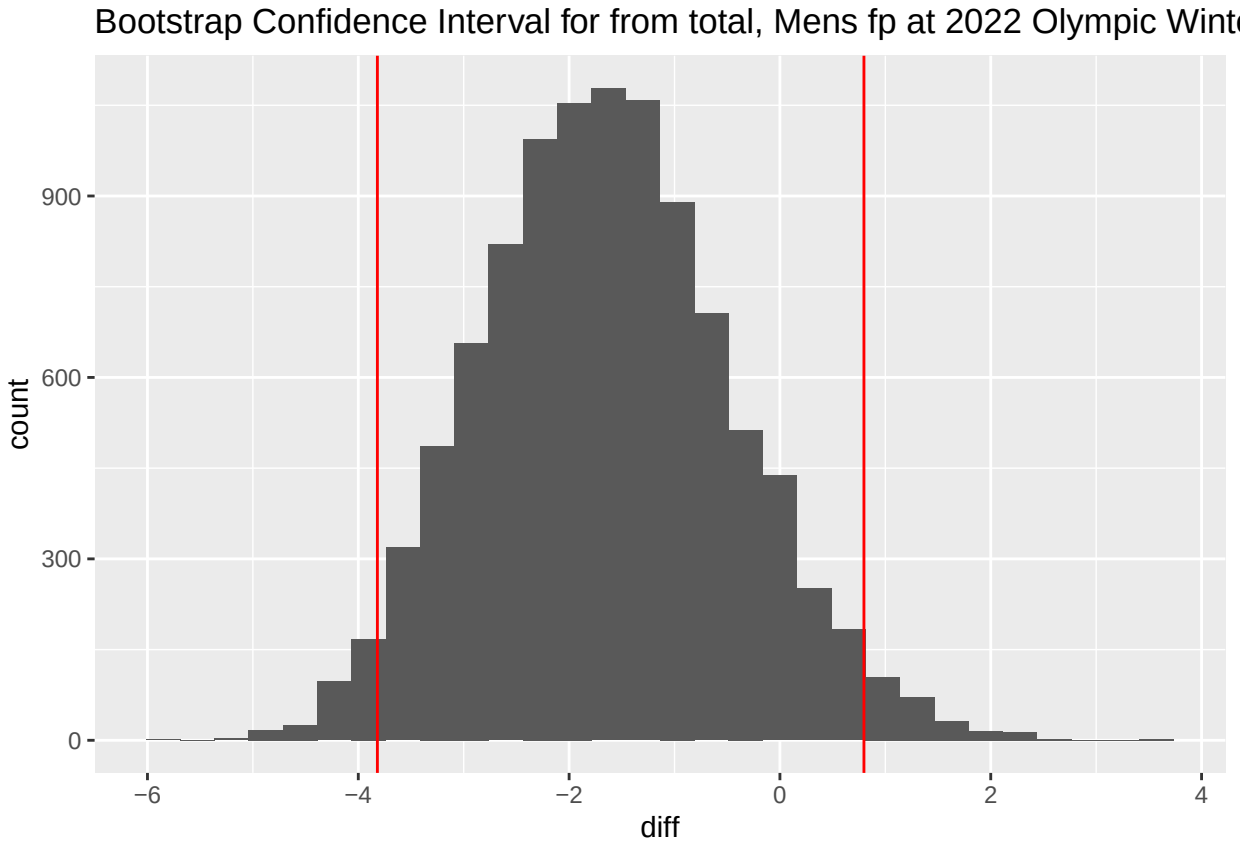
```
## [[2]][[2]][[6]][[2]][[5]][[4]]
## [[2]][[2]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.0663
##
##
## [[2]][[2]][[6]][[2]][[5]][[5]]
## [1] "diff in means"    "2.62724137931034"
##
##
## [[2]][[2]][[6]][[2]][[6]]
## [[2]][[2]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[2]][[6]][[2]][[6]][[2]]
## [1] "USA"
##
## [[2]][[2]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 50, p-value = 0.2669
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[6]][[4]]
## [[2]][[2]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[6]][[4]][[2]]
## [1] 0.3057
##
##
## [[2]][[2]][[6]][[2]][[6]][[5]]
## [1] "diff in means"    "0.35222222222222"
##
##
## [[2]][[2]][[6]][[2]][[7]]
## [[2]][[2]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[2]][[6]][[2]][[7]][[2]]
## [1] "CZE"
##
## [[2]][[2]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 21, p-value = 0.3
## alternative hypothesis: true location shift is greater than 0
```

```
##
##
## [[2]][[2]][[6]][[2]][[7]][[4]]
## [[2]][[2]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.2652
##
##
## [[2]][[2]][[6]][[2]][[7]][[5]]
## [1] "diff in means"     "0.999310344827578"
##
##
## [[2]][[2]][[6]][[2]][[8]]
## [[2]][[2]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[2]][[6]][[2]][[8]][[2]]
## [1] "EST"
##
## [[2]][[2]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 24, p-value = 0.1492
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[8]][[4]]
