Code for Figure 2

August 6, 2016

Load the necessary libraries, source the file with the R functions:

```
library(ggplot2)
source("functions.R")
```

Will use the same theme throughout, so just declare this variable:

```
themeUsed <- theme_bw(base_size = 20) +
    theme(axis.line = element_line(colour = "black"),
        plot.title = element_text(size = 15, hjust=0.5),
        panel.grid.major = element_blank(),
        panel.grid.minor = element_blank(),
        panel.border = element_blank(),
        panel.background = element_blank(),
        legend.background = element_rect(fill="transparent"),
        legend.key = element_blank(),
        legend.text.align = 0,
        legend.position = c(0.15,0.28),
        axis.line.x = element_line(color="black", size = 0.5), ##this is to show axes - bug in this ver.
        axis.line.y = element_line(color="black", size = 0.5))</pre>
```

1 Panel a)

Get what is needed for panel a): Load the files representing the summary for each scenario with 0 heterogeneity and save the results in a single dataframe, Vars0:

```
VarsAll$known <- VarsAll$unknown <- VarsAll$univKnown <- VarsAll$univ <- NA
for(file in 1:length(allFiles))
    load(paste("simResultsComb",
                allFiles[file], sep="/"))
    rowNr <- gsub("combine_cost_of_estimation_", "", allFiles[file])</pre>
    rowNr <- gsub(".RData", "", rowNr)</pre>
    rowNr <- as.numeric(rowNr)</pre>
    VarsAll[rowNr, colnames(VarsAll)] <- Vars[rowNr, colnames(VarsAll)]</pre>
}
VarsAll$Ratio <- VarsAll$known/VarsAll$unknown</pre>
VarsAll$RelEff <- VarsAll$unknown/VarsAll$univ</pre>
VarsAll$RelEffT <- VarsAll$known/VarsAll$univKnown</pre>
range(VarsAll$Ratio)
## [1] 0.8381268 0.9947634
##only keep the ones with varBtw = 0 and I=20
Vars0 <- VarsAll[VarsAll$varBtw == 0 & VarsAll$I == 20 ,]</pre>
```

Load the files representing the summary for each scenario with non-0 heterogeneity and save the results in a single dataframe, VarsAll:

```
allFiles <- list.files("simResultsComb")</pre>
##keep only files that have "bd het" in the title
allFiles <- allFiles[grep("bd_het", allFiles)]</pre>
##save the three Vars for the different combinations
VarsAll <- expand.grid(I = 20,</pre>
                        p = 2:10,
                        corrBtw = c(0.5),
                        varBtw = c(1/5, 1, 5))
VarsAll$known <- VarsAll$unknown <- VarsAll$univKnown <- VarsAll$univ <- NA
for(file in 1:length(allFiles))
    load(paste("simResultsComb", allFiles[file], sep="/"))
    rowNr <- gsub("combine_cost_of_estimation_bd_het_", "", allFiles[file])</pre>
    rowNr <- gsub(".RData", "", rowNr)</pre>
    rowNr <- as.numeric(rowNr)</pre>
    VarsAll[rowNr, colnames(VarsAll)] <- Vars[rowNr, colnames(VarsAll)]</pre>
}
VarsAll$Ratio <- VarsAll$known/VarsAll$unknown
VarsAll$RelEff <- VarsAll$unknown/VarsAll$univ
VarsAll$RelEffT <- VarsAll$known/VarsAll$univKnown
range(VarsAll$Ratio)
## [1] 0.9538238 0.9989515
```

```
Separate out what is needed for Panel a):
Vars <- VarsAll[VarsAll$corrBtw == 0.5,]</pre>
##add in the 0 heterogeneity case
Vars <- rbind(Vars, Vars0)</pre>
RelEff.b <-
  rbind(cbind(as.matrix(Vars[,c("I", "p", "corrBtw", "varBtw", "RelEff"),]),"RelEff"),
        cbind(as.matrix(Vars[,c("I", "p", "corrBtw", "varBtw", "RelEffT"),]),"RelEffT"))
colnames(RelEff.b)[6] <- "Estimate"</pre>
RelEff.b <- as.data.frame(RelEff.b)</pre>
sapply(RelEff.b, class)
                 p corrBtw varBtw RelEff Estimate
## "factor" "factor" "factor" "factor" "factor"
RelEff.b$p <- as.numeric(as.character(RelEff.b$p))</pre>
RelEff.b$corrBtw <- as.numeric(as.character(RelEff.b$corrBtw))</pre>
RelEff.b$varBtw <- as.numeric(as.character(RelEff.b$varBtw))</pre>
RelEff.b$RelEff <- as.numeric(as.character(RelEff.b$RelEff))</pre>
panelA <- ggplot(RelEff.b, aes(x=p, y=RelEff))+</pre>
  geom_point(size=3.0, aes(color=as.factor(varBtw), shape=as.factor(varBtw)))+
  geom_line(aes(linetype=Estimate,color=as.factor(varBtw), shape=as.factor(varBtw)))+
  themeUsed +
  ylab(expression(RelEff)) +
  vlim(limits=c(0.45, 1)) +
  scale_color_discrete(name = "",
                       labels =
                          c(expression(paste(sigma^2, "/", S^2, "=",
                                              0)),
                            expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                              1/5)),
                            expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                            expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                              5)))) +
  scale_shape_discrete(name = "",
                          c(expression(paste(sigma^2, "/", S^2, "=",
                            expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                              1/5)),
                            expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
```

