

Exam 2 - Problem 7.10

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Ch 7 Problem 10 - Commercial Properties Data. Test if $\beta_1 = -0.1$ and $\beta_2 = 0.4$ Use alpha = 0.01.

```
fullRegressionAnova <- function(lm_anova){
  VariationSource <- c("Regression", rownames(lm_anova), "Total")
  SSR <- sum(lm_anova$"Sum Sq"[1:(length(lm_anova$"Sum Sq")-1)])
  SST <- sum(lm_anova$"Sum Sq")
  DFReg <- sum(lm_anova$"Df"[1:(length(lm_anova$"Df")-1)])
  MSE <- lm_anova$"Mean Sq"[length(lm_anova$"Mean Sq")]
  MSR <- SSR / DFReg

  SS <- c(SSR,lm_anova$"Sum Sq",SST)
  MS <- c(MSR, lm_anova$"Mean Sq", NA)
  DF <- c(DFReg, lm_anova$"Df", sum(lm_anova$"Df"))
  F_stat <- MSR / MSE
  F_stats <-c(F_stat, lm_anova$"F value",NA)
  df_out <- data.frame(VariationSource, DF,SS, MS, F_stats)
  print(df_out)
  return(df_out)
}

df <- read.csv("data/6.18.csv")

full <- lm(Rental ~ Age + Expense + Vacancy + Footage, data = df)
full_aov <- fullRegressionAnova(anova(full))
```

##	VariationSource	DF	SS	MS	F_stats
## 1	Regression	4	138.326906	34.581727	26.755526
## 2	Age	1	14.818520	14.818520	11.464936
## 3	Expense	1	72.802011	72.802011	56.326167
## 4	Vacancy	1	8.381417	8.381417	6.484616
## 5	Footage	1	42.324958	42.324958	32.746385
## 6	Residuals	76	98.230594	1.292508	NA
## 7	Total	80	236.557500	NA	NA

```
df$Yc <- df$Rental + (0.1 * df$Age) - (0.4 * df$Expense)
reduced <- lm(Yc ~ Vacancy + Footage, data = df)
reduced_aov <- fullRegressionAnova(anova(reduced))
```

##	VariationSource	DF	SS	MS	F_stats
## 1	Regression	2	41.077196	20.538598	14.545034
## 2	Vacancy	1	9.204914	9.204914	6.518741
## 3	Footage	1	31.872281	31.872281	22.571327
## 4	Residuals	78	110.141416	1.412069	NA
## 5	Total	80	151.218612	NA	NA

```

SSE_full <- full_aov[6, 3]
degFreedom_full <- full_aov[6,2]
SSE_red <- reduced_aov[4,3]
degFreedom_red <- reduced_aov[4,2]

num <- (SSE_red - SSE_full) / 2
den <- SSE_full / degFreedom_full

F_stat <- num / den
F_crit <- qf(0.99, 2, degFreedom_full)

msg <- paste("F* = ", F_stat, "\n", "F crit = ", F_crit, sep="")
cat(msg)

```

```

## F* = 4.60764021727857
## F crit = 4.89583988401818

```

$\beta_1 = \text{Age}$

$\beta_2 = \text{Expense}$

$\beta_3 = \text{Vacancy}$

$\beta_4 = \text{Footage}$

Full Model: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$

Reduced Model: $Y + 0.1X_1 - 0.4X_2 = \beta_0 + \beta_3 X_3 + \epsilon$

$H_o : \beta_1 = -0.1, \beta_2 = 0.4$

$H_a : \text{not both equalities hold}$

If $F^* \leq F_{crit}$ conclude H_o

Answer: Conclude H_o .