## [[2]][[2]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.2263
##
##
## [[2]][[2]][[6]][[2]][[8]][[5]]
## [1] "diff in means"   "1.1796551724138"
##
##
## [[2]][[2]][[6]][[2]][[9]]
## [[2]][[2]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[2]][[6]][[2]][[9]][[2]]
## [1] "KOR"
##
## [[2]][[2]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
```

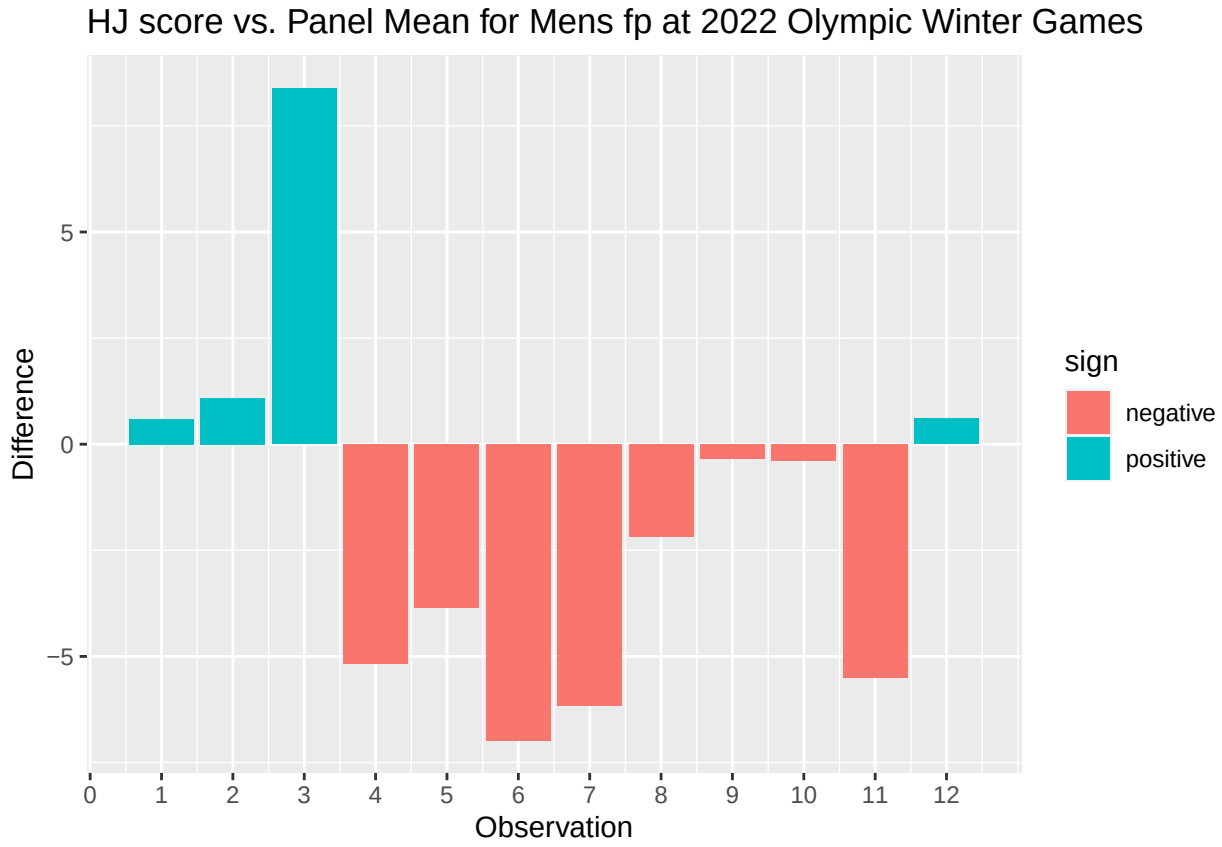
```
## W = 38, p-value = 0.2299
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[2]][[6]][[2]][[9]][[4]]
## [[2]][[2]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[2]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.1952
##
##
## [[2]][[2]][[6]][[2]][[9]][[5]]
## [1] "diff in means"     "0.829642857142861"
##
##
##
##
##
## [[2]][[3]]
## [[2]][[3]][[1]]
## [1] "Mens"                              "fp"
## [3] "# of Obs."                         "12"
## [5] "Standard Deviation of Observations" "4.2943067862168"
##
## [[2]][[3]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 24, p-value = 0.1331
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[3]]
## [[2]][[3]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[3]][[3]][[2]]
```




```
##
## [[2]][[3]][[3]][[3]]
## [1] 0.1059
##
## [[2]][[3]][[3]][[4]]
## [1] "hA = true mean is less than 0 (underscoring)"
##
##
## [[2]][[3]][[4]]
## [[2]][[3]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[3]][[4]][[2]]
```




```
##
## [[2]][[3]][[4]][[3]]
## [1] -3.818935  0.796974
##
## [[2]][[3]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[3]][[4]][[5]]
## [1] 2.307954
##
##
## [[2]][[3]][[5]]
```




```