##"\n",

title=expression(atop("(a)",paste("Random effects: ",

5)))) +

rho^BS, " = ", 0.5, ", ",

labs(color="", shape="",

expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),

S[i]^2, phantom() %~~% phantom() , 1, ", ", rho[i], phantom() %~~% phantom(), (i-1)/I, ", ",

2 Panels b) and c)

Load the files representing the summary for each scenario and save the results in a single dataframe, VarsAll:

```
allFiles <- list.files("simResultsComb")</pre>
##remove files that have "bd_het" in the title
allFiles <- allFiles[-grep("bd_het", allFiles)]</pre>
##save the three Vars for the different combinations
VarsAll \leftarrow expand.grid(I = c(5, 10, 15, 20),
                        p = 2:10,
                        corrBtw = c(0, 0.5),
                        varBtw = c(0, 1))
##only keep combinations of corrBtw=0 & varBtw=0, corrBtw=0.5 & varBtw=0.5
VarsAll <- VarsAll[(VarsAll$corrBtw == 0 & VarsAll$varBtw == 0) |</pre>
                    (VarsAll$corrBtw == 0.5 & VarsAll$varBtw == 1) ,]
VarsAll$known <- VarsAll$unknown <- VarsAll$univKnown <- VarsAll$univ <-
  VarsAll$Bayes <- VarsAll$univBayes <- NA
for(file in 1:length(allFiles))
    load(paste("simResultsComb",
                allFiles[file], sep="/"))
    rowNr <- gsub("combine_cost_of_estimation_", "", allFiles[file])</pre>
    rowNr <- gsub(".RData", "", rowNr)</pre>
    rowNr <- as.numeric(rowNr)</pre>
    ##only consider files which have the Bayesian results included
    if(length(grep("Bayes", colnames(Vars)))>0)
      VarsAll[rowNr, colnames(VarsAll)] <- Vars[rowNr, colnames(VarsAll)]</pre>
    }
VarsAll$Ratio <- VarsAll$known/VarsAll$unknown
VarsAll$RelEff <- VarsAll$unknown/VarsAll$univ</pre>
VarsAll$RelEffT <- VarsAll$known/VarsAll$univKnown</pre>
VarsAll$RelEffB <- VarsAll$Bayes/VarsAll$univBayes</pre>
VarsAll$MVMAcomp <- VarsAll$unknown/VarsAll$Bayes</pre>
range(VarsAll$Ratio)
## [1] 0.8381268 0.9947634
```

```
VarsAll$I <- as.factor(paste("I=", VarsAll$I, sep=""))
VarsAll$I <- relevel(VarsAll$I, ref="I=5")</pre>
```

