UST700 RESEARCH METODS I
COMPUTER LAB #1

First we learn how to do simple computations with MathCad.

(1) Type:3*4= The answer is: 12.

$$3 \cdot 4 = 12$$

(2) Type 24-35= The answer is -11

$$24 - 35 = -11$$

(3) Type: \3= (this is square root of 3). The answer is 1.73

$$\sqrt{3} = 1.732$$

(4) Type 2.3^4.5= (this is 2.3 to the power 4.5). The answer is 42.44

$$2.3^{4.5} = 42.44$$

(5) Type: (3-4)*4-6= The answer is -10

$$(3 - 4) \cdot 4 - 6 = -10$$

(6) Type: 7/(2.3-8.6)space bar+3=. The answer is:1.889

$$\frac{7}{(2.3 - 8.6)} + 3 = 1.889$$

Data from Plain Dealer Sunday August 17,1997, Section A, pg1 and 23, *Prisoners not doing the same time for the same crime* by Mark Tatge. The article gives in a Table the percentage of Ohio prison inmates released annualy after review by the Ohio Adult Parole Authority.

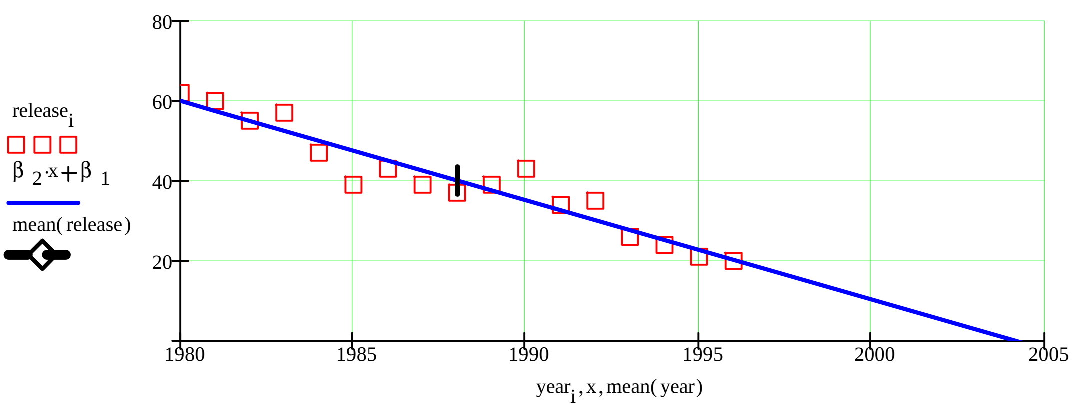
$$release := \begin{bmatrix} 62 \\ 60 \\ 55 \\ 57 \\ 47 \\ 39 \\ 43 \\ 39 \\ 37 \\ 39 \\ 43 \\ 34 \\ 35 \\ 26 \\ 24 \\ 21 \\ 20 \end{bmatrix} \qquad year := \begin{bmatrix} 1980 \\ 1981 \\ 1982 \\ 1983 \\ 1984 \\ 1985 \\ 1986 \\ 1987 \\ 1988 \\ 1989 \\ 1990 \\ 1991 \\ 1992 \\ 1993 \\ 1994 \\ 1995 \\ 1996 \end{bmatrix}$$

$i := 0 .. 16$

$\beta_2 := \mathrm{slope}(year, release)$ $\qquad \beta_1 := \mathrm{intercept}(year, release)$ $\qquad r := \mathrm{corr}(year, release)$

$\beta_2 = -2.483$ $\qquad \beta_1 = 4.976 \cdot 10^3$ $\qquad r = -0.956$

$x := 1980 .. 2010$



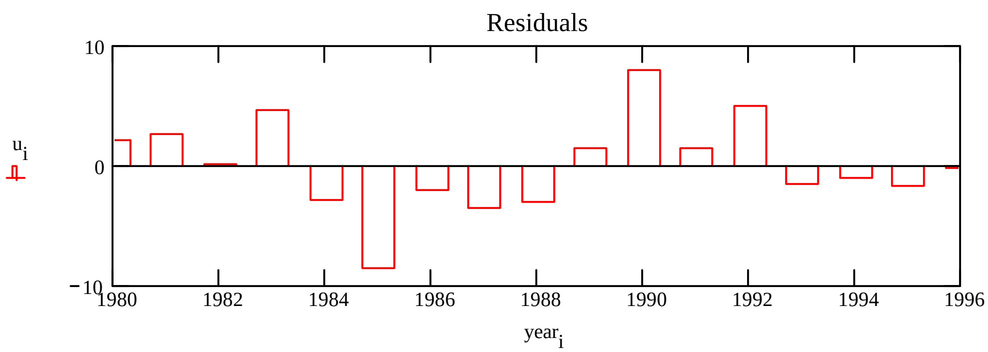
The linear regression predicts that in the year 2004 the percentage of paroled inmates will be zero.

We define next the residuals *uhat*. We then check two properties: sum of *uhat* is zero; sum of *uhat* times X is zero. Due to the finite precision of the computer the numerical values are very small though not exactly zero.

$$u_i := release_i - \beta_1 - \beta_2 \cdot year_i$$

$$\sum_{j=0}^{16} u_j = 9.095 \cdot 10^{-12}$$

$$\sum_{j=0}^{16} u_j \cdot year_j = 1.808 \cdot 10^{-8}$$



Next we compute the standard error of estimate: σhat.

$$\sigma hat := \sqrt{\frac{1}{17-2} \cdot \sum_{j=0}^{16} \left(u_j\right)^2}$$

$\sigma hat = 3.965$ $\sigma hat^2 = 15.721$

Next we compute the variances, the standard errors and the covariance of the β parameters.

$$\mathrm{var}\beta_2 := \frac{\sigma\mathrm{hat}^2}{17\cdot \mathrm{var}(\mathrm{year})} \qquad \mathrm{se}\beta_2 := \sqrt{\mathrm{var}\beta_2}$$

$$\mathrm{var}\beta_2 = 0.039 \qquad \mathrm{se}\beta_2 = 0.196$$

$$\mathrm{var}\beta_1 := \frac{\sigma\mathrm{hat}^2}{17\cdot \mathrm{var}(\mathrm{year})}\cdot \mathrm{mean}\left(\overrightarrow{\mathrm{year}^2}\right) \qquad \mathrm{se}\beta_1 := \sqrt{\mathrm{var}\beta_1}$$

$$\mathrm{var}\beta_1 = 1.523\cdot 10^5 \qquad \mathrm{se}\beta_1 = 390.241$$

$$\mathrm{cov}\beta 1\beta 2 := -\frac{\sigma\mathrm{hat}^2}{17\cdot \mathrm{var}(\mathrm{year})}\cdot \mathrm{mean}(\mathrm{year})$$

$$\mathrm{cov}\beta 1\beta 2 = -76.603$$