

UGS CONNECTION



AMERICAS 2008



Siemens PLM Software

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An In-Depth Look at the Modeling Spreadsheet

Presented by :

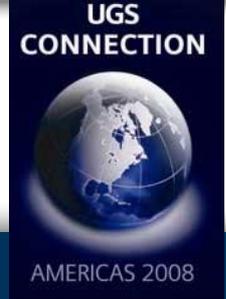
Travis Bennett
& Dan Rumble

Employer:

● DePuy Orthopaedics
a Johnson & Johnson company

Travis Bennett

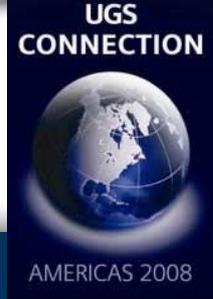
Senior Product Designer



- ▶ **8 yrs Orthopedic design experience**
- ▶ **Multiple UGS courses**
- ▶ **Certified Design Professional ~ One of the Elite 100!**
- ▶ **Associates degree in Tool Engineering Technology from ITT Technical Institute (Ft Wayne, IN)**

Dan Rumple

Senior Product Designer



- ▶ **11 yrs Orthopedic design experience 21 yrs total design experience**
- ▶ **Multiple UGS courses**
- ▶ **Certified Design Professional ~ One of the Elite 100!**
- ▶ **Associates degree in Tool Engineering Technology from ITT Technical Institute (Ft Wayne, IN)**

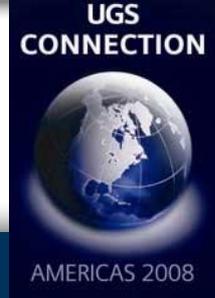
DePuy Orthopaedics

Warsaw, Indiana



- ▶ **Founded by Revra DePuy in 1895**
- ▶ **The World's FIRST Orthopaedic company.**
- ▶ **A Johnson & Johnson company**
- ▶ **Designs, Manufactures and Distributes Orthopaedic Devices and Supplies.**
- ▶ **Fully Integrated Surgical Package**
- ▶ **Less Invasive Joint Replacement Surgery**

