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STAT2008/STAT6038

More on MR Residual Diagnostics

Body Fat Data

2

A study of the relationship of body fat to several physical measurements was conducted on a sample of 20 healthy women aged 25-34 years. The predictor measurements were the triceps, skinfold, the thigh circumference and the midarm circumference.

If we perform a multiple linear regression of body fat on the three predictors, the associated internally and externally Studentized residuals are:

Body Fat Data

3

```
> bft.df <- read.csv("bft.csv")
> attach(bft.df)
> names(bft.df)
[1] "Triceps" "Thigh"   "Midarm"
"BodyFat"
> bft.reg <-
lsfit(cbind(Triceps,Thigh,Midarm),BodyFa
t)
> bft.sum <- ls.diag(bft.reg)
> ri <- bft.sum$std.res
> ti <- bft.sum$stud.res
> cbind(ri,ti)
```

```
               ri          ti
 [1,] -1.46802633 -1.52803951
 [2,]  1.13326956  1.14416429
 [3,] -1.23262045 -1.25452990
 [4,] -1.29571232 -1.32606735
 [5,]  0.57630252  0.56388572
 [6,] -0.23525791 -0.22818249
 [7,]  0.62249950  0.61016668
 [8,]  1.38022830  1.42385079
 [9,]  0.76529502  0.75493974
[10,] -0.57761774 -0.56519997
[11,]  0.34965240  0.33985038
[12,]  0.94324119  0.93979234
[13,] -1.50477923 -1.57251203
[14,]  1.84715613  2.01637183
[15,]  0.49352568  0.48153342
[16,]  0.07392664  0.07159138
[17,] -0.16107977 -0.15609143
[18,] -0.63614383 -0.62388391
[19,] -1.61308352 -1.70680191
[20,]  0.25538013  0.24777625
```

Diagnostics

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None of these (internally or externally) studentised residuals seem excessively large.

Suppose we wish to test whether the data point with the largest standardised residual is a mean-shift residual.

We could compare the t_i or r_i value for the 14th observation with

```
> bodyfat.lm$df
[1] 16
> qt(0.975, bodyfat.lm$df)
[1] 2.119905
```

Bonferroni correction

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If we look at all nt_i values, we are implicitly performing n hypothesis tests.

We need to adjust α thresholds with Bonferroni

An adjustment made to P values when several dependent or independent statistical tests are being performed simultaneously on a single data set.

Divide α by the number of comparisons being made.

Bonferroni

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Suppose a researcher is testing 20 hypotheses simultaneously, with a critical P value of 0.05. In this case, the following would be true:

P (at least one significant result) = $1 - P(nosignificantresults)$
P (at least one significant result) = $1 - (1 - 0.05)^{20}$
P (at least one significant result) = 0.64

So performing 20 tests on a data set yields a 64 percent chance of identifying at least one significant result, even if all of the tests are actually not significant.

If you want an overall significance level α and you perform n individual tests, simply divide α by n to obtain the significance level required for the individual tests.

Suppose alpha = 0.05, with 20 tests

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```
> qt(1-0.05/(2*20)), bodyfat.lm$df)
[1] 3.580522
```

Which is far larger than any of the studentised residual values