How People Learn

Exercises for Week 4

Question 1

(a)

Here in the first part you are recoding the data into categories which are more substantial. Where you have small numbers in a given category, you might sometimes need to re-organise your data in this way.

(b)

The questions here are phrased in a more open way than previously in that it simply says test the hypothesis without telling you which test to use. This is deliberate: in real life settings you will get data and no instructions; you will then need to decide for yourself what test to use in which setting. It is good to practice figuring out how to make that decision.

For both of the parts to this question (b) and (c) you are looking at tests related to the mean average. The standard tests used in relation to the mean average are z-test, t-test and F-test (ANOVA). Part (b) deals with a one sample situation. This suggests z-test or t-test. Part (c) deals with a two sample situation. This also suggests z-test or t-test.

Thereafter, the test you will use will depend on the conditions that arise in each situation.

Hypothesis:

H_0: mean for EPFL = 3.36

H_1: mean for EPFL $\neq$ 3.36

Conditions:

The sample size here is 59. There are different rules of thumb regarding how sample size impacts on whether to use a z-test or a t-test and you can use any one that you can reference to a reputable source. Once the sample size reaches 25 the t-distribution is very close to the z-distribution, so I will use that as my rule of thumb and so we can use a z-test in this case.

Our critical value for 95% confidence interval two tailed is therefore plus or minus 1.96

Mean score from the sample: 2.54 (I'm using 3 sf here to match to the level of precision of the data we have on the population mean)

Mean score for the population 3.36

Standard deviation of the sample: 0.57

Test:

Estimated Standard Error: $\frac{standard\ deviation\ of\ sample}{\sqrt{sample\ size}} = \frac{0.57}{7.68} = 0.07$

z-score: $\frac{sample\ mean - hypothesised\ population\ mean}{ESE} = \frac{2.54 - 3.36}{0.07} = -11.05$

Interpretation:

The z-score obtained is far more extreme than the critical value. We therefore reject the null hypothesis that the mean for the population of EPFL masters students is the same as that found in the US reference sample. Examination of the data suggests that the US sample scores higher than the EPFL sample.

The same caveats that were made last week about the randomness of the sample apply here. Again, however, the difference is quite notable and so it would be a surprise if the population of EPFL Masters students did in fact have a mean score like that of the US sample.

(c)

Note: We are moving into new territory here. Previously all of the exercises dealt only with one variable at a time (monovariate stats). This is the first time you are looking at two variables at the same time (bivariate). The two variables are section (a categorical variable) and score (a continuous variable).

Hypothesis:

H_0: mean for IC minus mean for SB = 0

H_1: mean for IC minus mean for SB $\neq 0$

Conditions:

There are 18 responses from IC and 8 from SB. The numbers here are small suggesting the use of a t-test rather than a z-test. You will find different rules of thumb in different text books: I use the following: “If either sample size is less than 25, use t-test”.

You will need to decide whether we can assume a common population variance or not (i.e. use pooled variance or not). The variances are as follows:

IC = 0.477

SB = 0.261

Again there are different rules of thumb that can be used that are found in different textbooks. Or you can test to see if it is probable that the variances are unequal. I use the following rule of thumb "If the sample variances differ by a factor of less than three, assume that there is a common population variance". You can use any rule of thumb that you can reference to a reputable source. In this case we can assume common population variance.

Test:

We will therefore use a 2 sample t-test assuming a common population variance. The calculation is much that same as above. However this time Excel also has a function for this, which returns a p value of 0.83.

There is therefore no evidence against null hypothesis that the population of SB and IC students have the same score on the Metacognitive Self-Regulation Scale.