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HW #5 Solutions

1 Problem 7.1 of Agresti

a) Log(π1/π2) = (.883+.758) + (.419-.105) Gender + (.342-.271) Race = 1.641 + .314 Gender + .071 Race

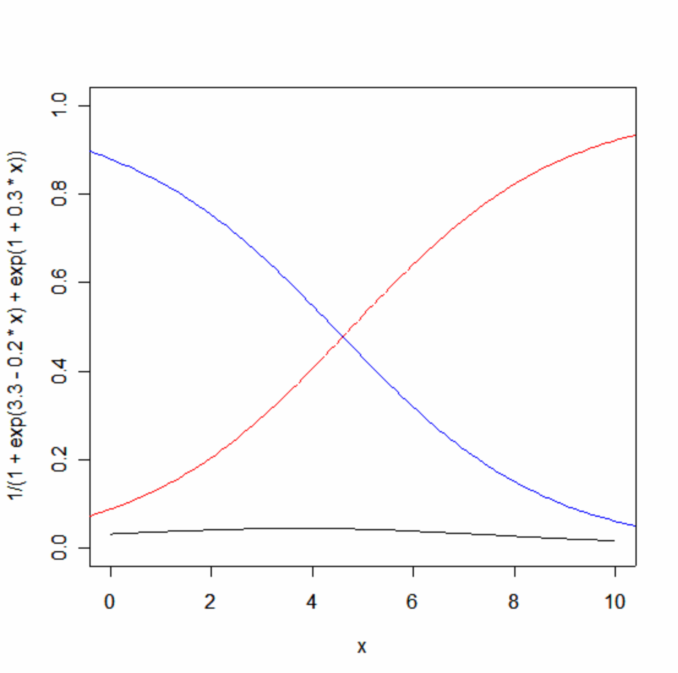
b) Log(π1/π3) = .883 + .419 Gender + .0342 Race. Thus the estimated odds for females are exp(0.419) = 1.5 times those for males, controlling for race, and that's the conditional gender effect. 95% CI for that is c(exp(0.419-2*0.171), exp(0.419+2*0.171)) = 1.080, 2.140).

c) P(Yes| white, females) = exp(.883+.419 + .342)/ (1+ exp(.883+.419 + .342)+ exp(-.758+.105+ .271)) = .755

d) For black males, Log(P(Yes)/P(No)) = .883, Log(P(Undecided)/P(No)) = -.758. (Only intercepts) The logit is positive for Yes and negative for Undecided, compared to No. Thus, the probability is larger for Yes and lower for Undecided, compared to No, which leads to π1>π3>π2.

e) Being white or female both increase the log odds ratio for Yes/No (by .419 and .342, respectively) and leads to lower No probability. Similarly, being white or female both increase the log odds ratio for Undecided/No, leading to lower No probability. Thus, P(No) is highest for black males.

f) For each of 2 logits, there are 4 gender-race combinations and 3 parameters, so df = 2(4)-2(3) = 2. Deleting the gender effect leads to 2 race combinations and 2 parameter for each of 2 logits, so df=2(4)-2(2) = 4. The likelihood-ratio statistic of 8.0-0.9=7.1, based on df = 4-2=2, has a P-value of .03 and shows evidence of a gender effect.



2 Problem 7.2 of Agresti

a) Log(πR/πD) = Log(πR/πI)-Log(πD/πI) = (1.0-3.3) +(0.3+0.2)x = -2.3 + 0.5 x. The slope of x is the increase of the log odds of preferring Republican compared to Democrats for a $10K increase in annual income. (Rich people prefer republicans) πR>πD for x>2.3/0.5 = 4.6 (*10K $ annual income)

b) πI = 1/(1+exp(3.3-0.2*x) + exp(1.0+0.3*x))

c) Using R,

```
curve(1/(1+exp(3.3-0.2*x) + exp(1.0+0.3*x)),0,10, ylim=c(0,1))
curve(exp(3.3-0.2*x) /(1+exp(3.3-0.2*x) + exp(1.0+0.3*x)),add=TRUE, col='blue')
curve(exp(1.0+0.3*x)/(1+exp(3.3-0.2*x) + exp(1.0+0.3*x)),add=TRUE, col='red')
```

3 Problem 7.3 of Agresti. In SAS, run the following SAS code.

Both gender and race have significant effects.

The logit model with additive effects and no interaction fits well, with $G^2 = 0.2$ based on df = 2.

The estimated odds of preferring Democrat instead of Republican are higher for females and for blacks, with estimated conditional odds ratios of 1.77 (= exp(0.2202+0.3526)) between gender and party ID and 9.76 (= exp(1.1183 + 1.1598)) between race and party ID.

```
data ex7_3;
input gender $ race $ party $ count;
datalines;
M W D 132
M W R 176
M W I 127
M B D 42
M B R 6
M B I 12
F W D 172
F W R 129
F W I 130
F B D 56
F B R 4
F B I 15
;
proc logistic; freq count; class gender race / param=ref;
  model party (ref='I') = gender race / link=glogit aggregate scale=none;
  run;
proc catmod; weight count;
  population gender race;
  model party = gender race / pred=freq pred=prob;
run;
```

Analysis of Maximum Likelihood Estimates

Parameter		party	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		D	1	0.0498	0.1198	0.1726	0.6778
Intercept		R	1	0.3353	0.1148	8.5269	0.0035
gender	F	D	1	0.2202	0.1583	1.9359	0.1641
gender	F	R	1	-0.3526	0.1651	4.5611	0.0327
race	B	D	1	1.1183	0.2335	22.9337	<.0001
race	B	R	1	-1.1598	0.3801	9.3099	0.0023

4 Problem 10.1 of Agresti. In SAS, run the following SAS code.

a) a. Sample marginal proportions are 1300/1825 = 0.712 and 1187/1825 = 0.650. The difference of .062 has an estimated variance of $[(90+203)/1825-(90-203)^2/1825^2]/1825$ =.000086, for SE = .0093. The 95% Wald CI is .062 ±1.96(.0093), or .062 ± .018, or (.044,.080).

b) McNemar chi-squared = $(203-90)^2$=(203 + 90) = 43.6, df = 1, P < :0001; there is strong evidence of a higher proportion of `yes' responses for `let patient die.'

c) β-hat = log(203/90) = log(2.26) = 0.81. For a given respondent, the odds of a `yes' response for `let patient die' are estimated to equal 2.26 times the odds of a `yes' response for `suicide.

```
data prob_10_1;
input suicide $ let_die $ count;
```

```
datalines;
Yes Yes 1097
Yes No 90
No Yes 203
No No 435
;
proc freq data=prob_10_1 order=data;
 weight count;
 table suicide * let_die/ agree;
run;
```