Typesetting Subtleties

Horizontal Space

Non-standard thin horizontal space may make certain strings easier to parse. All of the following rules apply identically in paragraph mode and displayed equations.

Case statements

Use newly-defined macros by Vivek to open case statements (`rl` almost exclusively).

Extra space

To separate a compound expression where none are subscripted

$A^{-1}\,\Delta y$	instead of	$A^{-1}\Delta y$
$U^*\,\Delta A\,U$		$U^*\Delta AU$

Multiply something times an absolute value

$c\,\lvert s+t\rvert$	instead of	$c\lvert s+t\rvert$

To separate expressions with tall subscripts from expressions that follow

Sets expressed with capital letters create tall subscripts

$\Phi_{\mathcal{I}}\,\alpha$	instead of	$\Phi_{\mathcal{I}}\alpha$

Restriction operator always has a tall subscript, so it always has some extra space

$1_{\{k\}}\,x$	instead of	$1_{\{k\}}x$

Right parenthesis next to unrelated expression

Multiply functions with arguments

$f(t)\,g(t)$	instead of	$f(t)g(t)$
$G(z)\,H(z)$		$G(z)H(z)$

Multiply something with an argument with something else

$H(e^{j\omega})\,v$	instead of	$H(e^{j\omega})v$

No extra space

Anything else

$2\pi\delta(\omega)$	instead of	$2\pi\,\delta(\omega)$
$2\pi\delta_{n-k}$		$2\pi\,\delta_{n-k}$
$j\omega H(\omega)$		$j\omega\,H(\omega)$

Multiply something with a subscript with something else

H_kv	instead of	$H_k\,v$
x_kh_{n-k}		$x_k\,h_{n-k}$
$\lambda_{\min}\|x\|^2$		$\lambda_{\min}\,\|x\|^2$

Multiply functions without arguments

fg	instead of	$f\,g$
GH		$G\,H$

Basic products of scalars

ab	instead of	$a\,b$

Basic products of matrices and vectors (without subscripts)

AB	instead of	$A\,B$
Av		$A\,v$
y^*x		$y^*\,x$
ABy		$A\,By$

Scalar times matrix or operator

λI	instead of	$\lambda\,I$

Basic products with explict constants

$\frac{1}{2}(1+(-1)^n)$	instead of	$\frac{1}{2}\,(1+(-1)^n)$

Basic products with scalars

$\alpha N\log_2 N + \beta N$	instead of	$\alpha\,N\log_2 N + \beta\,N$

Compositions of operators without subscripts

$\Phi\alpha$	intead of	$\Phi\,\alpha$
Φ^*x		$\Phi^*\,x$
$\Phi\Phi^*x$		$\Phi\,\Phi^*\,x$

Multiplications of very basic expressions including superscripts and subscripts

t^kt^i	instead of	$t^k\,t^i$
2^ke_k		$2^k\,e_k$

Even more complicated expressions

$\langle x,\, \varphi_0\rangle\varphi_0$	instead of	$\langle x,\, \varphi_0\rangle\,\varphi_0$
$(\|x\|\cos\theta)\,\varphi$		$(\|x\|\cos\theta)\,\varphi$

Parentheses naturally create significantly more space than absolute value bars

$c(s+t)$	instead of	$c\,(s+t)$

Fractions

Universal proscriptions. Stacked fractions are NOT allowed in exponents/subscripts

$x_{k/N}$	instead of	$x_{\frac{k}{N}}$
$e^{j2\pi/N}$		$e^{j\frac{2\pi}{N}}$

Textstyle vs displaystyle.

Textstyle arises in

paragraph mode (plain text, figure caption)

table entry mode (elements of vectors, matrices, and other tables in displayed equations)

matrix entry mode (elements of vectors and matrices)

case left mode (left side of case statement)

case right mode (right side of case statement)

Displaystyle arises in display mode (displayed equations except the entries of tables as above). **Do not force displaystyle.**

In what follows we answer: **In which (rare) circumstances, will we use frac in textstyle?**

Paragraph mode

When numerator and denominator are both fixed single-digit integers (no radicals or variables)

$\frac{1}{2}$	instead of	$1/2$
$11/12$		$\frac{11}{12}$
$1/\sqrt{2}$		$\frac{1}{\sqrt{2}}$
$1/k$		$\frac{1}{k}$
$1/(2\pi)$		$\frac{1}{2\pi}$

When a row vector is inline

$\begin{bmatrix}\frac{1}{2} & \frac{1}{3}\end{bmatrix}$	instead of	$\begin{bmatrix}1/2 & 1/3\end{bmatrix}$
$\begin{bmatrix}1/k & k/3\end{bmatrix}$		$\begin{bmatrix}\frac{1}{k} & \frac{k}{3}\end{bmatrix}$.