An In-Depth Look at the Modeling Spreadsheet

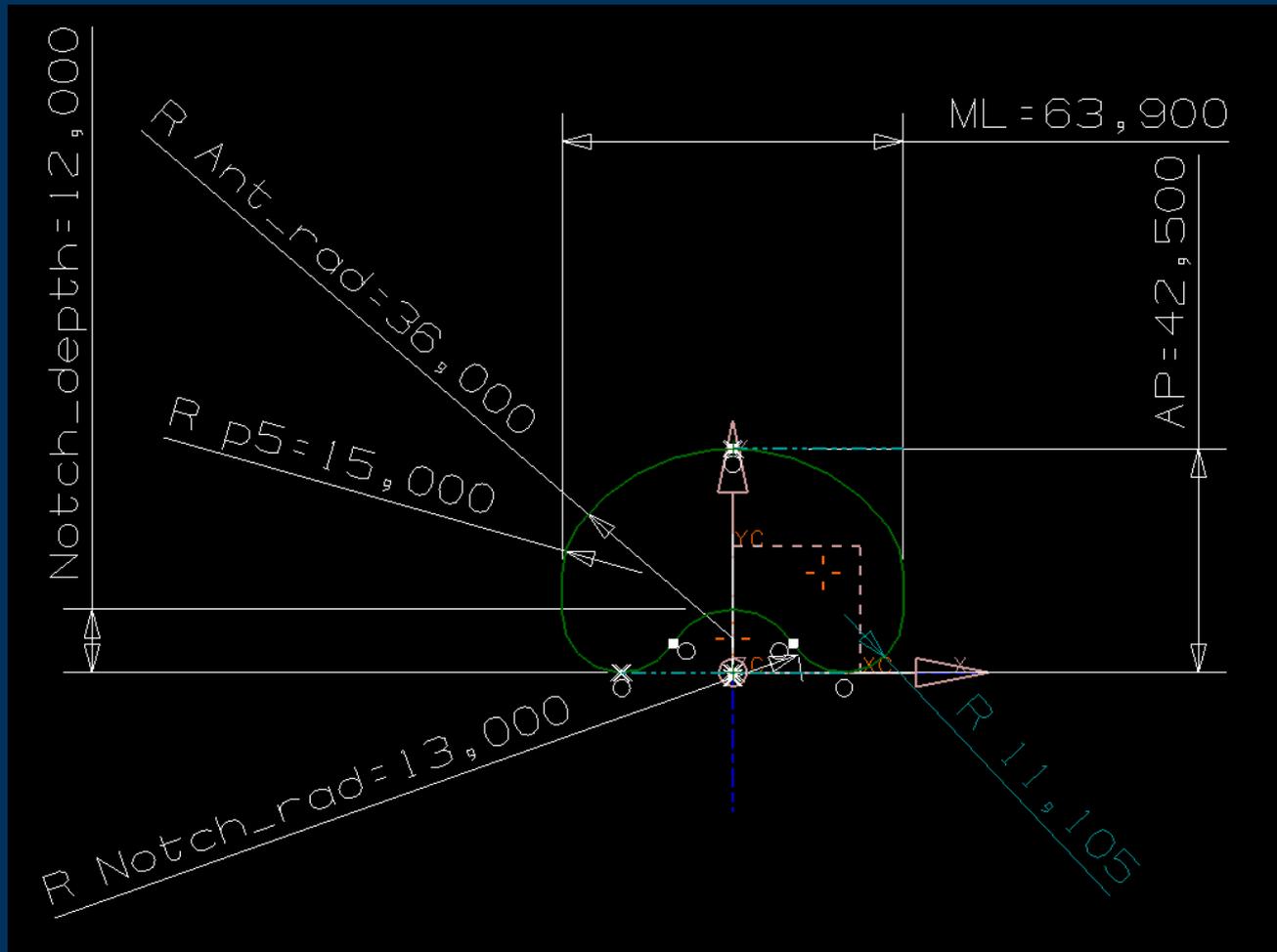


- ▶ **What is the Modeling Spreadsheet**
 - ▶ The Modeling Spreadsheet is a tool that utilizes the parametric abilities to model multiple variations within one part file.
- ▶ **Overview**
 - ▶ Model Prep
 - ▶ Spreadsheet Basics
 - ▶ Mass 3-D functions
 - ▶ Spreadsheet Goalseek
 - ▶ Closing Q/A

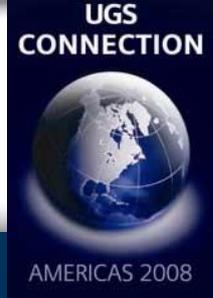


Spreadsheet Model Prep

► Naming Expression



Spreadsheet Model Prep

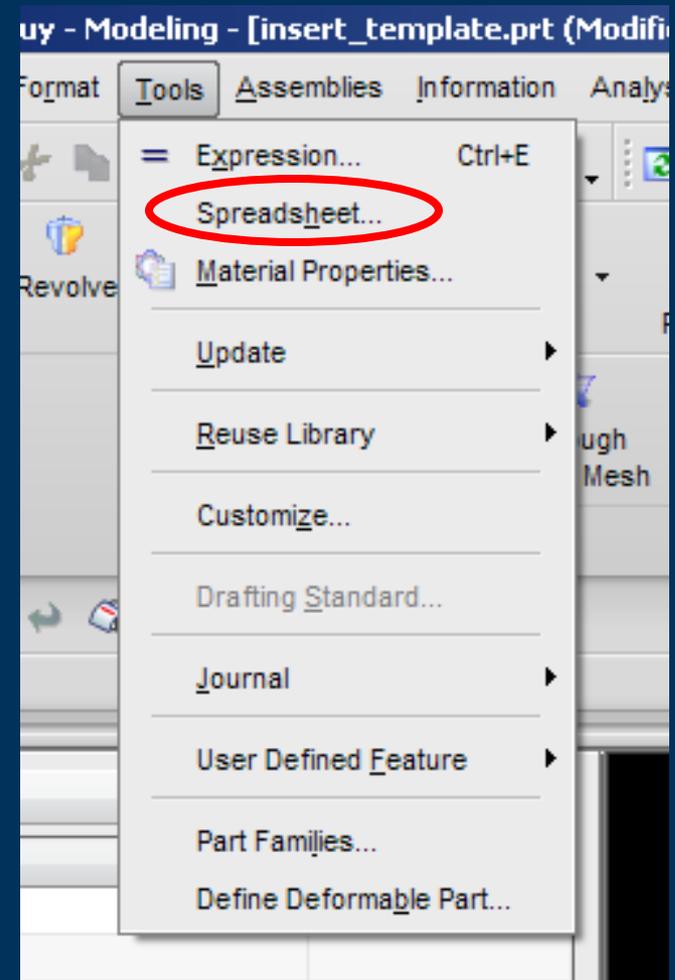


- ▶ **Parametric Practices**
 - ▶ Keep sketches simple
 - ▶ Organize your model
 - ▶ Name sketches, features
 - ▶ Keep it clean

The Spreadsheet



- ▶ To access the Spreadsheet



Spreadsheet Population



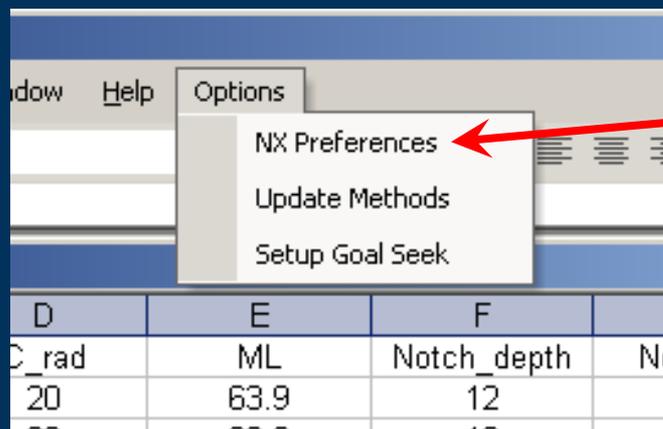
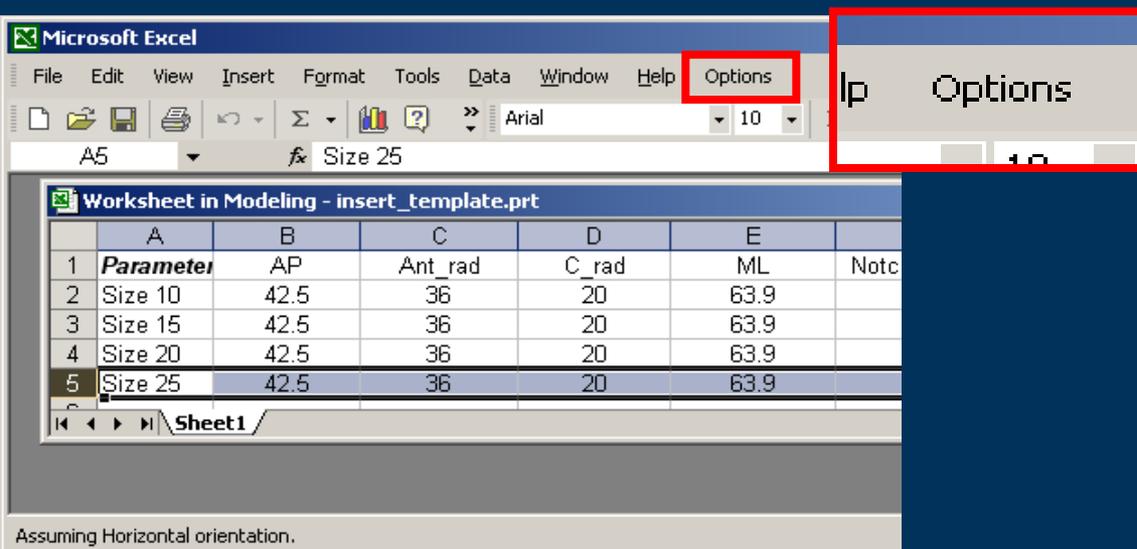
The screenshot shows the Microsoft Excel interface with the 'Tools' menu open. The 'Update NX Part' and 'Extract Expr' options are highlighted in the menu. A red box highlights a table in the spreadsheet with the following content:

