

FILE S2**Supporting Method: Modifications to R/EMMA**

This file details the changes made to three functions of the R/EMMA package, version 1.0.7 (KANG *et al.* 2008).

emma.eigen.L.w.Z ()

changed:

```
eig <- eigen(K%%crossprod(Z,Z),symmetric=FALSE,EISPACK=TRUE)
```

to:

```
eig <- eigen(K%%crossprod(Z,Z),symmetric=F,EISPACK=F)
```

emma.eigen.R.w.Z ()

changed:

```
eig <- eigen(K%%crossprod(Z,SZ),symmetric=FALSE,EISPACK=TRUE)
```

to:

```
eig <- eigen(K%%crossprod(Z,SZ),symmetric=F,EISPACK=F)
```

emma.ML.LRT ()

changed:

```
for(i in 1:g) {
  vrows <- !is.na(ys[i,])
  if ( is.null(Z) ) {
    ML0[i] <-
emma.MLE(ys[l,vrows],X0[vrows,,drop=FALSE],K[vrows,vrows],NULL,ngrids,1
lim,ulim,esp)$ML
  }
  else {
    vids <- colSums(Z[vrows,]>0)
    ML0[i] <-
emma.MLE(ys[i,vrows],X0[vrows,,drop=FALSE],K[vids,vids],Z[vrows,vids],n
grids,llim,ulim,esp)$ML
  }
}
```

to:

```
for(i in 1:g) {      # for each trait
  vrows <- !is.na(ys[i,])
  if( var(ys[i,vrows],na.rm=T)>0 ) {
    if ( is.null(Z) ) {
      ML0[i] <-
emma.MLE(ys[i,vrows],X0[vrows,,drop=FALSE],K[vrows,vrows],NULL,ngrids,1
lim,ulim,esp)$ML
    }
    else {
      #vids <- colSums(Z[vrows,]>0)
      vids <- as.logical(colSums(Z[vrows,]>0))
      ML0[i] <-
emma.MLE(ys[i,vrows],X0[vrows,,drop=FALSE],K[vids,vids],Z[vrows,vids],n
grids,llim,ulim,esp)$ML
    }
  }
}
```