MATLAB Information and Formulas

OPERATOR PRECEDENCE

<table>
<tr><td>1</td><td>()</td><td>Parentheses</td></tr>
<tr><td>2</td><td>.' '
.^ ^</td><td>Transpose, Matrix Transpose,
Power, Matrix Power</td></tr>
<tr><td>3</td><td>~</td><td>Logical Negation</td></tr>
<tr><td>4</td><td>.* *
./ /
.\ \</td><td>Multiplication, Matrix Multiplication,
Right Division, Matrix Right Division,
Left Division, Matrix Left Division</td></tr>
<tr><td>5</td><td>+
-</td><td>Addition
Subtraction</td></tr>
<tr><td>6</td><td>:</td><td>Colon Operator</td></tr>
<tr><td>7</td><td>< <=
> >=
== ~=</td><td>Less Than, Less Than Or Equal To,
Greater Than, Greater Than Or Equal To,
Equal To, Not Equal To</td></tr>
<tr><td>8</td><td>&</td><td>Element-wise AND</td></tr>
<tr><td>9</td><td>|</td><td>Element-wise OR</td></tr>
<tr><td>10</td><td>&&</td><td>Short-circuit AND</td></tr>
<tr><td>11</td><td>||</td><td>Short-circuit OR</td></tr>
</table>

fprintf SPECIFIER

%d	Integer
%f	Fixed-Point Notation
%e	Exponential Notation
%s	String of Characters
%c	Single Character
\t	Horizontal Tab
\n	New Line
%%	Percent Character
\''	Single Quote Mark
\\	Backslash
\b	Backspace

Fixed-Point Notation Syntax

%<field_width>.<precision>f

COLOR SPECIFIER

r	Red
g	Green
b	Blue
c	Cyan
m	Magenta
y	Yellow
k	Black
w	White

LINE STYLE SPECIFIER

-	Solid Line
--	Dashed Line
:	Dotted Line
-.	Dash-dot Line

MARKER TYPE SPECIFIER

+	Plus Sign
o	Circle
*	Asterisk
.	Point
x	Cross
s	Square
d	Diamond
^	Triangle (Up)
v	Triangle (Down)
>	Triangle (Right)
<	Triangle (Left)

Root Finding

Bisection Method

$$x_r = \frac{x_l + x_u}{2}$$

False Position Method

$$x_r = x_u - \frac{f(x_u)(x_l - x_u)}{f(x_l) - f(x_u)}$$

Newton-Raphson Method

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

Secant Method

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

Modified Secant Method

$$x_{i+1} = x_i - \frac{\delta x_i f(x_i)}{f(x_i + \delta x_i) - f(x_i)}$$

Alternative Modified Secant Method

$$x_{i+1} = x_i - \frac{\delta f(x_i)}{f(x_i + \delta) - f(x_i)}$$

Curve Fitting

Linear Regression:

$$y = a_o + a_1 x$$

$$a_1 = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - \left(\sum x_i\right)^2}$$

$$a_0 = \bar{y} - a_1 \bar{x}$$

Coefficient of Determination

$$r^2 = \frac{S_t - S_r}{S_t}$$

Linearizing Nonlinear Models

Nonlinear	Linearized
$y = \alpha_1 e^{\beta_1 x}$	$\ln y = \ln \alpha_1 + \beta_1 x$
$y = \alpha_2 x^{\beta_2}$	$\log y = \log \alpha_2 + \beta_2 \log x$
$y = \alpha_3 \dfrac{x}{\beta_3 + x}$	$\dfrac{1}{y} = \dfrac{1}{\alpha_3} + \dfrac{\beta_3}{\alpha_3}\dfrac{1}{x}$

Standard Deviation

$$S_t = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

$$s_y = \sqrt{\frac{S_t}{n-1}}$$

Standard Error of the Regression Estimate

$$S_r = \sum_{i=1}^{n} \left(y_i - a_0 - a_1 x_i\right)^2$$

$$s_{y/x} = \sqrt{\frac{S_r}{n-2}}$$

Numerical Integration (*n* is the number of points)

Trapezoidal Rule:

$$I = (b-a)\frac{f(b)+f(a)}{2}$$

$$E_t = -\frac{1}{12} f''(\xi)(b-a)^3$$

Composite Trapezoidal Rule

$$I = \frac{h}{2}\left[f(x_1) + 2\sum_{i=2}^{n-1} f(x_i) + f(x_n)\right]$$

$$\textit{where} \qquad h = \frac{(b-a)}{n-1}$$

Composite Trapezoidal Rule with Unequal Segments

$$I = (x_2 - x_1)\frac{f(x_2)+f(x_1)}{2} + (x_3 - x_2)\frac{f(x_3)+f(x_2)}{2} + \cdots + (x_n - x_{n-1})\frac{f(x_{n-1})+f(x_n)}{2}$$

Simpson's 1/3 Rule

$$I = \frac{h}{3}\left[f(x_1) + 4f(x_2) + f(x_3)\right]$$

$$E_t = -\frac{1}{2880} f^{(4)}(\xi)(b-a)^5$$

Simpson's 3/8 Rule

$$I = \frac{3h}{8}\left[f(x_1) + 3f(x_2) + 3f(x_3) + f(x_4)\right]$$

$$E_t = -\frac{1}{6480} f^{(4)}(\xi)(b-a)^5$$

Composite Simpson's 1/3 Rule: $$I = \frac{h}{3}\left[f(x_1) + 4\sum_{\substack{i=2,4,6,\ldots \\ i,\,\text{even}}}^{n-1} f(x_i) + 2\sum_{\substack{j=3,5,7,\ldots \\ j,\,\text{odd}}}^{n-2} f(x_j) + f(x_n)\right]$$

ODE: Initial Value Problems

Euler's Method

$$y_{i+1} = y_i + f(t_i, y_i)h$$

Heun's Method

$$y_{i+1}^0 = y_i + f(t_i, y_i)h$$

$$y_{i+1} = y_i + \frac{f(t_i, y_i) + f(t_{i+1}, y_{i+1}^0)}{2}h$$

Midpoint Method

$$y_{i+1/2} = y_i + f(t_i, y_i)\frac{h}{2}$$

$$t_{i+1/2} = t_i + \frac{h}{2}$$

$$y_{i+1} = y_i + f(t_{i+1/2}, y_{i+1/2})h$$