	Update NX Part
	Extract Expr

The status bar at the bottom indicates '2 parts have been loaded'.



Spreadsheet Options



Select NX Preferences

Spreadsheet Preferences

Microsoft Excel - Worksheet in Modeling - insert_temp

	A	B
1	Parameters	
2	AP	42.5
3	Ant_rad	36
4	Ant_rad_2	15
5	C_rad	20
6	ML	63.9
7	Notch_depth	12
8	Notch_rad	13
9	S_rad	40
10	Thickness	10
11	_p4	11.10490904
12	_p9	0

Preferences

Vertical Orientation

Auto Refresh on Load

Use Fixed Update Range

Auto Fit on Update

OK Cancel

Brings the Imported Expressions in a vertical orientation

Refreshes Model

Click Off to manually set expression range

Resizes/Fits model in NX

Removing the check reloads expressions to a horizontal orientation

Microsoft Excel - Worksheet in Modeling - insert_template.prt

	A	B	C	D	E	F	G
1	Parameter	AP	Ant_rad	C_rad	ML	Notch_depth	Notch_rad
2	Size 10	42.5	36	20	63.9	12	13
3	Size 15	42.5	36	20	63.9	12	13
4	Size 20	42.5	36	20	63.9	12	13
5	Size 25	42.5	36	20	63.9	12	13

Preferences

Vertical Orientation

Auto Refresh on Load

Use Fixed Update Range

Auto Fit on Update

OK Cancel



Populated Spreadsheet

Microsoft Excel - Worksheet in Modeling - insert_template.prt

File Edit View Insert Format Tools Data Window Help Options

Type a question for help

Arial 10 B I U

17

	A	B	C	D	E	F	G	H	I	J
1	Parameter	AP	Ant_rad	C_rad	ML	Notch_depth	Notch_rad	S_rad	Thickness	
2	Size 10	42.5	36	20	63.9	12	13	40	10	
3	Size 15	42.5	36	20	63.9	12	13	40	15	
4	Size 20	42.5	36	20	63.9	12	13	40	20	
5	Size 25	42.5	36	20	63.9	12	13	40	25	
6										
7										
8										
9										
10										

Sheet1

Done

Any of the parameters listed can be scaled or driven to different values

Parameter can be populated by a size, part number, name...

Parameter that drives part to multiple sizes



Execute Spreadsheet

The screenshot shows a Microsoft Excel window titled "Microsoft Excel - Worksheet in Modeling - insert_template.prt". The spreadsheet contains a table with the following data:

	A	B	C	D	E	F	G	H	I	J
1	Parameter	AP	Ant_rad	C_rad	ML	Notch_depth	Notch_rad	S_rad	Thickness	
2	Size 10	42.5	36	20	63.9	12	13	40	10	
3	Size 15	42.5	36	20	63.9	12	13	40	15	
4	Size 20	42.5	36	20	63.9	12	13	40	20	
5	Size 25	42.5	36	20	63.9	12	13	40	25	
6										
7										
8										
9										
10										

The status bar at the bottom shows "Done" on the left and "Sum=242.4" on the right. The spreadsheet is titled "Sheet1" and the active cell is A3, containing the text "Size 15".

Select the size required

Execute Spreadsheet

Select
Tools

Select
Update NX Part

The screenshot shows the Microsoft Excel interface with the 'Tools' menu open. The 'Update NX Part' option is highlighted in the menu. A red box highlights the 'Tools' menu, and another red box highlights the 'Update NX Part' option. A red arrow points from the 'Tools' menu to the 'Update NX Part' option. Below the Excel window, a 3D model of a part is visible, and a red box highlights the 'Update NX Part' option in the context menu.

Parameter	AP	Ant
Size 10	42.5	36
Size 15	42.5	36
Size 20	42.5	36
Size 25	42.5	36

A close-up view of the 'Update NX Part' option in the context menu, highlighted with a red box. The text 'Update NX Part' is clearly visible.

