**S1 Text: Bayesian latent-class model code for four diagnostic tests**

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##Definition of the variables in the model

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var p[N], q[N,8], pr[N], L[N],checks[N,16];

#N <- observations

# p <- individual samples

# q <- different combinations of test results

# pr <- prevalence

# s <- test sensitivities

# c <- test specificities

# cs <- conditional dependency between tests sensitivities

# cc <- conditional dependency between tests specificities

# mobokupa <- data set name

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## Modelling the different probabilities of combinations of tests results

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model {

 for(i in 1:N){

 q[i,1]<-pr[i]\*(s1\*s2\*s3\*s4+cs12+cs13+cs23+cs14+cs24+cs34)+(1-pr[i])\*((1-c1)\*(1-c2)\*(1-c3)\*(1-c4)+cc12+cc13+cc23+cc14+cc24+cc34);

 q[i,2]<-pr[i]\*(s1\*s2\*s3\*(1-s4)+cs12+cs13+cs23-cs14-cs24-cs34)+(1-pr[i])\*((1-c1)\*(1-c2)\*(1-c3)\*c4+cc12+cc13+cc23-cc14-cc24-cc34);

 q[i,3]<-pr[i]\*(s1\*s2\*(1-s3)\*s4+cs12-cs13-cs23+cs14+cs24-cs34)+(1-pr[i])\*((1-c1)\*(1-c2)\*c3\*(1-c4)+cc12-cc13-cc23+cc14+cc24-cc34);

 q[i,4]<-pr[i]\*(s1\*s2\*(1-s3)\*(1-s4)+cs12+cs13-cs23-cs14-cs24+cs34)+(1-pr[i])\*((1-c1)\*(1-c2)\*c3\*c4-cc12+cc13-cc23-cc14-cc24+cc34);

 q[i,5]<-pr[i]\*(s1\*(1-s2)\*s3\*s4-cs12+cs13-cs23+cs14-cs24+cs34)+(1-pr[i])\*((1-c1)\*c2\*(1-c3)\*(1-c4)-cc12+cc13-cc23+cc14-cc24+cc34);

 q[i,6]<-pr[i]\*(s1\*(1-s2)\*s3\*(1-s4)-cs12+cs13-cs23-cs14+cs24-cs34)+(1-pr[i])\*((1-c1)\*c2\*(1-c3)\*c4-cc12+cc13-cc23-cc14+cc24-cc34);

 q[i,7]<-pr[i]\*(s1\*(1-s2)\*(1-s3)\*s4-cs12-cs13+cs23+cs14-cs24-cs34)+(1-pr[i])\*((1-c1)\*c2\*c3\*(1-c4)-cc12-cc13+cc23+cc14-cc24-cc34);

 q[i,8]<-pr[i]\*(s1\*(1-s2)\*(1-s3)\*(1-s4)-cs12-cs13+cs23-cs14+cs24+cs34)+(1-pr[i])\*((1-c1)\*c2\*c3\*c4-cc12-cc13+cc23-cc14+cc24+cc34);

 q[i,9]<-pr[i]\*((1-s1)\*s2\*s3\*s4-cs12-cs13+cs23-cs14+cs24+cs34)+(1-pr[i])\*(c1\*(1-c2)\*(1-c3)\*(1-c4)-cc12-cc13+cc23-cc14+cc24+cc34);

 q[i,10]<-pr[i]\*((1-s1)\*s2\*s3\*(1-s4)-cs12-cs13+cs23+cs14-cs24-cs34)+(1-pr[i])\*(c1\*(1-c2)\*(1-c3)\*c4-cc12-cc13+cc23+cc14-cc24-cc34);

 q[i,11]<-pr[i]\*((1-s1)\*s2\*(1-s3)\*s4-cs12+cs13-cs23-cs14+cs24-cs34)+(1-pr[i])\*(c1\*(1-c2)\*c3\*(1-c4)-cc12+cc13-cc23-cc14+cc24-cc34);

 q[i,12]<-pr[i]\*((1-s1)\*s2\*(1-s3)\*(1-s4)-cs12+cs13-cs23+cs14-cs24+cs34)+(1-pr[i])\*(c1\*(1-c2)\*c3\*c4-cc12+cc13-cc23+cc14-cc24+cc34);

 q[i,13]<-pr[i]\*((1-s1)\*(1-s2)\*s3\*s4+cs12-cs13-cs23-cs14-cs24+cs34)+(1-pr[i])\*(c1\*c2\*(1-c3)\*(1-c4)+cc12-cc13-cc23-cc14-cc24+cc34);

 q[i,14]<-pr[i]\*((1-s1)\*(1-s2)\*s3\*(1-s4)+cs12-cs13-cs23+cs14+cs24-cs34)+(1-pr[i])\*(c1\*c2\*(1-c3)\*c4+cc12-cc13-cc23+cc14+cc24-cc34);

 q[i,15]<-pr[i]\*((1-s1)\*(1-s2)\*(1-s3)\*s4+cs12+cs13+cs23-cs14-cs24-cs34)+(1-pr[i])\*(c1\*c2\*c3\*(1-c4)+cc12+cc13+cc23-cc14-cc24-cc34);

 q[i,16]<-pr[i]\*((1-s1)\*(1-s2)\*(1-s3)\*(1-s4)+cs12+cs13+cs23+cs14+cs24+cs34)+(1-pr[i])\*(c1\*c2\*c3\*c4+cc12+cc13+cc23+cc14+cc24+cc34);