Case-right mode

The paragraph mode rules apply in the right-hand side of a case statement.

$$x(t) = \begin{cases} y(t), & \text{for } t > \frac{1}{2}; \\ z(t), & \text{otherwise.} \end{cases} \quad \text{instead of} \quad x(t) = \begin{cases} y(t), & \text{for } t > 1/2; \\ z(t), & \text{otherwise.} \end{cases}$$

$$x(t) = \begin{cases} y(t), & \text{for } t > 1/k; \\ z(t), & \text{otherwise.} \end{cases} \quad \text{instead of} \quad x(t) = \begin{cases} y(t), & \text{for } t > \frac{1}{k}; \\ z(t), & \text{otherwise.} \end{cases}$$

$$x(t) = \begin{cases} y(t), & \text{for } t \in [\frac{1}{2}, \infty); \\ z(t), & \text{otherwise.} \end{cases} \quad \text{instead of} \quad x(t) = \begin{cases} y(t), & \text{for } t \in [1/2, \infty); \\ z(t), & \text{otherwise.} \end{cases}$$

$$x(t) = \begin{cases} y(t), & \text{for } t \in [1/k, \infty); \\ z(t), & \text{otherwise.} \end{cases} \quad \text{instead of} \quad x(t) = \begin{cases} y(t), & \text{for } t \in [\frac{1}{k}, \infty); \\ z(t), & \text{otherwise.} \end{cases}$$

Case-left mode

The paragraph mode rules apply in the left-hand side of a case statement.

$$\kappa(A) = \begin{cases} 2, & \text{for } a \geq 1; \\ \frac{1}{2}, & \text{for } a < 1. \end{cases} \quad \text{instead of} \quad \kappa(A) = \begin{cases} 2, & \text{for } a \geq 1; \\ 1/2, & \text{for } a < 1. \end{cases}$$

$$\kappa(A) = \begin{cases} a, & \text{for } a \geq 1; \\ 1/a, & \text{for } a < 1. \end{cases} \quad \text{instead of} \quad \kappa(A) = \begin{cases} a, & \text{for } a \geq 1; \\ \frac{1}{a}, & \text{for } a < 1. \end{cases}$$

Display mode

Single-line, non-matrix. Stack fractions in displayed equations.

$$\frac{1}{3}x^2 + 2x + \frac{1}{2} \;=\; 0 \quad \text{instead of} \quad (1/3)x^2 + 2x + (1/2) \;=\; 0$$

$$\int_0^1 \left(\frac{1}{3}t^2 + 2t + \frac{1}{2}\right) dt \quad \text{instead of} \quad \int_0^1 \big((1/3)t^2 + 2t + (1/2)\big)\, dt$$

Multiple levels of fractions; apply the paragraph mode rules to numerators and denominators separately.

$$h_{4,n} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-\left(\frac{2}{3}\right)^4} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-16/81} \;=\; \left(\frac{2}{3}\right)^n \frac{81}{65}$$

instead of

$$h_{4,n} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-\left(\frac{2}{3}\right)^4} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-\frac{16}{81}} \;=\; \left(\frac{2}{3}\right)^n \frac{81}{65}$$

or

$$h_{4,n} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-(2/3)^4} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-16/81} \;=\; \left(\frac{2}{3}\right)^n \frac{81}{65}$$

Similarly

$$h_{4,n} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-(t/2)^4} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-t^4/16} \;=\; \left(\frac{2}{3}\right)^n \frac{16}{16-t^4}$$

instead of

$$h_{4,n} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-\left(\frac{t}{2}\right)^4} \;=\; \left(\frac{2}{3}\right)^n \frac{1}{1-\frac{t^4}{16}} \;=\; \left(\frac{2}{3}\right)^n \frac{16}{16-t^4}$$

