Reproduce the plots in TOWARD BETTER BIAS ANALYSIS

Paul Gustafson

03/01/2021

Production plots require extra plotting code

```
PRDCTN <- F
if (PRDCTN) {
source("C:/Users/paulg/ownCloud/OPUS2/Rcode/AuxFunctions.R")
}
```

Simulate from the posterior distribution

```
logit <- function(p) {log(p)-log(1-p)}

m <- 400000
plt <- sample(1:m, size=500)   ### don't saturate plots with ink
set.seed(13)

th.0.hat <- 103/(103+844)
th.1.hat <- 118/(118+832)

th.0 <- rbeta(m, 1+103, 1+884)
th.1 <- rbeta(m, 1+118, 1+832)

ppv.0 <- rbeta(m, 1+18, 1+4)
npv.0 <- rbeta(m, 1+130, 1+13)

ppv.1 <- rbeta(m, 1+24,1+2)
npv.1 <- rbeta(m, 1+144, 1+19)

r.0 <- th.0*ppv.0 + (1-th.0)*(1-npv.0)
sn.0 <- th.0*ppv.0/r.0
sp.0 <- 1 - th.0*(1-ppv.0)/(1-r.0)

r.1 <- th.1*ppv.1 + (1-th.1)*(1-npv.1)
sn.1 <- th.1*ppv.1/r.1
sp.1 <- 1 - th.1*(1-ppv.1)/(1-r.1)
```

Generate some summaries and analyses

```
ans.nv <- logit(th.1)-logit(th.0)

sn.0.hat <- 18/31
sn.1.hat <- 24/43

sp.0.hat <- 130/134
sp.1.hat <- 144/146
```

```
### point correction - wrong
ans.nv2 <- logit(th.1/sn.1.hat) - logit(th.0/sn.0.hat)

### point correction -better
ans.nv3 <- logit((th.1-(1-sp.1.hat))/(sn.1.hat+sp.1.hat-1)) -
           logit((th.0-(1-sp.0.hat))/(sn.0.hat+sp.0.hat-1))

### fully adjusted
ans.adj <- logit(r.1)-logit(r.0)
```

Fully adjusted inference

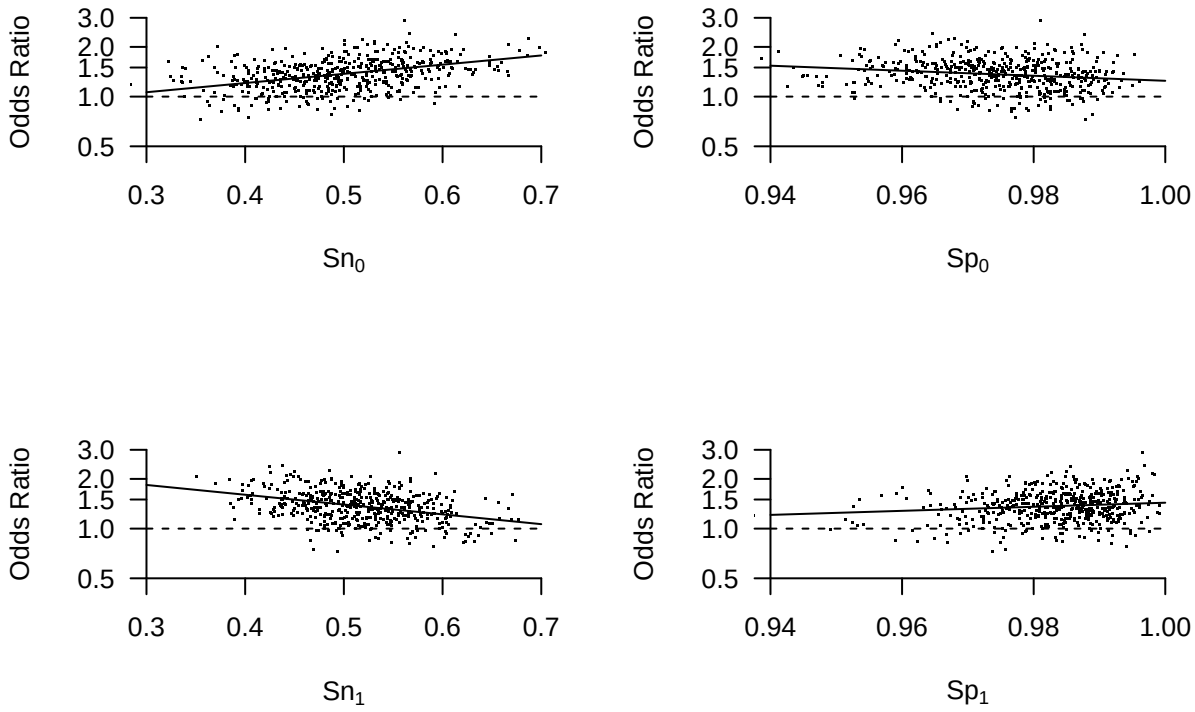
```
round(exp(quantile(ans.adj, c(.025, .5, .975))),2)
```

```
##  2.5%   50% 97.5%
##  0.88  1.37  2.14
```

