

Homework 7

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Section 11.2

Problem 16

Factor A - Curing time ($I = 3$)

Factor B - Type of Mix ($J = 4$)

3 Observations for each, 36 total sample size.

$$SSA = 30763.0$$

$$SSB = 34185.6$$

$$SSE = 97436.8$$

$$SST = 205966.6$$

```
# Sums of Squares ---  
ssa <- 30763  
ssb <- 34185.6  
sse <- 97436.8  
sst <- 205966.6  
ssab <- sst - (ssa + ssb + sse)  
sums <- c(ssa,ssb,sse,ssab,sst)  
  
# Categories and samples ---  
i <- 3  
j <- 4  
k <- 3  
  
# Degrees of freedom ---  
dfa <- i-1
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dfb <- j-1
dfe <- i*j*(k-1)
dfab <- (i-1)*(j-1)
dft <- (i*j*k)-1
dfs <- c(dfa, dfb, dfe, dfab, dft)

# Mean Square Ratios ---
mean_square_names <- c("MSA", "MSB", "MSE", "MSAB")
mean_squares <- round(sums[1:4] / dfs[1:4], 3)

# Test Statistics ---
test_stats <- (mean_squares[c(1,2,4)] / mean_squares[3]) |> round(3)
test_names <- c("fa", "fb", "fab")

# p-values ---
p_val <- pf(q = test_stats[1:3], df1 = dfs[c(1,2,4)], df2 = dfs[3], lower.tail = F)

p_val_names <- c("a", "b", "ab")

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MSA = 15381.5
MSB = 11395.2
MSE = 4059.867
MSAB = 7263.533

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fa = 3.789
fb = 2.807
fab = 1.789

```

```

P-Value a: 0.037
P-Value b: 0.061
P-Value ab: 0.144

```

	DF	SS	MS	<i>f</i>	<i>p</i>
Curing Time	2	30763	15381.5	3.789	0.037
Type of Mix	3	34185.6	11395.2	2.807	0.061
Interaction	6	43581.2	7263.533	1.789	0.144
Error	24	97436.6	4059.867		
Total	35	205966.6			

Utilizing all of the information collected above to generate the ANOVA table, we can draw the following conclusions:

$$H_{0AB} : \text{no interaction of factors}$$

There is not statistically significant evidence to reject the null hypothesis, H_{0AB} , that there is no interaction effect between curing time and type of mix at the 0.05 significance level.

$$H_{0A} : \text{Factor A main effects are absent}$$

There is statistically significant evidence at the 0.05 level to reject the null hypothesis that factor A, curing time, has no effect on the compression strength of hardened cement cubes. It is reasonable to suggest that curing time has a positive impact on compression strength.

$$H_{0B} : \text{Factor B main effects are absent}$$

There is not statistically significant evidence at the 0.05 level to reject the null hypothesis that type of mix has no effect on the compression strength of hardened cement cubes.

Problem 17

check digital handout

Problem 18

skip part b check digital handout

Problem 20

check digital handout

Section 11.3

Problem 1

given on digital handout

Problem 27

skip part d

Problem 29**Problem 31**

check digital handout