##
## [[2]][[3]][[6]]
## [[2]][[3]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[3]][[6]][[2]]
## [[2]][[3]][[6]][[2]][[1]]
## [[2]][[3]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[3]][[6]][[2]][[1]][[2]]
## [1] "ITA"
##
## [[2]][[3]][[6]][[2]][[1]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 33, p-value = 0.1522
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[1]][[4]]
## [[2]][[3]][[6]][[2]][[1]][[4]][[1]]
## [1] "Permutation test"
##
```

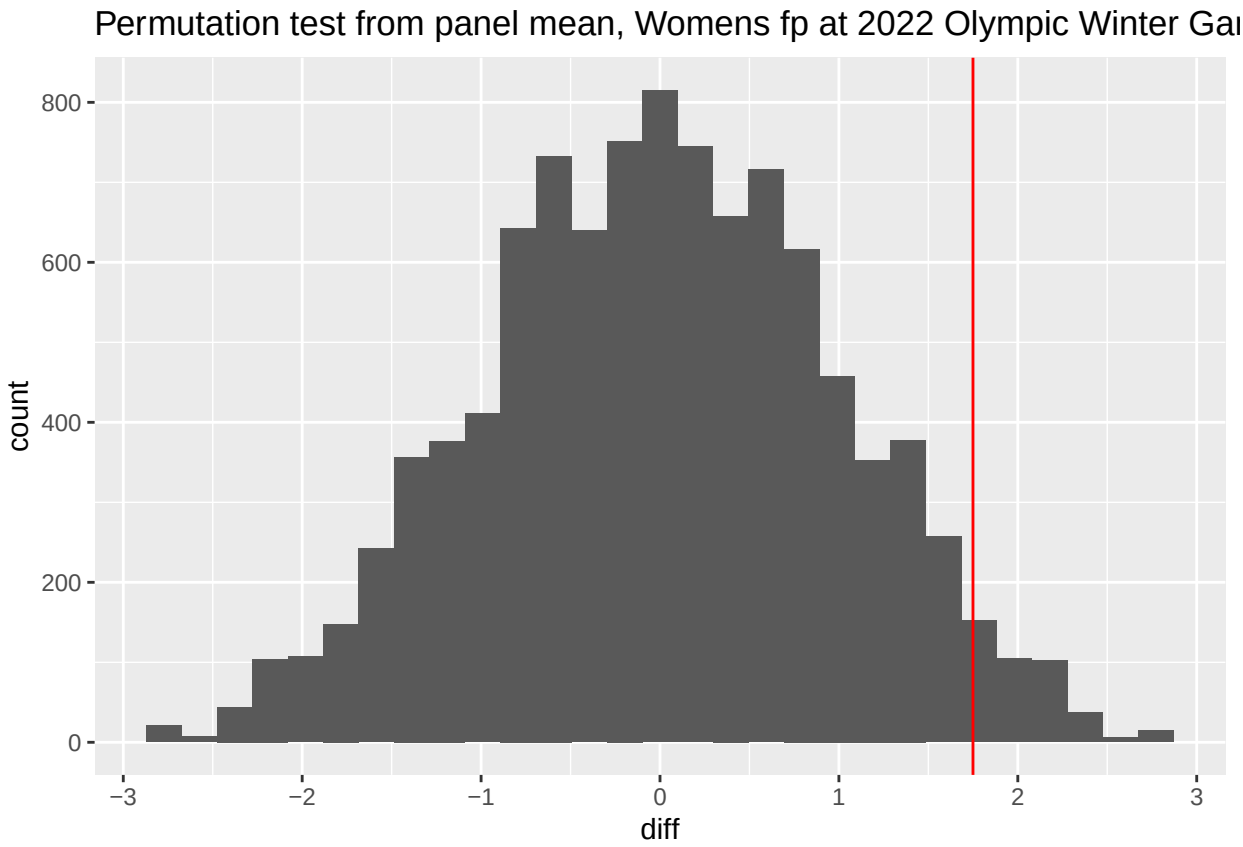
```
## [[2]][[3]][[6]][[2]][[1]][[4]][[2]]
## [1] 0.0765
##
##
## [[2]][[3]][[6]][[2]][[1]][[5]]
## [1] "diff in means"    "3.18590909090908"
##
##
## [[2]][[3]][[6]][[2]][[2]]
## [[2]][[3]][[6]][[2]][[2]][[1]]
## [1] "j_2"
##
## [[2]][[3]][[6]][[2]][[2]][[2]]
## [1] "CHN"
##
## [[2]][[3]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 2, p-value = 0.125
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[2]][[4]]
## [[2]][[3]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.1253
##
##
## [[2]][[3]][[6]][[2]][[2]][[5]]
## [1] "diff in means"     "-4.77043478260868"
##
##
## [[2]][[3]][[6]][[2]][[3]]
## [[2]][[3]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[3]][[6]][[2]][[3]][[2]]
## [1] "ISR"
##
## [[2]][[3]][[6]][[2]][[3]][[3]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[3]][[4]]
## [1] "No home scores to test"
##
## [[2]][[3]][[6]][[2]][[3]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[3]][[6]][[2]][[4]]
```

```
## [[2]][[3]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[3]][[6]][[2]][[4]][[2]]
## [1] "JPN"
##
## [[2]][[3]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  home and away
## W = 20.5, p-value = 0.1796
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[4]][[4]]
