PES University, Bangalore

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UE19CS203 – STATISTICS FOR DATA SCIENCE

Unit - 3 - Probability Distributions

QUESTION BANK

Confidence Intervals for Difference between Two Means

Exercises for Section 5.4

[Text Book Exercise – Section 5.4 – Q. No. [1 – 14] – Pg. No. [356-358]]

1. To study the effect of curing temperature on shear strength of a certain rubber compound, 80 specimens were cured at 150◦C and 95 were cured at 130◦C.The specimens cured at 150◦C had an average shear strength of 620 psi, with a standard deviation of 20 psi. Those cured at 130◦C had an average shear strength of 750 psi, with a standard deviation of 30 psi. Find a 95% confidence interval for the difference between the mean shear strengths of specimens cured at the two temperatures.

2. The article "Some Parameters of the Population Biology of Spotted Flounder (*Ciutharus linguatula* Linnaeus, 1758) in Edremit Bay (North Aegean Sea)" (D. T¨urker, B. Bayhan, et al., *Turkish Journal of Veterinary and Animal Science*, 2005:1013–1018) reports that a sample of 87 one-year-old spotted flounder had an average length of 126.31 mm with a standard deviation of 18.10 mm, and a sample of 132 two-year-old spotted flounder had an average length of 162.41 mm with a standard deviation of 28.49 mm. Find a 95% confidence interval for the mean length increase between one- and two-year-old fish.

3. The article "Inconsistent Health Perceptions for US Women and Men with Diabetes" (M. McCollum, L. Hansen, et al., *Journal of Women's Health*,2007:1421–1428) presents results of a survey of adults with diabetes. The average body mass index (BMI) in a sample of 1559 men was 30.4, with a standard deviation of 0.6. The average BMI in a sample of 1924 women was 31.1 with a standard deviation of 0.2. Find a 99% confidence interval for the difference in mean BMI between men and women with diabetes.

4. The article "Hatching Distribution of Eggs Varying in Weight and Breeder Age" (S. Viera, J. Almeida,et al., *Brazilian Journal of Poultry Science* 2005:(73–78) presents the results of a study in which the weights of 296 eggs from 27 week-old breeding hens averaged 54.1 g with a standard deviation of 4.4 g, and weights of 296 eggs from 59

week-old hens averaged 72.7 g with a standard deviation of 4.7 g. Find a 95% confidence interval for the difference between the mean weights.

5. The article "Automatic Filtering of Outliers in RR Intervals Before Analysis of Heart Rate Variability in Holter Recordings: a Comparison with Carefully Edited Data" (M. Karlsson, et al., *Biomedical Engineering Online*, 2012) reports measurements of the total power, on the log scale, of the heart rate variability, in the frequency range 0.003 to 0.4 Hz, for a group of 40 patients aged 25–49 years and for a group of 43 patients aged 50–75 years. The mean for the patients aged 25–49 years was 3.64 with a standard deviation of 0.23, and the mean for the patients aged 50–75 years was 3.40 with a standard deviation of 0.28. Find a 95% confidence interval for the difference in mean power between the two age groups.

6. A group of 78 people enrolled in a weight-loss program that involved adhering to a special diet and to a daily exercise program. After six months, their mean weight loss was 25 pounds, with a sample standard deviation of 9 pounds. A second group of 43 people went on the diet but didn't exercise. After six months, their mean weight loss was 14 pounds, with a sample standard deviation of 7 pounds. Find a95%confidence interval for the mean difference between the weight losses.

7. In experiments to determine the effectiveness of drugs such as anti-fungal ointments that are applied to the skin, the concentration of the drug in a patient's skin must be measured. The article "Determining Bioequivalence of Topical Dermatological Drug Products by Tape-Stripping" (W. Navidi, A. Hutchinson, et al.,*Journal of Pharmacokinetics and Pharmacodynamics*,2008:213–220) describes an improved method of measuring that is designed to ensure that all the drug in the skin is recovered. Assume that in an experiment using the old method, the mean amount of drug recovered from a sample of 49 patients was 105 ng with a standard deviation of 20 ng, and that in an experiment using the new method the mean amount of drug recovered in a sample of 35 patients was 117 ng with a standard deviation of 15 ng. Find a 98% confidence interval for the difference in the mean amounts recovered between the two methods.

8. A stress analysis was conducted on random samples of epoxy-bonded joints from two species of wood. A random sample of 120 joints from species A had a mean shear stress of 1250 psi and a standard deviation of 350 psi, and a random sample of 90 joints from species B had a mean shear stress of 1400 psi and a standard deviation of 250 psi. Find a 98% confidence interval for the difference in mean shear stress between the two species.

9. In a study to compare two different corrosion inhibitors, specimens of stainless steel were immersed for four hours in a solution containing sulfuric acid and a corrosion inhibitor.

Forty-seven specimens in the presence of inhibitor A had a mean weight loss of 242 mg and a standard deviation of 20 mg, and 42 specimens in the presence of inhibitor B had a mean weight loss of 220 mg and a standard deviation of 31 mg. Find a 95% confidence interval for the difference in mean weight loss between the two inhibitors.

10. An electrical engineer wishes to compare the mean lifetimes of two types of transistors in an application involving high-temperature performance. A sample of 60 transistors of type A were tested and were found to have a mean lifetime of 1827 hours and a standard deviation of 168 hours. A sample of 180 transistors of type B were tested and were found to have a mean lifetime of 1658 hours and a standard deviation of 225 hours. Find a 95% confidence interval for the difference between the mean lifetimes of the two types of transistors.

11. In a study of the effect of cooling rate on the hardness of welded joints, 50 welds cooled at a rate of 10◦C/s had an average Rockwell (B) hardness of 91.1 and a standard deviation of 6.23, and 40 welds cooled at a rate of 30◦C/s had an average hardness of 90.7 and a standard deviation of 4.34.

    a) Find a 95% confidence interval for the difference in hardness between welds cooled at the different rates.
    b) Someone says that the cooling rate has no effect on the hardness. Do these data contradict this claim? Explain.

12. Refer to Exercise 11. Ten more welds will be made in order to increase the precision of the confidence interval. Which would increase the precision the most, cooling all 10 welds at the rate of 10◦C/s, cooling all 10 welds at the rate of 30◦C/s, or cooling 5 welds at 10◦C/s and 5 at 30◦C/s? Explain.

13. The article “The Prevalence of Daytime Napping and Its Relationship to Nighttime Sleep” (J. Pilcher,K. Michalkowski, and R. Carrigan), *Behavioral Medicine*, 2001:71–76) presents results of a study of sleep habits in a large number of subjects. In a sample of 87 young adults, the average time per day spent in bed (either awake or asleep) was 7.70 hours, with a standard deviation of 1.02 hours, and the average time spent in bed asleep was 7.06 hours, with a standard deviation of 1.11 hours. The mean time spent in bed awake was estimated to be $7.70-7.06 = 0.64$ hours.Is it possible to compute a 95% confidence interval for the mean time spent in bed awake? If so, construct the confidence interval. If not possible, explain why not.

14. The article “Occurrence and Distribution of Ammonium in Iowa Groundwater” (K. Schilling, *Water Environment Research*, 2002:177–186) describes measurements of

ammonium concentrations (in mg/L) at a large number of wells in the state of Iowa. These included 349 alluvial wells and 143 quaternary wells. The concentrations at the alluvial wells averaged 0.27 with a standard deviation of 0.40, and those at the quaternary wells averaged 1.62 with a standard deviation of 1.70. Find a 95% confidence interval for the difference in mean concentrations between alluvial and quaternary wells.