```
#You will often need packages and may need to install packages
#the first time you use a given computer.

install.packages("glmnet"); install.packages("leaps")

source("http://parker.ad.siu.edu/Olive/slpack.txt")

library(glmnet); library(MASS); library(leaps); library(survival)

banknote<-matrix(scan(),nrow=200,ncol=7,byrow=T)
#copied from the Cook and Weisberg ARC software
#or get from Weisberg's alr3 R package
#diagonal causes perfect separation and problems for BE
bank<-as.data.frame(banknote[,-7])
names(bank)<-c("status","length","left","right","bottom","top")
outf<-glm(status~.,family=binomial,data=bank)
y<-bank[,1]
x<-bank[,-1]
outbe<-vsLRboot2(x,y)
outbe$bhatimin0
out2<-glm(y~right+bottom+top,family=binomial,data=bank)
apply(outbe$betas,2,shorth3)
[1] -171266.52   44269.76
[1] -110.8499  285.0360
[1] -901.9596  962.1926
[1] -615.2445  964.0086
[1]    2.939766 1615.781158
[1]    4.09365 2324.23184
apply(outbe$btmix,2,shorth3)
[1] -66936.540    514.843
[1] -19.51313  36.63630
[1] -101.4159  320.9318
[1] -152.7484  261.8384
[1]   2.792621 519.315755
[1]   3.888964 798.077161
#test if beta_2 = beta_3 = beta_4 = 0
Abeta <- outbe$betas[,2:4]
#prediction region method
outvs<-predreg(Abeta)
$cuplim
  95.15%
1.993825
$D0
[1] 0.2028501
#test if beta_2 = beta_3 = beta_4 = 0
```

```
Abeta <- outfull$betas[,2:4]
#prediction region method
outf<-predreg(Abeta)
$cuplim
   95.15%
0.8939957
$D0
[1] 0.19243
#ratio of volumes for BE and full model
(sqrt(det(outvs$cov))*outvs$D0^3)/(sqrt(det(outf$cov))*outf$D0^3)
[1] 2.285524
#BE had lots of 0s but also lots of huge estimators
#also ESP range was really high which gives MLE difficulties

#test if beta_2 = beta_3 = beta_4 = 0
Abeta <- outbe$btmix[,2:4]
#prediction region method
outmix<-predreg(Abeta)
#failed

#ratio of volumes for MIX and full model
(sqrt(det(outmix$cov))*outmix$D0^3)/(sqrt(det(outf$cov))*outf$D0^3)

possum<-matrix(scan(),nrow=151,ncol=7,byrow=T)
#copied from the Cook and Weisberg ARC software
y<-possum[,7]
x<-possum[,-7]
possum<-as.data.frame(possum)
names(possum) <-c("acacia","bark","habitat","shrubs","stags","stumps","y")
prplot(x,y) #no overdispersion

out<-glm(y~.,family=poisson,data=possum)
summary(out)
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -1.04276    0.24796  -4.205 2.61e-05 ***
acacia       0.01656    0.01027   1.612  0.10701
bark         0.03612    0.01400   2.579  0.00991 **
habitat      0.07617    0.03749   2.032  0.04220 *