## [[2]][[3]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.2032
##
##
## [[2]][[3]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "-2.61285714285714"
##
##
## [[2]][[3]][[6]][[2]][[5]]
## [[2]][[3]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[3]][[6]][[2]][[5]][[2]]
## [1] "FRA"
##
## [[2]][[3]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 8, p-value = 0.09058
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[5]][[4]]
## [[2]][[3]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.1088
##
##
## [[2]][[3]][[6]][[2]][[5]][[5]]
## [1] "diff in means"     "-2.13636363636365"
##
```

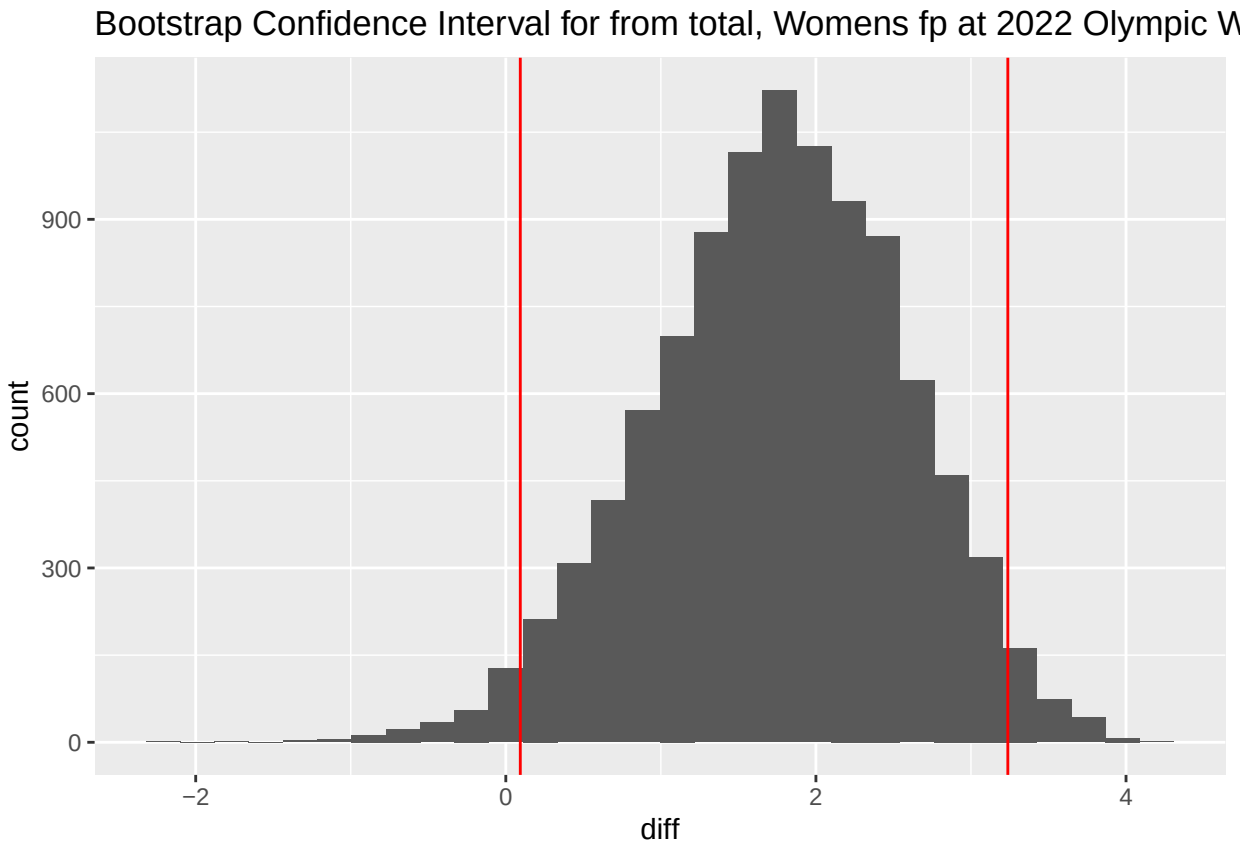
```
##
## [[2]][[3]][[6]][[2]][[6]]
## [[2]][[3]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[3]][[6]][[2]][[6]][[2]]
## [1] "KOR"
##
## [[2]][[3]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 5, p-value = 0.25
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[6]][[4]]
## [[2]][[3]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[6]][[4]][[2]]
## [1] 0.2491
##
##
## [[2]][[3]][[6]][[2]][[6]][[5]]
## [1] "diff in means"     "-3.03782608695654"
##
##
## [[2]][[3]][[6]][[2]][[7]]
## [[2]][[3]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[3]][[6]][[2]][[7]][[2]]
## [1] "BLR"
##
## [[2]][[3]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 4, p-value = 0.2083
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[7]][[4]]
## [[2]][[3]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.209
##
##
## [[2]][[3]][[6]][[2]][[7]][[5]]
```

```
