STA 4702 – Spring 2019 – Homework 2

Conduct all Tests at $\alpha = 0.05$ Significance Level

Part 1: Paired Differences for WNBA Regular Season Vegas Predictions and Game Outcomes

Oddsmakers set a point spread for the home team and Over/Under for total points for all games. This data includes all regular season games played over the 2010-2018 regular seasons. We are treating this as a random sample from a population of all games that could ever be played among these teams.

If the Home Team's spread is -3, then if it wins by 4 or more points it "covers," if it wins by 2 or fewer (including losing), it loses the bet, and if it wins by exactly 3 points it "pushes." Let:

W_1 = Home Team Spread, W_2 = Over/Under, W_3 = Home Team Points, W_4 = Opposing Team Points

Then: the predicted scores are: Home Team: $(W_2 - W_1) / 2$ and Opposing Team: $(W_2 + W_1) / 2$

Consider the p = 2 Differences: Home Spread: $D_3 = (W_3 - W_4) + W_1$ Over/Under: $D_4 = (W_3 + W_4) - W_2$

- Test the null hypothesis that the vector of population mean differences is $\boldsymbol{\delta} = [\ 0\ \ 0\ ]'$
- Obtain Simultaneous 95% Confidence Intervals for δ_3, δ_4 based on all simultaneous and Bonferroni's methods.
- Obtain a 95% Confidence Interval for sum of the two differences in the form: $\mathbf{a}'\boldsymbol{\delta}$

Part 2: Repeated Measures for Comparing Treatments

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Dataset:  mobile_3d_tasktime.dat

Source: C-Y. Hu, H-Y. Lin, L-C. Chen (2016). "The Effects of Screen Size
on Rotating 3D Contents Using Compound Gestures on a Mobile Device,"
Displays, Vol. 41, pp. 25-32

Description: 2-Factor ANOVA run in 30 subjects (each subject received
each treatment). Y=Time to Complete Reading Task
Factor A: Display Size (5", 7")
Factor B: Task (1=Easy, 2=Difficult, 3=Normal)
Authors did not remove Subject effects, blocks generated by a randomization
and data-based mechanism. Data simulated to match cell means, SDs, ANOVA.

Variables/Columns
Treatment    8
Display      16  /* 1=5", 2=7"  */
Task         24  /* 1=Easy, 2=Difficult, 3=Normal  */
Subject     31-32
Task Completion Time (seconds)   33-40
```

Note: In multivariate dataset: Trt11 = 5"/Easy, Trt12 = 5"/Difficult"…, Trt23 = 7"/Normal

- Test whether there are differences among the 6 Treatments (combinations of Display Size and Task) at $\alpha = 0.05$ significance level.
- Give simultaneous 95% Confidence Intervals for a) 5" versus 7" C_a' = [1 1 1 -1 -1 -1] and b) Difficult versus Easy C_b' = [-1 1 0 -1 1 0]

Part 3: Comparing Population Means for 2 Populations

Treating the NFL 2014 combine players as a random sample from a population of potential NFL future players:

- Conduct Hotelling's T^2 to test whether the population mean (Heights, Weights, Arm Lengths, and Hand Lengths) differ among Defensive Backs (Position = DB) and Wide Receivers (Position = WO).
- Obtain Simultaneous 95% Confidence Intervals for the population mean differences for each body dimension.
- Obtain Bonferroni 95% Confidence Intervals for the population mean differences for each body dimension.
- What linear combination of the body dimensions gives the largest population difference?

Part 4: MANOVA – Comparing 3 Treatments for 3 Response Variables

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Dataset:  meniscus.dat

Source: P. Borden, J. Nyland, D.N.M. Caborn, D. Pienkowski (2003).
"Biomechanical Comparison of the FasT-Fix Meniscal Repair Suture System
with Vertical Mattress Sutures and Meniscus Arrows," The American Journal
of Sports Medicine, Vol. 31, #3, pp. 374-378.

Description: Comparison of 3 Fixation Methods wrt 3 responses, with 6
replicates (knees) per method.
Methods:
1=Vertical Suture
2=Meniscus Arrow
3=FasT-Fix

Responses:
Load at failure (N)
Displacement (mm)
Stiffness  (N/mm)

Variables/Columns
Method     8
Load at Failure 10-16
Displacement    18-24
Stiffness      26-32
```

Test whether the 3 treatments (Vertical Suture, Meniscus Arrow and FasT-Fix) differ with respect to population mean outcomes (Load at Failure, Displacement, and Stiffness) at $\alpha = 0.05$ significance level. Conduct the test based on Wilks' Lambda. Do the test in matrix form, and using the **manova** function in R. Give the mean vectors and variance-covariance matrices by treatment, and the **B** and **W** matrices.

Part 5: Testing for Equality of Covariance Matrices

Based on the NFL Combine 2014 data in Part 3 (Defensive Backs and Wide Receivers), use Box's test to test whether the 2 population covariances matrices are equal.