Social Studies 201
Notes for March 31, 2005

Example – responses of University of Regina undergraduates to attitude questions

This question examines responses to two questions from the *Survey of Student Attitudes and Experiences* conducted in 1998 in Social Studies 306 and available in the file

`ssae.sav`

in the folder

`t:\students\public\201\`

The two questions examined are V1, "Free trade is positive for Canadians." and M5, "The government should fund festivals and special events celebrating different cultures" For each of these two statements, respondents were asked to give their view on a five-point scale, from 1 meaning strongly disagree to 5 meaning strongly disagree. Responses to each of these questions, along with the respective means and standard deviations, are given in Table 1. While the data were obtained using an ordinal five-point scale, in calculating means and standard deviations, we are treating these two variables as if they were measured at an interval level.

Question. For each of these two variables, test whether the mean response is on the agree side of a neutral response, that is, test whether the mean exceeds 3. Use the 0.01 level of significance. Assume this sample is a random sample of all University of Regina undergraduates in the Fall 1998 semester.

Table 1: Responses to attitude questions V1 and M5

Response	Responses to V1	M5
1 – strongly disagree	55	91
2 – somewhat disagree	86	151
3 – neutral	301	199
4 – somewhat agree	160	150
5 – strongly agree	78	106
Total	680	697
Mean	3.176	3.042
Standard deviation	1.056	1.250

Answer

Before conducting the two hypotheses tests, I will explain the reason for being interested in these tests. For each of the two variables, it appears that responses are fairly evenly split between agree and disagree, with the modal response being 3, or neutral, in each case. The sample mean response does not appear very different from the neutral response of 3 for each of these two variables, although the sample mean exceeds 3 in each case. The question thus asks whether these means are sufficiently greater than 3 to argue that respondents, on average, are in agreement with the two statements, or whether there is insufficient evidence to conlude that respondents, on average, can be considered to agree.

The method of conducting each test is more or less the same. In the following notes, all the steps in conducting the first test, for V1, are provided. For the second variable and test, attitude about M5, only those items that differ are discussed.

Hypothesis test for V1

Let μ be the true mean level of opinion among University of Regina undergraduates about issue V1, "free trade is positive for Canadians." The steps involved in conducting the hypothesis test are as follows.

1. **Hypotheses**. Since an hypothesis test must begin with an equality for the null hypothesis, the hypothesis that makes most sense here is $\mu = 3$, that is, that undergraduates on average, have a neutral response. Then the alternative suggested in the question is that the mean may exceed 3, that is, the question asks to test whether the mean exceeds 3. This is an example of a one-tailed test, to test whether $\mu > 3$. The null and alternative hypotheses are

$$\text{Null hypothesis} \quad H_0 : \mu = 3$$

$$\text{Alternative hypothesis} \quad H_1 : \mu > 3$$

   Once the test has been conducted, the conclusion will either be that we do not reject the null hypothesis that μ is 3, or, if the sample mean is in the critical region, the conclusion will be that μ exceeds 3, or that the average response is on the agreee side.

2. **Test statistic**. The claim is about μ, the mean of V1 for all undergraduate students. The sample mean, $\bar{X}$, is the test statistic.

3. **Distribution of the test statistic**. The sample is said to be a random sample of U of R undergraduates in the Fall 1998 semester, with a sample size of $n = 680$. This is a large random sample so the central limit theorem can be used. As a result,

$$\bar{X} \text{ is Nor}\left(\mu, \frac{\sigma}{\sqrt{n}}\right).$$

   The sampling distribution of $\bar{X}$ is normally distributed with mean μ and standard deviation $s/\sqrt{n}$, where s can be used as an estimate of the population standard deviation σ, since n is large.

4. **Significance level**. The level of significance requested here is 0.01, so this is $\alpha = 0.01$. Since the alternative hypothesis is that $\mu > 3$, this represents an area in only the right tail of the normal distribution.

5. **Critical region**. The critical region is the extreme area, in this case of a one-tailed or one-directional alternative hypothesis, the extreme area of $\alpha = 0.01$ is only in the right tail of the distribution. Looking

through the table of the normal distribution for a B area of 0.01 in a tail of the distribution gives a Z-value of 2.32 or 2.33. The latter value of $Z = 2.33$ will be used here, so the critical region is all Z-values exceeding 2.33.

