You should keep all your digits in your calculations to prevent rounding errors. The assignment will only be accepted online via avenue to learn before 11:59 pm on Friday April 5, 2019. Your mark corresponds to your last attempt, not your best attempt.

1 Kittens

At 8 weeks of age kittens at a specific shelter are assessed. A vet previously noted that the average weight of kittens (deemed healthy) at 8 weeks is 696.8 grams. A random sample of 9 kittens had an average weight of 664.2 grams and a sample standard deviation of 71.5. She calls a colleague at an affiliated rescue in another county to see if anything is happening with their kittens at 8 weeks of age. They observe that from a sample of 22 healthy independent kittens an average weight of 735.1g with a sample standard deviation of 82.5g. Assume the distribution of kitten weights at 8 weeks is sufficiently close to the normal distribution to use the CLT, and that kittens are independent (statistically, not literally).

1. (2 points) Test the null hypothesis that kittens from the two areas arise from populations with the same means. Assume the variance of the two populations are the same. Find the test statistic.

2. (2 points) Estimate the p-value given a 2-sided alternative.
    A. Less than 0.005
    B. Between 0.005 and 0.01
    C. Between 0.02 and 0.05
    D. Between 0.05 and 0.2
    E. Greater than 0.2

3. (1 point) Which of the following matches the lower limit of the 95% confidence interval for the true mean difference if you did assume the variances of the two populations were the same?
    A. Less than -130
    B. Between -130 and -110
    C. Between -110 and -90
    D. Between -90 and -70
    E. Greater than -70

4. (1 point) Which of the following matches the upper limit of the 95% confidence interval for the true mean difference if you did assume the variances of the two populations were the same?
    A. Less than -70
    B. Between -70 and -50
    C. Between -50 and -30
    D. Between -30 and -10
    E. Greater than -10

5. (2 points) Suppose we anticipate *equal number* of kitten in shelter A and shelter B. The true difference in the average weights of kittens is 10.0g, and the true standard deviation were 100.0g and 120.0g, respectively. Calculate the *total sample size* required in both shelters if a two-sided test is used with a 5% significance level and an 80% power is desired. *If using R, round the critical value to two decimal places to ensure you obtain an answer that matches what you would get if using the textbook method to get the critical value.*

2 Cancer

Unfortunately, some people develop more than one type of cancer, e.g. from metastisis. Consider the number of cases of unrelated people who develop kidney cancer, liver cancer, both, or neither:

	has kidney cancer	doesn't have kidney cancer
has liver cancer	21	3
doesn't have liver cancer	7	19

6. (2 points) Perform a χ^2 for independence between kidney cancer and liver cancer from the above table against the alternative that differences are more extreme than if obtaining either type of cancer was independent of the other. Estimate the χ^2 test statistic.

7. (2 points) Estimate the p-value.

    A. Less than 0.005

    B. Between 0.005 and 0.01

    C. Between 0.01 and 0.05

    D. Between 0.05 and 0.1

    E. Greater than 0.1

3 Sundry

For the questions below, assume $0 < \alpha < 1, \sigma^2 > 0, s^2 > 0, n > 1$, the null and alternative hypotheses are always written as we have in class.

8. (1 point) Which one of the following statements is true?

    A. A hypothesis test does not tell us for certain if a hypothesis is true.

    B. Larger samples make larger confidence intervals.

    C. The p-value is the probability the null hypothesis is true.

    D. α is the confidence of a hypothesis test.

    E. Test statistics are always positive.

9. (1 point) Which one of the following statements is false?

    A. The significance level of a hypothesis test is equivalent to α.

    B. If the null hypothesis at the 5% level is rejected in a one-tailed test, it is definitely rejected at the 10% level of a two-tailed test.

    C. If a null hypothesis is not rejected at the 1% level, it is definitely not rejected at the 5% level.

    D. If a null hypothesis is rejected at the 5% level of a two-tailed test, it is definitely rejected at the 10% level of a two-tailed test

    E. If the null hypothesis at the 5% level is rejected in a two-tailed test, it is definitely rejected at the 10% level of a one-tailed test.

10. (1 point) Choose the one statement that is always true. Assume normality when applicable.

    A. A large standard error makes a larger test statistic.

    B. A large p-value is associated with a test statistic close to zero.

    C. A small p-value is associated with a test statistic far from zero.

    D. A large sample size makes a large p-value

    E. A large sample size makes a large standard error.

4 Systolic Measurements

Consider the systolic measurements from people before and after implementing daily meditation as shown below. The values under the `pre` column represent the systolic blood pressure measurements before the regimen and the values under the `post` column represent the systolic blood pressure measurements after 2 weeks of the regimen.

	pre	post
1	150.52	147.72
2	153.16	148.10
3	167.47	165.64
4	155.56	150.66
5	156.03	152.26
6	168.72	165.34
7	158.69	151.28
8	144.88	147.06
9	149.51	149.09
10	151.43	146.11
11	164.79	168.55
12	157.88	158.50
13	158.21	156.09
14	155.89	158.29
15	150.55	152.89
16	169.30	171.42
17	158.98	160.60
18	139.27	140.37
19	160.61	159.37

11. (2 points) Determine the **absolute value** of the test statistic from the most appropriate t-test discussed in class when testing that there is no change in blood pressure when implementing this daily meditation for 5 minutes a day.

12. (1 point) Determine the degrees of freedom from the previous question.

13. (1 point) Determine the p-value from the question 11.

5 Cardiovascular Disease

14. (2 points) A study looked at the effects of OC use on heart disease in women 40 to 44 years of age. The researchers found that among 6000 current OC users at baseline, 26 women developed a myocardial infarction (MI) over a 3-year period, whereas among 1000 never-OC users, 10 developed an MI over a 3-year period.Assess the statistical significance of the results. Find the test statistic. *For this question and the next, you may use either the normal approximation or contingency table method. If you use the contingency table method, input the square root of the chi-square test statistic for this question.*

15. (1 point) Find the p-value for the previous question.