Homework #2 Solutions

March 2, 2010
Problem 1: Allele frequencies

(a)

freq<-c(9.6,48.3,2.8,34.3,5.0,0.0)/100
A1; A2; A3

[1] 0.3515
[1] 0.6095
[1] 0.039

(b)

HWE requires

\[ \Pr(A_i A_j) = \Pr(A_i) \Pr(A_j) (1 + 1_{i \neq j}) \quad \text{for all} \quad i \leq j = 1, 2, 3 \]
Problem 1 (cont.)

(c)

n<-178
observed<-n*freq
stat<-sum((observed-expected)^2/expected)
stat; pchisq(stat,2,lower=FALSE)

[1] 3.013057
[1] 0.2216782
Problem 2

```r
mat <- matrix(c(222, 106, 13, 230, 65, 0, 56, 0, 0), 3)
mat2 <- addmargins(mat)
mat2

[1,] 222 230 56 508
[2,] 106 65 0 171
[3,] 13 0 0 13
[4,] 341 295 56 692

n <- sum(mat)
A <- (2 * mat2[1, 4] + mat2[2, 4]) / (2 * n)
B <- (2 * mat2[4, 1] + mat2[4, 2]) / (2 * n)
A.exp <- n * c(A^2, 2*A*(1-A), (1-A)^2)
A.obs <- mat2[1:3, 4]
B.exp <- n * c(B^2, 2*B*(1-B), (1-B)^2)
B.obs <- mat2[4, 1:3]
A.stat <- sum((A.obs - A.exp)^2 / A.exp)
B.stat <- sum((B.obs - B.exp)^2 / B.exp)
pchisq(A.stat, 1, lower=FALSE);
pchisq(B.stat, 1, lower=FALSE)
```

```r
[1] 0.857659
[1] 0.705925
```
D<-ld.est(mat)
p<-allele.est(mat)
D; p

[1] -0.04185896
[1] 0.8576590 0.7059249

D/max(-prod(p),-prod(1-p))
D/sqrt(prod(p)*prod(1-p))
ld.test(mat)

[1] 1
[1] -0.2629406
[1] 1.314434e-20

These markers are in linkage disequilibrium.
Problem 4

allele.est2<-function(nA=20,nB=25,nAB=5,nOO=50,eps=1e-10){
  n<-nA+nB+nAB+nOO
  pA<-.1
  pB<-.3
  pO<-.6
  dif<-1
  while(dif>eps){
    param<-c(pA,pB,pO)
    nAA<-nA*(pA^2/(pA^2+2*pA*pO))
    nAO<-nA*(2*pA*pO/(pA^2+2*pA*pO))
    nBB<-nB*(pB^2/(pB^2+2*pB*pO))
    nBO<-nB*(2*pB*pO/(pB^2+2*pB*pO))
    pA<-(2*nAA+nAO+nAB)/(2*n)
    pB<-(2*nBB+nBO+nAB)/(2*n)
    pO<-(2*nOO+nAO+nBO)/(2*n)
    dif<-max(abs(param-c(pA,pB,pO)))
  }
  c(pA,pB,pO)
}

allele.est2()

[1] 0.1336784 0.1629788 0.7033428
Problem 4 (cont.)

\texttt{allele.est2()}

[1] 0.1336784 0.1629788 0.7033428

\[ p_A = .13, \ p_B = .16, \ p_O = .70 \]