Block 4: Weeks 1-3 Reaction Time Report

1 Introduction

The data available at https://uoepsy.github.io/data/reaction_time_2425.csv comprises of measurements of reaction times (RT) across two types of conditions - visual and auditory - from a sample of 175 Psychology 1A students at the University of Edinburgh. Data was collected across morning (AM) and afternoon (PM) lab sessions (`lab_session`) that took place on Wednesdays and Fridays. Participants worked in pairs, and switched roles after one person had completed both conditions (`participant_order`), and noted which condition was completed first (`first_condition`). The participant was tasked with catching a falling ruler as quickly as possible across 5 trials in the visual condition (`visualcue_attempt1` - `visualcue_attempt5`) and 5 trials in the auditory condition (`auditorycue_attempt1` - `auditorycue_attempt5`). Measurements were originally recorded in distance (*cm*).

1.1 Research Questions

- RQ1: Did the average reaction time to catch a falling ruler in the visual condition significantly differ from 0.16 seconds?

2 Analysis

First we transformed our distance into reaction time (t; measured in seconds) for each of the 5 trials in both the visual and auditory conditions. To do so, we applied the following conversion (where y is the distance the ruler fell (in cm), and g is the acceleration caused by gravity (which is known to be 980 cm/s^2)):

$$y = \frac{1}{2}gt^2$$

We set impossible values to `NA` (i.e., distance values outwith 0-30 cm), and only retained cases where participants had average RTs for both the visual and auditory conditions. This resulted in a final sample size of 167.

2.1 Research Question 1

To investigate whether the average reaction time (RT) of those in the visual cue condition significantly differed from 0.16, we performed a one sample t-test (two-sided). The sample of Psych 1A students had a slower RT ($M = 0.17, SD = 0.03$) than the population mean ($M = 0.16$). The evidence suggested that this difference was statistically significant, $t(166) = 4.74, p < .001, two - sided$. The size of the effect was found to be medium $D = 0.37[0.21, 0.52]$.

The sample data did not raise any concerns of violations of independence (this can be assumed based on study design). There were no concerns regarding the normality of the sampling distribution of the mean. The average RTs in the Visual Cue condition appeared to follow a normal distribution based on our histogram and density plots (see Figure 1). Since there were slight deviations from normality observed in the QQPlot (see Figure 1), we statistically assessed the assumption of normality using a Shapiro-Wilk test. The sample data did not provide sufficient evidence to reject the null hypothesis that in the population, the data followed a normal distribution ($W = 0.98, p = .263$). Alongside these visual and statistical assessments of normality, the sample size was sufficiently large ($n = 167$), there were no concerns regarding skew (< 1), and there appeared to be no outliers, hence we concluded that the normality assumption had been met.

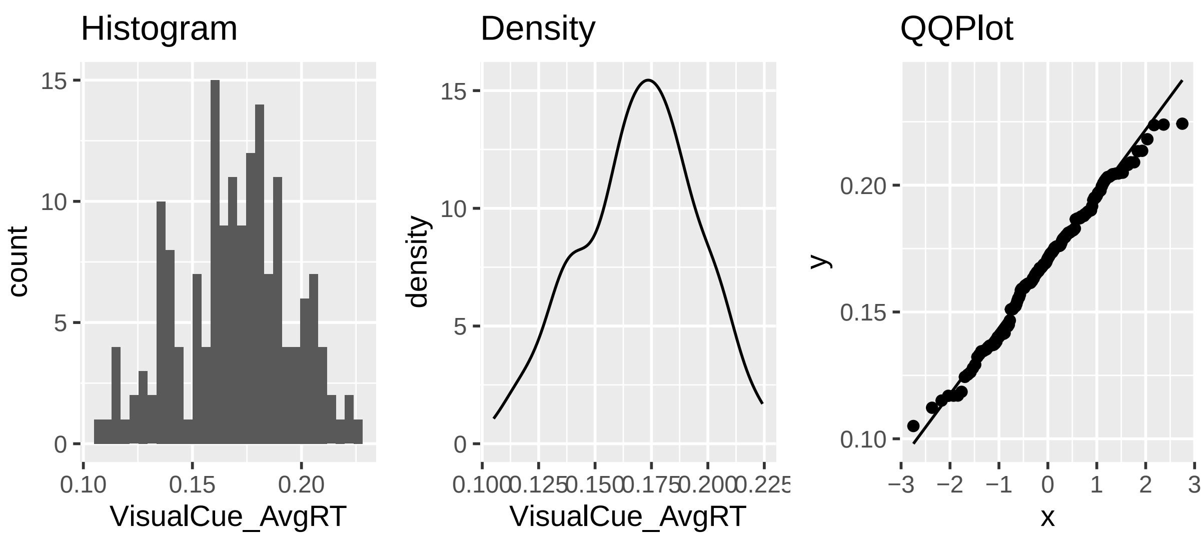

Figure 1: Distribution of Visual Cue Mean RTs

3 Discussion

In relation to our research questions, we concluded that: (1) the average reaction time to catch a falling ruler in the visual condition significantly differed from 0.16 seconds.

