SA1 TIME SERIES Q29

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Contents

READING THE DATA

Import

```
print(head(weightloss_data))
```

```
## # A tibble: 6 x 5
##   Participant `Diet Type` Baseline `After 1 month` `After 2 months`
##         <dbl> <chr>          <dbl>           <dbl>             <dbl>
## 1           1 Low-Carb           0             2                 4
## 2           2 Low-Carb           0             1.5               3.5
## 3           3 Low-Carb           0             1.8               3.8
## 4           4 Low-Carb           0             1.7               3.9
## 5           5 Low-Carb           0             2                 4.1
## 6           6 Low-Carb           0             1.9               3.7
```

1. Check Assumptions

Normality: Shapiro-Wilk

```
results
```

```
## $`Low-Carb After 1 month`
##
##  Shapiro-Wilk normality test
##
## data:  diet_data$WeightLoss
## W = 0.95225, p-value = 0.6951
##
##
## $`Low-Carb After 2 months`
##
##  Shapiro-Wilk normality test
##
## data:  diet_data$WeightLoss
## W = 0.97523, p-value = 0.9347
##
##
## $`Low-Fat After 1 month`
##
##  Shapiro-Wilk normality test
##
## data:  diet_data$WeightLoss
## W = 0.94808, p-value = 0.6459
##
##
## $`Low-Fat After 2 months`
##
##  Shapiro-Wilk normality test
##
## data:  diet_data$WeightLoss
## W = 0.93455, p-value = 0.4941
```

Homogeneity of Variance: Levene'sTest

Table 1: Test for Equality of Variances (Levene's)

	F	df1	df2	p
Baseline	NA	1	18	NA
After 1 month	1.266	1	18	0.275
After 2 months	2.761	1	18	0.114

Sphericity: w/ Greenhouse-Geisser

Table 2: Test of Sphericity

	Mauchly's W	Approx. X^2	df	p-value	Greenhouse-Geisser	Huynh-Feldt	Lower Bound
RM Factor 1	0.526	10.909	2	0.004	0.679	0.715	0.5

Independence

```
if (nrow(overlapping_participants) > 0) {
  print("The following participants appear in multiple diet types:")
  print(overlapping_participants)
} else {
  print("All participants are independent across diet types.")
}
```

```
## [1] "All participants are independent across diet types."
```

Findings:

While checking the assumptions before our ANOVA, the assumptions were examined. After one and two months, the weight loss data for all groups showed a **normal distribution** with **p-values $>$ 0.05** in accordance with the Shapiro-Wilk test. On the other hand, the absence of participant overlap among diet groups verified the **independence of the observations**. Given that the **p-values were more than 0.05**, Levene's test demonstrated that the **variances were equal** at each time point. Lastly, adjustments such as **Huynh-Feldt** and **Greenhouse-Geisser** were taken into consideration because the **Mauchly's test of sphericity was violated** with a significant outcome.

2. Conduct the Two-Way Mixed Model ANOVA

Main Effect

Including: Two-way mixed model ANOVA

- **Between-Subjects Factor:** Diet Type (Low-Carb vs. Low-Fat)
- **Within-Subjects Factor:** Time (Baseline, 1 Month, 2 Months)
- **Dependent Variable:** Weight Loss

Here, since our sphericity is violated this part of my code performs the ANOVA with Greenhouse-Geisser correction

```
print(anova_results)
```

```
## Anova Table (Type 3 tests)
##
## Response: WeightLoss
##                   Effect          df  MSE           F  ges p.value
## 1           `Diet Type`       1, 18 0.05  174.71 *** .859   <.001
## 2             TimePoint 1.36, 24.43 0.02 2889.94 *** .984   <.001
## 3 `Diet Type`:TimePoint 1.36, 24.43 0.02  229.88 *** .827   <.001
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
##
## Sphericity correction method: GG
```

Findings:

Diet Type: According to Diet Type, the main effect of diet type on weight loss was significant. With **F-Stats = 174.71**, a large effect size **ges = .859**, and a **p-value < 0.001**. Therefore, this implies that the type of diet (*Low-Carb vs. Low-Fat*) has an impact on weight loss.

Time: Our time report shows that the effect of time on weight loss was highly significant with **F-Stats = 2889.94**, a big effect size **ges = .984**, and a **p-value < 0.001**. This result indicates that weight loss significantly changes over time at different time points (*Baseline, 1 Month, 2 Months*). The very large effect size suggests that almost all variation in weight loss was explained by changes across time.

