

Lecture 30 Monday April 17

Announcements / Reminders

- Your homework score will be taken out of 145 points
- Everyone should do at least some of the last homework (HW04) which is posted, and is due Wednesday April 26 11:59 pm.

PLAN TODAY

Illustrate how to do Q#1 HW07 - fitting the two-way model w/ interaction, by the linear model approach

Ex. Castle Bakery
the dataset is in the following order for \tilde{Y}

$$\tilde{Y} =$$

$$\left[\begin{array}{l} Y_{111} \\ Y_{112} \\ Y_{121} \\ Y_{122} \\ Y_{211} \\ Y_{212} \\ Y_{221} \\ Y_{222} \\ Y_{311} \\ Y_{312} \\ Y_{321} \\ Y_{322} \end{array} \right]$$

Ex. Design matrix for Caste Bakery data, 2×2 covered factorial design w/ $n=8$

$$X = \begin{matrix} & A1 & A2 & B1 & A1B1 & A2B1 \\ \begin{matrix} \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \end{matrix} & \begin{matrix} 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 \end{matrix} & \begin{matrix} 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \end{matrix} \end{matrix}$$

effects vector =

$$\begin{pmatrix} \mu_{...} \\ \alpha_1 \\ \alpha_2 \\ \beta_1 \\ (\alpha\beta)_{11} \\ (\alpha\beta)_{21} \end{pmatrix}$$

Model Equation

$$E \tilde{Y} = X \tilde{\beta}$$

```
#####
### Lec3.r STA 4211 Script file with:
### I. Code to imitate for Hw07 Question 1
### II. Code for lecture notes pp. 162 - 185
###
### Q#1 requires use of the lm() function in R
### and setting up dummy variables for factor effects model.
### This process is illustrated here for the Castle Bakery dataset.
### Needs dataset CH19TA07.txt
###
#####
#### Castle Bakery data 3 x 2 balanced factorial design, w/ n=2
#####
### Read the dataset into R.
castle <- read.table("Datasets/CH19TA07.txt",
                    col.names=c("Y", "height", "width", "id"))
##
A1 <- rep(c(1,0,-1),c(4,4,4)); A1 # Height, Factor A, dummy var. 1
A2 <- rep(c(0,1,-1),c(4,4,4)); A2 # Height, Factor A, dummy var. 2
B1 <- rep(c(1,1,-1,-1),3); B1 # Width, Factor B, dummy var. 1 (and only)
A1B1 <- A1*B1 # Interaction, dummy 1, for cell (1,1)
A2B1 <- A2*B1 # interaction, dummy 2, for cell (2,1)
## The lm() function for regression automatically includes the intercept
fit.lm <- lm(Y ~ A1 + A2 + B1 + A1B1 + A2B1, data=castle)
summary(fit.lm)
##
##
```

* Since $lm()$ includes the intercept,
the design matrix automatically contains
the initial column of all 1's -
so don't create this column in R.

From $\text{lm}()$ in R we get our least-squares estimates to be:

$$\begin{pmatrix} \hat{\mu}_{\dots} \\ \hat{\alpha}_1 \\ \hat{\alpha}_2 \\ \hat{\beta}_1 \\ (\hat{\alpha}\hat{\beta})_{11} \\ (\hat{\alpha}\hat{\beta})_{21} \end{pmatrix} = \begin{pmatrix} 51.0 \\ -7.0 \\ 16.0 \\ -1.0 \\ 2.0 \\ -1.0 \end{pmatrix}$$

Coef column in summary (fit) output