4 Appendix

```
knitr::opts_chunk$set(echo = FALSE, message = FALSE, warning = FALSE)
######## LOAD LIBRARIES & DATA ########

#load packages
library(tidyverse)
library(patchwork)
library(kableExtra)
library(psych)
library(effectsize)

#read in data
rt_data <- read_csv("https://uoepsy.github.io/data/reaction_time_2425.csv")

########################### WEEK 1 ###############################
```

```r
###### STEP 1: INSPECT, CLEAN, AND TIDY DATA ######

#examine dataset
head(rt_data)
str(rt_data) # data that should be factors/numeric not currently coded as so
summary(rt_data) # we have values over 30cm, need to remove these

#make numeric / factors
rt_data <- rt_data |>
    mutate(age = as.numeric(age),
           sex = as.factor(sex),
           handedness = as.factor(handedness),
           participation_order = as.factor(participation_order),
           lab_session = as.factor(lab_session),
           first_condition = as.factor(first_condition),
           visualcue_attempt1 = as.numeric(visualcue_attempt1),
           visualcue_attempt2 = as.numeric(visualcue_attempt2),
           visualcue_attempt3 = as.numeric(visualcue_attempt3),
           visualcue_attempt4 = as.numeric(visualcue_attempt4),
           visualcue_attempt5 = as.numeric(visualcue_attempt5),
           auditorycue_attempt1 = as.numeric(auditorycue_attempt1),
           auditorycue_attempt2 = as.numeric(auditorycue_attempt2),
           auditorycue_attempt3 = as.numeric(auditorycue_attempt3),
           auditorycue_attempt4 = as.numeric(auditorycue_attempt4),
           auditorycue_attempt5 = as.numeric(auditorycue_attempt5)
           )

#remove impossible values - data can only range 0-30cm
rt_data[ , c(8:17)][rt_data[ , c(8:17)] > 30] <- NA


###### STEP 2: DISTANCE TO TIME CONVERSION (ON PSYCH 1A LAB SHEET) ######

#function to convert distance to time
rt_data <- rt_data |>
  mutate(across(visualcue_attempt1:auditorycue_attempt5, .fns = function(y) sqrt(2 * y / 980)) )

###### STEP 3: CREATE AVERAGE SCORES (QON PSYCH 1A LAB SHEET) AND SUBSET / FILTER ######

#create average scores
rt_data$VisualCue_AvgRT <- rowMeans(rt_data[ , c(8:12)], na.rm = TRUE)
rt_data$AuditoryCue_AvgRT <- rowMeans(rt_data[ , c(13:17)], na.rm = TRUE)

#subset
rt_data2 <- rt_data[ , c(1:7, 18:19)]

#retain only complete cases
rt_data2 <- rt_data2 |>
  filter(complete.cases(VisualCue_AvgRT, AuditoryCue_AvgRT))

### STEP 4: CONDUCT ANALYSIS & ASSUMPTION CHECKS #####

##Descriptive Stats
```

```r
#descriptives
rt_viz_one <- describe(rt_data2$VisualCue_AvgRT)
rt_viz_one

##Statistical test
# run our one sample t-test
t.test(rt_data2$VisualCue_AvgRT, mu = 0.16, alternative = "two.sided")

#effect size
cohens_d(rt_data2$VisualCue_AvgRT, mu = 0.16, alternative = "two.sided")

##Assumptions

###Normality

####Descriptives

#skew
rt_data2 |>
  summarise(
    viz_skew_one = round(skew(VisualCue_AvgRT), 2)
  )

####Visual Inspection

#hist
h_viz_one <- ggplot(rt_data2, aes(x = VisualCue_AvgRT)) +
  geom_histogram() +
  labs(title = "Histogram")
h_viz_one

#density
d_viz_one <- ggplot(rt_data2, aes(x = VisualCue_AvgRT)) +
  geom_density() +
  labs(title = "Density")
d_viz_one

#qq-plot
q_viz_one <- ggplot(rt_data2, aes(sample = VisualCue_AvgRT)) +
  geom_qq() +
  geom_qq_line() +
  labs(title = "QQPlot")
q_viz_one

####Testing

#shapiro-wilk

shapiro.test(rt_data2$VisualCue_AvgRT)

h_viz_one | d_viz_one | q_viz_one
```