shrubs       0.01451    0.02053   0.707  0.47976
stags        0.03254    0.01030   3.161  0.00157 **
stumps      -0.39075    0.28658  -1.364  0.17272
#BE keep bark, habitat, stags

outvs<-vsPRboot2(x,y) #1 minute
```

```
apply(outvs$betas,2,shorth3)
[1] -1.5662066 -0.5168532
[1] 0.00000000 0.03835547
[1] 0.00000000 0.05928499
[1] 0.0000000 0.1524235
[1] 0.00000000 0.05582123
[1] 0.00000000 0.05395911
[1] -0.9325927  0.0000000

apply(outvs$btmix,2,shorth3)
[1] -1.3680334 -0.3552789
[1] -0.0003774565  0.0397273310
[1] 0.00000000 0.05633108
[1] 0.0000000 0.1583799
[1] -0.01596326  0.04531568
[1] 0.00000000 0.05396789
[1] -0.8402184  0.1514880

outfull <- PRboot(x,y)
#test if beta_2 = beta_5 = beta_7 = 0
Abeta <- outfull$betas[,c(2,5,7)]
#prediction region method
outf<-predreg(Abeta)
$cuplim
  95.15%
2.773133
$D0
[1] 2.066745

#test if beta_2 = beta_5 = beta_7 = 0
Abeta <- outvs$betas[,c(2,5,7)]
#prediction region method
outbe<-predreg(Abeta)
$cuplim
  95.15%
2.702536
$D0
[1] 1.327213
#ratio of volumes for BE and full model
(sqrt(det(outbe$cov))*outbe$D0^3)/(sqrt(det(outf$cov))*outf$D0^3)
 0.3216447

#test if beta_2 = beta_5 = beta_7 = 0
Abeta <- outvs$btmix[,c(2,5,7)]
#prediction region method
```

```
outmix<-predreg(Abeta)
$cuplim
  95.15%
3.156637
$D0
[1] 1.066531

#ratio of volumes for MIX and full model
(sqrt(det(outmix$cov))*outmix$D0^3)/(sqrt(det(outf$cov))*outf$D0^3)
[1] 0.1165704

#table 4
library(glmnet)
library(survival)
RLPHbootsim2(BB=200,k=2,nruns=5000) #1 day
$cicov
 [1] 0.9372 0.9416 0.9894 0.9882 0.9698
0.9744 0.9774 0.9474 0.9664 0.9754
$avelen
 [1] 0.8521466 0.8525426 0.7282778 0.7258135
2.5439638 2.5439638 2.6467454
 [8] 2.5152051 2.5152051 2.6400616
$cicovmix
 [1] 0.9404 0.9424 0.9924 0.9918 0.9794
0.9776 0.9810 0.9458 0.9660 0.9756
$avelenmix
 [1] 0.8427528 0.8408888 0.6671034 0.6664256
2.6910880 2.6910880 2.7578615
 [8] 2.5145540 2.5145540 2.6234295
$beta
[1] 1 1 0 0
$k
[1] 2


RLPHbootsim2(BB=200,k=2,psi=0.5,nruns=5000)
#1 day
$cicov
 [1] 0.9678 0.9602 0.9922 0.9904 0.9798
0.9794 0.9840 0.9760 0.9654 0.9754
$avelen
 [1] 2.064483 2.064182 2.046634 2.045351
2.783542 2.783542 2.931524 2.557524
 [9] 2.557524 2.688334
$cicovmix
```

```
 [1] 0.9440 0.9400 0.9926 0.9922 0.9844
0.9844 0.9900 0.9330 0.9444 0.9534
$avelenmix
 [1] 2.219767 2.212316 1.970730 1.969206
2.783700 2.783700 2.929413 2.546251
 [9] 2.546251 2.666817
$beta
[1] 1 1 0 0
$k
[1] 2