Update Parts – Sizes 10, 15, 20 & 25



The screenshot displays the NX 5 Modeling interface with a 3D model of a part and an Excel spreadsheet overlaid. The spreadsheet contains the following data:

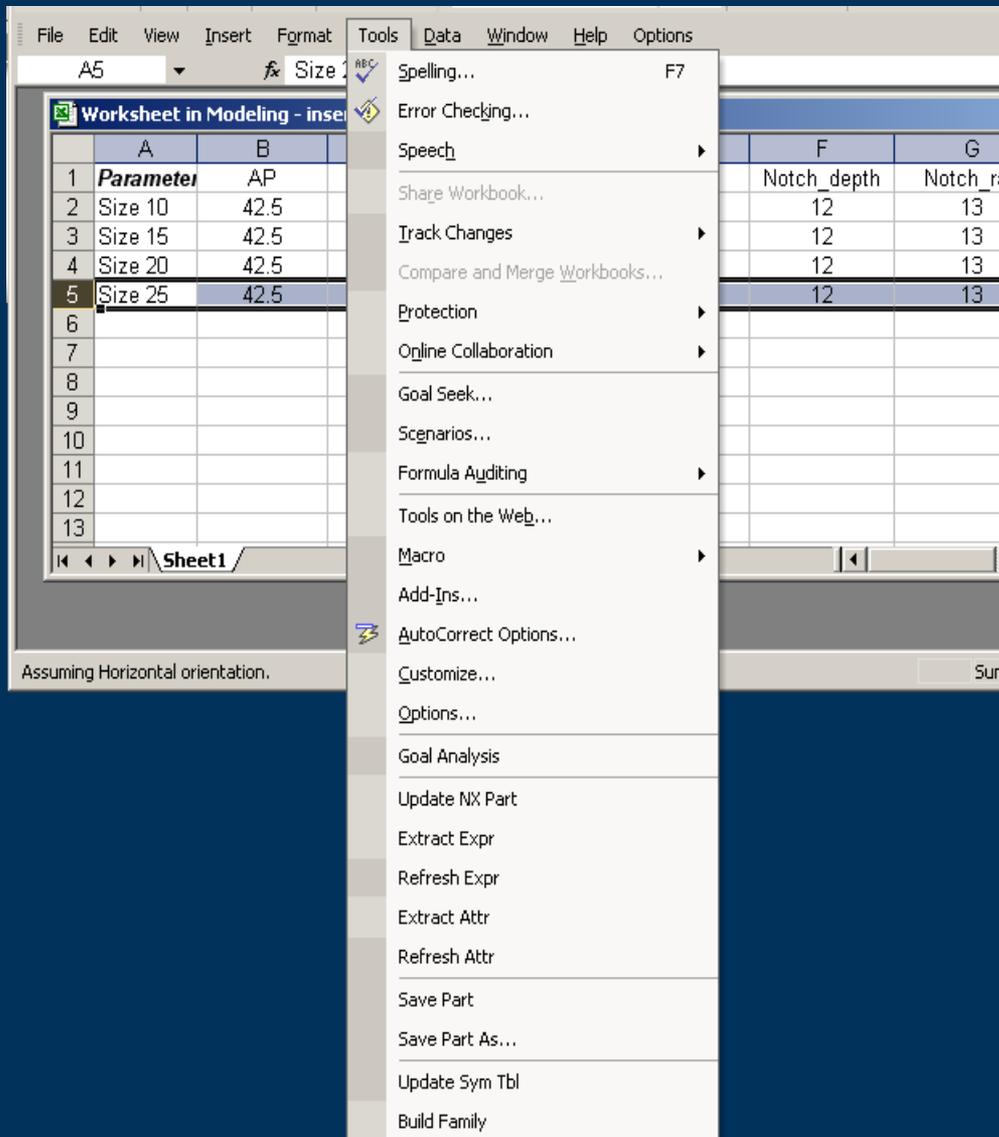
	A	B	C	D	E	F	G	H	I	J
1	Parameter	AP	Ant_rad	C_rad	ML	Notch_depth	Notch_rad	S_rad	Thickness	
2	Size 10	42.5	36	20	63.9	12	13	40	10	
3	Size 15	42.5	36	20	63.9	12	13	40	15	
4	Size 20	42.5	36	20	63.9	12	13	40	20	
5	Size 25	42.5	36	20	63.9	12	13	40	25	
6										
7										
8										
9										

Update successful with 8 expression(s) in 'Sheet1'!A5:15
Sum=252.4

The 3D model shows a blue part with a coordinate system (X, Y, Z) and a smaller coordinate system (Xc, Yc, Zc) on the part's surface. The Part Navigator on the left lists various features like Datum Coordinate System, Sketch, Extrude, Datum Plane, Sweep, Subtract, Edge Blend, and Feature Set.



Other Spreadsheet Options



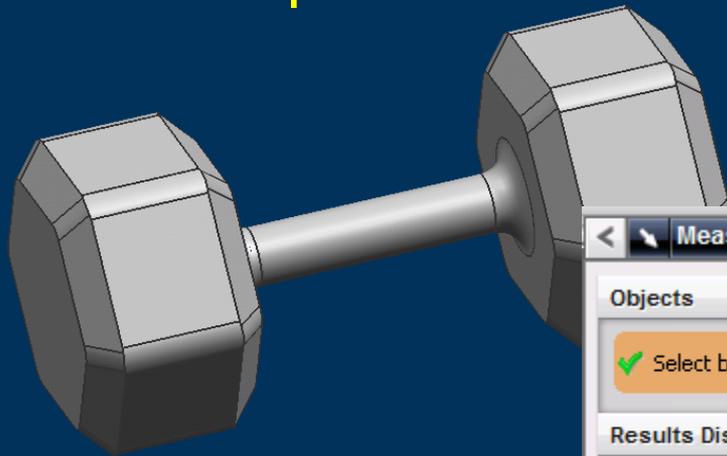
- A few of the other options that Spreadsheet offers;
- ▶ Goal Seek (will talk about)
 - ▶ Manipulate Attributes
 - ▶ Save parts off to different sizes
 - ▶ There are more ways to use this spreadsheet, what works for you

The Spreadsheet tool is a powerful tool for prototyping parts, multiple sizes, calculating various designs...