## [1] "diff in means"     "-3.83304347826087"
##
##
## [[2]][[3]][[6]][[2]][[8]]
## [[2]][[3]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[3]][[6]][[2]][[8]][[2]]
## [1] "SWE"
##
## [[2]][[3]][[6]][[2]][[8]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 14, p-value = 0.4167
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[3]][[6]][[2]][[8]][[4]]
## [[2]][[3]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.3746
##
##
## [[2]][[3]][[6]][[2]][[8]][[5]]
## [1] "diff in means"    "0.62260869565216"
##
##
## [[2]][[3]][[6]][[2]][[9]]
## [[2]][[3]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[3]][[6]][[2]][[9]][[2]]
## [1] "CAN"
##
## [[2]][[3]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 1, p-value = 0.08333
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[3]][[6]][[2]][[9]][[4]]
## [[2]][[3]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[3]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.0821
##
```

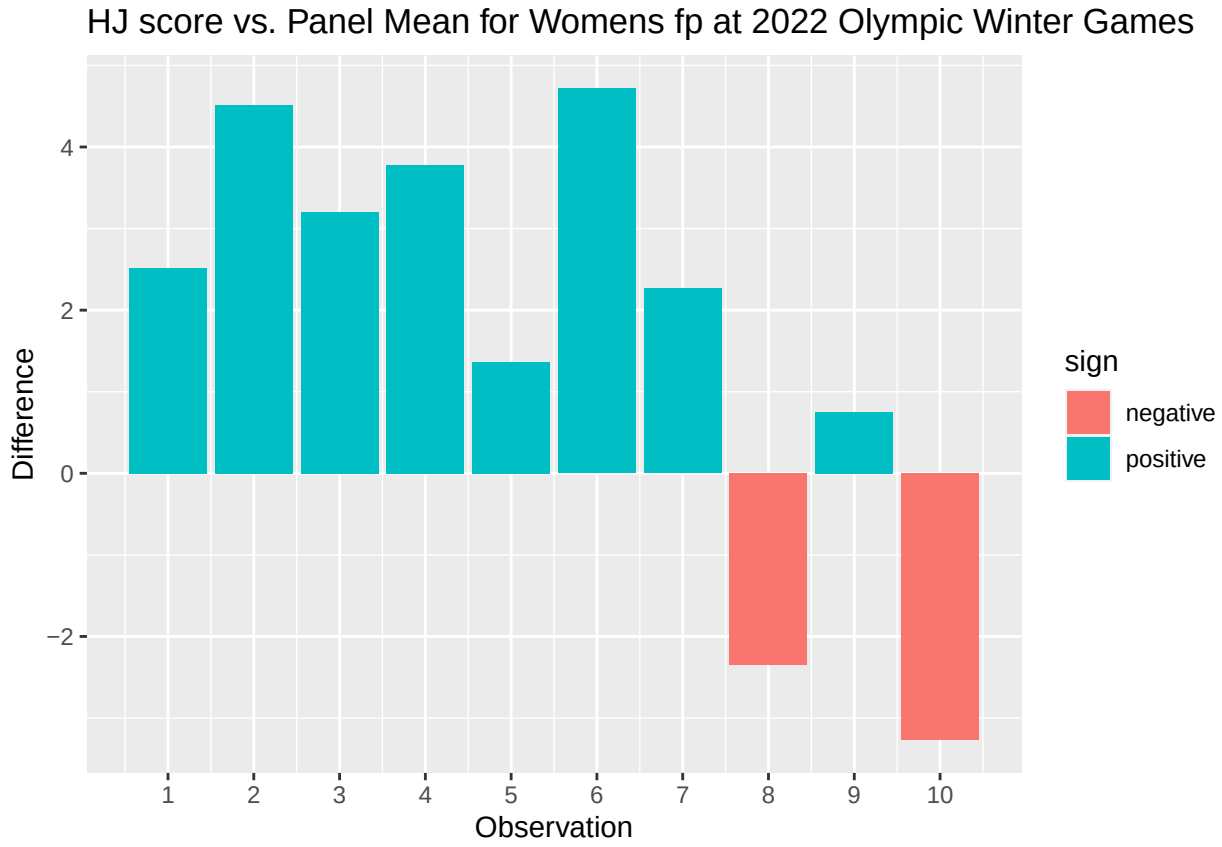
```
##
## [[2]][[3]][[6]][[2]][[9]][[5]]
## [1] "diff in means"    "-5.8104347826087"
##
##
##
##
##
## [[2]][[4]]
## [[2]][[4]][[1]]
## [1] "Womens"                              "fp"
## [3] "# of Obs."                           "10"
## [5] "Standard Deviation of Observations" "2.72165526125391"
##
## [[2]][[4]][[2]]
##
##  Wilcoxon signed rank exact test
##
## data:  home_judge and panel_mean
## V = 44, p-value = 0.05273
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[3]]
## [[2]][[4]][[3]][[1]]
## [1] "Permuation Test p-value"
##
## [[2]][[4]][[3]][[2]]
```




```
##
## [[2]][[4]][[3]][[3]]
## [1] 0.0363
##
## [[2]][[4]][[3]][[4]]
## [1] "hA = true mean is greater than 0 (overscoring)"
##
##
## [[2]][[4]][[4]]
## [[2]][[4]][[4]][[1]]
## [1] "Bootstrap Confidence Interval"
##
## [[2]][[4]][[4]][[2]]
```