Get what is needed for panels b) and c):

```
Vars.b <- VarsAll[VarsAll$corrBtw == 0 &</pre>
  VarsAll$varBtw == 0.7
##for panel c, have RelEff, RelEffT, RelEffB
##probably easier to just create another object
RelEff.c <-
  rbind(cbind(as.matrix(Vars.b[,c("I", "p", "corrBtw", "varBtw", "RelEff", "MVMAcomp"),]),"RelEff"),
        cbind(as.matrix(Vars.b[,c("I", "p", "corrBtw", "varBtw", "RelEffT", "MVMAcomp"),]), "RelEffT"),
        cbind(as.matrix(Vars.b[,c("I", "p", "corrBtw", "varBtw", "RelEffB", "MVMAcomp"),]), "RelEffB"))
colnames(RelEff.c)[ncol(RelEff.c)] <- "Estimate"</pre>
RelEff.c <- as.data.frame(RelEff.c)</pre>
sapply(RelEff.c, class)
                 p corrBtw varBtw
                                         RelEff MVMAcomp
## "factor" "factor" "factor" "factor" "factor"
## Estimate
## "factor"
RelEff.c$p <- as.numeric(as.character(RelEff.c$p))</pre>
RelEff.c$corrBtw <- as.numeric(as.character(RelEff.c$corrBtw))</pre>
RelEff.c$varBtw <- as.numeric(as.character(RelEff.c$varBtw))</pre>
RelEff.c$RelEff <- as.numeric(as.character(RelEff.c$RelEff))</pre>
RelEff.c$MVMAcomp <- as.numeric(as.character(RelEff.c$MVMAcomp))</pre>
RelEff.c$I <- relevel(RelEff.c$I, ref="I=5")</pre>
```

3 Create plots

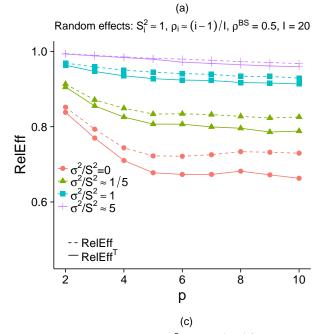
Panel b):

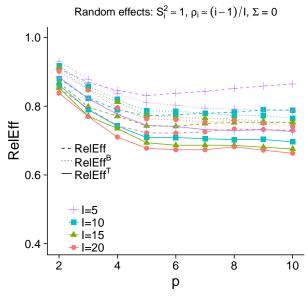
```
panelB <- ggplot(RelEff.c, aes(x=p, y=RelEff))+</pre>
  geom_point(size=3.0, aes(color=I, shape=I))+
  geom_line(aes(color=I, shape=I, linetype=Estimate))+
  themeUsed+
  ylab(expression(RelEff)) +
  ylim(min(RelEff.c$RelEff)*0.6, 1) +
  labs(color="", shape="",
       title=expression(atop("(b)", paste("Random effects: ",
                                           S[i]^2, phantom() %~~% phantom() , 1, ", ",
                                           rho[i], phantom() %~~% phantom(), (i-1)/I, ", ",
                                           Sigma, " = ", 0)))) +
  scale_linetype_manual(name = "",
                        labels =
                          c(expression(paste(RelEff)),
                            expression(paste(RelEff^B)),
                            expression(paste(RelEff^T))),
                        values=c(2,3,1))+
```

```
scale_color_manual(values=rev(gg_color_hue(4)), name="")+
scale_shape_manual(values=c(3,15,17,16),name="")
```

Panel c):

```
multiplot(panelA, panelC, panelB, cols=2)
## Loading required package: grid
```





(b)

