Do Exercise 27 on page 304-5 of your text where the average Time to extinction of 62 species of birds was recorded. The predictor that potentially affects extinction is average number of nesting Pairs. The factors that potentially affect extinction are Size and Status. You must report your answers to this problem as a Statistical Report. The report, not including the Appendix that contains your R-code and R-output and figures and any tables, should not exceed two pages. Your grade will be determined by how well you answer the questions and by the organization and clarity of your write-up.

1. Load in the data and perform initial summaries (that do not include Pairs) for this problem for all combinations of Size and Status.

```r
library(Sleuth3)
d = ex1027
summary(d)
dim(d)
Median=tapply(d$Time,interaction(d$Size,d$Status),median)
IQR=tapply(d$Time,interaction(d$Size,d$Status),IQR)
Mean=tapply(d$Time,interaction(d$Size,d$Status),mean)
SD=tapply(d$Time,interaction(d$Size,d$Status),sd)
n=tapply(d$Time,interaction(d$Size,d$Status),length)
cbind(Median,IQR,Mean,SD,n)
boxplot(Time ~ Size*Status,data=d)
```

2. Consider transforms of the quantitative variables Time and Pairs in this data set. Use matrix plots (via pairs()), fit candidate models and assess fit via normal probability and residual plots.

3. Consider interactions. Your book explicitly asks you to consider the 2-way interaction associated with the question: Does the effect of size differ depending on the number of nesting pairs? Also consider the other 2-way interaction between Pairs and Status. Use Trellis graphs, e.g., via coplot(Time ~ Pairs|Size*Status,data=d) - you however will have to update this plot to incorporate whatever transforms you find in #2. In addition, fit candidate models, assess fit via normal probability and residual plots, and consider lack-of-fit tests.

4. Consider more interactions. Consider the 2-way interaction between the factors Size and Status. The graphical technique to use is an interaction plot via interaction.plot(). For example, depending on the transformations that you found in #2 you could try interaction.plot(d$Size,d$Status,d$Time). In addition, fit candidate models, assess fit via normal probability and residual plots, and consider lack-of-fit tests.

5. In the State procedures section of your report, summarize what models you investigated and what model assumptions led to the final model that you present. You do not need to include all of the plots that you generated in the exploratory phase of your analysis!

6. After you determine your “final” model, regardless of the transforms that you performed of Time and/or Pairs, present the data on their original scale. There will be FOUR curves of Time as a function of Pairs, one for each combination of Size and Status. Here’s the R-code to plot the data with different colors and symbols depending on the combination of Size and Status.

```r
colLM=1
colSM=2
colLR=3
colSR=4

col.index=numeric(64)
col.index[d$Size=="L"&d$Status=="M"]=colLM
col.index[d$Size=="S"&d$Status=="M"]=colSM
col.index[d$Size=="L"&d$Status=="R"]=colLR
```
col.index[d$Size=="S"&d$Status=="R"]=colSR

plot(Time ~ Pairs,data=d,col=col.index,pch=col.index,
     main="Birds: times to extinction vs. number of mating pairs")

Now use the `lines()` function 4 times to add the four curves using the same coloring scheme used for the symbols above.

7. Add informative $x$-axis and $y$-axis labels to your plot from #6.

8. Indicate the sampling plan and the study design in the introduction to your report. In the *Scope of inference* part of your report you will indicate how the sampling plan and the study design affects the applicability (or lack of applicability) of your conclusion regarding extinction of birds.

9. Write out the final regression model that includes all parameters $\beta_0, \beta_1, \ldots$ in the *Stat procedures* section of your report.

10. State all relevant assumptions and include any plots or other output that indicate that the final model you fit satisfies these assumptions.

11. Report the correlation and $R^2$ for your final model.

12. Answer the questions posed by the book. For the parameters relevant to these questions, report and interpret CIs.