```
##
## [[2]][[4]][[4]][[3]]
## [1] 0.09341562 3.23775938
##
## [[2]][[4]][[4]][[4]]
## [1] "MOE"
##
## [[2]][[4]][[4]][[5]]
## [1] 1.572172
##
##
## [[2]][[4]][[5]]
```



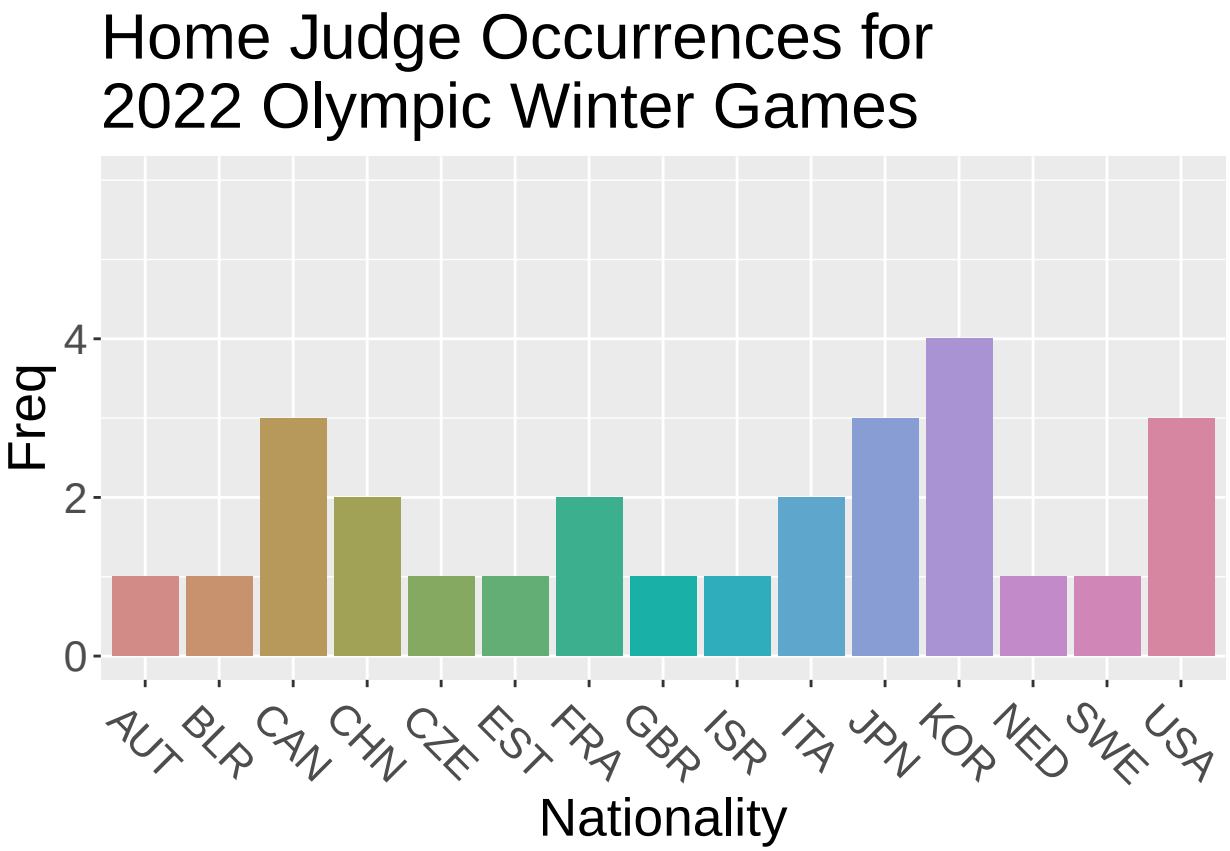

```
##
## [[2]][[4]][[6]]
## [[2]][[4]][[6]][[1]]
## [1] "Individual Judge Analysis"
##
## [[2]][[4]][[6]][[2]]
## [[2]][[4]][[6]][[2]][[1]]
## [[2]][[4]][[6]][[2]][[1]][[1]]
## [1] "j_1"
##
## [[2]][[4]][[6]][[2]][[1]][[2]]
## [1] "GBR"
##
## [[2]][[4]][[6]][[2]][[1]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[1]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[1]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[2]]
## [[2]][[4]][[6]][[2]][[2]][[1]]
## [1] "j_2"
```

```
##
## [[2]][[4]][[6]][[2]][[2]][[2]]
## [1] "NED"
##
## [[2]][[4]][[6]][[2]][[2]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 23, p-value = 0.08
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[2]][[4]]
## [[2]][[4]][[6]][[2]][[2]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[2]][[4]][[2]]
## [1] 0.041
##
##
## [[2]][[4]][[6]][[2]][[2]][[5]]
## [1] "diff in means"    "3.93666666666667"
##
##
## [[2]][[4]][[6]][[2]][[3]]
## [[2]][[4]][[6]][[2]][[3]][[1]]
## [1] "j_3"
##
## [[2]][[4]][[6]][[2]][[3]][[2]]
## [1] "CHN"
##
## [[2]][[4]][[6]][[2]][[3]][[3]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[3]][[4]]
## [1] "No home scores to test"
##
## [[2]][[4]][[6]][[2]][[3]][[5]]
## [1] "diff in means" "NaN"
##
##
## [[2]][[4]][[6]][[2]][[4]]
## [[2]][[4]][[6]][[2]][[4]][[1]]
## [1] "j_4"
##
## [[2]][[4]][[6]][[2]][[4]][[2]]
## [1] "AUT"
##
## [[2]][[4]][[6]][[2]][[4]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
```

