Modeling and measurement noise in a math elective course

Course: Math elective, such as Math for Liberal Arts, but designed for students with a more practical emphasis, such as students majoring in welding, physical therapy, etc.

What skills do the faculty in the students' majors want?

1. Spreadsheet skills
2. Skill in using even rather complex formulas.
3. Flexibility in using basic algebra, geometry, and unit conversions.
4. Skill in reading technical material with numbers.
5. Understanding of issues involving using unfamiliar and unusual measuring instruments.

I chose to include: Regression, with focus on separating the "pattern" from the "noise."

Reason for including regression:

1. Desired algebra skills definitely include applications of linear equations. It is awkward to only include relationships that are exactly linear and completely ignore those which are almost linear. That leads to linear regression very naturally.
2. To deal with measurement issues, students need to believe in measurement noise. We can approach that by repeated measurements of a single quantity or as variability around a linear model where it seems obvious that *y* should be very close to a linear function of *x*. Many students find the latter more compelling.

How long:
About two weeks.

When / prerequisites:

1. Students do a thorough review of linear functions / formulas early in the semester, including computing the linear formula, making predictions, and interpreting the slope and intercept.
2. Students also learn to use spreadsheets for all of these computations and to graph non-linear formulas as well. This is included fairly early in the semester.
3. The material on regression comes later, but when the students still remember the material about exact linear models and working with spreadsheets.

What problems can a student solve when completing the course?

1. Take a set of almost-linear data and use a spreadsheet to find the regression line and then do all the same things they would be able to do if the relationship was exactly linear, PLUS use a residual plot to explain why a linear model is appropriate.
2. Take a set of data which is clearly non-linear and experiment with various non-linear models to find one that fits reasonably well.
3. Produce and interpret a residual plot for that.
4. Use that non-linear model and the graph/ spreadsheet to make predictions of *y* from *x* and also to find what *x*-values give a particular *y*-value.

5. Understand that the variability around the line that is shown in the residual plot is "noise" rather than "pattern" and that this noise can often be thought of as measurement noise.

Resources:
I found ideas for data appropriate for non-linear models in some current College Algebra books. I am pursuing more examples from the faculty in the areas of the students' majors, of course.