Section 2.5 Case Study: Butterfly Wings

Load needed packages.

```
library(Stat2Data)
library(mosaic)
```

Create a dataframe for **ButterfliesBc** and look at the structure of the data.

```
data("ButterfliesBc")
str(ButterfliesBc)
```

```
## 'data.frame':    32 obs. of  4 variables:
##  $ Temp   : num  0.9 1.1 1.4 1.6 1.6 1.6 2.3 2.4 2.4 2.8 ...
##  $ Wing   : num  18.1 18.2 18.4 18.1 17.9 17.8 17.8 17.9 17.7 18.3 ...
##  $ Sex    : Factor w/ 2 levels "Female","Male": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Species: Factor w/ 1 level "Bc": 1 1 1 1 1 1 1 1 1 1 ...
```

TABLE 2.1 Previous summer temperature and average wing length for female butterflies in Greenland

```
FemaleButterflies=subset(ButterfliesBc, Sex=='Female')
FemaleButterflies
```

```
##    Temp Wing    Sex Species
## 17  0.9 19.1 Female      Bc
## 18  1.1 18.8 Female      Bc
## 19  1.4 19.5 Female      Bc
## 20  1.6 19.0 Female      Bc
## 21  1.6 18.9 Female      Bc
## 22  1.6 18.6 Female      Bc
## 23  2.3 18.9 Female      Bc
## 24  2.4 18.9 Female      Bc
## 25  2.4 18.8 Female      Bc
## 26  2.8 19.1 Female      Bc
## 27  2.7 18.9 Female      Bc
## 28  2.6 18.7 Female      Bc
## 29  2.6 18.6 Female      Bc
## 30  2.9 18.6 Female      Bc
## 31  2.7 18.4 Female      Bc
## 32  4.0 18.2 Female      Bc
```

Case Study FIT

```
SLRmodelBcF <- lm(Wing ~ Temp, data=FemaleButterflies)
SLRmodelBcF
```

```
##
## Call:
## lm(formula = Wing ~ Temp, data = FemaleButterflies)
##
## Coefficients:
## (Intercept)         Temp
##     19.3439      -0.2388
```

FIGURE 2.4 Scatterplot of wing length versus temperature for female butterflies in Greenland

```
plot(Wing ~ Temp, data=FemaleButterflies, pch=16, ylab="Wing length", xlab="Temp previous summer")
```

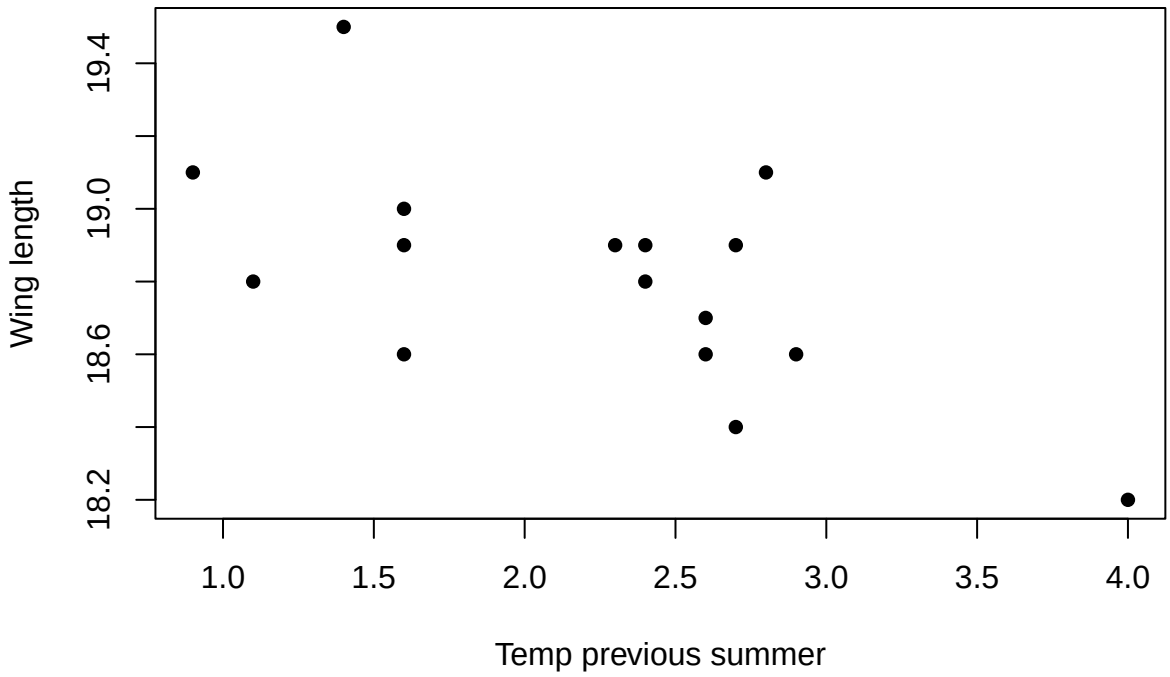
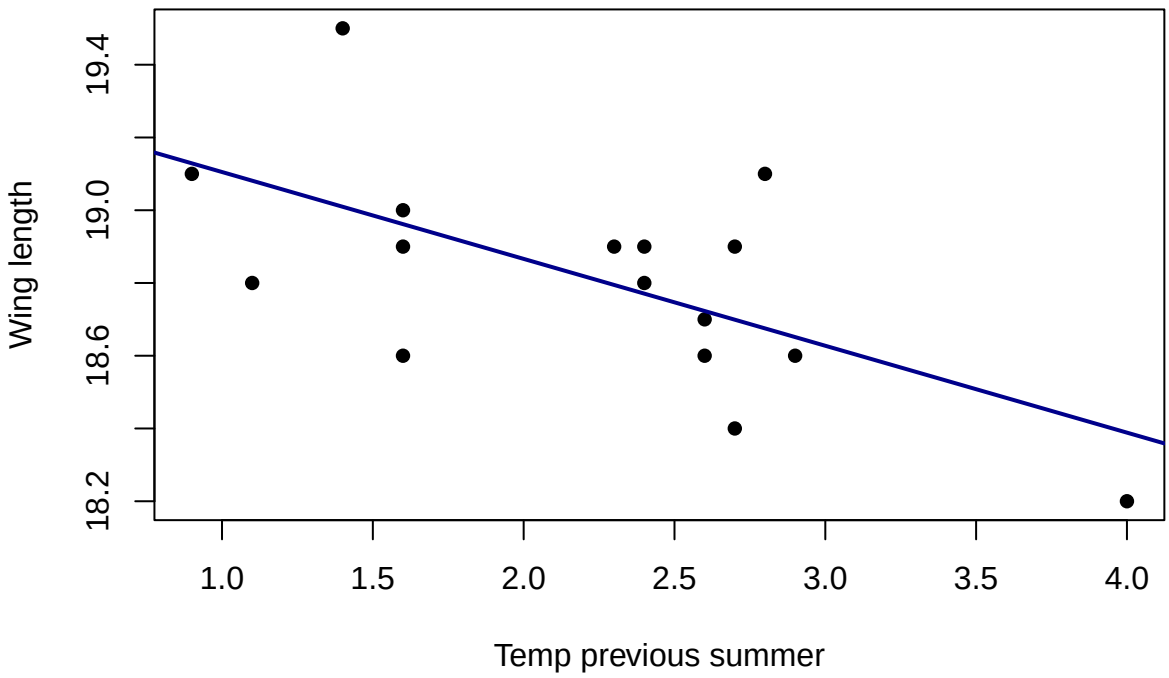