Figure 1

```
if (PRDCTN) {
  pdf.PG("Fig1.pdf",2,2,ttlspc=T)
  par(cex=0.6)
  par(oma=c(2,2,2,0))
  par(mar=c(3, 2.8, 1.7, 2))
} else {
  par(mfrow=c(2,2))
}

# Part A)

plot(sn.0[plt],exp(ans.adj[plt]),
     pch=".", log="y", xaxt='n', yaxt='n', frame=F,
     xlim=c(0.3,0.7), ylim=c(0.5,3.0),
     ylab="Odds Ratio", xlab=expression(Sn[0]), main="")
axis(1, at=seq(from=.3, to=.7, by=0.1), pos=0.5)
axis(2, at=c(0.5,1.0,1.5,2.0,3.0), pos=.3, las=1)

# ref line - null
points(c(0.3,0.7), c(1,1), type="l", lty=2)

# ref line - LS
tmp <- lm(ans.adj~sn.0)
gr <- c(.3,.7)
points(gr, exp(tmp$coef[1]+gr*tmp$coef[2]), type="l")

# Part B)

plot(sp.0[plt],exp(ans.adj[plt]),
     pch=".", log="y", xaxt='n', yaxt='n', frame=F,
     xlim=c(0.94,1), ylim=c(0.5,3.0),
     xlab=expression(Sp[0]), ylab="Odds Ratio", main="")

axis(1, at=seq(from=0.94, to=1, by=0.02), pos=0.5)
axis(2, at=c(0.5,1.0,1.5,2.0,3.0), pos=.94, las=1)
```

```r
# ref line - null
points(c(0.94,1), c(1,1), type="l", lty=2)

# ref line - LS
tmp <- lm(ans.adj~sp.0)
gr <- c(.94,1)
points(gr, exp(tmp$coef[1]+gr*tmp$coef[2]), type="l")

# Part C)

plot(sn.1[plt],exp(ans.adj[plt]),
     pch=".", log="y", xaxt='n', yaxt='n', frame=F,
     xlim=c(0.3,0.7), ylim=c(0.5,3.0),
     ylab="Odds Ratio", xlab=expression(Sn[1]), main="")

axis(1, at=seq(from=.3, to=.7, by=0.1), pos=0.5)
axis(2, at=c(0.5,1.0,1.5,2.0,3.0), pos=.3, las=1)

# ref line - null
points(c(0.3,0.7), c(1,1), type="l", lty=2)

# ref line - LS
tmp <- lm(ans.adj~sn.1)
gr <- c(.3,.7)
points(gr, exp(tmp$coef[1]+gr*tmp$coef[2]), type="l")

# Part D)
plot(sp.1[plt],exp(ans.adj[plt]),
     pch=".", log="y", xaxt='n', yaxt='n', frame=F,
     xlim=c(0.94,1), ylim=c(0.5,3.0),
     xlab=expression(Sp[1]), ylab="Odds Ratio", main="")

axis(1, at=seq(from=0.94, to=1, by=0.02), pos=0.5)
axis(2, at=c(0.5,1.0,1.5,2.0,3.0), pos=.94, las=1)

# ref line - null
points(c(0.94,1), c(1,1), type="l", lty=2)

# ref line - LS
tmp <- lm(ans.adj~sp.1)
gr <- c(.94,1)
points(gr, exp(tmp$coef[1]+gr*tmp$coef[2]), type="l")
```

