Assignment ON5

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Due at 3:55 PM on Monday 30 March 2020

Instructions

You must attempt all questions. All answers must be submitted on ICE. The *ONLY* submission format accepted is an RMD file.

Data

Family caregiving of older adults is common in South Korea. Son et al. [1] studied 100 caregivers of older adults with dementia in Seoul, South Korea. The dependent variable was caregiver burden as measured by the Korean Burden Inventory (`KBI`). Scores ranged from 28 to 140, with higher scores indicating higher burden. Explanatory variables were indexes that measured the following:

- `ADL`: total activities of daily living (low scores indicate that the elderly perform activities independently).
- `MEM`: memory and behavioral problems (higher scores indicate more problems).
- `COG`: cognitive impairment (lower scores indicate a greater degree of cognitive impairment).

```
SON <- data.frame(ID <- c(1:100),
                  KBI <- c(28, 68, 59, 91, 70, 38, 46, 57, 89, 48,
                           74, 78, 43, 76, 72, 61, 63, 77, 85, 31,
                           79, 92, 76, 91, 78, 103, 99, 73, 88, 64,
                           52, 71, 41, 85, 52, 68, 57, 84, 91, 83,
                           73, 57, 69, 81, 71, 91, 48, 94, 57, 49,
                           88, 54, 73, 87, 47, 60, 65, 57, 85, 28,
                           40, 87, 80, 49, 57, 32, 52, 42, 49, 63,
                           89, 67, 43, 47, 70, 99, 53, 78, 112, 52,
                           68, 63, 49, 42, 56, 46, 72, 95, 57, 88,
                           81, 104, 88, 115, 66, 92, 97, 69, 112, 88),
                  ADL <- c(39, 52, 89, 57, 28, 34, 42, 52, 88, 90,
                           38, 83, 30, 45, 47, 90, 63, 34, 76, 26,
                           68, 85, 22, 82, 80, 80, 81, 30, 27, 72,
                           46, 63, 45, 77, 42, 60, 33, 49, 89, 72,
                           45, 73, 58, 33, 34, 90, 48, 47, 32, 63,
                           76, 79, 48, 90, 55, 83, 50, 44, 79, 24,
                           40, 35, 55, 45, 46, 37, 47, 28, 61, 35,
                           68, 80, 43, 53, 60, 63, 28, 35, 37, 82,
                           88, 52, 30, 69, 52, 59, 53, 65, 90, 88,
                           66, 60, 48, 82, 88, 63, 79, 71, 66, 81),
                  MEM <- c(4, 33, 17, 31, 35, 3, 16, 6, 41, 24,
                           22, 41, 9, 33, 36, 17, 14, 35, 33, 13,
                           34, 28, 12, 57, 51, 20, 20, 7, 27, 9,
                           15, 52, 26, 57, 10, 34, 14, 30, 64, 31,
                           24, 13, 16, 17, 13, 42, 7, 17, 13, 32,
```

```
                          50, 44, 57, 33, 11, 24, 21, 31, 30, 5,
                          20, 15, 9, 28, 19, 4, 29, 23, 8, 31,
                          65, 29, 8, 14, 30, 22, 9, 18, 33, 25,
                          16, 15, 16, 49, 17, 38, 22, 56, 12, 42,
                          12, 21, 14, 41, 24, 49, 34, 38, 48, 66),
                  COG <- c(18, 9, 3, 7, 19, 25, 17, 26, 13, 3,
                          13, 11, 24, 14, 18, 0, 16, 22, 23, 18,
                          26, 10, 16, 3, 3, 18, 1, 17, 27, 0,
                          22, 13, 18, 0, 19, 11, 14, 15, 0, 3,
                          19, 3, 15, 21, 18, 6, 23, 18, 15, 15,
                          5, 11, 9, 6, 20, 11, 25, 18, 20, 22,
                          17, 27, 21, 17, 17, 21, 3, 21, 7, 26,
                          6, 10, 13, 18, 16, 18, 27, 14, 17, 13,
                          0, 0, 18, 12, 20, 17, 21, 2, 0, 6,
                          23, 7, 13, 13, 14, 5, 3, 17, 13, 1))
str(SON)
```