Mass3d Functions

- Provides a way to capture mass properties of a part file and use that information in the modeling spreadsheet.



The screenshot shows the 'Measure Bodies' dialog box in the UGS software. The 'Objects' section has 'Select bodies (1)' checked. The 'Results Display' section has 'Show Information Window' unchecked and 'Annotation' set to 'None'. The 'Settings' section has 'Line Color' set to blue, 'Box Color' set to gray, 'Text Color' set to black, 'Text Size' set to 'Medium', and 'Text Style' set to 'Normal'. The 'Apply' button is highlighted in green.

Overlaid on the right is a Microsoft Excel spreadsheet titled 'Worksheet in Modeling - dumbell_inch.prt'. The spreadsheet contains the following data:

	A	B	C	D
1	Parameters			
2	Handle_thickr	1		
3	Handle_width	5		
4	Thickness	3		
5	Width	2.75		
6				
7				
8	Weight	27.96782		
9				
10				
11				
12				

The Excel formula bar shows the formula: `=mass3d("solids",3,2)`. The status bar at the bottom indicates 'Assuming' and 'NUM'.

Mass3d Functions

► List of mass properties - Type

Type	# Values	Description
0	42	All properties
1	1	Area
2	1	Volume
3	1	Mass
4	3	Center of Mass (CofM), WCS
5	3	First Moments, WCS Axes and Origin
6	3	Moments of Inertia with respect to (w.r.t.) WCS Axes and Origin
7	3	Moments of Inertia w.r.t. CofM Origin/WCS Axes
8	1	Spherical Moment of Inertia w.r.t. CofM Origin/ WCS Axes
9	3	Inertia Products w.r.t. WCS Axes and Origin
10	3	Inertia Products w.r.t. CofM Origin/WCS Axes
11	3x3=9	Principal Axes, WCS
12	3	Principal Moments w.r.t. CofM Origin
13	3	Radii Of Gyration w.r.t. WCS Axes and Origin
14	3	Radii Of Gyration w.r.t. CofM Origin/WCS Axes
15	1	Spherical Radius of Gyration w.r.t. CofM Origin/WCS Axes
16	1	Density

► Units

1	pounds & inches
2	pounds & feet
3	grams & centimeters
4	kilograms & meters

Mass 3d Functions

Important Notes

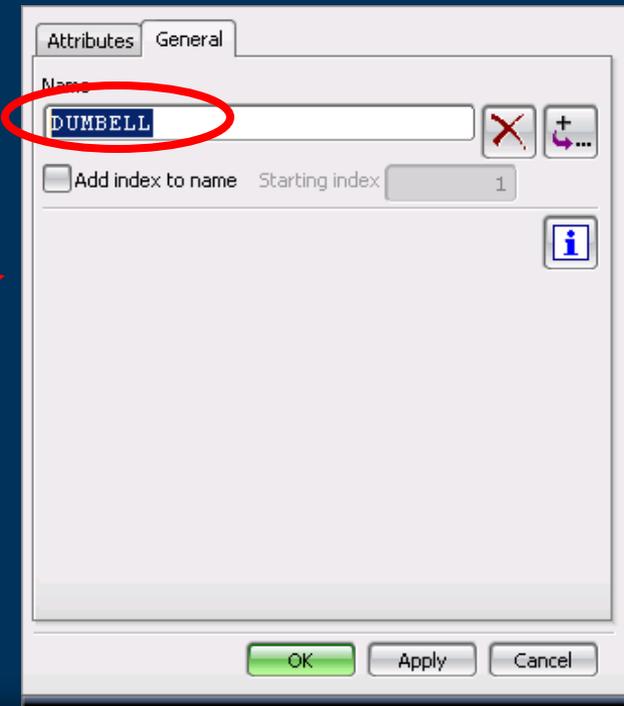
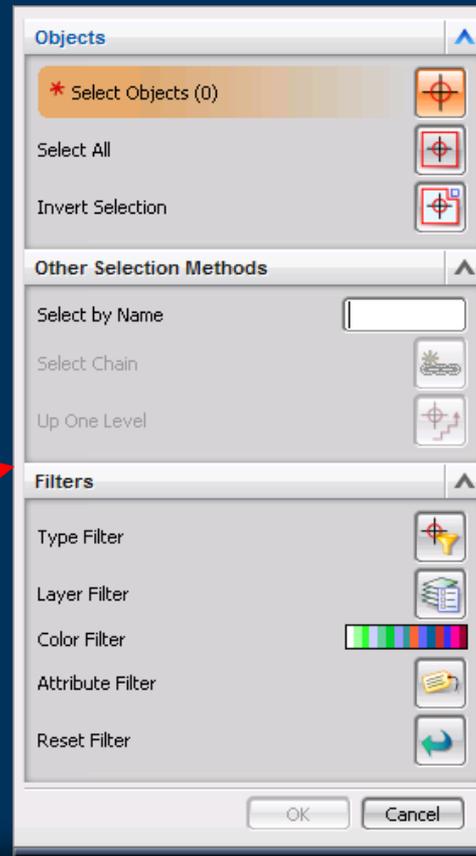
- ▶ Make sure density and units are correct

