PSYC234: Lecture 7 post-lecture worksheet

This worksheet is to help you consolidate what you learned about the Kruskal-Wallis test and Friedman's ANOVA during Lecture 7. It contains two activities.

This worksheet could be completed as part of the independent study hours for PSYC234. **It is optional but recommended**. **It is recommended that you complete this worksheet in advance of the WBA.**

Once you have finished, compare your answers to the answer sheet provided on Moodle. You can also use this sheet and the answer sheet for revision purposes when preparing for the class test.

Activity 1: Understanding how the non-parametric tests differ and when to use them

It is really important that you understand which statistical test you should run in different situations. Fill in the tables below based on the research design. In each scenario, you are interested in whether the type of chocolate eaten affects feelings of contentment (response = 0-100).

Design	How would you check whether the assumption of normality is violated for this design?	If the assumption of normality is violated, which non-parametric test would you run?
You recruit 20 participants. On day 1, they eat milk chocolate. On day 2, they eat dark chocolate. On day 3, they eat white chocolate.	Assess whether the assumption of normality is violated per condition This can be done using Q-Q plots and the Shapiro-Wilk test	Friedman's ANOVA
You recruit 12 participants and randomly assign them to either a "white chocolate", "milk chocolate", or "dark chocolate" group.	Assess whether the assumption of normality is violated per group This can be done using Q-Q plots and the Shapiro-Wilk test	Kruskal-Wallis test
You recruit 7 participants. On day 1, they eat milk chocolate and on day 2, they eat dark chocolate.	Calculate a difference score for each participant (Timepoint 1 – Timepoint 2)	Wilcoxon signed-rank test

	Assess whether the assumption of normality is violated for the "difference" This can be done using Q-Q plots and the Shapiro-Wilk test	
You recruit 10 participants and randomly assign them to either a "white chocolate" or "milk chocolate" group.	Assess whether the assumption of normality is violated per group This can be done using Q-Q plots and the Shapiro-Wilk test	Wilcoxon rank-sum test

Activity 2: Interpreting R output

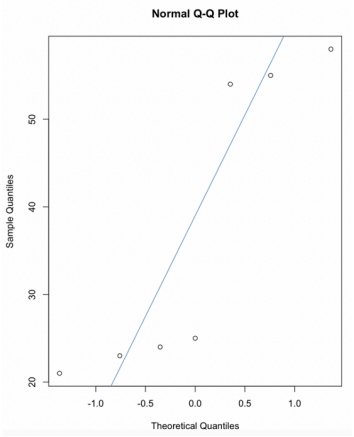
Interpret the following R output. Part 1 uses an independent groups design, whilst part 2 uses a repeated measures design.

Part 1: An independent groups design

You are a developmental researcher interested in whether the books children are exposed to affects their language production (how many words they can say). You recruit 21 2-year-old children and assign them to one of three groups – "Pinocchio", "Cinderella", and "Gruffalo". The children's parents then read this story every day for three months (i.e. children in the "Gruffalo" group read the Gruffalo every day). You then ask their parents to complete a language production assessment on their child (score = 0-100).

Testing the assumption of normality:

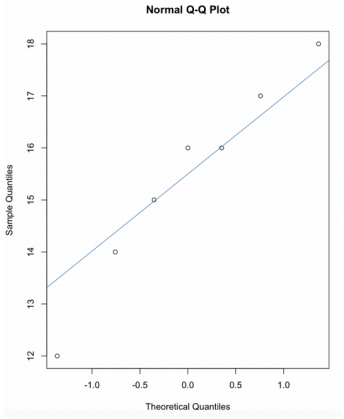
Pinocchio




```
        Shapiro-Wilk normality test

data:  Pinocchio$Words
W = 0.75208, p-value = 0.01334
```

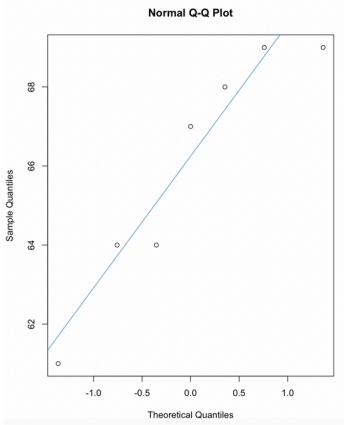
Cinderella




```
        Shapiro-Wilk normality test

data:  Cinderella$Words
W = 0.96705, p-value = 0.8764
```

Gruffalo




```
        Shapiro-Wilk normality test

data:  Gruffalo$Words
W = 0.89119, p-value = 0.2809
```

Interpretation:

The Q-Q plot and the Shapiro-Wilk test suggests that the assumption of normality is violated for the Pinocchio group. Data in the Cinderella and Gruffalo group does not appear to violate the assumption.

