University of California, Davis Department of Biomedical Engineering

Fall 2019	Probability and Statistics	BIM 105
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Homework Assignment 5 Due November 14, 2019

Always show your work

All tests and intervals with means and proportions are two-sided

- 1. A mail order company is investigating the potential advantages of using a new heavy-duty packaging material. They shipped 1000 orders in the new packaging and another 1000 orders in the regular light packaging. Of the orders shipped in the regular packaging, 34 were damaged in shipment, and of the orders shipped in the new packaging, only 15 were damaged in shipment.
 - (a) Find a 95% confidence interval for the difference between the proportions of damaged shipments. You may use either the "traditional" or the "modern" method.
 - (b) Test the hypothesis that there is no difference in the percentage of packages damaged in shipment between the regular light packaging and the new heavy-duty packaging. Find the p-value. What is your conclusion?
- 2. The article "Determination of Carboxyhemoglobin Levels and Health Effects on Officers Working at the Istanbul Bosphorus Bridge" (G. Kocasoy and H. Yalin, Journal of Environmental Science and Health, 2004:1129–1139) presents assessments of health outcomes of people working in an environment with high levels of carbon monoxide (CO). Following are the numbers of workers reporting various symptoms, categorized by work shift. The numbers were read from a graph.

	Morning Shift	Evening Shift	Night Shift
Influenza	16	13	16
Headache	24	33	6
Weakness	11	16	5

Can you conclude that the proportions of workers with the various symptoms differ among the shifts?

- (a) State the appropriate null hypothesis.
- (b) Compute the expected values under the null hypothesis.
- (c) Compute the value of the chi-square statistic.
- (d) Find the p-value (within a range). What do you conclude?

- 3. In an experiment involving high-temperature performance of two types of transistors, a sample of 60 transistors of type A were tested and were found to have a mean lifetime of 1437 hours and a standard deviation of 179 hours. A sample of 180 transistors of type B were tested and were found to have a mean lifetime of 1356 hours and a standard deviation of 244 hours.
 - (a) Find a 95% confidence interval for the difference of the mean lifetimes between the two types of transistors.
 - (b) Conduct a test of the null hypothesis that the mean lifetimes are the same. Find the p-value. Can you conclude that the mean lifetimes differ between the two types of transistors?
- 4. The Valsalva maneuver involves blowing into a closed tube in order to create pressure in respiratory airways. Impedance cardiography is used during this maneuver to assess cardiac function. The article "Impedance Cardiographic Measurement of the Physiological Response to the Valsalva Manoeuvre" (R. Patterson and J. Zhang, Medical and Biological Engineering and Computing, 2003:40–43) presents a study in which the impedance ratio was measured for each of 11 subjects in both a standing and a reclining position. The results at an airway pressure of 10 mmHg are presented in the following table.

Subject	Standing	Reclining	Difference
1	1.45	0.98	0.47
2	1.71	1.42	0.29
3	1.81	0.70	1.11
4	1.01	1.10	-0.09
5	0.96	0.78	0.18
6	0.83	0.54	0.29
7	1.23	1.34	-0.11
8	1.00	0.72	0.28
9	0.80	0.75	0.05
10	1.03	0.82	0.21
11	1.39	0.60	0.79

- (a) Find a 95% confidence interval for the mean difference in the impedance ratios.
- (b) Conduct a test of the hypothesis that the mean difference is zero. Find the p-value. Can you conclude that there is a difference between the mean impedance ratio measured in the standing position and that measured in the reclining position? Do this problem by hand (show your work) and using MATLAB (show code and output).

5. In a comparison of the effectiveness of distance learning with traditional classroom instruction, 12 students took a business administration course online, while 14 students took it in a classroom. The final exam scores were as follows.

Online	64 66 74 69 75 72 77 83 77 91 85 89
Classroom	80 77 74 64 71 80 68 85 83 59 55 79 81 81

- (a) Find a 95% confidence interval for the difference in the mean scores between the two instructional modes.
- (b) Conduct a (two-sided) test of the null hypothesis that the mean scores are the same. Find the p-value. Can you conclude that the mean score differs between the two types of course? Do this problem by hand (show your work) and using MATLAB (show code and output).