Edit – feature – solid density

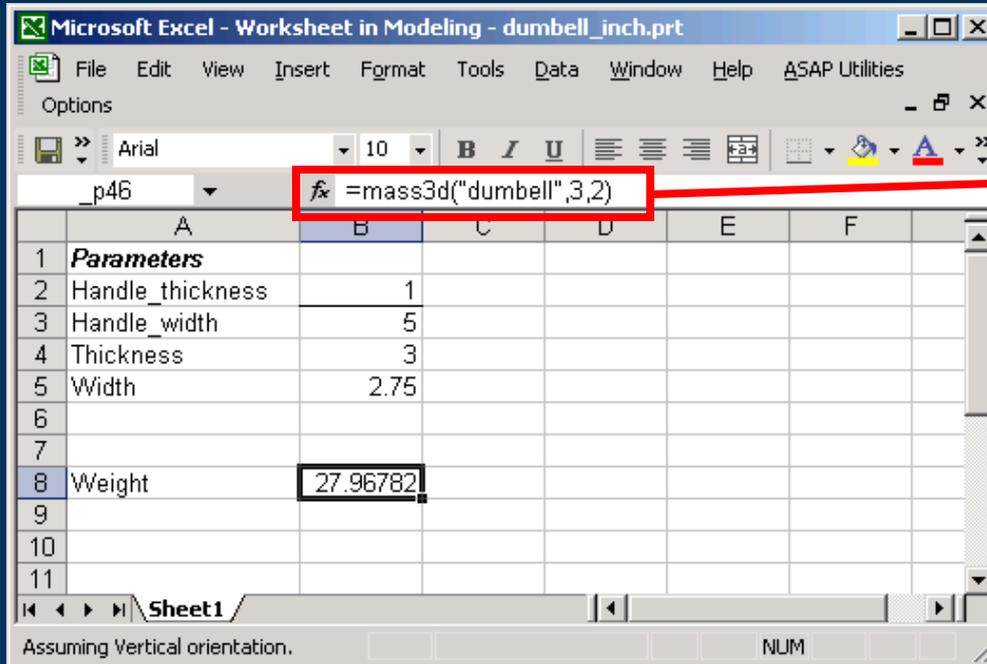


- ▶ Name solid bodies and faces that you will be extracting information from

Edit – properties



Mass3d Functions



```
=mass3d("dumbell",3,2)
```

► Spreadsheet syntax =Mass3d("object_name",type,units)

=Mass3d("dumbell",3,2)



Extracts the mass of the solid named "dumbell" and displays the value in pounds



Mass3d functions

Additional info:

For functions that will output multiple cells, highlight the number of cells required and press ctrl-shift-enter to return the results properly

Microsoft Excel

File Edit View Insert Format Tools Data Window Help ASAP Utilities Options

B9 {=mass3d("dumbell",4,2)}

Worksheet in Modeling - dumbell_inch.prt

	A	B	C	D	E
1	Parameters				
2	Handle_thickness	1			
3	Handle_width	5			
4	Thickness	3			
5	Width	2.75			
6					
7					
8	Weight	27.96781946			
9	Center of mass	-1.82527E-16	-8.27761E-09	6.24822E-09	
10					

Sheet1

Assuming Vertical orientation. Sum=-2.02939E-09 NUM

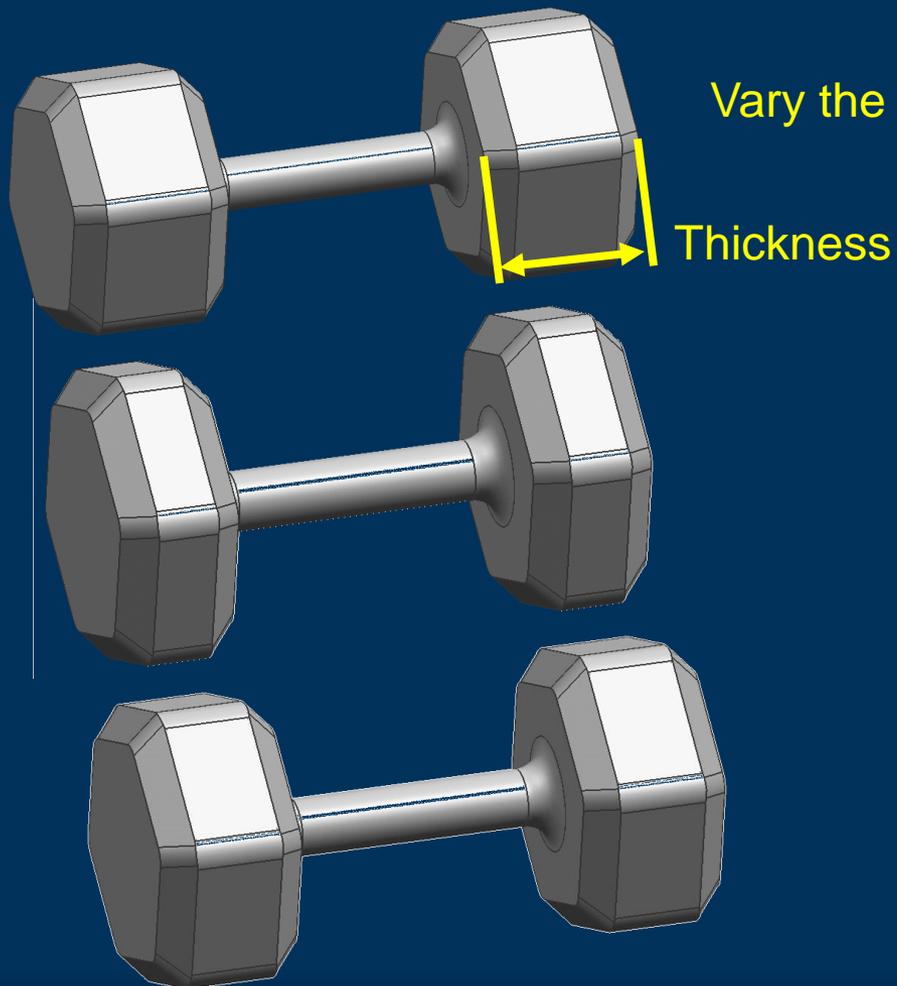
For Excess spreadsheets, place the "@" symbol after the equal sign

=@Mass3d("object_name",type,units)



Goal Seek

- ▶ An optimization tool that varies one or more parameter (expressions) between two limits until a specified result is achieved.



