

Stat 536 Homework 3

Due: 9/22/08

1. Consider two estimators for within-person gene correlation f : (1) MLE \hat{f} and (2) MOM \tilde{f} . In this problem, you study possible differences between these two estimators in the two-allele case.

- (a) Using a rough argument, find a choice of allele frequency p and f for which you would have 80% power to reject $H_0 : f = 0$ given a sample of size $n = 100$. [Hint: Use the results for D_1 and your choice of allele frequencies, then convert from D_1 to f and assume that the power argument transfers to a test of $H_0 : f = 0$.]
- (b) Generate multiple simulated datasets using the p and f identified in part (a). Each dataset is like one random sample from a hypothetical population at HW disequilibrium. For each dataset, estimate \hat{f} and \tilde{f} , and use these estimates to answer the question whether one estimator is better than the other. Recall that we prefer unbiased estimators and those with smaller variance.

[Hint: You can generate simulated data with R code

```
n.ij <- rmultinom(n=1, size=100, prob=c(P.AA,P.Aa,P.aa))
```

after computing the population genotype proportions P.AA, P.Aa, and P.aa according to the selected model.]

2. Follow the WinBUGS tutorial (linked separately) to estimate the additive HW disequilibrium parameters D_{uv} for the data below.

Genotype	AA	BB	CC	DD	AB	AC	AD	BC	BD	CD
Count n_{xy}	101	430	329	568	103	214	74	99	65	402

- (a) Report the posterior mean and 95% credible sets for each parameter D_{uv} .
- (b) Retool the above example to estimate f_{uv} and provide posterior means and credible sets for these parameters.
- (c) Compare the full model with distinct f_{uv} to the model with $f_{uv} = f$ for all u, v using the DIC.
- (d) Write a short discussion about this data analysis, answering the following questions.
 - i. Is there evidence to reject HWE? What about the hypothesis of homogeneity, i.e. $f_{uv} = f$?
 - ii. How would you construct a likelihood ratio test for homogeneity? What is the asymptotic sampling distribution?
 - iii. Could you have computed an exact probability for testing HWE? How would you compute it, using what tools? Could exact tests be used to test homogeneity?
 - iv. Could you have tested the homogeneity of disequilibrium using the D_{uv} model? If so, write down the constrained model.