Practicum 3

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2. Replicating Nerlove's Classic Results on Scale Economies

A.

The purpose of this assignment is to replicate some of the principles of returns-to-scale reported by Nerlove in his 1955 article. His estimated equation was as follows:

$lnC^* = \beta_o + \beta_y ln(y) + \beta_1 lnp_1^* + \beta_2 lnp_2^*$

For part A I will generate the variables necesary for estimating his parameters. includes $lnCP3 = ln(COSTS/PF), lnP13 = ln(PL/PF), lnP23 = ln(PK/PF), lnKWH = ln(KWH)$

I will do this using the mutate function in Tidyverse.

```r
# Load packages and data from the NERLOV file
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.1     v tibble    3.2.1
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.0.2
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becom
```

```r
library(readxl)

nerlov <- read_excel("/Users/kieran/Documents/MASTERS/METRICS/code/metrics/practicum_3_files/

# Clean data and generate new variables per assignment request

clean <- nerlov |>
    mutate(
        LNCP3 = log(COSTS/PF),
        LNP13 = log(PL/PF),
        LNP23 = log(PK/PF),
        LNKWH = log(KWH)
        )

# Preview order of LNKWH

print(clean$LNKWH)
```

```
  [1] 0.6931472 1.0986123 1.3862944 1.3862944 1.6094379 2.1972246 2.3978953
  [8] 2.5649494 2.5649494 3.0910425 3.2188758 3.2188758 3.5553481 3.6635616
 [15] 3.7612001 4.1431347 4.2195077 4.3944492 4.4308168 4.2904594 4.5951199
 [22] 4.6151205 4.7791235 4.7874917 4.8040210 4.8675345 4.9272537 5.0039463
 [29] 5.2781147 5.2832037 5.3423343 5.3659760 5.3936275 5.4553211 5.4595855
 [36] 5.5333895 5.6312118 5.6698809 5.6698809 5.6869754 5.7004436 5.7807435
 [43] 5.8081425 5.8230459 5.8664681 5.8664681 6.0306853 6.0402547 6.1224928
 [50] 6.1820849 6.2461068 6.3099183 6.3332796 6.3385941 6.3835066 6.5087691
 [57] 6.5453497 6.5778614 6.6093492 6.6783421 6.6846117 6.6945621 6.6982681
 [64] 6.7511015 6.7569324 6.8123451 6.8167359 6.8287121 6.8916259 6.8987145
 [71] 6.9077553 7.0012456 7.0112140 7.0192967 7.0228681 7.0361485 7.0527210
 [78] 7.0613344 7.0647590 7.1024994 7.1538338 7.1631724 7.1623975 7.1936858
 [85] 7.2247534 7.2584122 7.2957351 7.3112184 7.3427792 7.4079243 7.4193806
 [92] 7.4854916 7.5126175 7.5137092 7.5164333 7.4882935 7.5590383 7.5652753
 [99] 7.6148054 7.6290039 7.6420444 7.7079615 7.7424020 7.7583335 7.7634464
[106] 7.7693786 7.8042514 7.8066964 7.8268421 7.8359746 7.8539931 7.8659554
[113] 7.9620673 8.0040315 8.0715309 8.0974263 8.1053075 8.1599467 8.1713169
[120] 8.2411762 8.2534880 8.2975435 8.3468793 8.3675324 8.4104985 8.4688429
[127] 8.5711130 8.5722494 8.6425916 8.6448826 8.6688837 8.6995147 8.7191540
[134] 8.7219283 8.8808636 8.9728443 9.0382463 9.0643893 9.0810286 9.1573614
[141] 9.2059307 9.3481003 9.3755158 9.5721322 9.7243011
```

```
# The observations are by size of output, looks good!
```

B.

Now that I have all of the data in line, I will estimate the following model:

$lnC^* = \beta_o + \beta_y ln(y) + \beta_1 lnp_1^* + \beta_2 lnp_2^*$

```
model1 <- lm(data = clean, LNCP3~LNKWH+LNP13+LNP23)
summary(model1)
```

```
Call:
lm(formula = LNCP3 ~ LNKWH + LNP13 + LNP23, data = clean)

Residuals:
     Min       1Q   Median       3Q      Max
-1.01200 -0.21759 -0.00752  0.16048  1.81922

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -4.690789   0.884871  -5.301 4.34e-07 ***
LNKWH        0.720688   0.017436  41.334  < 2e-16 ***
LNP13        0.592910   0.204572   2.898  0.00435 **
LNP23       -0.007381   0.190736  -0.039  0.96919
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3918 on 141 degrees of freedom
Multiple R-squared:  0.9316,    Adjusted R-squared:  0.9301
F-statistic:   640 on 3 and 141 DF,  p-value: < 2.2e-16
```