Multi-line, non-matrix. Having multiple lines in an eqnarray should not change the formatting, even at the risk of wasting some vertical space.

$$\begin{array}{rrcl}
\text{DO THIS} & \mathrm{E}[\mathrm{x}] &=& \displaystyle\int_0^1 \int_0^{s^2} 3s\, dt\, ds \;=\; \frac{3}{4}, \\
& \mathrm{E}[\mathrm{y}] &=& \displaystyle\int_0^1 \int_0^{s^2} 3t\, dt\, ds \;=\; \frac{3}{10}, \\
\text{INSTEAD OF THIS} & \mathrm{E}[\mathrm{x}] &=& \textstyle\int_0^1 \int_0^{s^2} 3s\, dt\, ds \;=\; \frac{3}{4}, \\
& \mathrm{E}[\mathrm{y}] &=& \textstyle\int_0^1 \int_0^{s^2} 3t\, dt\, ds \;=\; \frac{3}{10}, \\
\text{OR THIS} & \mathrm{E}[\mathrm{x}] &=& \textstyle\int_0^1 \int_0^{s^2} 3s\, dt\, ds \;=\; 3/4, \\
& \mathrm{E}[\mathrm{y}] &=& \textstyle\int_0^1 \int_0^{s^2} 3t\, dt\, ds \;=\; 3/10.
\end{array}$$

Matrix-entry mode

Stack the fractions because we are in a displayed equation, but with the default textstyle sizing.

DO THIS $$\varphi_0 = \begin{bmatrix} \sqrt{\tfrac{2}{3}} \\ 0 \end{bmatrix}, \qquad \varphi_1 = \begin{bmatrix} -\tfrac{1}{\sqrt{6}} \\ \tfrac{1}{\sqrt{2}} \end{bmatrix}, \qquad \varphi_2 = \begin{bmatrix} -\tfrac{1}{\sqrt{6}} \\ -\tfrac{1}{\sqrt{2}} \end{bmatrix},$$

INSTEAD OF THIS $$\varphi_0 = \begin{bmatrix} \sqrt{2/3} \\ 0 \end{bmatrix}, \qquad \varphi_1 = \begin{bmatrix} -1/\sqrt{6} \\ 1/\sqrt{2} \end{bmatrix}, \qquad \varphi_2 = \begin{bmatrix} -1/\sqrt{6} \\ -1/\sqrt{2} \end{bmatrix},$$

OR THIS $$\varphi_0 = \begin{bmatrix} \sqrt{\dfrac{2}{3}} \\ 0 \end{bmatrix}, \qquad \varphi_1 = \begin{bmatrix} -\dfrac{1}{\sqrt{6}} \\ \dfrac{1}{\sqrt{2}} \end{bmatrix}, \qquad \varphi_2 = \begin{bmatrix} -\dfrac{1}{\sqrt{6}} \\ -\dfrac{1}{\sqrt{2}} \end{bmatrix},$$

OR THIS $$\varphi_0 = \begin{bmatrix} \sqrt{\dfrac{2}{3}} \\[1ex] 0 \end{bmatrix}, \qquad \varphi_1 = \begin{bmatrix} -\dfrac{1}{\sqrt{6}} \\[1ex] \dfrac{1}{\sqrt{2}} \end{bmatrix}, \qquad \varphi_2 = \begin{bmatrix} -\dfrac{1}{\sqrt{6}} \\[1ex] -\dfrac{1}{\sqrt{2}} \end{bmatrix}.$$

Similarly

DO THIS $$A = \begin{bmatrix} 1 & & & & \\ & \tfrac{1}{2} & & & \\ & & \tfrac{1}{3} & & \\ & & & \ddots & \\ & & & & \tfrac{1}{N} \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & \cdots & 0 \\ 1 & 1 & 0 & \cdots & 0 \\ 1 & 1 & 1 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & 1 & 1 & \cdots & 1 \end{bmatrix},$$

INSTEAD OF THIS $$A = \begin{bmatrix} 1 & & & & \\ & 1/2 & & & \\ & & 1/3 & & \\ & & & \ddots & \\ & & & & 1/N \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & \cdots & 0 \\ 1 & 1 & 0 & \cdots & 0 \\ 1 & 1 & 1 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & 1 & 1 & \cdots & 1 \end{bmatrix},$$

