Polytomous Regression

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SPPH 504/007

Reference

- Applied Logistic Regression, 3rd Edition David W. Hosmer, Jr., Stanley Lemeshow, Rodney X. Sturdivant (ch 8)

Logistic Regression Extensions

- Logistic model can be generalized to handle the case where the outcome variable is **nominal with more than two levels**.
- Such generalizations are commonly known as
  - multinomial,
  - polychotomous, or
  - polytomous logistic regression
- Pay attention to the measurement scale
  - Nominal scale [topic for these slides]
  - Ordinal scale

APS Data

- Examines factors associated with level of aftercare decisions for psychiatrically hospitalized adolescents

[HTML] Need or availability? Modeling **aftercare** decisions for psychiatrically hospitalized adolescents

CA **Fontanella**, TJ Early, G Phillips - Children and Youth Services Review, **2008** - Elsevier

Discharge planning and linkage to appropriate aftercare services are crucial to successful outcomes following inpatient psychiatric care. Yet little is known about how aftercare decisions are made and what factors clinicians consider most important when making …

☆ 99 Cited by 26 Related articles All 7 versions

APS Data

- Outcome = placement [place3] (3 categories)
  - Ref = Outpatient and Day Treatment [OutDay]
  - Intermediate Residential [Int]
  - Residential [Res]

```
> table(aps$place3)

OutDay    Int    Res
   259    130    119
```

```
> require(aplore3)
> head(aps, n = 5)
  id place place3      age      race gender    neuro       emot    danger   elope los behav custd viol
1  1   Day OutDay 15.95346     White Female   Severe     Severe Unlikely No Risk  14     0    No   No
2  2   Res    Res 14.57084 Non-white   Male     None Not Severe Possible No Risk  44     7    No  Yes
3  3   Out OutDay 15.81930 Non-white Female     None Not Severe Possible No Risk  11     4    No   No
4  4   Out OutDay 15.59754     White   Male     None Not Severe   Likely At Risk   4     6   Yes  Yes
5  5   Out OutDay 16.35044     White   Male Moderate     Severe   Likely No Risk   5     7    No  Yes
```

Multiple categories in Outcome

- Outcome = place3
- Independent variable: history of violence [viol]

PLACE3	History of Violence: No (0)	History of Violence: Yes (1)	Total	$\widehat{OR}$
Day or Outpatient (0)	80	179	259	1.00
Intermediate residential (1)	26	104	130	1.79
Residential (2)	15	104	119	3.10
Total	121	387	508	

Calculate OR in the same way as logistic:

$$\widehat{OR}_1 = \frac{104 \times 80}{179 \times 26} = 1.79$$

$$\widehat{OR}_2 = \frac{104 \times 80}{179 \times 15} = 3.10.$$

- Compare outcome categories (1 vs 0)
- Compare outcome categories (2 vs 0)

Multiple categories in Outcome

- Logistic regression fits

```
> fit.IvO <- glm(place3 ~ viol,
+                family = binomial(),
+                data = subset(aps, place3 != "Res"))
> c(exp(coef(fit.IvO))[2] , exp(confint(fit.IvO))[2,])
Waiting for profiling to be done...
 violYes    2.5 %   97.5 %
1.787709 1.091428 3.001267
```

```
> fit.RvO <- glm(place3 ~ viol,
+                family = binomial(),
+                data = subset(aps, place3 != "Int"))
> c(exp(coef(fit.RvO))[2] , exp(confint(fit.RvO))[2,])
Waiting for profiling to be done...
 violYes    2.5 %   97.5 %
3.098696 1.740403 5.846408
```

$$\widehat{\text{OR}}_1 = \frac{104 \times 80}{179 \times 26} = 1.79$$

$$\widehat{\text{OR}}_2 = \frac{104 \times 80}{179 \times 15} = 3.10.$$

Multiple categories in Outcome

- Multinomial Model fit

```
> library(nnet)
> fit <- multinom(place3 ~ viol, data = aps)
# weights:  9 (4 variable)
initial  value 558.095043
final  value 515.732252
converged
> cbind(exp(coef(fit)[, "violYes"]), t(exp(confint(fit)["violYes", ,])))
                  2.5 %   97.5 %
Int 1.787732 1.079826 2.959723
Res 3.098815 1.697103 5.658264
```

$$\widehat{OR}_1 = \frac{104 \times 80}{179 \times 26} = 1.79$$

$$\widehat{OR}_2 = \frac{104 \times 80}{179 \times 15} = 3.10.$$

OR same? What about SE?

Fit assessment

- Multinomial Model fit = [viol only covariate]
- Multinomial Model fit = [no covariate]

```
> anova(fit, fit0, test = "Chisq")
Likelihood ratio tests of Multinomial Models

Response: place3
  Model Resid. df Resid. Dev   Test    Df LR stat.      Pr(Chi)
1     1      1014   1048.742
2  viol      1012   1031.465 1 vs 2     2 17.27736 0.0001771204
```

Ordinal regression

- Outcome = placement [place3] (3 categories)
    - Ref = Outpatient and Day Treatment [OutDay]
    - Intermediate Residential [Int]
    - Residential [Res]

Ordering present?

polr() from MASS

Thanks!

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