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## Check and correct potential errors of probabilities exceeding (0,1) bounds

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 checks[i,1]<- s1\*s2\*s3\*s4+cs12+cs13+cs23+cs14+cs24+cs34;

 checks[i,2]<- (1-c1)\*(1-c2)\*(1-c3)\*(1-c4)+cc12+cc13+cc23+cc14+cc24+cc34;

 checks[i,3]<- s1\*s2\*s3\*(1-s4)+cs12+cs13+cs23-cs14-cs24-cs34;

 checks[i,4]<- (1-c1)\*(1-c2)\*(1-c3)\*c4+cc12+cc13+cc23-cc14-cc24-cc34;

 checks[i,5]<- s1\*s2\*(1-s3)\*s4+cs12-cs13-cs23+cs14+cs24-cs34;

 checks[i,6]<- (1-c1)\*(1-c2)\*c3\*(1-c4)+cc12-cc13-cc23+cc14+cc24-cc34;

 checks[i,7]<- s1\*s2\*(1-s3)\*(1-s4)+cs12+cs13-cs23-cs14-cs24+cs34;

 checks[i,8]<- (1-c1)\*(1-c2)\*c3\*c4-cc12+cc13-cc23-cc14-cc24+cc34;

 checks[i,9]<- s1\*(1-s2)\*s3\*s4-cs12+cs13-cs23+cs14-cs24+cs34;

 checks[i,10]<- (1-c1)\*c2\*(1-c3)\*(1-c4)-cc12+cc13-cc23+cc14-cc24+cc34;

 checks[i,11]<- s1\*(1-s2)\*s3\*(1-s4)-cs12+cs13-cs23-cs14+cs24-cs34;

 checks[i,12]<- (1-c1)\*c2\*(1-c3)\*c4-cc12+cc13-cc23-cc14+cc24-cc34;

 checks[i,13]<- s1\*(1-s2)\*(1-s3)\*s4-cs12-cs13+cs23+cs14-cs24-cs34;

 checks[i,14]<- (1-c1)\*c2\*c3\*(1-c4)-cc12-cc13+cc23+cc14-cc24-cc34;

 checks[i,15]<- s1\*(1-s2)\*(1-s3)\*(1-s4)-cs12-cs13+cs23-cs14+cs24+cs34;

 checks[i,16]<- (1-c1)\*c2\*c3\*c4-cc12-cc13+cc23-cc14+cc24+cc34;

 checks[i,17]<- (1-s1)\*s2\*s3\*s4-cs12-cs13+cs23-cs14+cs24+cs34;

 checks[i,18]<- c1\*(1-c2)\*(1-c3)\*(1-c4)-cc12-cc13+cc23-cc14+cc24+cc34;

 checks[i,19]<- (1-s1)\*s2\*s3\*(1-s4)-cs12-cs13+cs23+cs14-cs24-cs34;

 checks[i,20]<- c1\*(1-c2)\*(1-c3)\*c4-cc12-cc13+cc23+cc14-cc24-cc34;

 checks[i,21]<- (1-s1)\*s2\*(1-s3)\*s4-cs12+cs13-cs23-cs14+cs24-cs34

 checks[i,22]<- c1\*(1-c2)\*c3\*(1-c4)-cc12+cc13-cc23-cc14+cc24-cc34;

 checks[i,23]<- (1-s1)\*s2\*(1-s3)\*(1-s4)-cs12+cs13-cs23+cs14-cs24+cs34;

 checks[i,24]<- c1\*(1-c2)\*c3\*c4-cc12+cc13-cc23+cc14-cc24+cc34;

 checks[i,25]<- (1-s1)\*(1-s2)\*s3\*s4+cs12-cs13-cs23-cs14-cs24+cs34;

 checks[i,26]<- c1\*c2\*(1-c3)\*(1-c4)+cc12-cc13-cc23-cc14-cc24+cc34;

 checks[i,27]<- (1-s1)\*(1-s2)\*s3\*(1-s4)+cs12-cs13-cs23+cs14+cs24-cs34;

 checks[i,28]<- c1\*c2\*(1-c3)\*c4+cc12-cc13-cc23+cc14+cc24-cc34;

 checks[i,29]<- (1-s1)\*(1-s2)\*(1-s3)\*s4+cs12+cs13+cs23-cs14-cs24-cs34;