#0.9 causes convergence issues
RLPHbootsim2(BB=200,k=2,psi=0.9,nruns=5000)

#full model
PHbootsim(nruns=5000,B=200,k=2,psi=0) #one hour
$cicov
 [1] 0.9364 0.9344 0.9522 0.9564 0.9512
0.9622 0.9680 0.9448 0.9654 0.9740
$avelen
 [1] 0.8505280 0.8523898 0.7440659
0.7435776 2.5246971 2.5246971 2.5522047
 [8] 2.5139238 2.5139238 2.6396088
$beta
[1] 1 1 0 0
$k
[1] 2

PHbootsim(nruns=5000,B=200,k=2,psi=0.5)
$cicov
 [1] 0.9454 0.9534 0.9542 0.9512 0.9512
0.9632 0.9652 0.9438 0.9618 0.9676
$avelen
 [1] 2.372077 2.373428 2.332737 2.338152
2.529054 2.529054 2.556168 2.522359
 [9] 2.522359 2.571274
$beta
[1] 1 1 0 0
$k
[1] 2


PHbootsim(nruns=5000,B=200,k=2,psi=0.9) #n=100,p=4
$cicov
 [1] 0.9522 0.9508 0.9438 0.9534 0.9450 0.9590
```

```
0.9634 0.9490 0.9630 0.9636
$avelen
 [1] 16.850336 16.870085 16.939576 16.892691
2.527421  2.527421  2.554732
 [8]  2.525794  2.525794  2.553295
$beta
[1] 1 1 0 0
$k
[1] 2


#table 3
library(MASS)
source("http://lagrange.math.siu.edu/Olive/slpack.txt")
vsprbootsim2(n=250,p=10,k=1,psi=0.9,BB=500,int=1,a=1,nruns=5000)

vsprbootsim2(n=250,p=10,k=1,psi=0.0,BB=500,int=1,a=1,nruns=5000)
$cicov #3 days
 [1] 0.9468 0.9524  0.9990 0.9982 0.9986 0.9972 0.9972
0.9988   0.9980 0.9990 0.9976 0.9974 0.9988 0.9498 0.9540 0.9580
$avelen
 [1] 0.1751435 0.1322283 0.1045801 0.1047333 0.1053999
0.1051324 0.1053139 0.1052327   0.1046373 0.1043775
[11] 4.3025484 4.3025484 4.7395933 2.4524567 2.4524567 2.4991058
$cicovmix
 [1] 0.9484 0.9534  0.9994 0.9990 0.9990 0.9978 0.9978 0.9992
0.9986 0.9996 1.0000 0.9996 0.9998 0.9510
[15] 0.9494 0.9508
$avelenmix
 [1] 0.17367535 0.12890569 0.08844147 0.08756616 0.08761665
0.08807070 0.08791330 0.08731638 0.08786960
[10] 0.08781295 5.12167940 5.12167940 5.39648203 2.45328226
2.45328226 2.47467943
$beta
 [1] 1 1 0 0 0 0 0 0 0 0
$k
[1] 1

library(MASS)
source("http://lagrange.math.siu.edu/Olive/slpack.txt")
vsprbootsim2(n=250,p=10,k=1,psi=0.9,BB=500,int=1,a=1,nruns=5000)
$cicov
 [1] 0.9482 0.9426 0.9982 0.9980 0.9986 0.9982 0.9990 0.9990
0.9980 0.9988 0.9984 0.9970 0.9988 0.9682 0.9670 0.9726
$avelen
```

```
 [1] 0.1751834 2.8617355 2.8165813 2.8070626 2.8077379 2.7969156
2.8018353 2.7972642   2.8096060 2.8199496 4.2612122 4.2612122
4.6854449 2.4803694
[15] 2.4803694 2.6376792
$cicovmix
 [1] 0.9506 0.9214 0.9988 0.9984 0.9990 0.9990 0.9994 0.9996
0.9984 0.9990 0.9998 0.9990 0.9996 0.8990 0.8738 0.8976
$avelenmix
 [1] 0.1735466 2.5271761 2.2299102 2.2314928 2.2255775 2.2252809
