

# STA 6167 – PROJECT 1

## DUE THURSDAY 9/19/19

### PART 1: EXPERIMENTS ON OYSTERS

A STUDY WAS CONDUCTED TO MEASURE THE EFFECTS OF SEVERAL FACTORS ON THE GROWTH OF OYSTER SHELLS THE VARIABLES UNDER STUDY ARE:

- RESPONSE: GROWTH (MM IN SHELL WIDTH)
- PREDICTOR 1: FOOD CONCENTRATION
- PREDICTOR 2: FLOW SPEED

THE AUTHORS FIT 2 MODELS:

#### COMPLETE MODEL:

$$E(\text{Width}) = \beta_0^* + \beta_1^*(\text{Food conc}) + \beta_2^*(\text{Flow}) + \beta_3^*(\text{Flow}^2) + \beta_4^*(\text{Conc x Flow})$$

<i>SOURCE</i>	<i>DF</i>	<i>SS</i>
REGRESSION	4	101.68
RESIDUAL	15	37.35
TOTAL	19	139.03

<i>PARAMETER</i>	<i>ESTIMATE</i>	<i>STANDARD ERROR</i>
INTERCEPT	0.96	N/A
FOOD CONC	2.52	0.785
FLOW	1.72	0.595
FLOW <sup>2</sup>	-0.10	0.064
CONC X FLOW	-0.19	0.204

#### REDUCED MODEL

$$E(\text{Width}) = \beta_0^{**} + \beta_1^{**}(\text{Food conc}) + \beta_2^{**}(\text{Flow})$$

<i>SOURCE</i>	<i>DF</i>	<i>SS</i>
REGRESSION	2	93.33
RESIDUAL	17	45.70
TOTAL	19	139.03

<i>PARAMETER</i>	<i>ESTIMATE</i>	<i>STANDARD ERROR</i>
INTERCEPT	2.41	N/A
FOOD CONC	1.98	0.549
FLOW	0.67	0.144

- FOR EACH MODEL, GIVE THE FITTED VALUE (PREDICTION) WHEN FOOD CONC=8 AND FLOW=2.5
- GIVE THE COEFFICIENT OF DETERMINATION FOR EACH MODEL
- FOR THE COMPLETE MODEL, TEST  $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
- FOR THE COMPLETE MODEL, TEST  $H_0: \beta_i = 0$  ( $i=1,2,3,4$ )
- FOR THE COMPLETE MODEL, TEST  $H_0: \beta_3 = \beta_4 = 0$

SOURCE: LENIHAN, H.S., C.H. PETERSON, J.M. ALLEN (1996). "DOES FLOW SPEED ALSO HAVE A DIRECT EFFECT ON GROWTH OF ACTIVE SUSPENSION-FEEDERS: AN EXPERIMENTAL TEST ON OYSTERS," *LIMNOLOGY AND OCEANOGRAPHY*, VOL.41,#6, PP. 1359-1366

## PART 2: BALLISTIC TESTS ON VARIOUS LAYERS OF CLOTH PANELS

A STUDY WAS CONDUCTED TO MEASURE THE EFFECT OF THE NUMBER OF LAYERS OF PANELS IN CLOTH FABRIC AND THE VELOCITY NEEDED FOR HALF OF A BALLISTIC DISCHARGE TO PENETRATE THE FABRIC, SEPARATELY FOR 3 TYPES OF BULLETS (ROUNDED, SHARP, FSP).

THE MODEL FIT IS:

$$E(V_{50}^2) = \beta_0 + \beta_1 \text{Layers} + \beta_2 \text{Sharp} + \beta_3 \text{FSP} + \beta_4 (\text{Layers} \times \text{Sharp}) + \beta_5 (\text{Layers} \times \text{FSP})$$

- GIVE THE FITTED EQUATION
- TEST WHETHER REGRESSIONS DIFFER AMONG BULLET TYPES ( $H_0: \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ )
- TEST WHETHER THE LAYERS EFFECT IS THE SAME FOR EACH BULLET TYPE ( $H_0: \beta_4 = \beta_5 = 0$ )
- OBTAIN THE INFLUENCE STATISTICS. DO ANY OBSERVATIONS APPEAR TO HAVE UNDUE INFLUENCE ON REGRESSION COEFFICIENTS (DFBETAS), OWN FITTED VALUES (DFFITS), OR APPEAR TO BE OUTLIERS (STUDENTIZED RESIDUALS). GIVE THE RULES FOR EXTREME CASES FOR EACH MEASURE

## Part 3: Stature, Hand Length, Foot Length, and Gender

Dataset: stature\_hand\_foot.csv

Source: S.G. Sani, E.D. Kizilkanat, N. Boyan, et al. (2005). "Stature Estimation Based on Hand Length and Foot Length," *Clinical Anatomy*, Vol. 18, pp. 589-596.

Description: Stature, hand length, and foot length among 80 males and 75 females.  
Data simulated to have equal means, SDs, and correlations.

Variables/Columns

ID (w/in gender) 7-8

gender 16 /\* 1=M, 2=F \*/

Stature (height, mm) 18-24

Hand length (mm) 26-32

Foot length (mm) 34-40

Fit a regression model, relating Stature to Hand Length, Foot Length and Female Indicator (Gender-1). Include interactions and quadratics in Hand and Foot Length.

- A. Select a parsimonious model based on minimizing AIC (this may be the Complete Model).
- B. Obtain a Plot of Residuals versus Fitted Values. Does the constant variance assumption seem reasonable?
- C. Obtain a Normal Probability Plot for the residuals. Does the Normality assumption appear to be reasonable?
- D. Conduct the Shapiro-Wilk Test for testing  $H_0$ : Errors are Normally Distributed.
- E. Conduct the Breusch-Pagan Test for testing  $H_0$ : Errors have Constant Variance

#### **Part 4: Water Evaporation in the Growing Season in India**

Dataset: h2o\_evap.dat

Source: A. Krishnan and R.S. Kushwaha (1973). "A Multiple Regression Analysis of Evaporation During the Growing Season of Vegetation in the Arid Zone of India," Agricultural Meteorology, Vol. 12, pp. 297-307

Description: Factors related to Evaporation (mm/day) for 49 5-day periods in 1963-1964. Predictors: total global radiation ( $X_1$ , cal/cm<sup>2</sup>/day), estimated net radiation ( $X_2$ , cal/cm<sup>2</sup>/day), saturation deficit at max temp ( $X_3$ , mm of Hg), mean daily wind speed ( $X_4$  km/hour) and saturation deficit at mean temp ( $X_5$ , mm of Hg). Models fit:  $Y=X_1, X_3, X_4$  and  $Y=X_2, X_3, X_4$

Variables/Columns

Period 7-8

Evaporation 10-16

total global radiation 18-24

net radiation 26-32

saturation deficit at max temp 34-40

wind speed 42-48

saturation deficit at mean temp 50-56

Fit the model relating Evaporation to Total global radiation, Saturation deficit at max temp, and wind speed.

- A. See whether a Box-Cox Transformation on Evaporation improves Normality
- B. If necessary, transform Evaporation, and re-fit the model.
- C. Conduct the Durbin-Watson Test, to test  $H_0$ : Errors are independent.
- D. Obtain Estimated Generalized Least Squares estimates of the Regression Coefficients, and t-tests.