

## Model Solutions for Assignment 5

**Note on grading for Assignment 5:** You'll note below in question 3 that the correct solution required McNemar's test and an associated confidence interval. Since I didn't cover the confidence interval in lectures (it's described in section 7.5.3, p. 279 of the text) I am changing the grading scheme so the assignment is out of 22.

### Q1.

(a) With the table organized as follows, the relevant percentages for comparing groups are the column percentages.

	Fans	On reserve	Off reserve
Like it	208/743(28.0%)	24/209(11.5%)	44/134(32.8%)
Don't Care	379/743(51.0%)	100/209(47.8%)	66/134(49.3%)
Don't like it	156/743(21.0%)	85/209(40.7%)	24/134(17.9%)

We see that Indians off reserve are similar to fans, but the Indians on reserve are more likely to dislike the "tomahawk chop".

(b) After fitting the additive log-linear model we get the following standardized residuals.

	Fans	On reserve	Off reserve
Like it	2.8277694	-5.7767338	2.0157200
Don't Care	0.7983634	-0.7579761	-0.2307895
Don't like it	-3.9408266	5.5554290	-1.9621748

The residuals show the same pattern as the percentages in (a). The positive values correspond to percentages that are higher than the overall percentages, e.g. the percent of Indians on reserve that dislike the "chop" is high relative to the groups.

(c) Since the expressed opinions follow a natural ordering from like, to don't care, to dislike, it makes sense to convert the opinion variable to integer scores to examine "trends".

### Analysis of Deviance Table

```

Model 1: counts ~ opinion + group
Model 2: counts ~ group + opinion + group:(as.integer(opinion))
Model 3: counts ~ opinion * group
  Resid. Df Resid. Dev Df Deviance P(>|Chi|)
1         4      50.096
2         2       0.147  2   49.949 1.425e-11
3         0 -8.216e-14  2    0.147    0.929

```

We see in the above that model 2 is very significant in relation to the independence model, i.e. there is strong evidence for a difference between groups. Furthermore, the integer scores model seems to fit well, as there is no evidence that the saturated model is better. The goodness of fit can also be seen by comparing the fitted column percentages from model 2 (below) and the observed (part a above).

	Fans	On reserve	Off reserve
Like it	27.9	12.0	32.4
Don't Care	51.1	46.9	50.2
Don't like it	20.9	41.2	17.4

## Q2.

(a) We examine association between first and second child using a test for independence, either Pearson's chi-squared test or Fisher's exact test. For example Fisher's test yields  $P=.04$ , indicating that there is evidence for an association between first and second child fingerprint types.

(c) Here are the percentages from the row and column totals.

	Arches	Loops	Whorls
[1,]	10/104( 9.6%)	68/104(65.4%)	26/104(25.0%)
	Arches	Loops	Whorls
[1,]	19/104(18.3%)	60/104(57.7%)	25/104(24.0%)

The percentages of *Arches* and *Loops* seem to differ, but applying the Stewart-Maxwell test yields a chi-squared value of 4.3 on 2 degrees of freedom, with  $P=.112$ , so the difference is not significant.

## Q3.

(a) The positivity rates for the physicians are just the proportions of positive tests, which are  $19/50 = .38$  (95% C.I.: 0.31 to 0.58) and  $22/50 = .44$  (95% C.I. 0.26 to 0.52). To compare the physicians, we have to take into account the pairing, which means using McNemar's test, which yields  $P=.45$ , i.e. no evidence for a difference. To calculate a confidence interval for the difference we apply the formula on page 279 of Simonoff (see R code as well) which yields an interval for the difference (Physician 1 - Physician 2) of -0.16 to 0.04 around the point estimate of -0.06.

(c) The kappa coefficient for agreement is .712 (see R code for details).

## Q4.

(a) The odds ratios and relative risks are below:

	<49	>65
OR:	1.364716	1.356254
	<49	>65
RR:	1.101470	1.026067

We see that the odds ratios are considerably larger than the corresponding relative risks, due to the fact that the *rare disease assumption* for CAD doesn't hold in these populations.

(a) Apply the Mantel-Haenszel procedure we obtain a pooled estimated of 1.36 which is significantly different from 1 with  $P=.0002$  and a 95% confidence interval of 1.16 to 1.60. It is reasonable to use this combined estimate since the odds ratios in the separate tables are similar.