2.2302524 2.2344084   2.2306391 2.2282116 4.9710912 4.9710912
5.2874943 2.5688852
[15] 2.5688852 2.7109910
$beta
 [1] 1 1 0 0 0 0 0 0 0 0
$k
[1] 1


#table 2
binregbootsim(n=200,p=4,k=1,psi=0.0,m=1,B=200,int=0,a=5/3,nruns=5000)
$cicov
 [1] 0.9504 0.9440 0.9552 0.9544 0.9584 0.9662 0.9674 0.9580 0.9662 0.9728
$avelen
 [1] 0.7538862 0.6770763 0.4582570 0.4587556 2.4884031 2.4884031 2.4992048
 [8] 2.4846499 2.4846499 2.5745589
$beta
[1] 0 1 0 0
$k
[1] 1

#5 hours
vsbrbootsim2(n=200,p=4,k=1,psi=0.0,m=1,BB=200,int=0,a=5/3,
nruns=5000,binary=T)
$cicov
 [1] 0.9540 0.9484 0.9982 0.9980 0.9960 0.9926 0.9972 0.9616 0.9682 0.9762
$avelen
 [1] 0.7498969 0.6751495 0.3927350 0.3903652 2.7250987 2.7250987 3.0308846
2.4817954 2.4817954 2.5749440
$cicovmix
 [1] 0.9562 0.9474 0.9988 0.9984 0.9978 0.9936 0.9978 0.9618 0.9648 0.9704
$avelenmix
 [1] 0.7401919 0.6632245 0.3205373 0.3219557 3.1292825 3.1292825 3.3411016
2.4823281 2.4823281 2.5484023
$beta
[1] 0 1 0 0
```

```
$k
[1] 1

#5 hours
vsbrbootsim2(n=200,p=4,k=1,psi=0.9,m=1,BB=200,int=0,a=5/3,
nruns=5000,binary=T)
$cicov
 [1] 0.9540 0.9490 0.9960 0.9966 0.9928 0.9906 0.9956 0.9756 0.9798 0.9838
$avelen
 [1] 0.7502585 5.3200162 5.3848252 5.3880475 2.7883864 2.7883864 3.0389941
2.5876468 2.5876468 2.7228211
$cicovmix
 [1] 0.9546 0.9664 0.9972 0.9968 0.9956 0.9890 0.9964 0.9772 0.9676 0.9738
$avelenmix
 [1] 0.7407268 3.9383258 3.8594983 3.8652509 2.8685002 2.8685002 3.0459042
2.6038264 2.6038264 2.7065515
$beta
[1] 0 1 0 0
$k
[1] 1

binregbootsim(nruns=5000, n=200,p=4,B=200,psi=0.9,k=1,m=1,a=5/3)
$`cicov`
 [1] 0.9470 0.9532 0.9490 0.9524 0.9544 0.9660 0.9672 0.9552 0.9626 0.9654
$avelen
 [1] 0.7544891 6.1001012 6.0835972 6.0805560 2.4906811 2.4906811 2.5001671
 [8] 2.4862073 2.4862073 2.4968331
$beta
[1] 0 1 0 0
$k
[1] 1

library(leaps)

regbootsim3(n=100,p=4,k=1,nruns=5000,type=3,psi=0.0,BB=1000)
$cicov
 [1] 0.9390 0.9492 0.9492 0.9436 0.9408 0.9422 0.9422 0.9366 0.9374 0.9378
$avelen
 [1] 0.3925734 0.3996466 0.3988171 0.3997443 2.4738114 2.4738114 2.4749873
 [8] 2.4531369 2.4531369 2.4547692
$beta
[1] 1 1 0 0
$k
[1] 1
```

```
regbootsim3(n=100,p=4,k=1,nruns=5000,type=3,psi=0.9,BB=1000)
$cicov
 [1] 0.9404 0.9476 0.9528 0.9534 0.9458 0.9478 0.9478 0.9334 0.9334 0.9322
$avelen
 [1] 0.3918422 3.2487498 3.2492677 3.2487933 2.4751225 2.4751225 2.4763185
 [8] 2.4538394 2.4538394 2.4548728
$beta
[1] 1 1 0 0
$k
[1] 1