```
## W = 16, p-value = 0.36
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[4]][[4]]
## [[2]][[4]][[6]][[2]][[4]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[4]][[4]][[2]]
## [1] 0.3127
##
##
## [[2]][[4]][[6]][[2]][[4]][[5]]
## [1] "diff in means"     "0.493749999999996"
##
##
## [[2]][[4]][[6]][[2]][[5]]
## [[2]][[4]][[6]][[2]][[5]][[1]]
## [1] "j_5"
##
## [[2]][[4]][[6]][[2]][[5]][[2]]
## [1] "CAN"
##
## [[2]][[4]][[6]][[2]][[5]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 8, p-value = 0.36
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[5]][[4]]
## [[2]][[4]][[6]][[2]][[5]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[5]][[4]][[2]]
## [1] 0.3653
##
##
## [[2]][[4]][[6]][[2]][[5]][[5]]
## [1] "diff in means"      "-0.831666666666665"
##
##
## [[2]][[4]][[6]][[2]][[6]]
## [[2]][[4]][[6]][[2]][[6]][[1]]
## [1] "j_6"
##
## [[2]][[4]][[6]][[2]][[6]][[2]]
## [1] "USA"
##
## [[2]][[4]][[6]][[2]][[6]][[3]]
##
##  Wilcoxon rank sum exact test
```

```
##
## data:  home and away
## W = 44, p-value = 0.1991
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[6]][[4]]
## [[2]][[4]][[6]][[2]][[6]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[6]][[4]][[2]]
## [1] 0.1997
##
##
## [[2]][[4]][[6]][[2]][[6]][[5]]
## [1] "diff in means"    "1.02878787878789"
##
##
## [[2]][[4]][[6]][[2]][[7]]
## [[2]][[4]][[6]][[2]][[7]][[1]]
## [1] "j_7"
##
## [[2]][[4]][[6]][[2]][[7]][[2]]
## [1] "CZE"
##
