Reading Inferential Statistics

LLE – Mathematics and Statistics Skills

1. A new treatment for loose feet has been designed. The foot loose index (FLI) is a measure of the performance of the foot, with higher values demonstrating better performance. A group of individuals are recruited to test the new treatment. The FLI is recorded before treatment and then again after 3 months of treatment.

   (a) Is this an example of a between-groups analysis (that is individuals are divided into distinct groups) or a within-groups analysis (that is the same individuals having multiple recordings)?

   Solution

   Each participant is measured on two different occasions, before treatment and after 3 months. This is a within-groups analysis.

   A related-samples t-test is carried out to test whether there is evidence that the treatment works. The summary results and t-test are given:

	Before	After
N	35	35
Mean	11.1	13.1
SD	5.54	6.51
Mean difference (after − before)	1.91	
95% confidence interval for difference	(0.734, 3.09)	
t	3.30	
p	0.002	

   (b) Did any participants drop-out during the trials? Explain your answer.

Solution

The sample size at the start is 35, and it is 35 at the end. Therefore, no participants dropped out of the trial.

(c) Interpret the 95% confidence interval for the mean of the difference between before and after treatment.

Solution

95% of possible samples will have the true mean difference contained within the 95% confidence interval. We can be 95% confident that the true population mean increase in FLI after treatment is between 0.734 and 3.09

(d) Use the confidence interval and p-value given to determine whether there is any evidence that the treatment makes a difference to FLI.

Solution

The lower and upper end of the 95% confidence interval both indicate a positive difference in FLI between before and after. The p-value of 0.002 is less than the standard cut-off of 0.05. Low p-values mean that we can reject the null hypothesis of there being no difference. There is evidence that the treatment makes a difference to FLI.

2. Treatments for excessive snoring are going to be tested. A good sleep index (gsi) is to be used, with higher values representing better sleep. Two drugs, codenamed Drug A and Drug B, are going to be tested. Three groups of participants are going to be given either a placebo or one of the two drugs. The trial will be double-blinded.

(a) Is this an example of a between-groups analysis (that is individuals are divided into distinct groups) or a within-groups analysis (that is the same individuals having multiple recordings)?

Solution

There are three distinct groups. This is a between-groups analysis.

(b) What is meant by 'double-blinded' and what are the advantages of this?

Solution

Double-blinded means that the participants are not aware of which drug they are receiving. Additionally, the researcher is also unaware when analysing the results which group belongs to which drug. This reduces risks of participant and researcher bias.

The summary statistics are given below. Mean gsi was adjusted for age and sex of participants.

Treatment	Placebo	Drug A	Drug B
N	25	25	22
Mean	47.7	50.7	51.8
Adjusted mean	47.7	51.1	51. 4
95% CI for adjusted mean	43.7, 51.7	47.0, 55.2	47.0, 55.7

(c) Is there any evidence in the table above that either of the drugs are significantly effective in improving a person's gsi?

Solution

There isn't any test statistic and p-values given in the table. However, we can get some indication by looking at the 95% confidence intervals for the three adjusted means. We can see that the mean gsi for the placebo is likely to lie between 43.7 and 51.7. This interval overlaps with the confidence intervals for both drugs. Therefore, this indicates that there may not be any difference in gsi between the drugs and the placebo.

(d) An analysis of covariance was carried out (with age and sex taken as confounding variables) and the results for treatment type were:

$$F(2, 67) = 1.020, p = 0.366$$

How would you interpret this result in determining the effectiveness of either of the drugs?

Solution

The p-value is not below the traditional cut-off value of 0.05. We would therefore not have enough evidence of a difference in the drugs.

3. A medical researcher is concerned about whether wearing a red top causes premature death. To test this, they watch episodes of the original series of Star Trek and record deaths based on whether the crew member wore a red shirt.

Shirt - Status	Dead	Alive	Total
Red	24	215	239
Not red	16	175	191
Total	40	390	430

(a) Find the percentage (correct to 1 decimal place) of crew members who died whilst in red.

Solution

$\frac{24}{239} \times 100 = 10.04 = 10.0$ (1 d.p.)

(b) Find the percentage (correct to 1 decimal place) of crew members who died whilst not in red.

Solution

$\frac{16}{191} \times 100 = 8.4$ (1 d.p.)

(c) Which group, wear red v did not wear red, had the higher proportion of deaths?

Solution

10 percent is higher than 8.4 percent, so red

(d) A chi-square test of association gives the result

$$\chi^2 = 0.349, p = 0.555$$

Is there evidence that wearing red is anymore dangerous than not wearing red?

Solution

The p-value is more than the traditional cut-off of p<0.05. Therefore, there isn't any evidence that wearing red is associated with premature termination.