Prepare for Program Assignment on Looping

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Computer Programming for Mechanical Engineers

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Quiz next Tuesday (3/14) covers if statements

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Outline

- Review VBA Format function
- Exit commands: Exit Function, Exit For, and Exit Loop
- Comments on third programming assignment due next Tuesday (3/16)
- Introduction to fourth programming assignment on looping due April 18
- Work on programming assignments

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Review VBA Format Function

- The Format function defines the appearance of a variable
- Its structure is <string variable> = Format(<variable>, <format string>)
  - <string variable> contains the formatted variable what can be used as output to the worksheet or another function/sub
  - <variable> is the variable being formatted
  - <format string> is described on next slide

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Review Format String Codes

- 0 place a digit in this position, even if it is a lead or trailing zero
- # place a digit in this position only if it is **not** a leading or trailing zero
- . Notes position of the decimal point
- E asks for power of ten notation
- + or – asks for explicit display of sign (used in font of number or after E)
- % multiply by 100; append % sign

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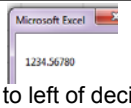
Review Format Examples

```
Dim x As Double
x = 1234.5678
MsgBox Format(x, "0.00000")
```



Note trailing zero and all digits to left of decimal

```
Dim i as Integer
i = 1
MsgBox Format(i, "0000.00")
```

Lead and trailing zeroes and decimal point for integer

```
MsgBox Format(-0.012345678, _
              "00.0000")
```

Note automatic minus sign & extra 0 before decimal

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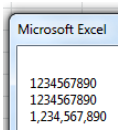
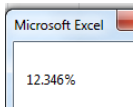
Review More Format Examples

```
Dim x As Double
Dim i As Long
i = 1234567890
MsgBox Format(i, "#") & vbCrLf _
  & Format(i, "0") & vbCrLf  _
  & Format(i, "#,###")
```



Note ability to get repeating commas with limited format

```
Dim x As Double
x = 0.123456
MsgBox Format(x, "0.000%")
```



Note automatic conversion from decimal to percent, rounding, and all leading digits

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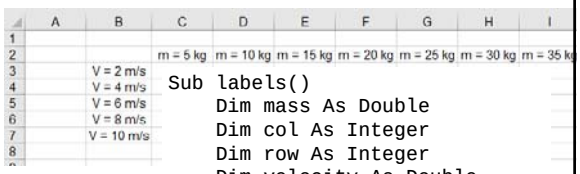
Review in-class Exercise



	A	B	C	D	E	F	G	H	I
1									
2			m = 5 kg	m = 10 kg	m = 15 kg	m = 20 kg	m = 25 kg	m = 30 kg	m = 35 kg
3		V = 2 m/s							
4		V = 4 m/s							
5		V = 6 m/s							
6		V = 8 m/s							
7		V = 10 m/s							
8									

```
Sub labels()
    Dim mass As Double
    Dim col As Integer
    Dim row As Integer
    Dim velocity As Double
    mass = 5
    row = 2
    For col = 3 To 10
       Cells(row, col).Value =
```



```
   For col = 3 To 10
      Cells(row, col).Value = "m = " & _
                Format(mass, "#") & " kg"
      Cells(row, col).HorizontalAlignment _
                                  = xlCenter
      mass = mass + 5
   Next col                          Mass labels
   velocity = 2
   col = 2
   For row = 3 To 7
      Cells(row, col).Value = "V = " & _
             Format(velocity, "#") & " m/s"
      Cells(row, col).HorizontalAlignment _
                                    = xlCenter
      velocity = velocity + 2
   Next row                        Velocity labels
End Sub
```

Exit Commands

- Used to leave functions and loops before normal completion
- Some programming texts consider these constructs to violate rules of well structured programs
- Generally used to provide alternate exits from loops and functions when meaning is clear

Exit Function Command

- Transfers control from function prior to normal end function statement

```
Function fake(x As Double) As Variant
   If x = 1 Then
      fake = "Error: function fake(x) is infinite" _
                                    & "when x = 1"
      Exit Function
   End If
   fake = 1 / (x - 1)
End Function
```


Without Exit Function

- Structured approach has only one entrance and one exit

```
Function fake(x As Double) As Variant
   If x = 1 Then
      fake = "Error: function fake(x) is infinite" _
                                    & "when x = 1"
   Else
      fake = 1 / (x - 1)
   End If
End Function
```


What happens here?

- What does function return if x = 1?

```
Function fake(x As Double) As Variant
    If x = 1 Then Exit Function
    fake = 1 / (x - 1)
End Function
```

- If x = 1, the functions returns a zero because the values of all variables in a function or sub, including the function name, are set to zero initially

Exit For

- Command to leave a For loop

```
Mycos = "Error"
For n = 1 To maxIterations
    term = -term * x^2 / (2 * n * (2*n-1))
    sum = sum + term
    if Abs(term) <= maxRelErr * _
                          Abs(sum) Then
        myCos = sum
        Exit For
    End If
Next n
If myCos <> "Error" Then h = x * myCos
```

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Exit Do

- The Exit Do statement is similar to the Exit For statement
- It is used to exit a Do-While loop or a Do-Loop-Until loop
- When executed control is transferred immediately to the first statement after the end statement of the loop
- Can also use an exit function statement in the middle of any loop structure

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Work on Program Assignments

- Assignment three: uses if statements to solve quadratic equation
  - Due March 16 at 11:59 pm
- Assignment four: use of looping to construct two way table and construct infinite series for cosine
- Now available on line
- Due April 18

