

## APM 153 LECTURE TWENTY-ONE – MathCad Basics

### Introduction

- (1) MathCad is a powerful mathematics package that combines an equation editor with a sophisticated calculator and a word processor.
- (2) The idea behind MathCad is that you type in an equation like you would write it down on a sheet of paper and then the equation calculator solves the problem.
- (3) MathCad has tools to solve an incredible number of problems in mathematics of all different types from matrix algebra to differential and integral equations.
- (4) MathCad is very powerful, but it is especially tricky to learn how to use. In particular, it takes quite a bit of practice to learn how to type in equations into the MathCad GUI.

### Getting Started

- (5) When you first open up MathCad, you are shown a blank page called a “worksheet”. All work is typed into the worksheet which are saved with the **\*.mcd** extension.
- (6) The blank page is divided down the center by a line. You can write on both sides of the line, but I usually stick to just the left hand page.
- (7) The fastest way to begin learning MathCad is to start one of the Tutorials. Click on the word Help in the main toolbar and select Tutorials.
- (8) Clicking on one of the subjects starts that tutorial. I recommend that you go through the tutorials on “Overview” and “Getting Started Primers”.
- (9) The Tutorials are one of three “Resources” in MathCad. The other two are “**Quicksheets**” and “**Reference Tables**”
- (10) While the Tutorials help you learn the basics of using MathCad, **Quicksheets** demonstrate specific functions and problem solving techniques. These Quicksheets might be very useful for those of you taking Calculus and Differential Equations.

(11) The **Reference Tables** define physical and math constants in MathCad format.

(12) You can access Quicksheets and the Reference Tables either by clicking on Help in the GUI or by clicking on the “home” icon in the tutorial window.

(13) **Navigation** from one subject or resource to another works like **web-browser**. (back, forward, home). This shows the influence of Microsoft which is pushing software developers to make their software work and look like a collection of web pages.

## Toolbars

(14) In addition to the MathCad toolbar located above the worksheet you have access to 15 additional different toolbars which allow you to access different symbols and functions.

(15) There are toolbars for example for

Standard	- the usual Windows icons (cut, past, find, etc)
Math	- allows you to select some of the toolbars below
Calculator	- symbols you would find on a calculator
Matrix	- symbols for setting up vectors, matrices, inverses, etc.
Graph	- options for different types of graphs
Calculus	- symbols for integrals, derivatives and limits
Symbolic	- symbols for logical operators including <b>Boolean logic</b>

(16) All of these toolbars can be opened and closed as needed, resized, and “docked” which means they can be added to the main toolbar at the top of the GUI.

## Three Kinds of Equal

(17) There are at least three ways to say that something is equal to something else in MathCad. This is one of the things that makes MathCad powerful and confusing.

= plain old equal sign - means mathematically equal – used **after** an equation to generate a numerical solution

example:  $2 + 4 = 6$  the numerical solution for adding 2 plus 4 is 6

$:=$  colon equal - means that the value on the right hand is being assigned to the symbol or variable on the left hand

example:  $x := 4$  the value 4 is being assigned to the variable “x”  
Typed in as  $:=$

$=$  “Boolean equal” - means that the equation on the left hand side is, for at least some values, logically equal to the equation on the right hand side of the symbol.

example:  $\sin(x) = \frac{x+1}{10}$  - sets the two equations equal to each other for some value

(18) The three different types of “equal” used in MathCad allows the user to set up and solve different types of equations.

(19) If you type in a formula with no unknowns, using the plain  $=$  sign calculates the numeric solution.

(20) If you want to store a value in a variable, using the  $:=$  assigns the value to the variable.

(21) And if you use the Boolean equal sign you set the two equations equal to each other. When using the Boolean equal sign we say that those values of x where the two equations are equal to each other are the “roots” of the two equations.

(22) The Boolean equal sign is named for George Boole (1815-1864), a nineteenth century Scottish mathematician who largely invented the symbols used today to represent formal statements in logic.

(23) In Matlab, the plain old equal sign is used for most equations with the exception of the double equal sign ( $= =$ ) used in if-then statements.

(24) MathCad however requires these different types of equal signs because the three ways of writing the equal sign represents very different ideas in math.

## Active Calculation

(25) When you type an equation into MathCad, you are not just typing in the equation, you are actually setting up a mathematical problem.

(26) If it helps, you can think of MathCad as a combination of MS Word and your pocket calculator. You type the in the equation into the document and MathCad solves it.

(27) This means that any mathematical formula or symbol typed into the worksheet is like **an active line of code** in a programming language.

## Inactive Lines

(28) Just like in other programming languages however, you can also add comments as **text**. These lines of code are **inactive** and do not participate in any calculations.

(29) Most of the time, if you just start typing text somewhere into your worksheet, MathCad recognizes that you are typing in comments and it creates a **text box**.

(30) Or you can create a text box and type your comments, section headers, notes, etc into each text box.

## Cut and Paste

(31) Because MathCad was designed to have some of the same features as a word processor, it is possible to cut and paste and move both text and calculations on your worksheets to make them look nicer and be easier to understand.

## First Comes First

(32) However, you must remember that calculations are done in order with the first calculation appearing above the rest and each subsequent calculation appearing further down on the worksheet.

## Reading Assignment

(33) By Wednesday, please go to the lab, do the first and third MathCad Tutorials and check out the Quicksheets and Reference Tables.