

Statistics 305/605: Introduction to Biostatistical Methods for Health Sciences

R Demo for Chapter 18, part 3: Prediction intervals, r^2 and
Residual Plots

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Load the data, fit the regression model, get CIs

- We'll continue working with the data on low-birthweight babies.

```
uu <- url("http://people.stat.sfu.ca/~jgraham/Teaching/S305_17/Data/lbwt.csv")
lbwt <- read.csv(uu) #load the data
lfit <- lm(headcirc ~ gestage, data=lbwt) #fit the regression model
lCI <- predict(lfit, interval="confidence") #get the 95% CI
#Now make a dataframe of the results
lbwtCIs<-data.frame(gestage=lbwt$gestage, lCI )
head(lbwtCIs)
```

##	gestage	fit	lwr	upr
## 1	29	26.53581	26.21989	26.85172
## 2	31	28.09591	27.68437	28.50745
## 3	33	29.65602	29.05247	30.25956
## 4	31	28.09591	27.68437	28.50745
## 5	30	27.31586	26.97102	27.66070
## 6	25	23.41559	22.83534	23.99584

- Next, we'll compare these CIs to *prediction intervals*

95% PIs for example data

```
lPI <- predict(lfit,interval="prediction")
lbwtPIs <- data.frame(gestage=lbwt$gestage, lPI)
head(lbwtPIs,n=3)
```

##	gestage	fit	lwr	upr
## 1	29	26.53581	23.36391	29.70770
## 2	31	28.09591	24.91307	31.27875
## 3	33	29.65602	26.44271	32.86933

- Predicted values \hat{y} and lower and upper limits of PI are in the columns fit, lwr and upr, respectively.

PIs are wider than CIs

- ▶ E.G. Compare for gestational age 29 weeks:

```
lbwtCIs[1,] #95% CI for gestational age 29 weeks
```

```
##      gestage      fit      lwr      upr  
## 1          29 26.53581 26.21989 26.85172
```

```
lbwtPIs[1,] #95% PI for gestational age 29 weeks
```

```
##      gestage      fit      lwr      upr  
## 1          29 26.53581 23.36391 29.7077
```

- ▶ The CI **estimates a parameter**, namely the population-mean head circumference of a baby of gestational age 29 weeks.
 - ▶ The CI is an interval *estimate* of a *parameter*.
- ▶ The PI **predicts a future random value**, namely the head circumference of a new baby of gestational age 29 weeks.
 - ▶ The PI is an interval *prediction* of a future *random value*.

r^2 in simple linear regression

- For the regression of head circumference on gestational age, we can get r^2 , the coefficient of determination as follows:

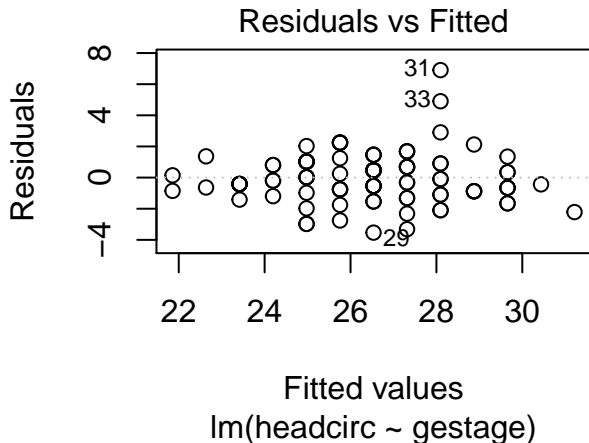
```
with(summary(lfit), r.squared)
```

```
## [1] 0.6094799
```

Plots of residuals vs. fitted values

- In the low-birthweight babies data, the regression of head circumference on gestational age gives:

```
plot(lfit,which=1, add.smooth=FALSE)
```



- ▶ R's `plot()` function will plot the regression-modelling output in `lfit`.
- ▶ Recall that we got `lfit` by applying the `lm()` function to the dataframe `lbwt` in `lfit <- lm(headcirc ~ gestage,data=lbwt)`
- ▶ For regression-model objects such as `lfit` the `plot()` function has 6 different diagnostic plots, specified by the `which` argument.
 - ▶ The first (`which=1`) is the plot of the residuals vs fitted values.
- ▶ The resulting plot labels the three most extreme residuals (i.e. residuals farthest from zero) by their case number in the `lbwt` dataframe: 29, 31 and 33.
- ▶ These cases can be viewed in the context of the dataframe:

```
lbwt[c(29,31,33),]
```

##	headcirc	length	gestage	birthwt	momage	toxemia
## 29	23	33	29	560	29	0
## 31	35	36	31	900	23	0
## 33	33	39	31	1440	26	0