 checks[i,30]<- c1\*c2\*c3\*(1-c4)+cc12+cc13+cc23-cc14-cc24-cc34;

 checks[i,31]<- (1-s1)\*(1-s2)\*(1-s3)\*(1-s4)+cs12+cs13+cs23+cs14+cs24+cs34;

 checks[i,32]<- c1\*c2\*c3\*c4+cc12+cc13+cc23+cc14+cc24+cc34;

 valid[i]<- step(s1+c1-1.0)\*step(s2+c2-1.0)\*step(s3+c3-1.0)\*step(s4+c4-1.0)\*

 step(1-checks[i,1])\*step(checks[i,1])\*

 step(1-checks[i,2])\*step(checks[i,2])\*

 step(1-checks[i,3])\*step(checks[i,3])\*

 step(1-checks[i,4])\*step(checks[i,4])\*

 step(1-checks[i,5])\*step(checks[i,5])\*

 step(1-checks[i,6])\*step(checks[i,6])\*

 step(1-checks[i,7])\*step(checks[i,7])\*

 step(1-checks[i,8])\*step(checks[i,8])\*

 step(1-checks[i,9])\*step(checks[i,9])\*

 step(1-checks[i,10])\*step(checks[i,10])\*

 step(1-checks[i,11])\*step(checks[i,11])\*

 step(1-checks[i,12])\*step(checks[i,12])\*

 step(1-checks[i,13])\*step(checks[i,13])\*

 step(1-checks[i,14])\*step(checks[i,14])\*

 step(1-checks[i,15])\*step(checks[i,15])\*

 step(1-checks[i,16])\*step(checks[i,16])\*

 step(1-checks[i,17])\*step(checks[i,17])\*

 step(1-checks[i,18])\*step(checks[i,18])\*

 step(1-checks[i,19])\*step(checks[i,19])\*

 step(1-checks[i,20])\*step(checks[i,20])\*

 step(1-checks[i,21])\*step(checks[i,21])\*

 step(1-checks[i,22])\*step(checks[i,22])\*

 step(1-checks[i,23])\*step(checks[i,23])\*

 step(1-checks[i,24])\*step(checks[i,24])\*

 step(1-checks[i,25])\*step(checks[i,25])\*

 step(1-checks[i,26])\*step(checks[i,26])\*

 step(1-checks[i,27])\*step(checks[i,27])\*

 step(1-checks[i,28])\*step(checks[i,28])\*

 step(1-checks[i,29])\*step(checks[i,29])\*

 step(1-checks[i,30])\*step(checks[i,30])\*

 step(1-checks[i,31])\*step(checks[i,31])\*

 step(1-checks[i,32])\*step(checks[i,32]);

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## Contribution to the likelihood for each observation

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 L[i]<- equals(valid[i],1)\*(

 equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],1)\*q[i,1]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],0)\*q[i,2]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],1)\*q[i,3]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],0)\*q[i,4]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],1)\*q[i,5]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],0)\*q[i,6]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],1)\*q[i,7]

 + equals(mobokupa [i,2],1)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],0)\*q[i,8]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],1)\*q[i,9]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],0)\*q[i,10]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],1)\*q[i,11]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],1)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],0)\*q[i,12]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],1)\*q[i,13]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],1)\*equals (mobokupa [i,6],0)\*q[i,14]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],1)\*q[i,15]

 + equals(mobokupa [i,2],0)\*equals(mobokupa[i,3],0)\*equals(mobokupa [i,4],0)\*equals (mobokupa [i,6],0)\*q[i,16]

 ) +(1-equals(valid[i],1)) \*(1e-14);

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## Ensure the probabilities are always less than 1

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##Since in a Bernoulli density an observation of 1 has a likelihood of p[i]

 p[i] <- L[i] / 1;## divided by a constant just to ensure all p's <1

 ones[i] ~ dbern(p[i]);

 }

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## Definition of model priors

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 prc~dbeta(1,1);

 c1~dbeta(1,1); # Specificity SICT test

 c2~dbeta(1,1); # Specificity Bovigam® assay

 c3<-1; # Specificity culture fixed

 c4~dbeta(1,1); # Specificity necropsy

 s1~dbeta(1,1); # Sensitivity SICT test

 s2~dbeta(1,1); # Sensitivity Bovigam® assay

 s3~dbeta(1,1); # Sensitivity culture

 s4~dbeta(1,1); # Sensitivity necropsy

## Covariance terms

 cs12<-0;

 cs13<-0;

 cs23<-0;*#~dbeta(1,1);*

 cs14<-0;

 cs24<-0;

 cs34<-0;

 cc12<-0;

 cc13<-0;

 cc23<-0;

 cc14<-0;

 cc24<-0;

 cc34<-0;

 logL<-sum(log(p[1:N]));

 }