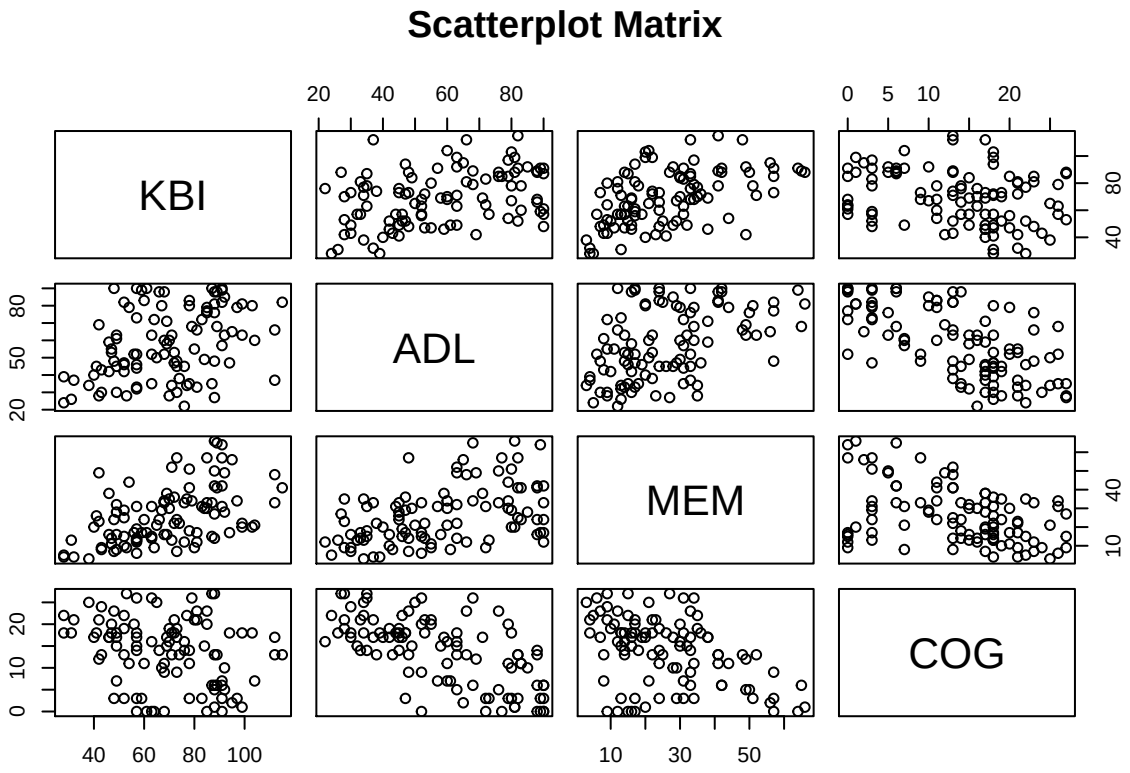
```
## 'data.frame':    100 obs. of  5 variables:
##  $ ID....c.1.100.                                          : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ KBI....c.28..68..59..91..70..38..46..57..89..48..74..78..43..: num  28 68 59 91 70 38 46 57 89 48
##  $ ADL....c.39..52..89..57..28..34..42..52..88..90..38..83..30..: num  39 52 89 57 28 34 42 52 88 90
##  $ MEM....c.4..33..17..31..35..3..16..6..41..24..22..41..9..33..: num  4 33 17 31 35 3 16 6 41 24 ..
##  $ COG....c.18..9..3..7..19..25..17..26..13..3..13..11..24..14..: num  18 9 3 7 19 25 17 26 13 3 ...
```

```
head(SON)
```

```
##   ID....c.1.100. KBI....c.28..68..59..91..70..38..46..57..89..48..74..78..43..
## 1              1                                                             28
## 2              2                                                             68
## 3              3                                                             59
## 4              4                                                             91
## 5              5                                                             70
## 6              6                                                             38
##   ADL....c.39..52..89..57..28..34..42..52..88..90..38..83..30..
## 1                                                            39
## 2                                                            52
## 3                                                            89
## 4                                                            57
## 5                                                            28
## 6                                                            34
##   MEM....c.4..33..17..31..35..3..16..6..41..24..22..41..9..33..
## 1                                                             4
## 2                                                            33
## 3                                                            17
## 4                                                            31
## 5                                                            35
## 6                                                             3
##   COG....c.18..9..3..7..19..25..17..26..13..3..13..11..24..14..
## 1                                                            18
## 2                                                             9
## 3                                                             3
## 4                                                             7
## 5                                                            19
## 6                                                            25
```

