Problem 1 (*adapted from J&W Exercise 6.23*)
The data can be found in "iris.dat". Columns correspond to sepal length, sepal width, petal length, petal width, and type (1,2,3 for setosa, versicolor, and virginica, respectively). *Note that this problem asks for analysis only on the two width variables.*

a) State the MANOVA hypotheses for this situation. Define the parameters involved.

b) Use the SAS code below to carry out the MANOVA test for this situation. State your conclusion with $\alpha = .05$.

c) The code also provides confidence intervals for all pairs of iris types and width measurements. Include these here, and explain the use of alpha=.00833 in the code.

d) Comment on the assumption of equal population covariance matrices.

SAS code for this problem is

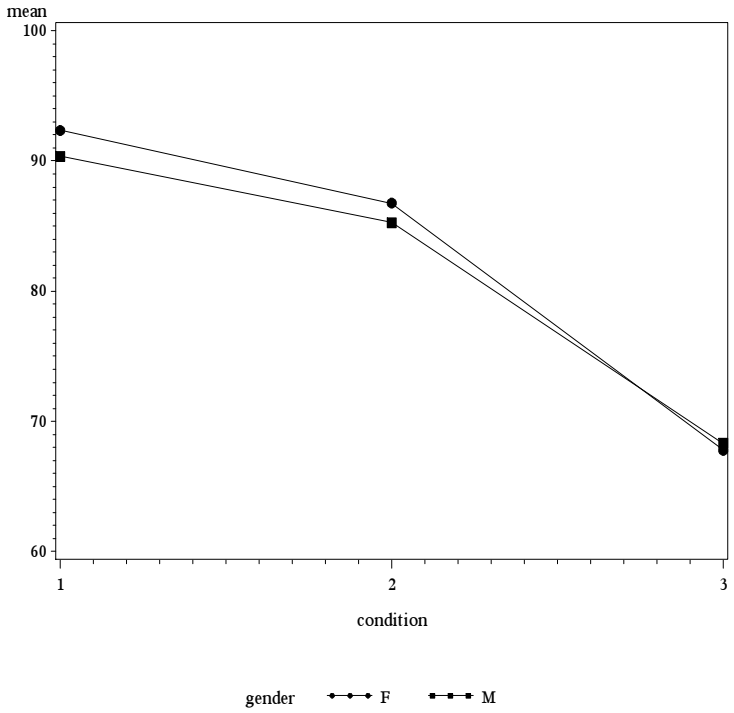
```
proc glm data=iris;
  class type;
  model swidth pwidth = type / clparm alpha=.00833;
  estimate '1 vs 2' type 1 -1 0;
  estimate '1 vs 3' type 1 0 -1;
  estimate '2 vs 3' type 0 1 -1;
  manova h=type / printe printh;
  run; quit;
```

Problem 2
Twenty drivers participate in a repeated measures experiment done to investigate how talking on a cell phone affects driving skill. Each driver responds to driving situations on a simulator while experiencing three different conditions. The first condition is complete silence. In the second condition, the driver and a researcher have a conversation. In the third condition, the driver talks on a cell phone with the researcher. For each condition, the percentage of correct and timely responses to various driving situations is recorded. In the "skill.dat" dataset, these percentages are given in order of the conditions just described, with the first column corresponding to the driver's sex.

a) Briefly explain why the usual ANOVA model is not appropriate for modeling the relationships among the variables here.

b) Explain what interaction between sex and driving condition would mean in this situation. Conduct the appropriate test for interaction between sex and driving condition.

c) Provide a profile plot with the three conditions along the horizontal axis, the mean percentages given on the vertical axis, and with separate lines for the two sexes. Comment on how this supports your conclusion from part b) above.



d) How do males and females compare in this situation? Test for an overall effect due to sex. Comment on the appropriateness of this test in light of your answers from parts b) and c).

e) Letting X_1, X_2, and X_3 denote the percentages for the three conditions, define $Y_1 = X_2 - X_1$ and $Y_2 = X_3 - X_2$, and consider Hotelling's T^2 test of $E(\mathbf{Y}) = \mathbf{0}$ versus $E(\mathbf{Y}) \neq \mathbf{0}$. In terms of the variables in this situation, what exactly is being tested with these hypotheses. Conduct this test.

SAS code for this problem is

```
data driver;
 infile 'v:\skill.dat';
 input gender $ p1 p2 p3;
 y1=p2-p1;
 y2=p3-p2; run;
proc glm data=driver;
 class gender;
 model p1 p2 p3 = gender;
 manova h=gender m=p3-p2,p2-p1;
 manova h=gender m=p1+p2+p3; run;
quit;
```

```
proc iml;
start hotel;
mu0={0, 0};
one=j(nrow(x),1,1);
ident=i(nrow(x));
ybar=x‘*one/nrow(x);
s=x‘*(ident-one*one‘/nrow(x))*x/(nrow(x)-1.0);
print mu0 ybar;
print s;
t2=nrow(x)*(ybar-mu0)‘*inv(s)*(ybar-mu0);
f=(nrow(x)-ncol(x))*t2/ncol(x)/(nrow(x)-1);
df1=ncol(x);
df2=nrow(x)-ncol(x);
p=1-probf(f,df1,df2);
print t2 f df1 df2 p;
finish;
use driver;
read all var{y1 y2} into x;
run hotel;
quit;
```

Problem 3 Use the SAS code below to answer the questions from textbook Exercise 11.28. The dataset "iris.dat" is the same as in the first problem. SAS code for this problem:

```
data iris;
  infile 'v:\505\datasets\iris.dat';
  input slength swidth plength pwidth type $;
  y1=log(slength/swidth);
  y2=log(plength/pwidth);
  run;
proc gplot data=iris;
  plot y2*y1=type;
  symbol1 v=b f=special h=2 i=join color=red interpol=none;
  symbol2 v=a f=special h=2 i=join color=green interpol=none;
  symbol3 v=c f=special h=2 i=join color=blue interpol=none;
  run; quit;
proc discrim data=iris pool=yes crossvalidate;
  class type;
  var y1;
  priors '1'=1 '2'=1 '3'=1;
  run;
proc discrim data=iris pool=yes crossvalidate;
  class type;
  var y2;
  priors '1'=1 '2'=1 '3'=1;
  run;
proc discrim data=iris pool=yes crossvalidate;
  class type;
  var y1 y2;
  priors '1'=1 '2'=1 '3'=1;
  run;
```