# MA 207 Exam 4 Review Name: Key

1. In an exit poll of 2500 randomly selected voters, 52% reported voting for the incumbent.

* 1. Is this sufficient evidence to predict that the incumbent will win the election? Yes.
  2. Justify and explain your answer.

The null and alternative hypotheses are:

(one-sided alternative)

The needed assumptions are satisfied:

The data was obtained by randomization.

 and 

The test statistic is:



We find one-sided (right-tailed) *P*-value:



We make the following conclusion:

The test results are statistically significant because 

Therefore, we reject the null hypothesis.

There is sufficient evidence to predict that the incumbent will win the election.

1. Historically, the average human body temperature was thought to be 98.6°F. We think the actual human body temperature is different than that due to inaccuracies in thermometer technologies, among other reasons. A random sample of 130 subjects recorded a mean temperature of 98.4°F with a standard deviation of 1.1°F. Test whether there is evidence that the actual population mean temperature is different than the historically believed average at the  level of significance.

One sample. Temperature is quantitative. So, use the one sample population mean test.

1. Explain the idea behind a hypothesis test (a test for significance).

Assume the null hypothesis is true and test for evidence against it.

1. State the null and alternative hypotheses. State whether the alternative is one-sided or two-sided.

(two-sided alternative)

1. Explicitly check any assumptions needed before applying the test. Then determine the appropriate test statistic.

Random sample and 



1. Statistical software gives a *P*-value of *P* = .04. Interpret the *P*-value in the context of the problem. (Note that here you need to give the meaning of the *P* -value, not an assessment of the evidence it provides against the null.)

Assuming that mean body temperature is 98.6o F, the probability of getting a sample as or more extreme than what we got is 4%.

1. Explain what it means for test results to be statistically significant.

For the test results to be statistically significant, it must be unlikely that they happened by chance variation between samples. (In other words, the probability that the test results happened by chance must be less than the level of significance. In other words, )

1. Explain in complete sentences what you would conclude based on your *P*-value.

The results are not statistically significant at the 1% level of significance because Therefore, we do not reject the null hypothesis. There is not sufficient evidence to conclude that the mean body temperature is different from 98.6o F.

1. Find a 99% confidence interval to two decimal places and explain what it means.

A two-sided test for significance at the  level of significance corresponds to a 99% confidence interval.

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We are 99% confident that the true value of the unknown population mean body temperature is in this interval.

1. Does the null hypothesis value lie in the confidence interval? Explain what that means.

Since the null hypothesis value of 98.6oF does lie in the confidence interval, we do not reject the null hypothesis.

1. Below are various possible explanations for what the 99% confidence interval above means. For each part below, circle true or false to indicate if the statement is a correct explanation. No work is needed.

* T/F We are 99% confident that the population mean body temperature lies in the above interval.
* T/F We are 99% confident that the sample mean body temperature lies in the above interval.
* T/F If we constructed a large number of confidence intervals from different samples of the same size, about 99% of them would contain the population mean body temperature.
* T/F The probability is 99% that the population mean body temperature lies in the above interval.
* T/F There is a 99% probability that the sample mean falls within the margin of error of the unknown population mean body temperature.
* T/F There is a 99% probability that the unknown population mean body temperature falls within the margin of error of the one particular sample mean that we got above.
* T/F 99% of people have a body temperature that lies in the above interval.
* T/F 99% of the time, a person’s body temperature will lie in the above interval.

3.

|  |  |  |  |
| --- | --- | --- | --- |
| Ad Source | n | mean | standard deviation |
| Wall Street Journal | 26 | 4.77 | 1.50 |
| Times | 61 | 4.30 | 1.34 |

(2 Samples. How trustworthy is a quantitative variable. So 2 sample population mean test.)  
You suspect that the trustworthiness of the Wall Street Journal and the Times are different. Test whether that is true at the 10% level of significance. Sample 1-Wall Street. Sample 2 –Times.



(two-tailed)

(or equivalently, and )

* 1. You are not asked to check the assumptions in this particular problem. Statistical software gives a test statistic of *t* = 1.38 and a *P*-value of *P* = .1675. Interpret the *P*-value in the context of this problem. (Note that here you need to give the meaning of the *P*-value, not an assessment of the evidence it provides against the null.)

Assuming there is no difference between the mean trustworthiness of the *Wall Street Journal* and the *Times*, the probability of getting samples as or more extreme than what we got is 16.75%.

* 1. Explain what you would conclude based on your P-value.

The results are not statistically significant since . Therefore, we do not reject the null hypothesis. There is not sufficient evidence to indicate a difference between the mean trustworthiness of the *Wall Street Journal* and the *Times* among all readers. That is, it is plausible that the *Wall Street Journal* and the *Times* are equally trustworthy.

* 1. Statistical software gives that the corresponding 90% confidence interval is (-0.11, 1.05). Explain what it means.