The critical region and the associated conclusions that can be made are as follows:

$$\text{Region of rejection of } H_0 : Z > +2.33$$

$$\text{Area of nonrejection of } H_0 : Z \leq +2.33$$

6. **Conclusion**. In order to determine whether the sample mean $\bar{X}$ is within the critical region or not, it is necessary to determine the distance $\bar{X}$ is from the hypothesized mean μ. This can be determined by obtaining the Z-value associated with the sample mean – that is, how many standard deviations $\bar{X} = 3.176$ is from the hypothesized mean of $\mu = 3$.

$$\begin{aligned} Z &= \frac{\bar{X} - \mu}{s/\sqrt{n}} \\ &= \frac{3.176 - 3}{1.056/\sqrt{680}} \\ &= \frac{0.176}{1.056/26.077} \\ &= \frac{0.176}{0.0405} \\ &= 4.346 > 2.33. \end{aligned}$$

That is, the sample mean is 4.346 standard deviations above the hypothesized mean of $\mu = 3$. This is above the critical cut-off point of +2.33, so this Z-value is in the critical region for the test. That is, the sample mean is 4.346 standard deviations above the hypothesized mean of 3, a great distance, and one that is extreme enough to be in the right 0.01 of the distribution.

Since this Z-value is in the critical region, the conclusion of the test is to reject the null hypothesis H_0 and accept the alternative hypothesis H_1. The conclusion is that the mean attitude of U of R undergraduates is on the agree side of neutral, a conclusion made at the $\alpha = 0.01$ level of significance. This provides quite strong evidence that students, on average, are not neutral on this issue but tend to agree.

Hypothesis test for M5

Let μ be the true mean level of opinion among all University of Regina undergraduates about issue M5, "The government should fund festivals and special events celebrating different cultures." The steps involved in conducting the hypothesis test are as follows.

1. **Hypotheses**. The null and alternative hypotheses are

$$\text{Null hypothesis} \quad H_0 : \mu = 3$$

$$\text{Alternative hypothesis} \quad H_1 : \mu > 3$$

2. **Test statistic**. The claim is about μ, the mean of M5 for all undergraduate students. The sample mean, $\bar{X}$, is the test statistic.

3. **Distribution of the test statistic**. Since this is a random sample with large sample size of $n = 697$

$$\bar{X} \text{ is Nor}\left(\mu, \frac{\sigma}{\sqrt{n}}\right).$$

s can be used as an estimate of the population standard deviation σ, since n is large.

4. **Significance level**. The level of significance requested here is 0.01, so this is $\alpha = 0.01$. Since the alternative hypothesis is that $\mu > 3$, this area represents an area in only the right tail of the normal distribution.

5. **Critical region**. The critical region and the associated conclusions that can be made are as follows:

$$\text{Region of rejection of } H_0 : Z > +2.33$$

$$\text{Area of nonrejection of } H_0 : Z \leq +2.33$$

6. **Conclusion**. For $\bar{X} = 3.042$, $s = 1.250$, $n = 697$, and hypothesized mean $\mu = 3$,

$$\begin{aligned} Z &= \frac{\bar{X} - \mu}{s/\sqrt{n}} \\ &= \frac{3.042 - 3}{1.250/\sqrt{697}} \\ &= \frac{0.042}{1.250/26.401} \\ &= \frac{0.042}{0.0473} \\ &= 0.879 < 2.33. \end{aligned}$$

The sample mean is only 0.879 standard deviations above the hypothesized mean of $\mu = 3$. This is well below the critical cut-off point of +2.33, so this Z-value is not in the critical region for the test. That is, while the sample mean exceeds 3, it is less than 1 standard deviation to the right of the hypothesized mean of 3, a small distance, and one that is great enough to be in the critical region in the right 0.01 of the distribution.

Since this Z-value is not in the critical region, the conclusion of the test is that there is insufficient evidence to reject the null hypothesis H_0. The conclusion is that the mean attitude of U of R undergraduates is no different than neutral on this issue, a conclusion made at the $\alpha = 0.01$ level of significance. While the mean for all undergraduates might be above 3, the sample mean is not far enough above 3 to conclude that, on average, student views on this issue are any different than a neutral view.

Last edited March 31, 2005.