Exploring the relationship between body mass and lifespan in animals

http://animaldiversity.ummz.umich.edu

In this exercise you will extract data from the Animal Diversity Web (ADW) database in order to test whether larger animals live longer (is lifespan dependent on body size?). You will also investigate variation in the relationship between lifespan and body size among animal orders.

The relationship between body mass and lifespan has been used primarily as a basis for exploring the relationship between energy used per gram of body tissue (metabolism) and lifespan, which remains an active field of research as scientists investigate what factors influence the aging process. Your questions are: Does body mass influence lifespan? And, is the relationship between body mass and lifespan similar among different groups of animals?

For an example of how these kinds of comparisons are used in research currently, see: http://jeb.biologists.org/cgi/content/full/208/9/1717 (if your institution subscribes to the Journal of Experimental Biology) or: http://www.npr.org/templates/story/story.php?storyId=12877984 for a news article.

To extract data from ADW, go to the structured query interface site: http://animaldiversity.ummz.umich.edu/local/inquiry/search

Search for all data records for Aves by selecting scientific name, is, and filling in Aves. Hit search and wait for the results to appear on the page.
Next you will determine which data for all of these avian species you’ll extract into a spreadsheet format. Go to the report builder and select Rank: Order, mass in units of grams, and extreme lifespan-wild in units of years. Make sure you’ve selected a “worksheet” format for export of the data and hit the “tabulate” button.

Once the export is complete, open the worksheet in Microsoft Excel. Start by deleting some of the extraneous columns in the results, leaving only the columns for: scientific name, order, extreme wild lifespan high, and average mass.
You’ll find that many species lack data on lifespan, mass, or both, so the first task is to narrow the data to those species for which you have both kinds of data. Do this by sorting in Excel: select all, then go to the data menu and select “sort.”
Sort first by mass and delete all entries that lack mass data. Then sort by lifespan and delete all entries that lack lifespan data. The result should be approximately 170 species of birds. Finally, sort by order so that the species are arranged by their taxonomic affiliation.

Next you’ll use the graphing tools in Excel. Select all rows for the two data columns (mass and lifespan) except for the first row which contains the column labels. Once you’ve selected the data field, go to the Insert menu and pull it down to chart.

This will bring up a charting wizard. Select XY scatter, then hit the “next” button. You’ll then see a preview of your chart, if it looks ok, select “next.” The next window asks you to provide a chart title and label your axes.

The final window asks if you want the chart as a new sheet or as an object in the spreadsheet, give it a title and have it come up in a new sheet.

As with most natural history data, your XY scatter plot probably has quite a bit of variation in it, although you are likely to notice that there is a “trend.” How would you characterize this trend in these data?
Next you’ll explore variation in that trend by plotting data for several different avian orders and comparing across orders. You can also compare between birds and mammals and within mammalian orders using the same methods. You should be able to explore variation in any animal group, but there is more ADW data for birds and mammals, so those explorations are richest.

This time you’ll use regression line fit plots to better visualize the differences among groups.

Go back to your data spreadsheet, pull down the **Tools** menu, and select **Data Analysis**. (If you don’t see **Data Analysis** as an option you’ll have to go to **Add Ins** in the **Tools** menu and select the data analysis add in.)

Select **Regressions**.
Enter the appropriate data range, and select **line fit plots**. For example, the data range should be in the format $D$2:$D$168 for the Y range (if column D is the column for mass) and $C$2:$C$168 for the X range (if Column C is the column for lifespan).

Select **OK** and you’ll get a page that has a statistical summary and an embedded line fit plot. You’ll have to select the chart by clicking on it and pull on a corner to enlarge it to a reasonable size. Next apply a trendline to the chart: select the chart, go to the **Chart** menu, and select **Add Trendline**.

Finally, add labels to your chart so that it makes sense. Select the chart by clicking on it, go to the **Chart** menu and select **Chart Options**. Add informative labels and a title. You can then print your chart or copy and paste it into a report. If you know a little about statistics, you can compare the regression statistics (R2 or adjusted R is typically reported) and the significance value of the regression (in the ANOVA portion of the summary).

Create charts for the following avian groups:
- **Falconiformes**
- **Passeriformes**
- **Anseriformes**

Compare those charts to one for all of Aves. What portions of the variation in lifespan and body mass are contributed by those different groups? Are there data points in the scatter plots that don’t fit the trend well? How might you explain those? You can go to the original ADW accounts to examine the data and look for potential inaccuracies or for clarification.