vsbootsim5(n=100,p=4,k=1,nruns=5000,type=3,psi=0.0,BB=1000)
$cicov
 [1] 0.9376 0.9438 0.9988 0.9974 0.9942 0.9836 0.9950 0.9318 0.9332 0.9342
$avelen
 [1] 0.3921993 0.3984681 0.3225366 0.3235926 2.7088778 2.7088778 3.0143763
 [8] 2.4529581 2.4529581 2.4599484
$cicovmix
 [1] 0.9366 0.9432 0.9990 0.9982 0.9976 0.9868 0.9952 0.9302 0.9306 0.9308
$avelenmix
 [1] 0.3906435 0.3969195 0.2739191 0.2776482 3.0715816 3.0715816 3.2882633
 [8] 2.4546526 2.4546526 2.4585308
$beta
[1] 1 1 0 0
$k
[1] 1

vsbootsim5(n=100,p=4,k=1,nruns=5000,type=3,psi=0.9,BB=1000)
$cicov
 [1] 0.9406 0.9664 0.9956 0.9972 0.9924 0.9830 0.9942 0.9570 0.9534 0.9620
$avelen
 [1] 0.3926322 2.7535471 2.7212812 2.7133389 2.7122289 2.7122289 2.9495222
 [8] 2.4923898 2.4923898 2.5970979
$cicovmix
 [1] 0.9410 0.9716 0.9974 0.9978 0.9948 0.8732 0.9956 0.9376 0.8924 0.9348
$avelenmix
 [1] 0.3911401 2.1045726 1.9993233 2.0004478 2.5468495 2.5468495 2.8283883
 [8] 2.4477006 2.4477006 2.6104396
$beta
[1] 1 1 0 0
$k
[1] 1

vsbootsim5(n=100,p=4,k=1,nruns=5000,type=3,psi=0,BB=250)
$cicov
```

```
 [1] 0.9356 0.9510 0.9982 0.9984 0.9946 0.9812 0.9944 0.9294 0.9290 0.9306
$avelen
 [1] 0.4006713 0.4069988 0.3420695 0.3426422 2.7211399 2.7211399 3.0292225
 [8] 2.4622647 2.4622647 2.4730994
$cicovmix
 [1] 0.9374 0.9504 0.9986 0.9988 0.9960 0.9838 0.9954 0.9294 0.9288 0.9296
$avelenmix
 [1] 0.3988261 0.4058259 0.2869574 0.2874644 3.1026939 3.1026939 3.3232261
 [8] 2.4634359 2.4634359 2.4713636
$beta
[1] 1 1 0 0
$k
[1] 1

vsbootsim5(nruns=5000) #N(0,1), n = 100, p =4, k = 1, B = 1000, psi=0
$cicov
 [1] 0.9452 0.9450 0.9970 0.9974 0.9928 0.9786 0.9934 0.9370 0.9390 0.9406
$avelen
 [1] 0.3965409 0.3998947 0.3252518 0.3232949 2.6847658 2.6847658 3.0010036
 [8] 2.4498365 2.4498365 2.4568628
$cicovmix
 [1] 0.9456 0.9466 0.9978 0.9982 0.9952 0.9832 0.9950 0.9366 0.9378 0.9386
$avelenmix
 [1] 0.3950377 0.3978288 0.2796063 0.2780082 3.0736196 3.0736196 3.2969097
 [8] 2.4499012 2.4499012 2.4541853
$beta
[1] 1 1 0 0
$k
[1] 1
vsbootsim5(nruns=5000,psi=0.9)
$cicov
 [1] 0.9440 0.9668 0.9952 0.9960 0.9920 0.9826 0.9930 0.9610 0.9584 0.9648
$avelen
 [1] 0.3957966 2.7651913 2.7341585 2.7394893 2.7187293 2.7187293 2.9672549
 [8] 2.4995321 2.4995321 2.5982596
$cicovmix
 [1] 0.9454 0.9716 0.9972 0.9968 0.9950 0.8728 0.9930 0.9434 0.8914 0.9398
$avelenmix
 [1] 0.3940542 2.1033635 2.0044654 2.0042583 2.5353342 2.5353342 2.8205079
 [8] 2.4529385 2.4529385 2.6104248
$beta
[1] 1 1 0 0  #k = 1
```