HW4-tk2886-2021

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Loading the Crash data

```
crash_df <-
  read.csv("Crash.csv")
```

Tidying the data

```
crash_dfn <-
  crash_df %>%
  pivot_longer(everything(),
               names_to = "type_of_accidents",
               values_to = "Values")
```

Problem 2a

Generating Descriptive statistics for each group:

```
crash_df %>%
  summary() %>%
  knitr::kable(caption = "Mean, Median, Min, Max, 1st & 3rd Quartile Values for each type of crash")
```

Table 1: Mean, Median, Min, Max, 1st & 3rd Quartile Values for each type of crash

pedestrian	bicycle	car
Min. :29.00	Min. :28.0	Min. :20.00
1st Qu.:36.00	1st Qu.:29.5	1st Qu.:21.00
Median :39.50	Median :31.5	Median :22.00
Mean :37.88	Mean :32.5	Mean :23.43
3rd Qu.:42.00	3rd Qu.:34.5	3rd Qu.:24.50
Max. :43.00	Max. :39.0	Max. :31.00
NA's :2	NA	NA's :3

```
crash_df %>%
  summarize_if(is_numeric, sd, na.rm = T) %>%
  knitr::kable(caption = "*Standard deviation* for each type of crash")
```

Table 2: *Standard deviation* for each type of crash

pedestrian	bicycle	car
5.43632	4.062019	3.866831

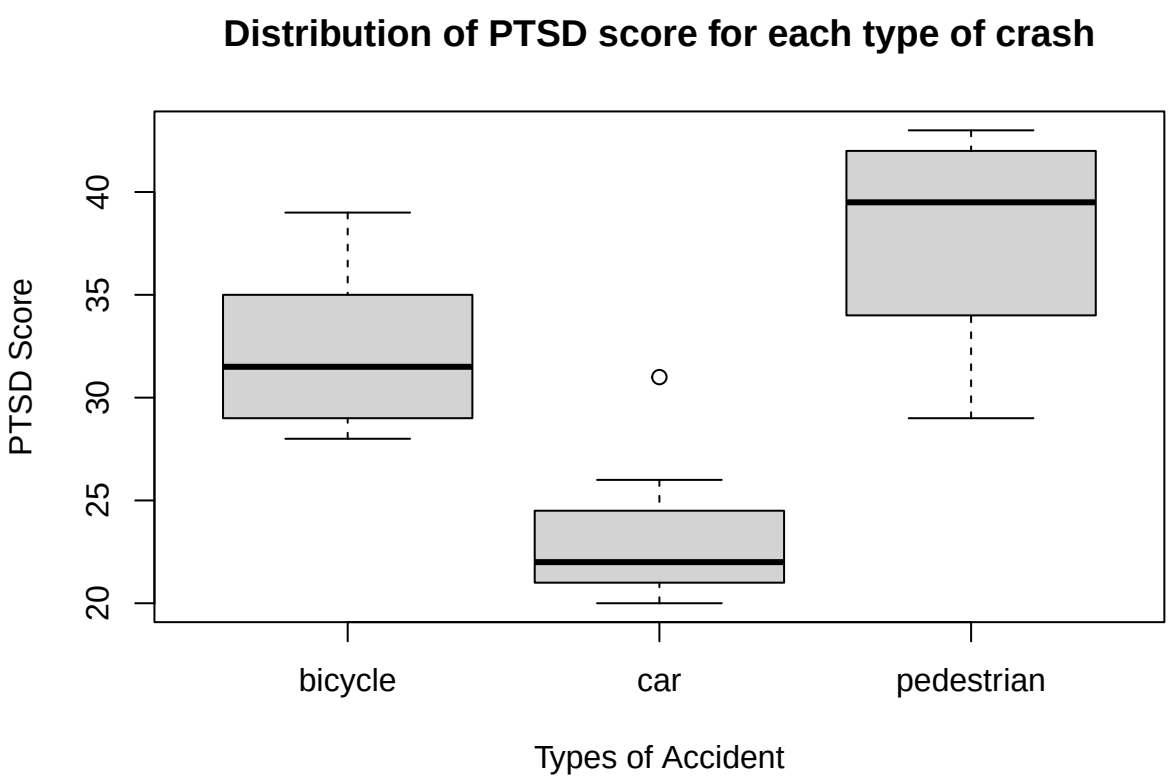
```
crash_dfn %>%
  group_by(type_of_accidents) %>%
  summarise(n = n(), mean = mean(Values, na.rm = T),
            sum = sum(Values, na.rm = T), variance = var(Values, na.rm = T)) %>%
  knitr::kable(caption = "Mean, Variance for each type of crash")
```