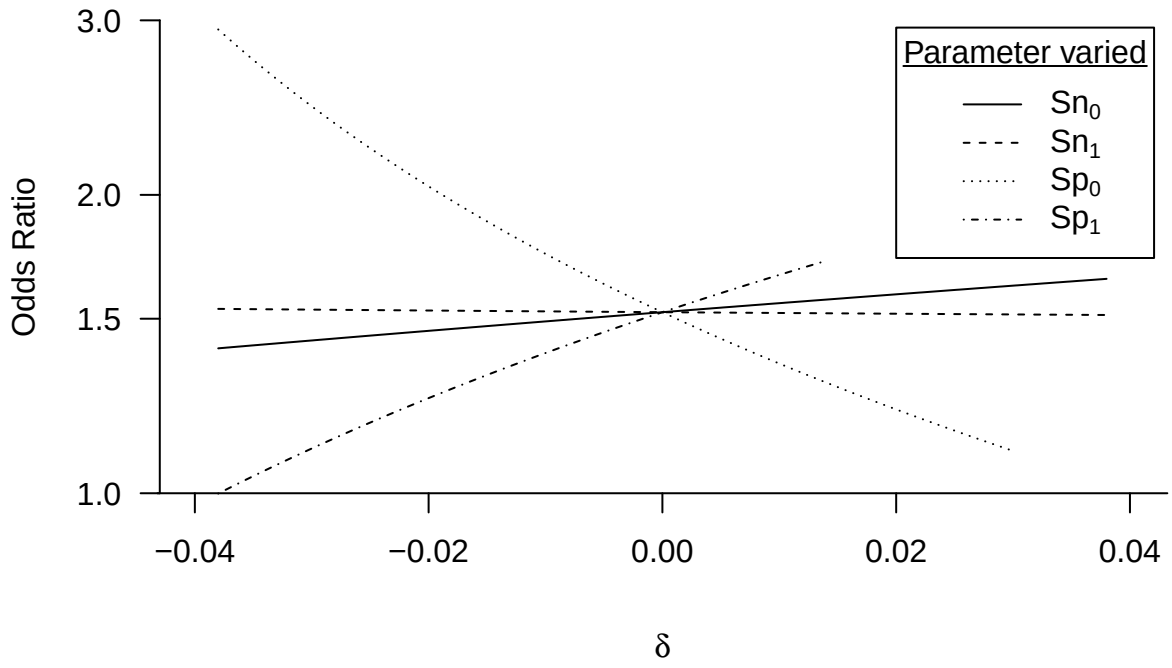



```
if (PRDCTN) {
  graphics.off()
}
```

Figure 2

```
if (PRDCTN) {
  pdf.PG("Fig2.pdf",1,1)
  par(cex=0.6)
  par(oma=c(2,2,2,0))
}

gr <- seq(from=(-.038), to=0.038, length=501)

### vary sn.0.hat
tmp <- logit((th.1.hat-(1-sp.1.hat))/(sn.1.hat+sp.1.hat-1)) -
       logit((th.0.hat-(1-sp.0.hat))/(sn.0.hat+gr+sp.0.hat-1))

plot(gr, exp(tmp), xaxt='n', yaxt='n', frame=F,
     log="y",type="l",
     xlim=c(-0.04,.04),
     ylim=c(1,3),
     xlab=expression(delta),ylab="Odds Ratio")

axis(1, at=seq(from=-0.4, to=0.4, by=0.02), pos=1)
axis(2, at=c(1,1.5,2.0,3.0), pos=-.043, las=1)
```

