Introduction to Mathematica
Fundamental Engineering Skills Workshop

Workshop Example: Damped Harmonic Oscillator

What’s the difference?

- Set (=)
  - Assigns the right-hand-side (RHS) to the left-hand-side (LHS), evaluating defined variables
  - If RHS is not defined, assignment is symbolic rather than literal
    - Symbolic example
      - $x = a$ (Line 1)
      - $a = 4$ (Line 2)
      - $a = 5$ (Line 3)
      - $x = ?$ In this case, Mathematica will return a value of 5, since $a$ was undefined at Line 1

\[
-dv = -c \frac{dx}{dt}
\]

\[
-kx
\]

\[
\frac{d^2x}{dt^2} + \frac{c}{m} \frac{dx}{dt} + \frac{k}{m} x = 0
\]

\[
x''[t] + \frac{c}{m} x'[t] + \frac{k}{m} x = 0
\]
• Literal example

  • \( a = 4 \) \hspace{1cm} \text{(Line 1)}
  \( x = a \) \hspace{1cm} \text{(Line 2)}
  \( a = 5 \) \hspace{1cm} \text{(Line 3)}
  \( x = ? \) In this case, Mathematica will return a value of 4, since \( a \) was specified to have a value of 4 before Line 2

• SetDelayed (\( := \))
  o Assigns the RHS to LHS without evaluating defined symbols

• ReplaceAll (\( /. \))
  o Evaluates the operator, e.g. D[] or Integrate[], and then evaluates the result at the given value

• Equal (\( == \))
  o This is a relational operator rather than an assignment operator (like =)
  o Compares the LHS to the RHS
  o Used in defining equations to be solved, and initial conditions

Useful Shortcuts

• Esc + Greek Letter + Esc
  o Insert the specified Greek letter at the cursor

• Ctrl + ^
  o Superscript (For example, \( x^2 \))

• Ctrl + /
  o Fraction (For example, \( \frac{a}{b} \))

• Esc + sumt + Esc
  o Summation operator, \( \sum \)

• Esc + intt + Esc
  o Indefinite integral operator

• Esc + dintt + Esc
  o Definite integral operator

• (* xyz *)
  o Comments a particular line of code