Using LaTeX Shorthands for Math Notation

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In LaTeX documents, I use a standard set of shorthands to keep math notation *consistent* and allow me to easily change how something is represented throughout an entire document.

```
\renewcommand*{\vec}[1]{\ensuremath{\mathbf{#1}}}
\newcommand{\trans}{\ensuremath{^\mathsf{T}}}
\newcommand*{\mat}[1]{\ensuremath{\mathbf{#1}}}
\newcommand*{\diag}[1]{\ensuremath{\mathrm{diag}\, #1}}
\renewcommand*{\det}[1]{\mathrm{det}(#1)}
\newcommand*{\rank}[1]{\ensuremath{\mathrm{rank} (\mathbf{#1})}}
\newcommand*{\trace}[1]{\ensuremath{\mathrm{tr} (\mathbf{#1})}}
\newcommand*{\dev}[1]{(#1 - \bar{#1})}
\newcommand*{\inv}[1]{\ensuremath{\mat{#1}^{-1}}}
\newcommand*{\half}[1]{\ensuremath{\mat{#1}^{1/2}}}
\newcommand*{\invhalf}[1]{\ensuremath{\mat{#1}^{-1/2}}}
\newcommand*{\nvec}[2]{\ensuremath{{#1}_{1}, {#1}_{2},\ldots,{#1}_{#2}}}
\newcommand*{\Beta}{B}
\newcommand*{\Epsilon}{E}
\newcommand*{\period}{\:\: .}
\newcommand*{\comma}{\:\: ,}
\newcommand*{\given}{\ensuremath{\, | \,}}
\newcommand*\widebar[1]{\overline{#1}}

% R stuff
\newcommand{\pkg}[1]{\textsf{#1}}
\newcommand{\Rpackage}[1]{\pkg{#1} package}
\let\proglang=\textsf
\newcommand{\R}{\textsf{R}\xspace}
```

I like to use R for data analysis and graphics, but I've also used `\proglang{SAS}` which prints as SAS. In R my favorite package is `\pkg{ggplot2}` which prints as ggplot2.

I love matrices: `\mat{X}, \mat{Y}` $\to$ $\mathbf{X}, \mathbf{Y}$ are favorites. Transpose, `\mat{X}\trans` $\to$ $\mathbf{X}^{\mathsf{T}}$ turns them on their side. But I can change the notation for transpose T to `'` with

```
\newcommand{\trans}{\ensuremath{^'}}
```

There are diagonal ones too, like `\diag{(1,2,3)}` $\to$ $\mathrm{diag}\,(1, 2, 3)$ which gives:

$$\mathbf{D} = \mathrm{diag}\,(1, 2, 3) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

Sometimes I like to talk about the `\trace{}` or `rank{}` of a matrix, as in

$$\mathrm{tr}(\mathbf{D}) = 6 \qquad \mathrm{rank}(\mathbf{D}) = 3$$

A data ellipsoid can be defined as:

```
\begin{equation}\label{eq:dsq}
\mathcal{E}_c ( \widebar{\vec{y}},  \mat{S} ) := \{ \vec{y} :
\dev{\vec{y}}\trans \, \inv{S} \, \dev{\vec{y}} \le c^2 \} \period
\end{equation}
```

where `\dev{\vec{y}}` and `\inv{S}` simplify the notation. This gives:

$$\mathcal{E}_c(\overline{\mathbf{y}}, \mathbf{S}) := \{\mathbf{y} : (\mathbf{y} - \bar{\mathbf{y}})^{\mathsf{T}}\, \mathbf{S}^{-1}\, (\mathbf{y} - \bar{\mathbf{y}}) \le c^2\}\ . \tag{1}$$