University of California, Davis
Department of Biomedical Engineering

Fall 2019	**Probability and Statistics**	**BIM 105**
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Homework Assignment 4, Part 2
Due October 24, 2019

Always show your work. MATLAB Exercises must have printed or copy-and-paste code and output. Always use two-sided tests and intervals.

1. Polychlorinated biphenyls (PCBs) are a group of synthetic oil-like chemicals that were at one time widely used as insulation in electrical equipment and were discharged into rivers. They were discovered to be a health hazard and were banned in the 1970s. Since then, much effort has gone into monitoring PCB concentrations in waterways. Suppose that a random sample of 63 water samples drawn from waterway has a sample mean of 1.52 ppb and a sample standard deviation of 0.28 ppb.
   (a) Find a 90% confidence interval for the PCB concentration.
   (b) Estimate the sample size needed so that a 90% confidence interval will specify the population mean to within ± 0.02 ppb.
2. The following data are selected from the paper "Chondroitinase ABC Treatment Results in Greater Tensile Properties of Self-Assembled Tissue-Engineered Articular Cartilage," by Roman M. Natoli, Christopher M. Revell, and Kyriacos A. Athanasiou, *Tissue Engineering*, A15, 2009. These consist of tensile strength measurements in kPa for 6 self-assembled pieces of engineered cartilage. Find a 95% confidence interval for the true mean tensile strength of the conceptual population from which these are derived. The measurements are 160, 250, 232, 309, 263, 288. Do this by hand using Table A.3 and also using MATLAB.

3. In a process that manufactures tungsten-coated silicon wafers, the target resistance for a wafer is 85 mΩ. In a simple random sample of 55 wafers, the sample mean resistance was 84.7 mΩ, and the standard deviation was 0.5 mΩ. Let μ represent the mean resistance of the wafers manufactured by this process. A quality engineer tests $H_0 : \mu = 85$

   (a) Find the p-value (always two-sided).

   (b) Do you believe it is plausible that the mean is on target, or are you convinced that the mean is not on target? Explain your reasoning.

   (c) Is it possible to show that the mean is exactly on target? Explain.

4. The thicknesses of seven pads designed for use in aircraft engine mounts were measured. The results, in mm, were 40.93, 41.11, 41.37, 40.96, 40.85, 40.91, and 41.32. Use MATLAB to answer the following questions. Always use two-sided tests and intervals.

   (a) Find a 95% confidence interval for the true mean.

   (b) At that level of confidence, can you conclude that the mean thickness is greater than 41 mm? What is the p-value?

   (c) At that level of confidence, can you conclude that the mean thickness is less than 41.4 mm? What is the p-value?

5. During a recent drought, a water utility in a certain town sampled 100 residential water bills and found that 76 of the residences had reduced their water consumption over that of the previous year. Answer the following questions first by hand using either the traditional or the modern (Agresti-Coull) formulas, then (for part 5a) using MATLAB to obtain both the usual (Wald) interval and the (default) Clopper-Pearson interval.

   (a) Find a 95% confidence interval for the proportion of residences that reduced their water consumption.

   (b) Find the estimated sample size needed for a 95% confidence interval to specify the proportion to within ± 0.05.

6. Using the data and formulation of Problem 5, test the null hypothesis at the 5% level that 2/3 of the residents had reduced their water bill. Is this consistent with the Wald interval? With the Clopper-Pearson interval? Explain why the results might not be consistent.