1. (10 marks) Construct a properly-formatted scatterplot matrix of the data.

```
pairs(~KBI + ADL + MEM + COG, data = SON,
      main = "Scatterplot Matrix")
```



2. (5 marks) Provide an evaluation of the relationships between pairs of variables in (1) above.

Visual inspection seems to suggest positive relationships between KBI and MEM, and ADL and MEM. There seems to be negative relationships between ADL and COG, and MEM and COG.

3. (10 marks) Find the multiple regression equation describing the relationship among these variables.

```
SON.LM <- lm(KBI ~ ADL + MEM + COG, data = SON)
summary(SON.LM)
```

```
##
## Call:
## lm(formula = KBI ~ ADL + MEM + COG, data = SON)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -42.037 -10.535  -1.503   9.213  43.151
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  40.4908    10.1030   4.008 0.000121 ***
## ADL           0.2162     0.1168   1.851 0.067273 .
## MEM           0.5547     0.1300   4.267 4.65e-05 ***
## COG           0.1210     0.3003   0.403 0.687978
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 17.26 on 96 degrees of freedom
## Multiple R-squared:  0.282,  Adjusted R-squared:  0.2596
## F-statistic: 12.57 on 3 and 96 DF,  p-value: 5.315e-07
```

The equation is $KBI = 40.5 + 0.2ADL + 0.6MEM + 0.1COG$

4. (40 marks) Interpret the intercept and each of the slope estimates.

- The average KBI score is 40.5 when ADL, MEM and COG are all zereo.
- For every unit increase in the ADL score, KBI will increase by 0.2 points after adjusting for MEM and COG
- As the MEM score increases by one point, KBI will increase by 0.6 points holding ADL and COG constant
- An increase in the COG score of one point will increase the KBI score by 0.1 points controlling for ADL and MEM

5. (20 marks) Test the null hypotheses that the intercept and slope estimates are zero at $\alpha = 0.03$.

The null hypothesis is rejected for the intercept and the slope estimate of MEM. The null hypothesis cannot be rejected for the slipe estimates of ADL and COG.

6. (20 marks) Construct 97% confidence intervals for the intercept and slope estimates.

```
confint(SON.LM, level = 0.97)
```

```
##                    1.5 %     98.5 %
## (Intercept) 18.23563084 62.7459565
## ADL         -0.04111709  0.4734715
## MEM          0.26831265  0.8409940
## COG         -0.54052559  0.7824503
```

The 97% confidence intervals for the intercept and slope estimates are given in table.

Table. Model estimates.

Parameter	Point Estimate	97% Confidence Interval
Intercept	40.5	(18.2, 62.7)
ADL	0.2	(-0.0, 0.5)
MEM	0.6	(0.3, 0.8)
COG	0.1	(-0.5, 0.8)

7. (10 marks) Consider two new caregivers. Construct values for each of these caregivers' independent variables. Then produce 97% confidence and prediction intervals of the dependent variable.

I will only use one caregiver as an example here. (I still need to see that you did this for two examples.)

In my example, my caregiver has the mean values of ADL, MEM and COG.

```
SON.NEW <- data.frame(ADL = mean(SON$ADL), MEM = mean(SON$MEM), COG = mean(SON$COG))
predict(SON.LM, SON.NEW, interval = "confidence", level = 0.97)
```

```
##     fit      lwr      upr
## 1 69.24 65.43817 73.04183
```

```
predict(SON.LM, SON.NEW, interval = "prediction", level = 0.97)
```

```
##     fit      lwr      upr
## 1 69.24 31.03208 107.4479
```

The 97% confidence and 97% prediction intervals are, respectively, (65.4, 73.0) and (31.0, 107,4).

THE END