Two Sample t-Tests

These questions are for you to complete in your own time. Please use them for extra revision of the concepts discussed in lectures and practised in tutorials. For help with these questions, you can ask any of your tutorial leaders or visit Maths-Aid. Maths-Aid can be found in Room 1.16 on Level 1 of the Marjorie Robinson Library and can be contacted at mathsaid@ncl.ac.uk.

One Tailed, Two Sample t-Test

1) Researchers believe that women cope with stressful situations better than men. To test this hypothesis, they monitor heart rate in 9 women and 9 men attending interviews, with the assumption that higher a heart rate means a higher stress level. Compare the data sets to see if women cope better with stressful situations.

Heart rate women (bmp)	Heart rate men (bmp)
84	80
81	74
80	73
70	72
72	78
69	75
65	70
74	74
80	69

a) State H_0 and H_1

b) Identify $\bar{x}_1$, $\bar{x}_2$, s_1,s_2,n_1,n_2 and use this information to calculate the pooled standard deviation s

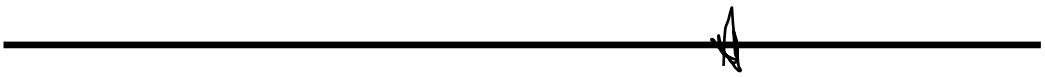
c) Calculate the test statistic t and identify the degrees of freedom ν

d) Compare t to the critical value in the tables to determine whether the result is significant. Interpret the result.

2) A researcher tests 22 schizophrenic patients and 19 depressed patients using a new test of executive function, believing that depressed patients score more highly than schizophrenic patients. The schizophrenic patients scored 39 on average with a standard deviation of 4.3 and the depressed patients scored 42 on average with a standard deviation of 3.2. Is there any evidence to support the researchers claim?

Two Tailed, Two Sample t-Test

3) In an experiment into whether music affects mood, participants were required to listen to a particular genre of music for one hour. After the hour, they had to mark on a 10cm long line (not shown to scale) how happy they felt. The distance from the 'sad' end of the scale to their mark was then measured and this is used as the participants' mood score. Is there any evidence to suggest different types of music effect mood?



SAD **HAPPY**

Mood score classical music	Mood score rap music
7.98	6.74
6.31	6.12
4.76	7.89
6.02	5.84
5.66	3.87
6.75	3.1
5.73	4.55
6.86	6.32
7.09	7.02
4.98	

a) State H_0 and H_1

b) Identify $\bar{x}_1$, $\bar{x}_2$, s_1,s_2,n_1,n_2 and use this information to calculate the pooled standard deviation s

c) Calculate the test statistic t and identify the degrees of freedom ν

d) Compare t to the critical value in the tables to determine whether the result is significant. Interpret the result.

4) A researcher has sent out questionnaires to all the houses in two different areas of Newcastle (Kenton and Byker). The questionnaires are being used to quantify an individual's perception of crime levels in their local area. A high score on the questionnaire corresponds to the individual thinking crime rates are high in their local area. The researcher has a good response to the questionnaires, receiving 27 questionnaires from the Kenton area and 36 questionnaires from the Byker area. On average, individuals in Kenton score 12 on the questionnaire with a variance of 4.2; in Byker the average is 19 with a variance of 2.9. Is there any evidence to suggest crime rates are perceived differently between the two areas?

Solutions

1) a) H_0: $\mu_1 = \mu_2$ (no difference in heart rate between the sexes), H_1: $\mu_1 < \mu_2$ (where μ_1 is the female population mean).

b) $\bar{x}_1 = 75, \bar{x}_2 = 73.89, s_1 = 6.5, s_2 = 3.52, n_1 = 9, n_2 = 9, s = 5.23$

c)

$$v = 9 + 9 - 2 = 16, \qquad t = \frac{75 - 73.89}{5.23 \times \sqrt{\frac{1}{9} + \frac{1}{9}}} = 0.45$$

d) The critical t-value for a 1-tailed test at the 95% level with 16 degrees of freedom is $1.746 > 0.45$ so the result is not significant and there is no evidence to reject the null hypothesis. Hence, there is no evidence to support the claim that women cope with stress better than men.

2) $t = 2.5$ and the critical t-value for a 1-tailed test at the 95% level with 39 degrees of freedom is $1.685 < 2.5$ so there is significant evidence to support the researcher's claim.

3) a) H_0: $\mu_1 = \mu_2$ (music does not affect mood). H_1: $\mu_1 \neq \mu_2$ (music does affect mood).

b) $\bar{x}_1 = 6.21, \ \bar{x}_2 = 5.72, s_1 = 0.99, s_2 = 1.57, n_1 = 10, n_2 = 9, s = 1.30$

c)

$$v = 10 + 9 - 2 = 17, \qquad t = \frac{6.21 - 5.72}{1.30 \times \sqrt{\frac{1}{10} + \frac{1}{9}}} = 0.82$$

d) The critical t-value for a 2-tailed test at the 95% level with 17 degrees of freedom is $2.11 > 0.82$. The result is not significant so there is no evidence to reject the null hypothesis. Hence, there is no evidence to suggest the two different types of music had different effects on mood.

4) Firstly we must find v, s and t.

$$v = 27 + 36 - 2 = 61$$

$$s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}} = \sqrt{\frac{26 \times 4.2^2 + 35 \times 2.9^2}{61}} = 3.513$$

$$t = \frac{12 - 19}{3.513 \times \sqrt{\frac{1}{27} + \frac{1}{36}}} = 7.827$$

The critical t-value for a 2-tailed test at the 95% level with 61 degrees of freedom is $2 < 7.827$. There is significant evidence to suggest that perceived crime rates differ between the two areas.