Vary the thickness until the weight is 25 pounds

	A	B
1	Parameters	
2	Handle_thickness	1
3	Handle_width	5
4	Thickness	3
5	Width	2.75
6		
7		
8	Weight	27.96781946
9		

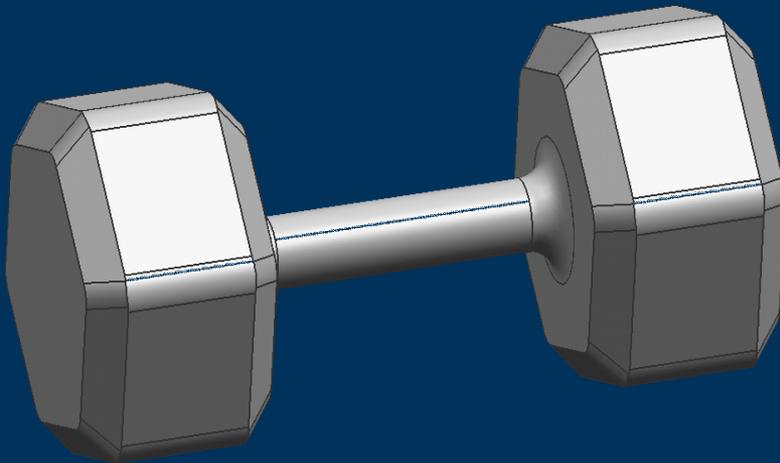
	A	B
1	Parameters	
2	Handle_thickness	1
3	Handle_width	5
4	Thickness	2.690464696
5	Width	2.75
6		
7		
8	Weight	25
9		



Goal Seek

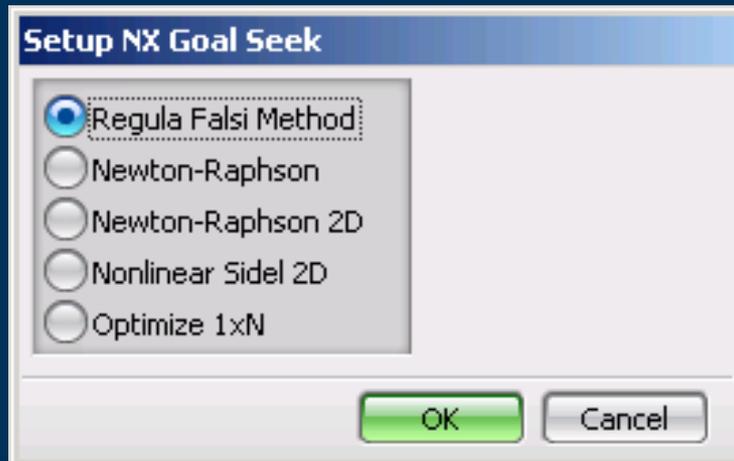
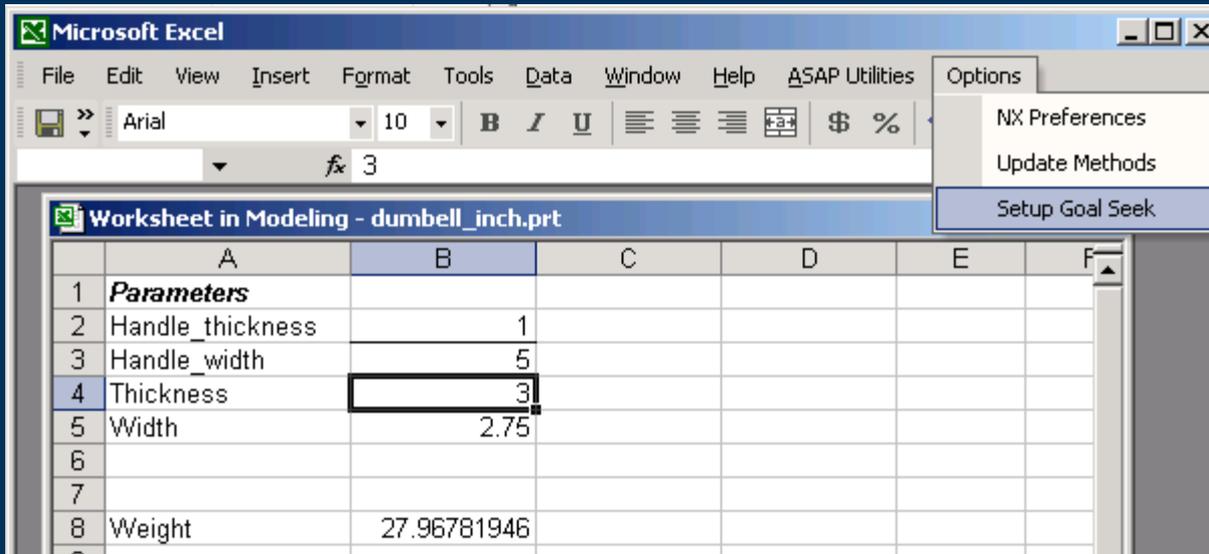
Before running Goalseek:

- ▶ Ensure part will updated without errors.
- ▶ Think about relationships of expressions – especially if it will be chosen as a variable in Goal Seek.



