

Multinomial Logistic Regression with R

Odds Ratios

- ▶ The ratio of the probability of choosing one outcome category over the probability of choosing the baseline category is often referred as **relative risk**
- ▶ It is also sometimes referred as **odds**.

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- ▶ The relative risk is the (right-hand side) linear equation exponentiated, leading to the fact that the exponentiated regression coefficients are relative risk ratios for a unit change in the predictor variable.
- ▶ We can exponentiate the coefficients from our model to see these odds ratios (next slide).

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Extract the coefficients from the model then and exponentiate

```
exp(coef(test))
```

	(Intercept)	sesmiddle	seshigh	write
general	17.33	0.5867	0.3126	0.9437
vocation	184.61	1.3383	0.3743	0.8926

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- ▶ The relative risk ratio for a one-unit increase in the variable **write** is 0.9437 for being in general program vs. academic program.
- ▶ The relative risk ratio switching from **ses** = 1 to 3 is 0.3126 for being in general program vs. academic program.

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- ▶ You can also use predicted probabilities to help you understand the model.
- ▶ You can calculate predicted probabilities for each of our outcome levels using the `fitted` function.
- ▶ We can start by generating the predicted probabilities for the observations in our dataset and viewing the first few rows

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```
head(pp <- fitted(test))
```

	academic	general	vocation
1	0.1483	0.3382	0.5135
2	0.1202	0.1806	0.6992
3	0.4187	0.2368	0.3445
4	0.1727	0.3508	0.4765
5	0.1001	0.1689	0.7309
6	0.3534	0.2378	0.4088

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Prediction

- ▶ Suppose we want to examine the changes in predicted probability associated with one of our two variables, we can create small datasets varying one variable while holding the other constant.
- ▶ We will first do this holding **write** at its mean and examining the predicted probabilities for each level of **ses**.
- ▶ (*i.e. Three Cases to predict for*)

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```
dses <- data.frame(ses = c("low", "middle", "high"),
                   write = mean(ml$write))
predict(test, newdata = dses, "probs")
```

	academic	general	vocation
1	0.4397	0.3582	0.2021
2	0.4777	0.2283	0.2939
3	0.7009	0.1785	0.1206

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- ▶ Another way to understand the model using the predicted probabilities is to look at the averaged predicted probabilities for different values of the continuous predictor variable **write** within each level of **ses**.

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Store the predicted probabilities for each value of ses and write

```
dwrite <- data.frame(  
  ses = rep(c("low", "middle", "high"), each = 41),  
  write = rep(c(30:70), 3))
```

```
pp.write <- cbind(dwrite,  
  predict(test, newdata = dwrite,  
    type = "probs", se = TRUE))
```

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Calculate the mean probabilities within each level of ses

```
by(pp.write[, 3:5], pp.write$ses, colMeans)
```

```
pp.write$ses: high
academic  general vocation
 0.6164    0.1808    0.2028
```

```
-----
pp.write$ses: low
academic  general vocation
 0.3973    0.3278    0.2749
```

```
-----
pp.write$ses: middle
academic  general vocation
 0.4256    0.2011    0.3733
```