## [[2]][[4]][[6]][[2]][[7]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 6, p-value = 0.28
## alternative hypothesis: true location shift is less than 0
##
##
## [[2]][[4]][[6]][[2]][[7]][[4]]
## [[2]][[4]][[6]][[2]][[7]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[7]][[4]][[2]]
## [1] 0.2778
##
##
## [[2]][[4]][[6]][[2]][[7]][[5]]
## [1] "diff in means"     "-1.39208333333332"
##
##
## [[2]][[4]][[6]][[2]][[8]]
## [[2]][[4]][[6]][[2]][[8]][[1]]
## [1] "j_8"
##
## [[2]][[4]][[6]][[2]][[8]][[2]]
## [1] "EST"
##
## [[2]][[4]][[6]][[2]][[8]][[3]]
```

```
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 14, p-value = 0.44
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[8]][[4]]
## [[2]][[4]][[6]][[2]][[8]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[8]][[4]][[2]]
## [1] 0.402
##
##
## [[2]][[4]][[6]][[2]][[8]][[5]]
## [1] "diff in means"     "0.161666666666664"
##
##
## [[2]][[4]][[6]][[2]][[9]]
## [[2]][[4]][[6]][[2]][[9]][[1]]
## [1] "j_9"
##
## [[2]][[4]][[6]][[2]][[9]][[2]]
## [1] "KOR"
##
## [[2]][[4]][[6]][[2]][[9]][[3]]
##
##  Wilcoxon rank sum exact test
##
## data:  home and away
## W = 25, p-value = 0.44
## alternative hypothesis: true location shift is greater than 0
##
##
## [[2]][[4]][[6]][[2]][[9]][[4]]
## [[2]][[4]][[6]][[2]][[9]][[4]][[1]]
## [1] "Permutation test"
##
## [[2]][[4]][[6]][[2]][[9]][[4]][[2]]
## [1] 0.4102
##
##
## [[2]][[4]][[6]][[2]][[9]][[5]]
## [1] "diff in means"     "0.370217391304351"
##
##
##
##
##
##
## [[3]]
```


Home Judge Occurrences for
2022 Olympic Winter Games
Freq
4
2
0
AUT
BLR
CAN
CHN
CZE
EST
FRA
GBR
ISR
ITA
JPN
KOR
NED
SWE
USA
Nationality