1B: Interpret the descriptive statistics and the model output

Descriptive statistics:

	Book	med_words	min_words	max_words
	<fct>	<int>	<int>	<int>
1	Cinderella	16	12	18
2	Gruffalo	67	61	69
3	Pinocchio	25	21	58

Model output:

```
        Kruskal-Wallis rank sum test

data:  Words by Book
Kruskal-Wallis chi-squared = 17.853, df = 2, p-value = 0.0001328
```

Post-hoc tests:

```
Dunn (1964) Kruskal-Wallis multiple comparison
  p-values adjusted with the Holm method.

              Comparison         Z       P.unadj         P.adj
1  Cinderella - Gruffalo -4.225276 0.00002386477 0.00007159432
2 Cinderella - Pinocchio -2.112638 0.03463174827 0.06926349653
3   Gruffalo - Pinocchio  2.112638 0.03463174827 0.03463174827
```

What can we conclude? Report in APA format.

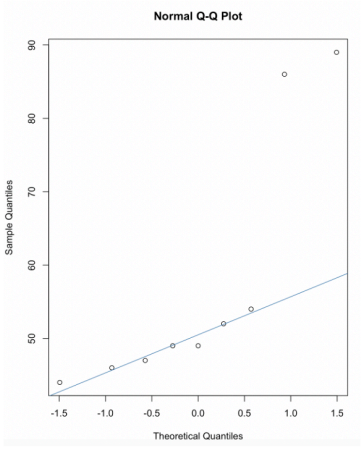
The Kruskal-Wallis test revealed a significant effect of book on the language production score, $H(2) = 17.85$, $p < .001$. Post-hoc comparisons were conducted using Dunn's test, with p-values corrected using Bonferroni-Holm. There was a significant difference between the Cinderella (median = 16; range = 12-18) and the Gruffalo groups (median = 67; range = 61-69), with participants in the Gruffalo group achieving a significantly higher score ($p < .001$). Participants in the Gruffalo group also achieved a significantly higher score than participants in the Pinocchio group (median = 25; range = 21-58; $p = .035$). No significant difference was observed between the Cinderella and the Pinocchio groups ($p = .069$).

Part 2: A repeated measures design

You are a researcher interested in whether the number of hours sleep individuals get affects their performance on an attention task (score = 0-100). You recruit nine participants, with all participants taking part in three conditions. In the first condition, participants get 6 hours sleep the night before (6 hours). In the second condition, they get 8 hours sleep the night before (8 hours), and in the third condition, they get 10 hours sleep the night before (10 hours).

2B: Testing the assumption of normality

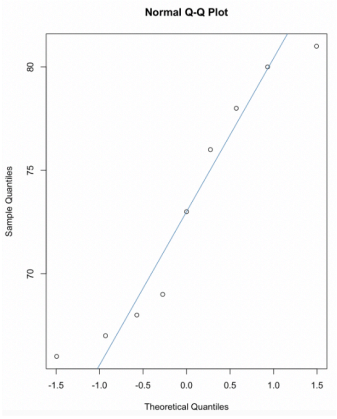
6 hours




```
        Shapiro-Wilk normality test

data:  sleep_data$six_hours
W = 0.70033, p-value = 0.001432
```

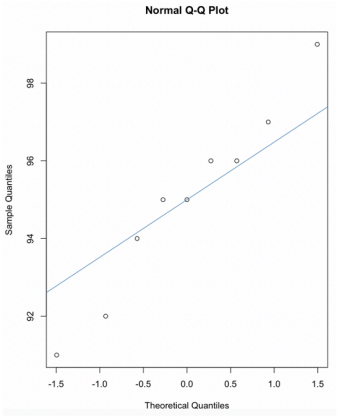
8 hours




```
        Shapiro-Wilk normality test

data:  sleep_data$eight_hours
W = 0.90246, p-value = 0.2666
```

10 hours




```
        Shapiro-Wilk normality test

data:  sleep_data$ten_hours
W = 0.96963, p-value = 0.8915
```

What can we conclude?

Data in the 6 hour condition appears to violate the assumption of normality.

2B: Interpret the descriptive statistics and the model output

Descriptive statistics:

	med_six_hours	med_eight_hours	med_ten_hours	min_six_hours	min_eight_hours	min_ten_hours	max_six_hours	max_eight_hours	max_ten_hours
1	54	73	95	46	66	91	89	81	99

Model output:

```
        Friedman rank sum test

data:  as.matrix(sleep_data_reduced)
Friedman chi-squared = 13.556, df = 2, p-value = 0.001139
```

Post-hoc tests:

```
        Pairwise comparisons using Conover's all-pairs test for a two-way balanced complete block design

data: y, groups and blocks

          eight_hours six_hours
six_hours 0.817       -
ten_hours 0.015       0.014

P value adjustment method: holm
```

What can we conclude? Report in APA format.

A Friedman's ANOVA revealed a significantly effect of sleep hours on the attention score, $X^2_F(2) = 13.56$, $p = .001$. Post-hoc comparisons were then conducting using the Conover test, with p-values corrected using Bonferroni-Holm. A significant difference emerged between the 6 hour (median = 54; range = 46-89) and the 10 hour conditions (median = 95; range = 91-99; $p = .014$), with participants performing better in the 10 hour condition. There was also a significant difference between the 8 hour (median = 73; range = 66-81) and the 10 hour conditions ($p = .015$). No significant difference emerged between the 6 hour and 8 hour conditions ($p = .817$).