mean, sum, variance

Table 3: Mean, Variance for each type of crash

type_of_accidents	n	mean	sum	variance
bicycle	10	32.50000	325	16.50000
car	10	23.42857	164	14.95238
pedestrian	10	37.87500	303	29.55357

```
boxplot(Values ~ type_of_accidents, data = crash_dfn,
        main = "Distribution of PTSD score for each type of crash",
        xlab = "Types of Accident",
        ylab = "PTSD Score")
```



Analysis of Differences Observed:

In the data set that was provided, the mean of the PTSD Score for Pedestrian Incidents is the largest among the three types of accidents. The mean of the PTSD Score of bicycle incidents is the second highest and the mean of the PTSD Scores for car incidents is the lowest. The standard deviation for PTSD score for pedestrian incident is 5.44, the standard deviation for PTSD score in bicycle incident is 4.06, and the standard deviation for the PTSD score for car crash is 3.87. Pedestrian has a larger standard deviation than bicycle and car. This indicates that the PTSD score for this pedestrian incidents is more spread out compared to the other two types if crash. When pedestrians is involved in an incident, their PTSD in general is more varied compared to the other groups (bicycle and cars).

Problem 2b:

```
res1 = aov(Values ~ factor(type_of_accidents), data = crash_dfn)
summary(res1)
```

ANOVA TABLE

```
##                            Df Sum Sq Mean Sq F value   Pr(>F)
## factor(type_of_accidents)  2  790.4   395.2   19.53 1.33e-05 ***
## Residuals                  22  445.1    20.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 5 observations deleted due to missingness
```

```
# Using R-code to obtain critical value
critical_value = qf(0.99, 2, 22)
```

Interpretation:

Hypothesis:

Ho: mu1 = mu2 = mu3

Ha: at least two means are not equal

Test-Statistics: F-Value: 19.53

Critical Value: Critical Value: 5.7190219

Decision Intercepted: Our F-statistics (19.53) is bigger than our critical value (5.72), we reject the null hypothesis. At 0.01 significance level, we reject the null hypothesis and conclude that at least two true mean PTSD score from the three type of crash groups are different.

Problem 2c:

```
pairwise.t.test(crash_dfn$Values, crash_dfn$type_of_accidents, p.adj = 'bonferroni')
```

```
##
##  Pairwise comparisons using t tests with pooled SD
##
## data:  crash_dfn$Values and crash_dfn$type_of_accidents
##
##            bicycle car
## car        0.0014  -
## pedestrian 0.0586  9.1e-06
##
## P value adjustment method: bonferroni
```

Analysis: We will be using be Tukey's adjustment since Bonferroni is the most conservative method and gives us less power while Tukey's method controls for all pairwise comparisons and it is less conservative. Based on our Tukey's adjustment method, it is indicated that the the true mean PTSD score for car and bicycle is different since the adjusted p-value for car-bicycle pairwise is 0.00134 which is smaller than our alpha 0.01. Also the the true mean PTSD score for pedestrian and car is different since the adjusted p-value for pedestrian-car pairwise is 0.0000088 which is smaller than our alpha 0.01. Based on the tukey's method, we do not have enough evidence to state that the true mean PTSD score for pedestrian-bicycle pairwise is different.