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Programming Assignment Three

- Apply if-else if structure to solution of quadratic equation: $ax^2 + bx + c = 0$
- Consider cases of improper specification (e.g.: a = 0)
- Regular results include $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
  - Two distinct real roots
  - Duplicate real root when $b^2 = 4ac$
  - Complex roots when $b^2 < 4ac$

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Output Requirements Table

Situation	Output 1 descriptor	Output 1 Equation	Output 2 descriptor	Output 2 Equation
Non-numeric data in a, b, or c	Use MsgBox function to give error message			
a=b=c=0, infinite solutions				
a=b=0, c<>0, no solution				
Linear equation (a=0), only one solution	x	-c/b		
Duplicate real root	x1 = x2	-b/(2a)		
Two real roots	x1	$\frac{-b+\sqrt{b^2-4ac}}{2a}$	x2	$\frac{-b-\sqrt{b^2-4ac}}{2a}$
Complex Root, real part ± i(complex part)	Real part	$\frac{-b}{2a}$	Complex part	$\frac{\sqrt{4ac-b^2}}{2a}$

Macro will always use same input and output cells. Copy input and results from each case given on assignment to separate area on worksheet before running another case.

Input-Output Example

Description of Output Situation

Description of Individual Output Items

Numerical Results

Solution of Quadratic Equation		
Input Data		
a	b	c
1	4	1
Output Results		
Two real roots		
X1	X2	
-0.26795	-3.73205	

Your VBA code writes all this information

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Another Input-Output Example

Description of Output Situation

Description of Individual Output Items

Numerical Results

Solution of Quadratic Equation		
Input Data		
a	b	c
1	2	5
Output Results		
Complex Roots		
Real Part	Imaginary Part	
-1	2	

Your VBA code writes all this information

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Example of Output For Input Error

Description of Input Error

Description of Result Implied by Bad Input

No Numerical Results

Solution of Quadratic Equation		
Input Data		
a	b	c
0	0	0
Input Error a=b=c=0		
Infinite Roots		

Your VBA code writes all this information

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Handling Errors

	A	B	C
1	Quadratic Equation Solver		
2	Input Data		
3	a	b	c
4	w	4	1
5	Output Results		
6	Two r	Microsoft Excel	
7	x1		
8	-0.3	a = w is nonNumeric data	
9			

	A	B	C
1	Quadratic Equation Solver		
2	Input Data		
3	a	b	c
4	w	4	1
5	Output Results		
6	Nonnumeric Data		
7	x1	x2	
8	-0.33333	-1	

Use VBA command to clear old answers as first part of code. For this example with answers in A6:B8 use

```
Range("A6:B8").ClearContents
```

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Programming Assignment 4

- Due April 18
- Task one: Use VBA to create two way table for A/P = i/[1 – (1 + i)^n] which gives ratio of n periodic loan payments, A, to loan Principal P at interest rate i

Table of A/P: Ratio of Periodic Payment, A, t							
	i = 0.05%	i = 0.10%	i = 0.15%	i = 0.20%	i = 0.25%	i = 0.30%	i = 0.35%
n = 1	1.000500	1.001000	1.001500	1.002000	1.002500	1.003000	1.003500
n = 2	0.500375	0.500750	0.501125	0.501500	0.501876	0.502251	0.502627
n = 3	0.333667	0.334000	0.334334	0.334668	0.335001	0.335335	0.335669
n = 4	0.250313	0.250625	0.250938	0.251251	0.251564	0.251878	0.252191
n = 5	0.200300	0.200600	0.200901	0.201202	0.201502	0.201804	0.202105
n = 6	0.166958	0.167250	0.167543	0.167835	0.168128	0.168421	0.168714
n = 7	0.143143	0.143429	0.143716	0.144002	0.144289	0.144577	0.144864
n = 8	0.125281	0.125563	0.125845	0.126128	0.126410	0.126693	0.126977
n = 9	0.111389	0.111667	0.111946	0.112225	0.112505	0.112784	0.113065

Programming Assignment 4

- Tasks 2, 3, 4
- Use a For loop, a While loop, and a Loop Until structure to sum the infinite series for the cosine
- Discussed in class on March 7
- Adjustment cosine argument to reduce size for very large angles to equivalent small periodic value (between –π/2 and π/2) for faster convergence

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Review Cosine Infinite Series

- $\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} + \cdots = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!}$
- We can write this series as $\cos(x) = \sum_{n=0}^{\infty} T_n$ where $T_n = (-1)^n x^{2n}/(2n)!$ ($T_0=1$)
- Found ratio of successive T_n terms?

$$\frac{T_n}{T_{n-1}} = \frac{\frac{(-1)^n x^{2n}}{(2n)!}}{\frac{(-1)^{n-1} x^{2n-2}}{(2n-2)!}} = \frac{(-1)x^{2n}}{x^{2n-2}} \frac{(2n-2)!}{(2n)!} = \frac{-x^2(2n-2)!}{2n(2n-1)(2n-2)!} = \frac{-x^2}{2n(2n-1)}$$

$$T_n = \frac{-x^2 T_{n-1}}{2n(2n-1)}$$

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Review Cosine Infinite Series VBA

```
term = 1
sum = term
For n = 1 To maxIterations
    term = -term * x^2 / (2 * n * (2*n-1))
    sum = sum + term
    if Abs(term) <= maxRelErr * _
                            Abs(sum) Then
        myCos = sum
        Exit Function
    End If
Next n
myCos = “ERROR: Max iterations exceeded”
```

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