Code for Supplementary Figure 3

August 6, 2016

1 Get the combined datasets for all the scenarios

Load the necessary libraries:

```
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 vers
        axis.line.y = element_line(color="black", size = 0.5))
```

2 Get combined dataset for panel a)

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

```
allFiles <- list.files("../make_Figure_2/simResultsComb")
##remove all the files with "Suppl" in title
allFiles <- allFiles[-grep("Suppl", allFiles)]

##save the three Vars for the different combinations
VarsAll <- 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=1
```

```
VarsAll <- VarsAll[(VarsAll$corrBtw == 0 & VarsAll$varBtw == 0) |
                   (VarsAll$corrBtw == 0.5 & VarsAll$varBtw == 1) ,]

VarsAll$known <- VarsAll$unknown <- VarsAll$univKnown <- VarsAll$univ <- NA

for(file in 1:length(allFiles))
{
    load(paste("../make_Figure_2/simResultsComb",
               allFiles[file], sep="/"))

    rowNr <- gsub("combine_cost_of_estimation_", "", allFiles[file])
    rowNr <- gsub(".RData", "", rowNr)
    rowNr <- as.numeric(rowNr)

    VarsAll[rowNr, colnames(VarsAll)] <- Vars[rowNr, colnames(VarsAll)]
}
VarsAll$Ratio <- VarsAll$known/VarsAll$unknown
VarsAll$RelEff <- VarsAll$unknown/VarsAll$univ
VarsAll$RelEffT <- VarsAll$known/VarsAll$univKnown
range(VarsAll$Ratio)

## [1] 0.7774397 0.9941824

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

Separate out what is needed for Panel b:

```
Vars.a <- VarsAll[VarsAll$corrBtw == 0 &
  VarsAll$varBtw == 0,]
```

3 Create plot for panel b

Panel b):

```
panelB <- ggplot(Vars.a, aes(x=p, y=Ratio))+
  geom_point(size=3.0, aes(color=I, shape=I))+
  geom_line(aes(color=I, shape=I))+
  themeUsed+
  ylab(expression(paste(Var, "(", mu[1]^MT, ")", "/",
                        Var, "(", mu[1]^M, ")"))) +
  ylim(min(Vars.a$Ratio)*0.9, 1) +
  labs(color="", shape="",
       title=expression(atop("(b)", paste("Random effects: ",
                                          S[i]^2,  phantom() %~~% phantom() , 1, ", ",
                                          rho[i], phantom() %~~% phantom(), (i-1)/I, ", ",
                                          ##"\n",
                                          Sigma, " = ", 0))))
```

4 Get combined dataset for panels a),c),d)

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

```
allFiles <- list.files("../make_Figure_2/simResultsComb")
##keep only files with "Suppl" in title
allFiles <- allFiles[grep("Suppl", allFiles)]

##save the three Vars for the different combinations
VarsAll <- expand.grid(I = 20,
                       p = 2:10,
                       corrBtw = c(0, 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("../make_Figure_2/simResultsComb", allFiles[file], sep="/"))

    rowNr <- gsub("combine_cost_of_estimation_Suppl_", "", allFiles[file])
    rowNr <- gsub(".RData", "", rowNr)
    rowNr <- as.numeric(rowNr)

    VarsAll[rowNr, colnames(VarsAll)] <- Vars[rowNr, colnames(VarsAll)]
}
VarsAll$Ratio <- VarsAll$known/VarsAll$unknown
VarsAll$RelEff <- VarsAll$unknown/VarsAll$univ
VarsAll$RelEffT <- VarsAll$known/VarsAll$univKnown
range(VarsAll$Ratio)

## [1] 0.9300576 0.9993072
```

Separate out what is needed for Panels a),c)d):

```
Vars.c <- VarsAll[VarsAll$corrBtw == 0,]
Vars.b <- VarsAll[VarsAll$corrBtw == 0.5,]

###################################

##for panel d), have both RelEff and RelEffT
##probably easier to just create another object
RelEff.d <-
  rbind(cbind(as.matrix(Vars.c[,c("I", "p", "corrBtw", "varBtw", "RelEff"),]),"RelEff"),
        cbind(as.matrix(Vars.c[,c("I", "p", "corrBtw", "varBtw", "RelEffT"),]),"RelEffT"))
colnames(RelEff.d)[6] <- "Estimate"
RelEff.d <- as.data.frame(RelEff.d)
sapply(RelEff.d, class)

##        I        p  corrBtw   varBtw   RelEff Estimate
## "factor" "factor" "factor" "factor" "factor" "factor"

RelEff.d$p <- as.numeric(as.character(RelEff.d$p))
RelEff.d$corrBtw <- as.numeric(as.character(RelEff.d$corrBtw))
RelEff.d$varBtw <- as.numeric(as.character(RelEff.d$varBtw))
RelEff.d$RelEff <- as.numeric(as.character(RelEff.d$RelEff))
```

5 Create plots for panels a),c),d)

Panel a):