Problem 2d:

Based on the data set provided for each type of crash (bicycle, car, pedestrian), our statistical analysis indicated that the mean PTSD score for pedestrian is 37.88 and the mean PTSD score bicycle crash is 32.5. It has been reported by the National Center for PTSD that a PTSD score of 31-33 or higher suggest the patient may benefit from PTSD treatment. Emergency Department physicians may provide additional resources or a better catered treatment plan to individuals involved in pedestrian and bicycle incidents/crashes for reducing their PTSD symptoms. In our statistical analysis, the mean PTSD score for car is 23.43 and it has been reported by the National Center for PTSD that scores lower than 31-33 may indicate the patient either has sub threshold symptoms of PTSD or does not meet criteria for PTSD, and this information should be incorporated into treatment planning when emergency department professionals are creating a treatment plan that individual's recovery. Furthermore, our statistical finding indicates that we do not have enough evidence to state that pedestrian and bicycle mean for PTSD score. In both groups the calculated mean and median PTSD score is above 31 and the emergency department physicians need to have a provide better treatment towards these two groups (pedestrian and bicycle incidents) so that they have a less difficulty in recovering after experiencing or witnessing a terrifying event.

Problem 3a: The appropriate test I used to address this question of interest is **Chi-Squared of Independence**. Our observational units are collected at random from a population, we are not gathering the data by randomly sampling from each sub-group separately, which is the case of Chi-Squared Test for Homogeneity. Also, we have two categorical variables (relapse and non-relapse) that are being observed for each unit (desipramine users, lithium users, and placebo users). Also we're interested in whether the knowledge of one variable (antidepressants) value provides an information about the value of the other variable (relapse status), i.e. are these two variables independent. Chi-Squared of Homogeneity assesses whether the pattern of relapse was different between the three groups of antidepressants.

Problem 3b:

```r
antidepressant_df = matrix(c(15, 18, 18, 15, 20, 13), nrow=3,ncol=2,byrow=T,
                  dimnames = list(c("Desipramine","Lithium","Placebo"),
                                  c("Relapse","Non-Relpase")))

antidepressant_dfa = addmargins(antidepressant_df)
antidepressant_dfa
```

```
##             Relapse Non-Relpase Sum
## Desipramine      15          18  33
## Lithium          18          15  33
## Placebo          20          13  33
## Sum              53          46  99
```

```r
test_statistic = (15-17.67)^2/17.67 +
  (18-17.67)^2/17.67 + (20-17.67)^2/17.67 +
  (18-15.33)^2/15.33 + (15-15.33)^2/15.33 + (13-15.33)^2/15.33
```

```r
critical_value = qchisq(.95, 2)
```

```r
new_var = chisq.test(antidepressant_df)
new_var
```

```
##
##  Pearson's Chi-squared test
##
## data:  antidepressant_df
## X-squared = 1.5431, df = 2, p-value = 0.4623
```

```r
new_var$expected
```

```
##              Relapse Non-Relpase
## Desipramine 17.66667    15.33333
## Lithium     17.66667    15.33333
## Placebo     17.66667    15.33333
```

```r
pval = pchisq(test_statistic, 2, lower.tail = FALSE)
```

Problem 3c:

Hypotheses:

Ho: Relapse Status and types of anti-depressant are independent (p1=p2=p3)

Ha: Relapse Status and types of anti-depressant are associated/dependent

Test Statistics: The test statistic is: 1.5431165

Critical Value: The critical value is: 5.9914645

P-Value: The p-value is: 0.4622921

Decision Rule: At 0.05 significance level, we reject the null hypothesis when Chi-Squared test is bigger than the critical value.

Interpretation in context to our problem: At 0.05 significance level, we fail to reject the null hypothesis because the Chi-squared test value is smaller than our critical value. We conclude that we do not have enough evidence that the subject's relapse is associated with the drug the subject was assigned to.