FIGURE 2.5 Scatterplot of wing length versus temperature with regression line

```
plot(Wing ~ Temp, data=FemaleButterflies,pch=16,ylab="Wing length", xlab="Temp previous summer")
abline(SLRmodelBcF,lwd=2,col="darkblue")
```



Case Study ASSESS

```
summary(SLRmodelBcF)
```

```
##
## Call:
## lm(formula = Wing ~ Temp, data = FemaleButterflies)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.36176 -0.13936 -0.02594  0.11138  0.49048
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 19.34386    0.18721 103.326  < 2e-16 ***
## Temp        -0.23881    0.07946  -3.006  0.00945 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2463 on 14 degrees of freedom
## Multiple R-squared:  0.3922, Adjusted R-squared:  0.3488
## F-statistic: 9.033 on 1 and 14 DF,  p-value: 0.009447
```

FIGURE 2.6a Residual versus fits plot for the butterfly model

```
plot(SLRmodelBcF$resid~SLRmodelBcF$fitted.values, pch=16, xlab="Predicted Wing Length",ylab="Residuals"
abline(h=0)
```

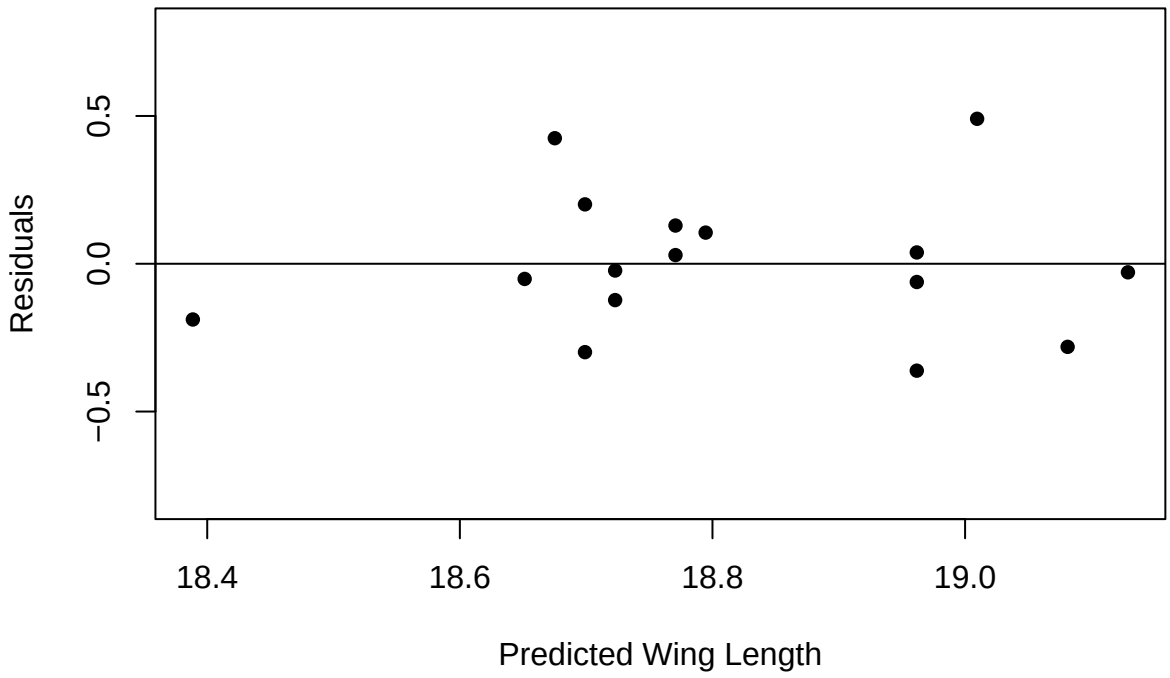
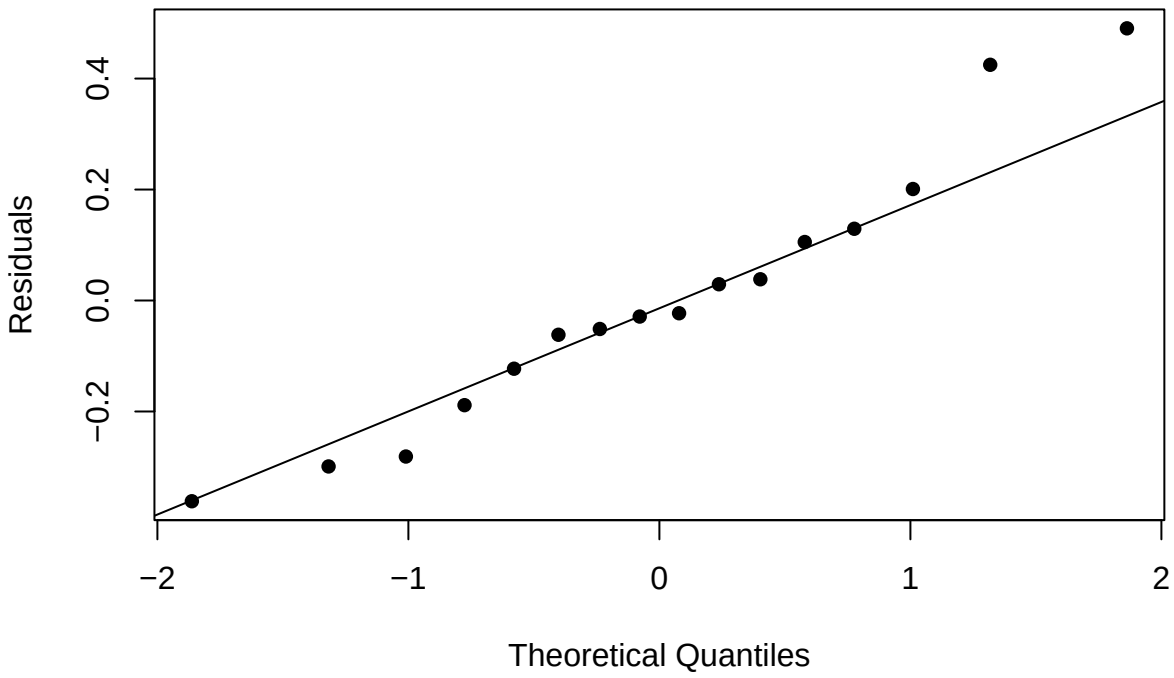


FIGURE 2.6b Normal quantile plot of residuals for the butterfly model

```
qqnorm(SLRmodelBcF$resid, pch=16, ylab="Residuals",xlab="Theoretical Quantiles",main="")
qqline(SLRmodelBcF$resid)
```



Case Study USE

Compute a confidence interval for the slope

```
confint(SLRmodelBcF)
```

```
##                  2.5 %      97.5 %
## (Intercept) 18.9423327 19.74538840
## Temp        -0.4092336 -0.06839385
```

Use our model to predict the average wing length in Greenland, where the temperature is 3.0 degrees (Celsius) this summer.

```
newx=data.frame(Temp=3)
fit=predict(SLRmodelBcF,newdata=newx)
fit
```

```
##        1
## 18.62742
```

Find a 95% confidence interval for average wing length of female butterflies in Greenland, where the temperature is 3.0 degrees (Celsius) this summer.

```
predict.lm(SLRmodelBcF, newx, interval='confidence')
```

```
##        fit      lwr     upr
## 1 18.62742 18.44064 18.8142
```

Find a 95% prediction interval for female wing length of butterflies in Greenland, where the temperature is 3.0 degrees (Celsius) this summer.

```
predict.lm(SLRmodelBcF, newx, interval='prediction')
```

```
##        fit      lwr      upr
## 1 18.62742 18.06707 19.18777
```