```
panelA <- ggplot(Vars.b, aes(x=p, y=Ratio))+
  geom_point(size=3.0, aes(color=as.factor(varBtw),
                           shape=as.factor(varBtw)))+
  geom_line(aes(color=as.factor(varBtw),
                shape=as.factor(varBtw)))+
  themeUsed+
  ylab(expression(paste(Var, "(", mu[1]^MT, ")", "/",
                        Var, "(", mu[1]^M, ")"))) +
  ylim(min(Vars.b$Ratio)*0.95, 1) +
  scale_color_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1/5)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            5)))) +
  scale_shape_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1/5)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            5)))) +
  labs(color="", shape="",
       title=expression(atop("(a)", paste("Random effects: ",
                                          S[i]^2,  phantom() %~~% phantom() , 1, ", ",
                                          rho[i], phantom() %~~% phantom(), (i-1)/I, ", ",
                                          rho^BS, " = ", 0.5, ", ",
                                          ##"\n",
                                          I, " = ", 20))))
```

Panel c):

```
panelC <- ggplot(Vars.c, aes(x=p, y=Ratio))+
  geom_point(size=3.0, aes(color=as.factor(varBtw),
                           shape=as.factor(varBtw)))+
  geom_line(aes(color=as.factor(varBtw),
                shape=as.factor(varBtw)))+
  themeUsed+
  ylab(expression(paste(Var, "(", mu[1]^MT, ")", "/",
                        Var, "(", mu[1]^M, ")"))) +
  ylim(min(Vars.c$Ratio)*0.9, 1) +
  scale_color_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "=",
                                            1/5)),
                           expression(paste(sigma^2, "=",
                                            1)),
                           expression(paste(sigma^2, "=",
                                            5)))) +
  scale_shape_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "=",
                                            1/5)),
                           expression(paste(sigma^2, "=",
                                            1)),
                           expression(paste(sigma^2, "=",
                                            5)))) +
  labs(color="", shape="",
       title=expression(atop("(c)", paste("Random effects: ",
                                          S[i]^2,  phantom() %~~% phantom() , 1, ", ",
                                          rho[i], phantom() %~~% phantom(), (i-1)/I, ", ",
                                          rho^BS, " = ", 0, ", ",
                                          ##"\n",
                                          I, " = ", 20))))
```

Panel d):

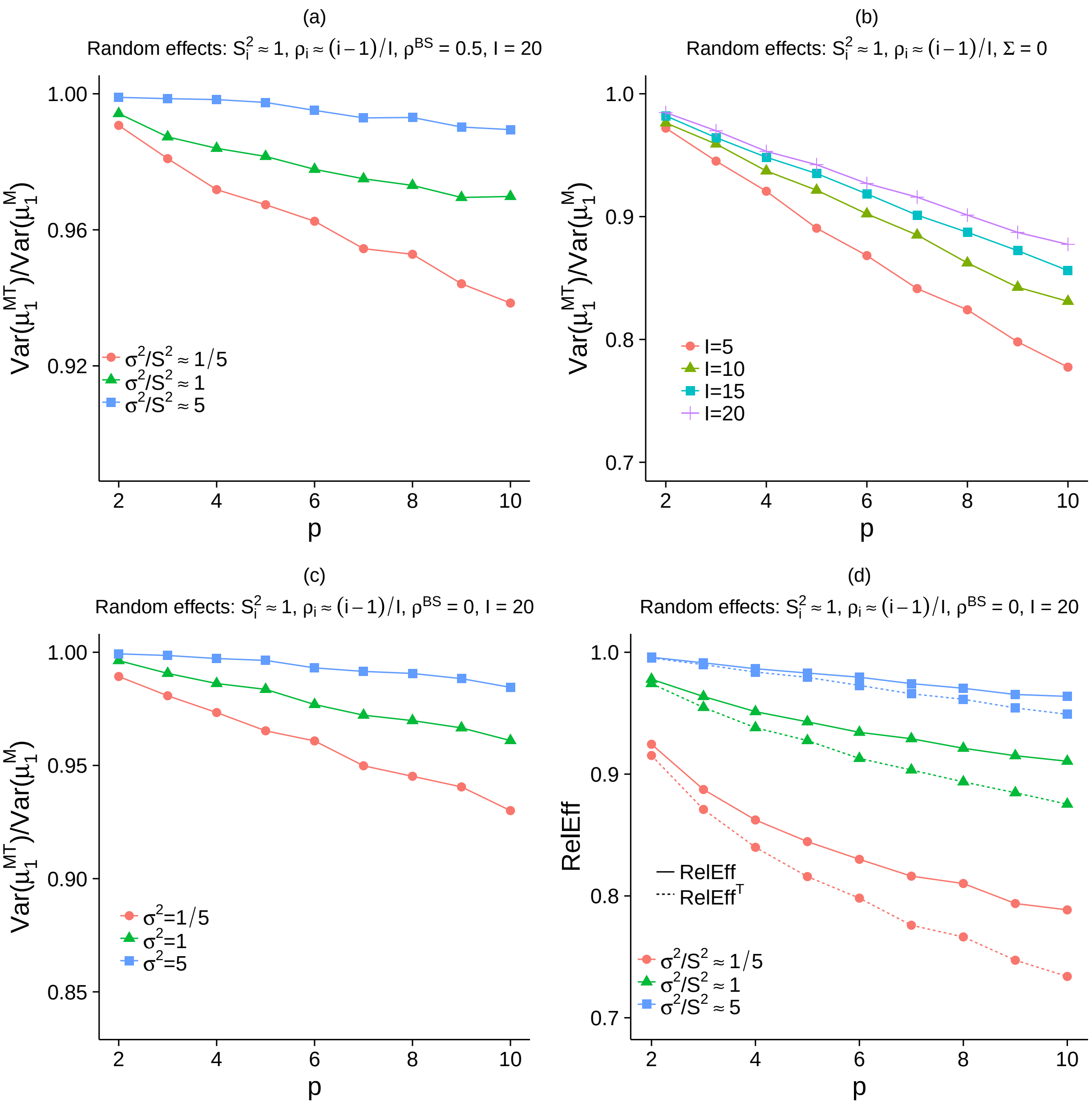
```
panelD <- ggplot(RelEff.d, aes(x=p, y=RelEff))+
  geom_point(size=3.0, aes(color=as.factor(varBtw), shape=as.factor(varBtw)))+
  geom_line(aes(color=as.factor(varBtw), shape=as.factor(varBtw), linetype=Estimate))+
  themeUsed+
  ylab(expression(RelEff)) +
  ylim(min(RelEff.d$RelEff)*0.95, 1) +
  scale_color_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1/5)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
  scale_shape_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1/5)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            5)))) +
  labs(color="", shape="",
       title=expression(atop("(d)", paste("Random effects: ",
                                          S[i]^2,  phantom() %~~% phantom() , 1, ", ",
                                          rho[i], phantom() %~~% phantom(), (i-1)/I, ", ",
                                          rho^BS, " = ", 0, ", ",
                                          ##"\n",
                                          I, " = ", 20)))) +
  scale_linetype_discrete(name = "",
                          labels =
                            c(expression(paste(RelEff)),
                              expression(paste(RelEff^T)))) +
  scale_color_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1/5)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            5)))) +
  scale_shape_discrete(name = "",
                       labels =
                         c(expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1/5)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            1)),
                           expression(paste(sigma^2, "/", S^2, phantom() %~~% phantom(),
                                            5))))