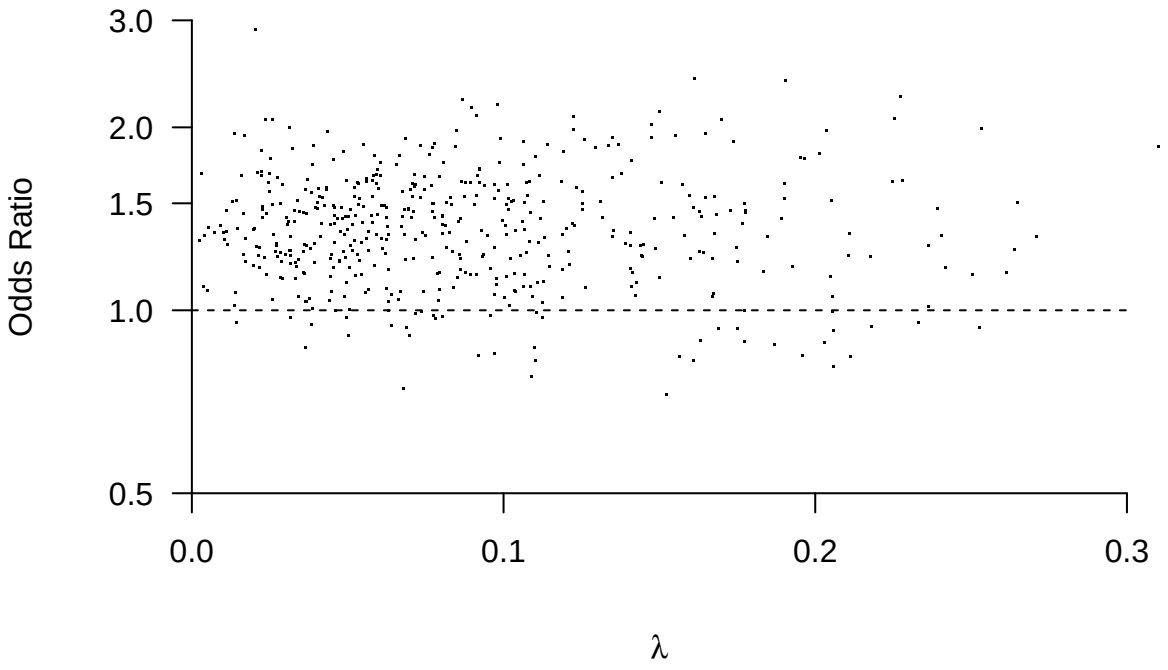
```
legend(0.02,2.95,
  legend=c(expression(Sn[0]), expression(Sn[1]),
           expression(Sp[0]), expression(Sp[1])),
  lty=1:4,
  title=expression(underline("Parameter varied")))



### vary sn.1.hat
tmp <- logit((th.1.hat-(1-sp.1.hat))/(sn.1.hat+gr+sp.1.hat-1)) -
       logit((th.0.hat-(1-sp.0.hat))/(sn.0.hat+gr+sp.0.hat-1))
points(gr,exp(tmp), type="l", lty=2)

### vary sp.0.hat
ndx <- ((sp.0.hat+gr)<1)

tmp <- logit((th.1.hat-(1-sp.1.hat))/(sn.1.hat+sp.1.hat-1)) -
  logit((th.0.hat-(1-(sp.0.hat+gr[ndx])))/(sn.0.hat+sp.0.hat+gr[ndx]-1))

points(gr[ndx], exp(tmp),
  type="l", lty=3)

### vary sp.1.hat
ndx <- ((sp.1.hat+gr)<1)

tmp <- logit((th.1.hat-(1-(sp.1.hat+gr[ndx])))/(sn.1.hat+sp.1.hat+gr[ndx]-1)) -
  logit((th.0.hat-(1-sp.0.hat))/(sn.0.hat+sp.0.hat-1))

points(gr[ndx], exp(tmp), type="l",lty=4)
```




```
if (PRDCTN) {
  graphics.off()
}
```

