

Lab 2 - Plot Models 4, 9, 10 and 11

WILD 502 - Jay Rotella

To help promote understanding of the patterns in models 4, 9, 10, and 11, consider the following plots. First, we'll set up a data frame for making predictions, which has the full range of values of length for each sex. We then use functions in the `dplyr` package to add the product of `sex * length`.

```
library(dplyr)
library(ggplot2)

dat <- expand.grid(int = 1, sex = c(0, 1),
                  length = seq(from = 108, to = 136, by = 2))
dat <- dat %>%
  mutate(sex.x.length = sex * length)
head(dat)
```

```
##   int sex length sex.x.length
## 1   1  0   108           0
## 2   1  1   108          108
## 3   1  0   110           0
## 4   1  1   110          110
## 5   1  0   112           0
## 6   1  1   112          112
```

Next, we'll create the predicted values of `log_odds` of survival and of survival for each of the 4 models. To do so, we first create the design matrix for the model. The code below displays the first few rows of each design matrix so you can see the model structure clearly. Next, the code produces $X\beta$ (estimated log-odds of S) and $\frac{\exp(X\beta)}{1+\exp(X\beta)}$ (estimated S). Then, we'll store all of the information on the estimates and which model they are from with the original data in a long data frame for use in plotting.

S(length) or Model 4

```
# S(length) or Model 4 or m4
m4.DM <- model.matrix(~ length, data = dat)
head(m4.DM, 4)

##   (Intercept) length
## 1           1    108
## 2           1    108
## 3           1    110
## 4           1    110

m4.beta <- matrix(c(-10.2340400, 0.0799874), nrow = 2, ncol=1)
m4.LO <- m4.DM %*% m4.beta
m4 <- data.frame(LO = m4.LO, S = plogis(m4.LO), mod = "S.len")
m4 <- cbind(dat[, 2:3], m4) # store sex, length, log_odds, S, and model name
```

S(sex + length) or Model 9

```
# S(sex + length) or Model 9 or m9
m9.DM <- model.matrix(~ sex + length, data = dat)
head(m9.DM, 4)

## (Intercept) sex length
## 1          1  0   108
## 2          1  1   108
## 3          1  0   110
## 4          1  1   110

m9.beta <- matrix(c(-12.6958420, -1.0554989, 0.1040179), nrow = 3, ncol=1)
m9.LO <- m9.DM %*% m9.beta
m9 <- data.frame(LO = m9.LO, S = plogis(m9.LO), mod = "S.sex.plus.len")
m9 <- cbind(dat[, 2:3], m9) # store sex, length, log_odds, S, and model name
```

S(length + sex*length) or Model 10

```
# S(length + sex*length) or Model 10 or m10
m10.DM <- model.matrix(~ length + length:sex, data = dat)
head(m10.DM, 4)

## (Intercept) length length:sex
## 1          1   108          0
## 2          1   108         108
## 3          1   110          0
## 4          1   110         110

m10.beta <- matrix(c(-13.295076, 0.1090090, -0.0087417), nrow = 3, ncol=1)
m10.LO <- m10.DM %*% m10.beta
m10 <- data.frame(LO = m10.LO, S = plogis(m10.LO), mod = "S.len:sex")
m10 <- cbind(dat[, 2:3], m10) # store sex, length, log_odds, S, and model name
```