## Scale for 'colour' is already present.  Adding another
## scale for 'colour', which will replace the existing
## scale.
## Scale for 'shape' is already present.  Adding another
## scale for 'shape', which will replace the existing scale.
```

6 Put all panels together

```
multiplot(panelA, panelC, panelB, panelD, cols=2)

## Loading required package:  grid
```


(a)
Random effects: $S_i^2 \approx 1$, $\rho_i \approx (i-1)/I$, $\rho^{BS} = 0.5$, I = 20
$\mathrm{Var}(\mu_1^{MT})/\mathrm{Var}(\mu_1^{M})$
1.00
0.96
0.92
2
4
6
8
10
p
$\sigma^2/S^2 \approx 1/5$
$\sigma^2/S^2 \approx 1$
$\sigma^2/S^2 \approx 5$
(b)
Random effects: $S_i^2 \approx 1$, $\rho_i \approx (i-1)/I$, $\Sigma = 0$
$\mathrm{Var}(\mu_1^{MT})/\mathrm{Var}(\mu_1^{M})$
1.0
0.9
0.8
0.7
2
4
6
8
10
p
I=5
I=10
I=15
I=20
(c)
Random effects: $S_i^2 \approx 1$, $\rho_i \approx (i-1)/I$, $\rho^{BS} = 0$, I = 20
$\mathrm{Var}(\mu_1^{MT})/\mathrm{Var}(\mu_1^{M})$
1.00
0.95
0.90
0.85
2
4
6
8
10
p
σ^2=1/5
σ^2=1
σ^2=5
(d)
Random effects: $S_i^2 \approx 1$, $\rho_i \approx (i-1)/I$, $\rho^{BS} = 0$, I = 20
RelEff
1.0
0.9
0.8
0.7
2
4
6
8
10
p
RelEff
RelEff^T
$\sigma^2/S^2 \approx 1/5$
$\sigma^2/S^2 \approx 1$
$\sigma^2/S^2 \approx 5$