Practice Assignment: ANOVA with Technology

Properly washed and sanitized hands are essential to stopping the spread of germs and diseases. A 2016 study[1] evaluated the antimicrobial efficacy of four different name brand hand sanitizers: Sterillium, PureHands, Lifebuoy, and Dettol. The researchers studied the antimicrobial efficacy for a number of different disease-causing bacteria.

1) Let's focus on comparing the antimicrobial efficacy for the bacteria *Escherichia coli*, commonly known as *E. coli.* The antimicrobial efficacy was measured in millimeters (mm) by the "zones of inhibition which indicated the degree of susceptibility or resistance of the test organism to the antibacterial agent." The higher the value of the resistance (in mm), the more effective the sanitizer, since it is preventing the spread of the bacteria.

   The following data were hypothetically generated based on the actual means and standard deviations from the original study.

Sterillium	PureHands	Lifebuoy	Dettol
15.67	8.7	9.95	7.48
16.79	8.41	10.16	7.82
15.69	8.37	10.15	9.56
15.67	8.21	9.96	8.16
14.99	6.66	10.51	7.71
14.87	6.94	8.52	9.12
16.07	7.48	8.23	7.68
14.18	6.7	11.09	8.61
15.38	6.93	8.89	7.71
16.3	8.56	8.06	8.5

   Part A: What is the factor of interest?

   Part B: How many levels or groups were compared?

   Part C: What is the response variable?

[1] Jain, V. M., Karibasappa, G. N., Dodamani, A. S., Prashanth, V. K., & Mali, G. V. (2016, October 14). Comparative assessment of antimicrobial efficacy of different hand sanitizers: An *in vitro* study. *Dental Research Journal*, *13*(5), 424–431. https://doi.org/10.4103/1735-3327.192283

Part D: Do the factor of interest and response variable allow for reasonable use of an ANOVA? Explain.

2) Go to the *DCMP ANOVA: Analysis of Variance* tool at https://lumen-learning.shinyapps.io/anova/. Enter the data provided in the table in Question 1.

Part A: Were the groups selected in a way that an ANOVA is appropriate? Explain.

Part B: Do the groups have similar levels of variability? Explain.

Part C: Do you think it is reasonable to use an ANOVA in this scenario? Explain.

3) Use an ANOVA to verify the answer to the research question: "Is there a difference in antimicrobial efficacy (as measured by the zones of inhibition) between the four different brands of sanitizer?"

Part A: Write the null and alternative hypotheses for this scenario. Write your answers in statistical notation and using the context of the problem.

Part B: Use the DCMP data analysis tool to conduct the ANOVA. Write the F-statistic and P-value.

Part C: Using an alpha = 0.05 significance level, how would you interpret your results? Explain.

Part D: Can you use your answer in Part A to answer the following question: Is there a brand of sanitizer with significantly better antimicrobial efficacy? Explain.

Questions 4–7: Use the *DCMP ANOVA: Analysis of Variance* tool to perform all pair-wise comparisons. Adjust for multiple comparisons using the Tukey method.

4) Compare Sterillium and PureHands.

Part A: What is the adjusted P-value for comparing the antimicrobial efficacy of Sterillium to PureHands?

 Provided by: The Charles A. Dana Center at The University of Texas at Austin. **Modified by:** Lumen Learning. **License:** CC-BY-SA 4.0.

Part B: What is the null hypothesis of the test comparing the antimicrobial efficacy of Sterillium to PureHands? Write your answer in statistical notation and in the context of the problem.

Part C: What is the adjusted confidence interval for the difference in the mean between Sterillium and PureHands?

Part D: Using your answers from Parts A through C, when comparing Sterillium to PureHands, which brand would you prefer? Explain.

5) Compare PureHands and Dettol.

Part A: What is the adjusted P-value for comparing the antimicrobial efficacy between PureHands and Dettol?

Part B: What is the null hypothesis of the test comparing the antimicrobial efficacy of PureHands to Dettol? Write your answer in statistical notation and in the context of the problem.

Part C: What is the adjusted confidence interval for the difference in the mean between PureHands and Dettol?

Part D: Using your answers from Parts A through C, when comparing PureHands to Dettol, which brand would you prefer? Explain.

6) Which brand would you prefer (for its antimicrobial efficacy): PureHands or Lifebuoy? Explain.

7) Overall, what brand would you recommend for its antimicrobial efficacy? Explain.

 Provided by: The Charles A. Dana Center at The University of Texas at Austin. **Modified by:** Lumen Learning. **License:** CC-BY-SA 4.0.