We are 90% confident that the difference in the overall mean trustworthiness of the two Journals is between and .

* 1. Does the null hypothesis value lie in the confidence interval? Explain what that means.

Since the null hypothesis value of 0 does lie in the confidence interval, it is plausible that the difference in the population means is zero. That is, it is plausible that there is no difference in the trustworthiness of the two journals. We do not reject the null hypothesis.

1. To what extent do syntax textbooks, which analyze the structure of sentences, illustrate gender bias? One part of the study examined the use of the words girl, boy, man and woman. We will call the first two words *juvenile* and the last two *adult*. A random sample of textbooks contained 60 references to females and 130 references to males. 60% of the female references were *juvenile*, and 40% of the male references were *juvenile*. Is the overall proportion of female references that are *juvenile* equal to the proportion of male references that are *juvenile* at the  level of significance?

(2 Samples. Juvenile or not is a categorical variable. Use a 2 sample population proportion test for juvenile references.)

Sample 1-female references. Sample 2-male references.

1. State the hypotheses.

(two-sided alternative)

(or equivalently, and )

1. Explicitly check any assumptions needed before applying the test.

1) The data was obtained by randomization – “random sample of textbooks”

2) There are two independent populations—yes, there is no overlap or matched pairs.

3) ,

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1. Statistical software gives a test statistic of and a *P*-value of *P* = .0102. Draw a labeled curve and shade a region to represent the *P*-value. Is the region one-sided or two-sided? Interpret the *P*-value in the context of this problem. (Note that here you need to give the meaning of the *P*-value, not an assessment of the evidence it provides against the null.)

Assuming there is no difference between the proportion of juvenile references of females and males, the probability of getting samples as or more extreme than what we got is about 1.02%.

1. Explain what you would conclude based on your P-value.

The test results are statistically significant because  Therefore, we reject the null hypothesis. There is sufficient evidence to conclude that the proportions of juvenile references to females and males are different.

1. Statistical software gives that the corresponding 95% confidence interval is(0.0501, 0.3499). Explain what this means.

We are 95% confident that the difference in the population proportions of juvenile references to females and males is between and .

1. Does the null hypothesis value lie in the confidence interval? Explain what that means.

Since the null hypothesis value of 0 does not lie in the confidence interval, it is not plausible that . Since the null hypothesis value of 0 does not lie in the confidence interval, we reject the null hypothesis.

1. Decide what test is appropriate for each question: one population mean test, one population proportion test, two populations mean test, or two populations proportion test. State the null and alternative hypotheses. Do you reject the null (just yes/no)?
   * + 1. In a study of binge​ drinking, the percent who said they had engaged in unplanned sexual activities because of drinking alcohol was 37 in 1993 ​ (of 152 students​) and 143 in 2005 (of 494 students). Is this change statistically significant at the 0.05 significance​ level?

Table

Description automatically generated Two Sample Proportions (had engaged vs hadn’t is categorical). Do not reject.

* + - 1. A study evaluated the weekly time​ that non-tenured and tenured professors at a large college spend working. A random sample of 30 non-tenured faculty averaged 50 hours per week with a standard deviation of 10 hours. A random sample of 60 tenured professors averaged 38 hours per week with a standard deviation of 5 hours. At the 0.10 significance level, is this strong enough evidence that the average non-tenured faculty work time is more than the average tenured professor work time?

Table

Description automatically generated with medium confidence Two Sample Means (hours worked is quantitative). Reject.

* + - 1. A commercial claims that 9 out of 10 dentists prefer brand X toothpaste. You doubt that is true for the population of all dentists. A random sample of 70 dentists has 55 dentists who prefer brand X toothpaste. Test your belief using .

Table

Description automatically generated One Sample Proportion (brand preferred is categorical). Reject.

* + - 1. A study considered whether daily consumption of garlic could reduce flu rates. Of the 250 participants, 125 took garlic pills daily and 125 took placebo pills daily. 12% of those taking garlic contracted the flu and 15.2% of those taking placebo pills contracted the flu. Is this a significant difference using ?

Table

Description automatically generated Two Sample Proportions (contracted flu or not is categorical). Do not reject.

* + - 1. Students enrolled in 4 units should spend on average 40 hours a week on schoolwork (though some students need more). A random sample of 36 students at a college were asked how many hours they studied in the previous week. The sample mean was 32 hours and the standard deviation was 6 hours. Does this suggest that the population mean is different from 40 hours given ?

Table

Description automatically generated One Sample Mean (hours studied is quantitative). Reject.

* + - 1. A magazine claims the average American family has 1.9 kids under the age of 18. A random sample of 48 American families has an average of 2.1 with a standard deviation of 0.5. Test to see if the overall average number of kids per family is more than 1.9 by using this sample and .

Table

Description automatically generated One Sample, Mean (number of kids is quantitative). Reject.