Goal Seek

- ▶ Choose Goal Seek solve method



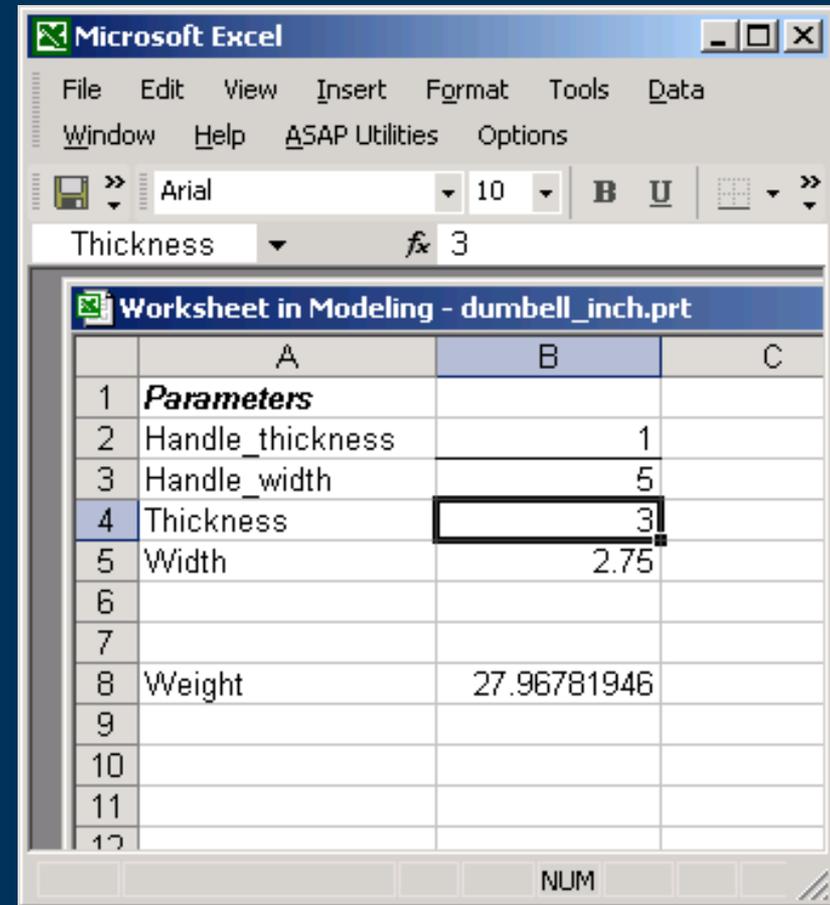
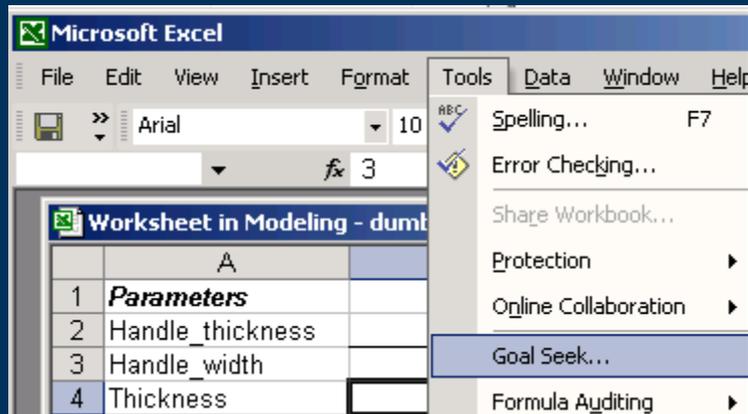
These are different mathematical methods that the program uses to achieve the target value specified.

Some methods will allow multiple variable cells. See NX documentation for further information.



Goal Seek

► Access Goal Seek dialogue





Goal Seek

▶ Run Goal Seek

Microsoft Excel

File Edit View Insert Format Tools Data
Window Help ASAP Utilities Options

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Thickness 3

Worksheet in Modeling - dumbell_inch.prt

	A	B	C
1	Parameters		
2	Handle_thickness	1	
3	Handle_width	5	
4	Thickness	3	
5	Width	2.75	
6			
7			
8	Weight	27.96781946	
9			
10			
11			
12			

NUM

Regula Falsi Goal Seek

Variable Cell: \$B\$4

Target Cell: \$B\$8

Target Value: 25

Lower Bracket: 2

Upper Bracket: 3

Tolerance: .1

Max Iterations: 20

Perform NX Update

OK Cancel

In this example, the thickness (cell B,4) will be changed within the limits set by the upper and lower bracket values until a target weight (cell B,8) of 25 lbs is achieved.

Goal Seek

▶ Evaluating the results

Regula Falsi Goal Seek

Variable Cell:

Target Cell:

Target Value:

Lower Bracket:

Upper Bracket:

Tolerance:

Max Iterations:

Perform NX Update



Microsoft Excel

File Edit View Insert Format Tools Data Window Help

ASAP Utilities Options

Thickness = 2.69046469569477

Worksheet in Modeling - dumbell_inch.prt

	A	B	C	D
1	Parameters			
2	Handle_thickness	1		
3	Handle_width	5		
4	Thickness	2.690464696		
5	Width	2.75		
6				
7				
8	Weight	25		
9				
10				
11				
12				

Sheet1

NX Goal Seek (Regula NUM

The “Thickness” expression has been changed to a value that will yield a mass of 25 lbs. The UG file has also been updated with the changes.

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