Figure 3

```
if (PRDCTN) {
  pdf.PG("Fig3.pdf",1,1)
  par(cex=0.6)
  par(oma=c(2,2,2,0))
}

tmp <- abs(sn.0-sn.1) +
       abs(sp.0-sp.1)

plot(tmp[plt], exp(ans.adj[plt]),
     pch=".",log="y", xaxt='n', yaxt='n', frame=F,
     xlim=c(0,.3), ylim=c(0.5,3),
     ylab="Odds Ratio", xlab=expression(lambda))

axis(1, at=seq(from=0, to=0.3, by=0.1), pos=0.5)
axis(2, at=c(0.5,1.0,1.5,2.0,3.0), pos=0, las=1)

points(c(0,.3),c(1,1), type="l",lty=2)
```




```
if (PRDCTN) {
  graphics.off()
}
```

Posterior prob effect is negative, overall, then stratified by differential parameter being below/above median

```
mean(ans.adj<0)
```

```
## [1] 0.08359
```

```
mean(ans.adj[tmp<=median(tmp)]<0)
```

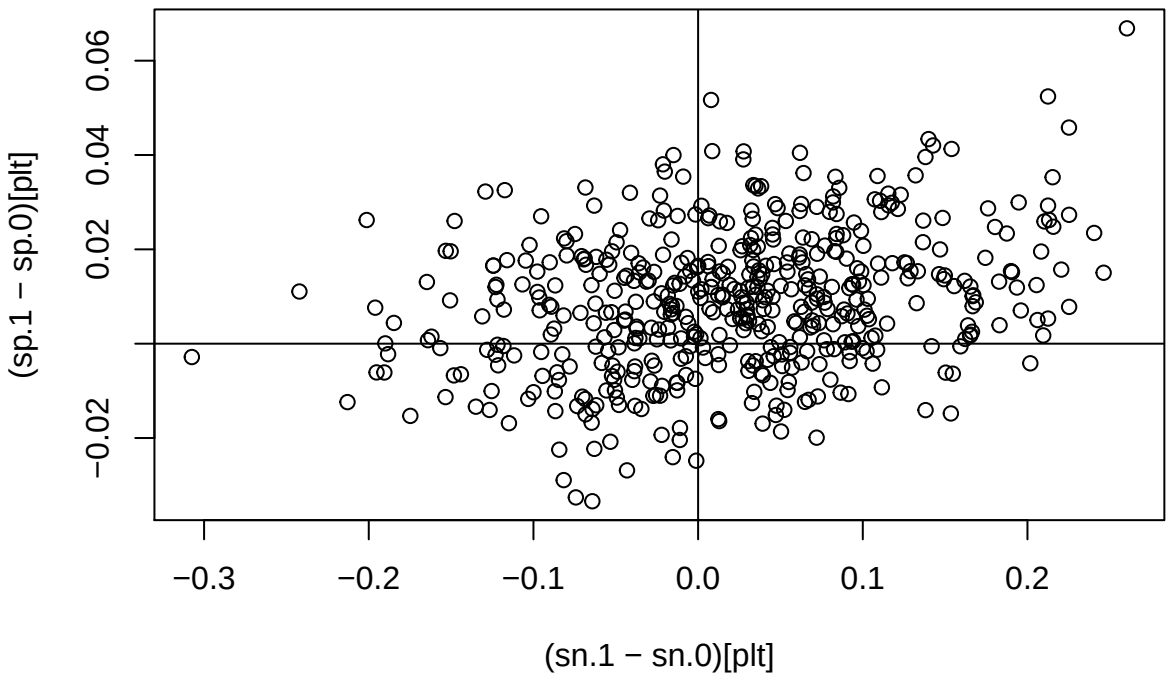
```
## [1] 0.04355
```

```
mean(ans.adj[tmp>median(tmp)]<0)
```

```
## [1] 0.12363
```

Not shown - bivariate dist of $(Sn_1 - Sn_0, Sp_1 - Sp_0)$.

```
plot((sn.1-sn.0)[plt], (sp.1-sp.0)[plt])
abline(h=0)
abline(v=0)
```


(sp.1 − sp.0)[plt]
0.06
0.04
0.02
−0.02
−0.3
−0.2
−0.1
0.0
0.1
0.2
(sn.1 − sn.0)[plt]