Economics 312 — Spring 2014
Daily Problem #11 — February 17

The matrix algebra investment we made in the simple regression model pays dividends with multiple regression. If we define

$$\mathbf{y} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}, \quad \mathbf{X} = \begin{bmatrix} 1 & x_{1,2} & x_{1,3} & \cdots & x_{1,K} \\ 1 & x_{2,2} & x_{2,3} & \cdots & x_{2,K} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_{N,2} & x_{N,3} & \cdots & x_{N,K} \end{bmatrix}, \quad \boldsymbol{\beta} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_K \end{bmatrix}, \quad \mathbf{e} = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_N \end{bmatrix}$$

then we can write the N equations $y_i = \beta_1 + \beta_2 x_{i,2} + \beta_3 x_{i,3} + \ldots + \beta_K x_{i,K} + e_i$ as $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{e}$. With $\mathbf{y}$ and $\mathbf{X}$ defined as above, show the properties of $\mathbf{X}'\mathbf{X}$ and $\mathbf{X}'\mathbf{y}$: what are their dimensions and what is a typical element. Do these matrices live up to their name as "cross-product matrices" or "moment matrices"?