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Problem 1

1. Suppose the instructor of the course is convinced that the mean engagement of students who become knowledgeable in the material (i.e., the engagement\_1 population) is 0.75.
   1. *[5 points]* Formulate null and alternative hypotheses for a statistical test that seeks to challenge this belief. What are the null and alternative hypotheses?

**ANSWER:**

**Null Hypothesis H0:** The mean engagement of students is equal to professors predictions**,** μ = 0.75

**Alternative Hypothesis H1:** The mean engagement of students is not equal to professors predictions, μ != 0.75

* 1. *[5 points]* What type of test should be used and why?

**ANSWER:** We should perform hypothesis testing because it lets us reject the null hypothesis

1. Carry out the statistical test defined in (1b) using the *`engagement\_1`* sample.
   1. *[1 point]* What is the sample size?

**ANSWER:** 937

* 1. *[1 point]* What is the sample mean?

**ANSWER:** 0.7430304110448239

* 1. *[2 points]* What is the standard error?

**ANSWER:** 0.004153027288269652

* 1. *[2 points]* What is the standard score?

**ANSWER:** -1.6781948375012814

* 1. *[2 points]* What is the p-value?

**ANSWER:** 0.09330906925243751

* 1. *[2 points]* Are the results statistically significant at a level of 0.05? How about 0.10? What (if anything) can we conclude (i.e., what is the interpretation of the result)?

**ANSWER:** 90% confidence interval, reject the null hypothesis

95% confidence interval, accept the null hypothesis

99% confidence interval, accept the null hypothesis

1. *[10 points]* What is the largest standard error for which the test will be significant at a level of 0.05? What is the corresponding minimum sample size? (You may assume that the population variance and mean does not change.)

**ANSWER:**

Standard error: 0.004237209220916103

Minimum sample size: 900.1385114802096

1. Suppose the instructor is also convinced that the mean engagement is different between students who become knowledgeable (the engagement\_1 population) and those who do not (the engagement\_0 population).
   1. *[5 points]* Formulate null and alternative hypotheses that seek to validate this belief. What are the null and alternative hypotheses?

**ANSWER:**

**Null Hypothesis H0:** The mean engagement of students is equal to the second sample.

**Alternative Hypothesis H1:** The mean engagement of students is not equal to the second sample.

* 1. *[5 points]* What type of test should be used and why?

**ANSWER:** We should perform hypothesis testing because it lets us reject the null hypothesis

1. Carry out the statistical test defined in (4b) using the *`engagement\_1`* and *`engagement\_2`* samples.
   1. *[1 point]* What are the sample sizes?

**ANSWER:** 1977

* 1. *[1 point]* What are the sample means?

**ANSWER:** 0.6399545077035914

* 1. *[2 points]* What is the standard error?

**ANSWER:** 0.005715989588773277

* 1. *[2 points]* What is the standard score?

**ANSWER:** -19.252220562568542

* 1. *[2 points]* What is the p-value?

**ANSWER:** 1.352401028607762e-82

* 1. *[2 points]* Are the results statistically significant at a level of 0.05? How about 0.10? What (if anything) can we conclude (i.e., what is the interpretation of the result)?

**ANSWER:**

Reject the null hypothesis for 90% confidence interval

Reject the null hypothesis for 95% confidence interval

Reject the null hypothesis for 99% confidence interval

Problem 2

1. Use the sample to construct a 90% confidence interval for the number of points by which the team wins on average.
   1. *[3 points]* Will you use a t-test or z-test (Hint: Think which distribution should you use here if very few data points are available)? Justify your answer.

**ANSWER:** I will perform the t-test.

* 1. *[3 points]* What is the sample mean?

**ANSWER:** 7.363636363636363

* 1. *[3 points]* What is the standard error?

**ANSWER:** 5.0762776757504415

* 1. *[3 points]* What is the standard statistic (t or z value)?

**ANSWER:** 1.4407478926091581

* 1. *[3 points]* What is the 90% confidence interval?

**ANSWER:** from 0.049999999999998934 to 14.677272727272728

1. Repeat Q1 for a 95% confidence interval.
   1. *[2 points]* What is the standard statistic (t or z value)?

**ANSWER:** 1.4456727611047144

* 1. *[2 points]* What is the 95% confidence interval?

**ANSWER:** from 0.025000000000000355 to 14.702272727272726

* 1. *[1 point]* Is your interval wider or narrower compared to using the 90% confidence interval in Q1?

**ANSWER:** The interval is wider

1. Repeat Q2 if you are told that the population standard deviation is 15.836.
   1. *[5 points]* Will you use a t-test or z-test (Hint: Think which distribution should you use here now that you have the true population standard deviation)? Justify your answer.

**ANSWER:** Perform z-test

* 1. *[3 points]* What is the standard error?

**ANSWER:** 4.774733652733465

* 1. *[3 points]* What is the standard statistic (t or z value)?

**ANSWER:** 1.385131997855033

*[3 points]* What is the 95% confidence interval?

**ANSWER:** 0.16601210933385924

* 1. *[6 points]* Is your interval wider or narrower than the interval computed in Q2?

**ANSWER:** The range is narrower.

1. *[10 points]* Assume you no longer know the population standard deviation. With what level of confidence can we say that the team is expected to win on average? (Hint: What level of confidence would you get a confidence interval with the lower endpoint being 0?)

**ANSWER:** Level of confidence is 0.9229747134327154.