Stat 407 Lab 11 Computer Simulation Fall 2012
Due: Wed, Nov 7 in class

In this lab we will explore the sensitivity of the Wilks Λ statistic for MANOVA to violations of the assumptions. We'll run a computer simulation experiment and examine the changes in Wilks Λ after varying the variance-covariance, and distribution.

1. Comparing the Wilks Λ for two samples with difference variance-covariance.

   (a) Simulate a data set that has two groups, both bivariate normal samples with different means and the same variance-covariance. Make a plot of your data, and turn this in.

   (b) Simulate a data set that has two groups, both bivariate normal samples with different means and one variance-covariance is twice the size of the other. Make a plot of your data, and turn this in.

   (c) Simulate a data set that has two groups, both bivariate normal samples with different means and one variance-covariance is four times the size of the other. Make a plot of your data, and turn this in.

   (d) Now we'll repeatedly make samples and compute the Wilks Λ and the p-values. Generate a sample with equal variance-covariance, and do MANOVA. Write these values in a table, like the one below. Repeat this 9 more times, recording the results. Now generate a sample where one group has twice the variance-covariance of the other, do MANOVA and record results. Repeat this 9 more times. Do this again for data where one group's variance-covariance is four times that of the other.

	Same var-cov		2x var-cov		4x var-cov	
Run	Λ	p-value	Λ	p-value	Λ	p-value
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Mean						
SD						

   (e) Compute the means and sd of the runs. What do you notice about the values of Λ and p-value? Include in your explanation (1) what happens from sample to sample, simulated from the same model, and (2) how the values change when the variance-covariance of one group is increased.

   (f) Explain **why** the Λ change as the variance-covariance of one group is increased.

2. How would you design a simulation study to understand the effect of distribution on the MANOVA test results? No need to run a simulation, just tell me how you'd approach this.

3. How would you design a study to compare the differences in results given by MANOVA and ANOVA? You don't need to run a simulation, just tell me how you would approach this.

Notes:

- Simulate samples with same var-cov

```
n1=50
n2=50
mn1<-c(0,0)
mn2<-c(0.5,0.5)
vc1<-matrix(c(1,-0.5,-0.5,1),ncol=2,byrow=T)
vc2<-matrix(c(1,-0.5,-0.5,1),ncol=2,byrow=T)
testdata<-rbind(rmvnorm(n1, mn1, vc1), rmvnorm(n2, mn2, vc2))
group<-c(rep("A",n1),rep("B",n2))
testdata<-data.frame(testdata, group)
head(testdata)
qplot(X1, X2, data=testdata, colour=group)
```

- Compute Wilks Λ

```
summary(manova(cbind(X1,X2)~group, testdata), test="Wilks")
```

- Simulate samples diff var-cov

```
n1=50
n2=50
mn1<-c(0,0)
mn2<-c(0.5,0.5)
vc1<-matrix(c(1,-0.5,-0.5,1),ncol=2,byrow=T)
vc2<-2*matrix(c(1,-0.5,-0.5,1),ncol=2,byrow=T)
testdata<-rbind(rmvnorm(n1, mn1, vc1), rmvnorm(n2, mn2, vc2))
group<-c(rep("A",n1),rep("B",n2))
testdata<-data.frame(testdata, group)
head(testdata)
qplot(X1, X2, data=testdata, colour=group)
```