S(Sex + Length + Sex*Length) or Model 11

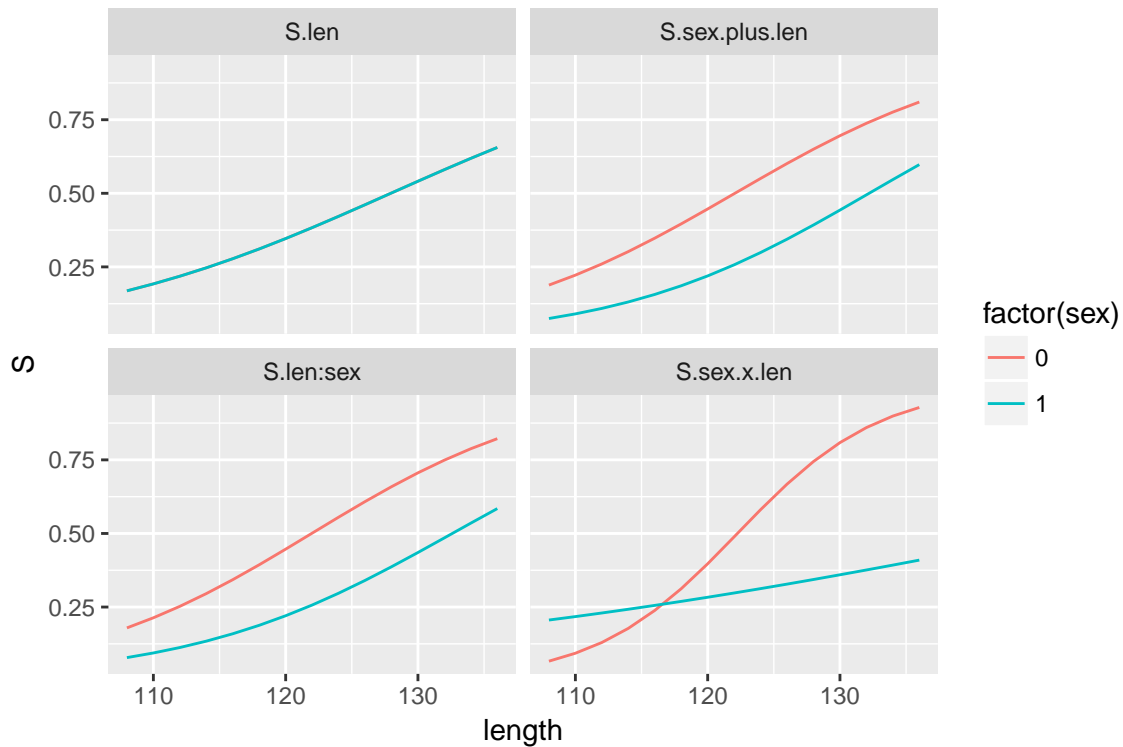
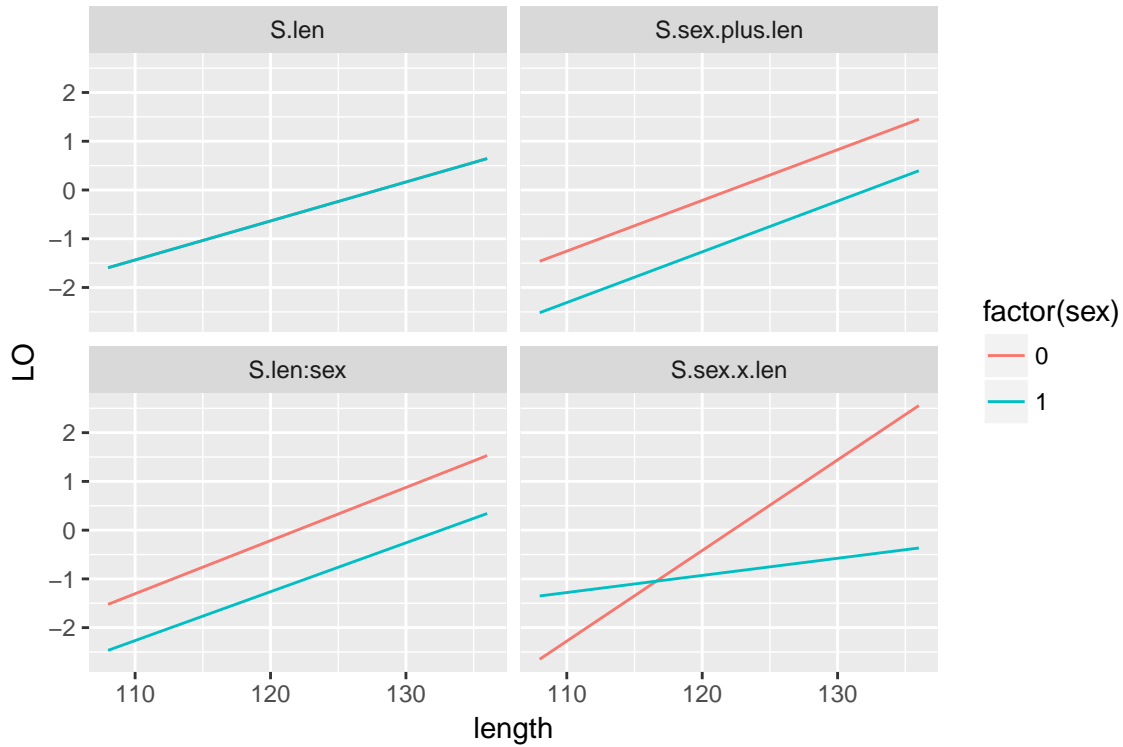
```
# S(sex + length + sex*length) or Model 11 or m11
m11.DM <- model.matrix(~ sex + length + length:sex, data = dat)
head(m11.DM, 4)

## (Intercept) sex length sex:length
## 1          1  0   108          0
## 2          1  1   108         108
## 3          1  0   110          0
## 4          1  1   110         110

m11.beta <- matrix(c(-22.724123, 17.579626, 0.1858879, -0.1507537), nrow = 4, ncol=1)
m11.LO <- m11.DM %*% m11.beta
m11 <- data.frame(LO = m11.LO, S = plogis(m11.LO), mod = "S.sex.x.len")
m11 <- cbind(dat[, 2:3], m11) # store sex, length, log_odds, S, and model name
```

Plots

Sex-specific fitted lines for Models 9 (sex-specific intercepts, 1 slope) and Model 10 (1 intercept, sex-specific slopes) look alike. Sex-specific lines for Model 11 (sex-specific intercepts and slopes) do look different from those for Models 9 and 10, and ΔAIC_c provides a bit more support for that model. However, the uncertainty associated with each model's estimates makes it hard to select a single model among these 3.



The plots below use a length range of 0 to 136, which covers values well below the minimum observed value of 108 cm (observed range highlighted in blue). This was done for educational purposes only to show the differences in intercepts and slopes more clearly on the plots of log-odds for Models 9 and 10; you would not want to predict survival for length values for which you have no observations.

