Zad.13

Fragment 1

```
> edu.m1 <- lm(ACHV~.,data=edu)
> summary(edu.m1)

Call:
lm(formula = ACHV ~ ., data = edu)

Residuals:
    Min      1Q  Median      3Q     Max
-5.2096 -1.3934 -0.2947  1.1415  4.5881

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.06996    0.25064  -0.279    0.781
FAM          1.10126    1.41056   0.781    0.438
PEER         2.32206    1.48129   1.568    0.122
SCHOOL      -2.28100    2.22045  -1.027    0.308

Residual standard error: 2.07 on 66 degrees of freedom
Multiple R-squared:  0.2063,        Adjusted R-squared:  0.1702
F-statistic: 5.717 on 3 and 66 DF,  p-value: 0.001535
```

Fragment 2

```
> sm1 <- summary(edu.m1)
> (sm1$sigma/sd(edu$ACHV))

[1] 0.910945
```

Fragment 3

```
> cor(edu)

            ACHV       FAM      PEER    SCHOOL
ACHV   1.0000000 0.4194588 0.4398464 0.4181006
FAM    0.4194588 1.0000000 0.9600806 0.9856837
PEER   0.4398464 0.9600806 1.0000000 0.9821601
SCHOOL 0.4181006 0.9856837 0.9821601 1.0000000
```

Fragment 4

```
> edu.m3 <- lm(ACHV~SCHOOL,data=edu)
> summary(edu.m3)

Call:
lm(formula = ACHV ~ SCHOOL, data = edu)
```

```
Residuals:
    Min      1Q  Median      3Q     Max
-4.9974 -1.4189 -0.1604  1.3130  5.3206

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.01043    0.24868  -0.042 0.966670
SCHOOL       0.92834    0.24460   3.795 0.000316 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.08 on 68 degrees of freedom
Multiple R-squared:  0.1748,        Adjusted R-squared:  0.1627
F-statistic: 14.41 on 1 and 68 DF,  p-value: 0.0003163
```

Fragment 5

```
> anova(edu.m1,edu.m3)

Analysis of Variance Table

Model 1: ACHV ~ FAM + PEER + SCHOOL
Model 2: ACHV ~ SCHOOL
  Res.Df    RSS Df Sum of Sq      F Pr(>F)
1     66 282.87
2     68 294.08 -2   -11.208 1.3076 0.2774
```

Fragment 6

```
> set.seed(160418)
> f <-numeric(10000)
> for (i in 1:10000){
+   g <- lm(sample(ACHV)~SCHOOL,data=edu)
+   f[i] <- summary(g)$fstatistic[1]
+ }
> sum(f>14.41)/10000

[1] 7e-04

> quantile(f,probs = c(0.95,0.99,0.999))

      95%       99%     99.9%
 3.975150  6.935677 12.091552
```

Fragment 7

```
> apply(edu[,2:4],MARGIN = 2,mean)
```

```
       FAM       PEER     SCHOOL
0.04938329 0.04631414 0.03190643

> (schQ <- quantile(edu$SCHOOL,probs = (1:4)*0.2))

      20%       40%       60%       80%
-0.824370 -0.215810  0.330906  0.877778

> (x0 <- data.frame(FAM=rep(x =0.04938329,4),PEER=rep(x =0.04631414,4),
+                   SCHOOL=schQ))

           FAM       PEER    SCHOOL
20% 0.04938329 0.04631414 -0.824370
40% 0.04938329 0.04631414 -0.215810
60% 0.04938329 0.04631414  0.330906
80% 0.04938329 0.04631414  0.877778

> predict(edu.m1,x0)

       20%        40%        60%        80%
 1.9723528  0.5842304 -0.6628261 -1.9102385
```

Fragment 8

```
> predict(edu.m3,data.frame(SCHOOL=schQ))

       20%        40%        60%        80%
-0.7757277 -0.2107754  0.2967646  0.8044493
```

Fragment 9

```
> x <- cbind(1,edu[,2:4])
> x <- as.matrix(x)
> xtxi <- solve(t(x) %*% x)
> x0g <- as.matrix(cbind(1,x0))
> (srodek <-predict(edu.m1,x0)[3])

       60%
-0.6628261

> (prd1<- sqrt(x0g[3,] %*% xtxi %*% x0g[3,]) *qt(0.975,66) * 2.07)

         [,1]
[1,] 1.414442

> c(srodek-prd1,srodek+prd1)

[1] -2.0772684  0.7516162
```

```
> x <- cbind(1,edu[,4])
> x <- as.matrix(x)
> xtxi <- solve(t(x) %*% x)
> x0g <- as.matrix(cbind(1,schQ))
> (srodek <-predict(edu.m3,data.frame(SCHOOL=schQ))[3])

      60%
0.2967646

> (prd1<- sqrt(x0g[3,] %*% xtxi %*% x0g[3,]) *qt(0.975,68) * 2.08)

          [,1]
[1,] 0.5171169

> c(srodek-prd1,srodek+prd1)

[1] -0.2203523  0.8138814
```