OR THIS $$A = \begin{bmatrix} 1 & & & & \\ & \dfrac{1}{2} & & & \\ & & \dfrac{1}{3} & & \\ & & & \ddots & \\ & & & & \dfrac{1}{N} \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & \cdots & 0 \\[1ex] 1 & 1 & 0 & \cdots & 0 \\[1ex] 1 & 1 & 1 & \cdots & 0 \\[1ex] \vdots & \vdots & \vdots & \ddots & \vdots \\[1ex] 1 & 1 & 1 & \cdots & 1 \end{bmatrix}.$$

Again, (last line of Section 3.2.1),
DO THIS

$$\left\{\ldots, \begin{bmatrix} \frac{1}{3} & \frac{1}{3} \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} \frac{2}{3} & \frac{1+\sqrt{2}}{3} \\ \frac{\sqrt{2}}{3} & \frac{\sqrt{2}}{3} \end{bmatrix}, \boxed{\begin{bmatrix} 1 & \frac{1+\sqrt{2}}{3} \\ \frac{1+\sqrt{2}}{3} & 1 \end{bmatrix}}, \begin{bmatrix} \frac{2}{3} & \frac{\sqrt{2}}{3} \\ \frac{1+\sqrt{2}}{3} & \frac{\sqrt{2}}{3} \end{bmatrix}, \begin{bmatrix} \frac{1}{3} & 0 \\ \frac{1}{3} & 0 \end{bmatrix}, \ldots\right\}.$$

INSTEAD OF THIS

$$\left\{\ldots, \begin{bmatrix} 1/3 & 1/3 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 2/3 & (1+\sqrt{2})/3 \\ \sqrt{2}/3 & \sqrt{2}/3 \end{bmatrix}, \boxed{\begin{bmatrix} 1 & (1+\sqrt{2})/3 \\ (1+\sqrt{2})/3 & 1 \end{bmatrix}}, \begin{bmatrix} 2/3 & \sqrt{2}/3 \\ (1+\sqrt{2})/3 & \sqrt{2}/3 \end{bmatrix}, \begin{bmatrix} 1/3 & 0 \\ 1/3 & 0 \end{bmatrix}, \ldots\right\}$$

OR THIS

$$\left\{\ldots, \begin{bmatrix} \dfrac{1}{3} & \dfrac{1}{3} \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} \dfrac{2}{3} & \dfrac{1+\sqrt{2}}{3} \\ \dfrac{\sqrt{2}}{3} & \dfrac{\sqrt{2}}{3} \end{bmatrix}, \boxed{\begin{bmatrix} 1 & \dfrac{1+\sqrt{2}}{3} \\ \dfrac{1+\sqrt{2}}{3} & 1 \end{bmatrix}}, \begin{bmatrix} \dfrac{2}{3} & \dfrac{\sqrt{2}}{3} \\ \dfrac{1+\sqrt{2}}{3} & \dfrac{\sqrt{2}}{3} \end{bmatrix}, \begin{bmatrix} \dfrac{1}{3} & 0 \\ \dfrac{1}{3} & 0 \end{bmatrix}, \ldots\right\}.$$

Similarly, for the case of (3.249),
DO THIS

$$A(e^{j\omega}) \;=\; \frac{1-a^4}{(1-a^2e^{-j\omega})(1-a^2e^{j\omega})} \begin{bmatrix} 1 & \frac{a}{1+a^2}(1+e^{j\omega}) \\ \frac{a}{1+a^2}(1+e^{-j\omega}) & 1 \end{bmatrix}.$$

INSTEAD OF THIS

$$A(e^{j\omega}) \;=\; \frac{1-a^4}{(1-a^2e^{-j\omega})(1-a^2e^{j\omega})} \begin{bmatrix} 1 & [a/(1+a^2)](1+e^{j\omega}) \\ [a/(1+a^2)](1+e^{-j\omega}) & 1 \end{bmatrix}.$$

OR THIS

$$A(e^{j\omega}) \;=\; \frac{1-a^4}{(1-a^2e^{-j\omega})(1-a^2e^{j\omega})} \begin{bmatrix} 1 & \dfrac{a}{1+a^2}(1+e^{j\omega}) \\ \dfrac{a}{1+a^2}(1+e^{-j\omega}) & 1 \end{bmatrix}.$$