3/28/2007 6:00:16 PM

```
Welcome to Minitab, press F1 for help.
MTB > Executing from file: C:\Program Files\Minitab
15\English\Macros\Startup.mac

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MTB > Save  "C:\rjs\Courses\3332\Minitab Demos\minitabdemo5.MPJ";
SUBC>   Project;
SUBC>   Replace.
Saving file as: 'C:\rjs\Courses\3332\Minitab Demos\minitabdemo5.MPJ'
```

This demonstrates fitting a regression curve for some examples of data.

EXAMPLE 1 is taken from the UTD course, General Chemistry Lab, and concerns "Determination of Rate Law" in various chemical reactions. Here, it is desired to find the relationship that determines the time until a particular enzyme reaction in the body becomes complete, as a function of the initial enzyme concentration. It is assumed from theory that this function is of the form:

(1) rate = K (enzyme concentration)^P ,

where "rate" is the speed of the reaction defined as the rate of consumption of the enzyme per unit time in the reaction, i.e.,
"rate" = (initial enzyme concentration)/(time until the reaction using this enzyme terminates).
Also, K is a constant, and P is another constant called the "order of the reaction".
This constant P is in fact the target parameter, to be estimated from the data. By taking logarithms, the above relation becomes transformed to an equivalent *linear* relation:

(2) log (rate) = log (K) + P log (enzyme concentration).

Now log (rate) is expressed as a linear function of log (enzyme concentration), and P is simply the slope of this line.

In the lab at UTD, logs to the base 10 are used, and we shall do the same, although we note that any other base can be used with no change in the final results about P.

Now let's look at the data from an experiment where 5 different initial concentrations were selected and for each case the reaction was run and the time until completion was recorded. These data are"conc" and "time". We shall not bother here with the units of these variables. The variable "rate" is calculated from the other variables: rate = conc/time.

```
MTB > let rate = conc/time
MTB > print conc time rate
```

Data Display

Row	conc	time	rate
1	0.1	7.5	0.01333
2	0.2	2.0	0.10000
3	0.3	1.3	0.23077
4	0.4	0.9	0.44444
5	0.5	0.5	1.00000

Now let's take a look at a plot of rate versus conc.

```
MTB > Plot 'rate'*'conc';
SUBC>   Symbol.
```

Scatterplot of rate vs conc

(See this plot in the accompanying file, "minitabdemo5graph1.gif".)

Note the rate is an increasing function of the initial concentration, but the form of the function is clearly nonlinear. Hence the constant P in the relation (1) cannot be = 1.

Now lets take logs of "conc" and "rate".

```
MTB > let logconc = log(conc)
MTB > let lograte = log(rate)
MTB > print logconc lograte
```

Data Display

```
Row   logconc   lograte
  1  -2.30259  -4.31749
  2  -1.60944  -2.30259
  3  -1.20397  -1.46634
  4  -0.91629  -0.81093
  5  -0.69315   0.00000
```

Now let's plot these variables, lograte versus logconc.

```
MTB > Plot 'lograte'*'logconc';
SUBC>   Symbol.
```

Scatterplot of lograte vs logconc

(See this plot in the accompanying file, "minitabdemo5graph2.gif".)

Note lograte is an increasing function of logcon, and now the form of the function is approximately linear.

We can find a best-fitting line passing near these points, and then estimate P as the slope of that line.

```
MTB > Plot 'lograte'*'logconc';
SUBC>   Symbol;
SUBC>   Regress.
```

Scatterplot of lograte vs logconc

(See this plot, with the fitted line included, in the accompanying file, "minitabdemo5graph3.gif".)

Now let us in fact carry out the relevant linear regression analysis.

```
MTB > Regress 'lograte' 1 'logconc';
SUBC>   Constant;
SUBC>   Brief 2.
```

Regression Analysis: lograte versus logconc

```
The regression equation is
lograte = 1.71 + 2.59 logconc


Predictor    Coef  SE Coef      T      P
Constant   1.7076   0.1634  10.45  0.002
logconc    2.5924   0.1119  23.17  0.000


S = 0.142189   R-Sq = 99.4%   R-Sq(adj) = 99.3%


Analysis of Variance

Source          DF      SS      MS       F      P
Regression       1  10.857  10.857  537.01  0.000
Residual Error   3   0.061   0.020
Total            4  10.918
```

Note that the fitted line is given by: lograte = 1.71 + 2.59 logconc,
so the estimate of P is the slope of the line: 2.59.

The p-value in the accompanying analysis of variance is 0.000,
i.e., the result is statistically significant.