3. Interaction Effect

A substantial effect size (**ges = .827**), a p-value smaller than **.001**, and an F-statistic of **229.88** all demonstrated the significance of the interaction between diet type and time. This strong interaction suggests that the type of diet had an impact on how weight loss progressed over time. Compared to the Low-Fat group, the Low-Carb group experienced a more significant increase in weight loss over time. Although both groups gradually lost a substantial amount of weight, the Low-Carb diet resulted in greater overall weight loss at a faster rate by the end of the trial. This implies that the duration of adherence to the diet determines its effectiveness, with the Low-Carb diet exhibiting a more pronounced impact over time.

POST-HOC

Post-Hoc: Diet Type

```
summary(post_hoc_diet_bonf)
```

```
## $emmeans
##  Diet Type emmean     SE df lower.CL upper.CL
##  Low-Carb    1.93 0.0424 18     1.84     2.02
##  Low-Fat     1.14 0.0424 18     1.05     1.23
##
## Results are averaged over the levels of: TimePoint
## Confidence level used: 0.95
##
## $contrasts
##  contrast               estimate   SE df t.ratio p.value
##  (Low-Carb) - (Low-Fat)    0.793 0.06 18  13.218  <.0001
##
## Results are averaged over the levels of: TimePoint
```

Findings:

With a **95% confidence interval**, the post-hoc analysis reveals that the Low-Carb diet group lost significantly more weight than the Low-Fat group. The Low-Carb diet resulted in much higher weight reduction, with an estimated difference in weight loss between the two diets of **0.793** and a highly significant difference (**t = 13.218**, **p-value < .0001**). Even after applying the Bonferroni correction for multiple comparisons, these findings remain significant.

Post-Hoc: TimePoint

```
summary(post_hoc_interaction)
```

```
## $emmeans
##  Diet Type TimePoint      emmean     SE df lower.CL upper.CL
##  Low-Carb  Baseline         0.00 0.0000 18     0.00     0.00
##  Low-Fat   Baseline         0.00 0.0000 18     0.00     0.00
##  Low-Carb  After.1.month    1.88 0.0626 18     1.75     2.01
##  Low-Fat   After.1.month    1.21 0.0626 18     1.08     1.34
##  Low-Carb  After.2.months   3.91 0.0687 18     3.77     4.05
##  Low-Fat   After.2.months   2.20 0.0687 18     2.06     2.34
##
## Confidence level used: 0.95
##
## $contrasts
##  contrast                                                estimate     SE df
##  (Low-Carb Baseline) - (Low-Fat Baseline)                    0.00 0.0000 18
##  (Low-Carb Baseline) - (Low-Carb After.1.month)             -1.88 0.0626 18
##  (Low-Carb Baseline) - (Low-Fat After.1.month)              -1.21 0.0626 18
##  (Low-Carb Baseline) - (Low-Carb After.2.months)            -3.91 0.0687 18
##  (Low-Carb Baseline) - (Low-Fat After.2.months)             -2.20 0.0687 18
##  (Low-Fat Baseline) - (Low-Carb After.1.month)              -1.88 0.0626 18
##  (Low-Fat Baseline) - (Low-Fat After.1.month)               -1.21 0.0626 18
##  (Low-Fat Baseline) - (Low-Carb After.2.months)             -3.91 0.0687 18
##  (Low-Fat Baseline) - (Low-Fat After.2.months)              -2.20 0.0687 18
##  (Low-Carb After.1.month) - (Low-Fat After.1.month)          0.67 0.0885 18
##  (Low-Carb After.1.month) - (Low-Carb After.2.months)       -2.03 0.0325 18
##  (Low-Carb After.1.month) - (Low-Fat After.2.months)        -0.32 0.0929 18
##  (Low-Fat After.1.month) - (Low-Carb After.2.months)        -2.70 0.0929 18
##  (Low-Fat After.1.month) - (Low-Fat After.2.months)         -0.99 0.0325 18
##  (Low-Carb After.2.months) - (Low-Fat After.2.months)        1.71 0.0971 18
##  t.ratio p.value
##      NaN     NaN
##  -30.040  <.0001
##  -19.334  <.0001
##  -56.932  <.0001
##  -32.034  <.0001
##  -30.040  <.0001
##  -19.334  <.0001
##  -56.932  <.0001
##  -32.034  <.0001
##    7.570  <.0001
##  -62.482  <.0001
##   -3.444  0.0278
##  -29.059  <.0001
##  -30.472  <.0001
##   17.606  <.0001
##
## P value adjustment: tukey method for comparing a family of 5.81507290636732 estimates
```

Findings:

According to the post-hoc interaction analysis, there was no baseline weight loss in either the Low-Carb or Low-Fat groups. By the first and second months, the Low-Carb group lost significantly more weight than the Low-Fat group at every time point. After two months, there was a substantial difference in the total amount of weight lost by the Low-Carb and Low-Fat groups.