

Department of Chemical Engineering  
ChE-101: Approaches to Chemical Engineering Problem Solving  
**MATLAB and Excel Tutorial Va**

**Formatting and Tables the “fprintf” Command**

(last updated 4/23/06 by GGB)

Objectives:

These tutorials are designed to show the introductory elements for any of the topics discussed. In almost all cases there are other ways to accomplish the same objective, or higher level features that can be added to the commands below. Read section 4.6.2 to learn more about the “fprintf” command

Any text below appearing after the double prompt (>>) can be entered in the Command Window directly or in an m-file.

The following topics are covered in this tutorial;

**Introduction****Formatting output \_ The "fprintf" Command (guided tour with examples)****Formatting tables in Excel (the use of the border lines, guided tour with examples)****Introduction:**

The **fprintf** command gives you more control over the output than the **disp** command. In a single command you can specify text and matrices to be printed, the format in which to print the matrix, and to move down a line at some point in the output. The general syntax is:

**fprintf('formatting structure commands', values to be displayed)**

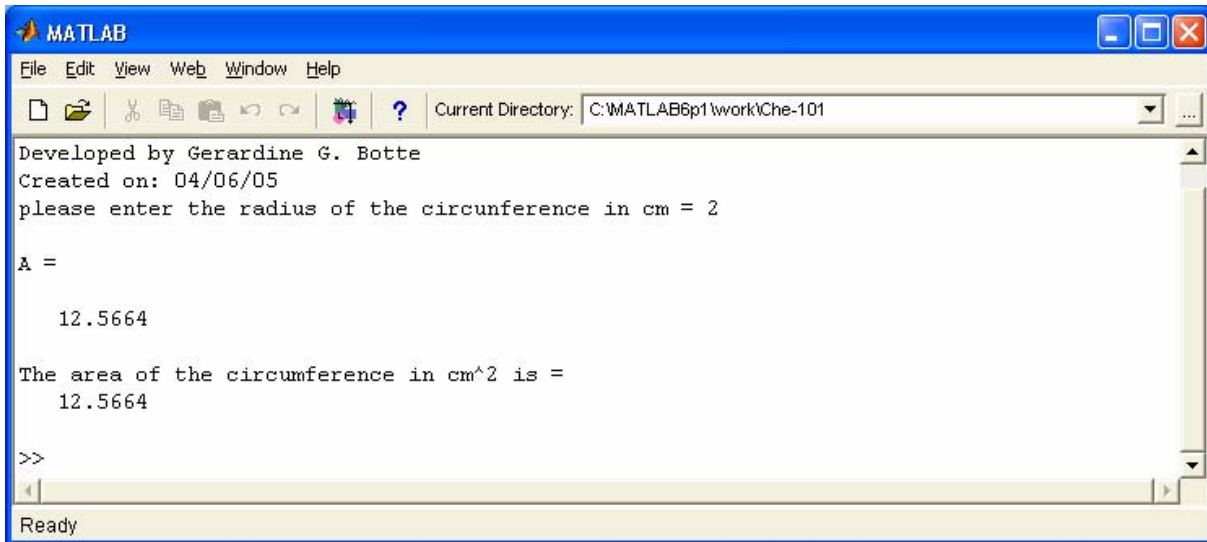
To practice some of the options of the *fprintf* command and to notice the differences with the *disp* command let us write the following m-file that allows calculating the area of the circumference. We will modify the script file to use several options of the *fprintf* command.

```

1  % This program calculates the Area of a Circumference given the radius
2  % Developed by Gerardine G. Botte
3  % Created on: 04/06/05
4  % Last modified on: 04/06/05
5  % Che-101, Spring 05
6  % The user must input the radius of the circumference "r" before running the code
7  % Description of variables:
8  % The area of the circumference is given in the variable "A"
9  %-----
10 - clc
11 - clear;
12 %Print heading of the program
13 disp('This program calculates the Area of a Circumference given the radius');
14 disp('Developed by Gerardine G. Botte');
15 disp('Created on: 04/06/05');
16
17 %Program calculations
18 r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circ
19 A=pi*r^2 % this is the area in cm2.
20 disp('The area of the circumference in cm^2 is = ');
21 disp(A);

```

When you run the above program this is what it will be displayed on the screen:



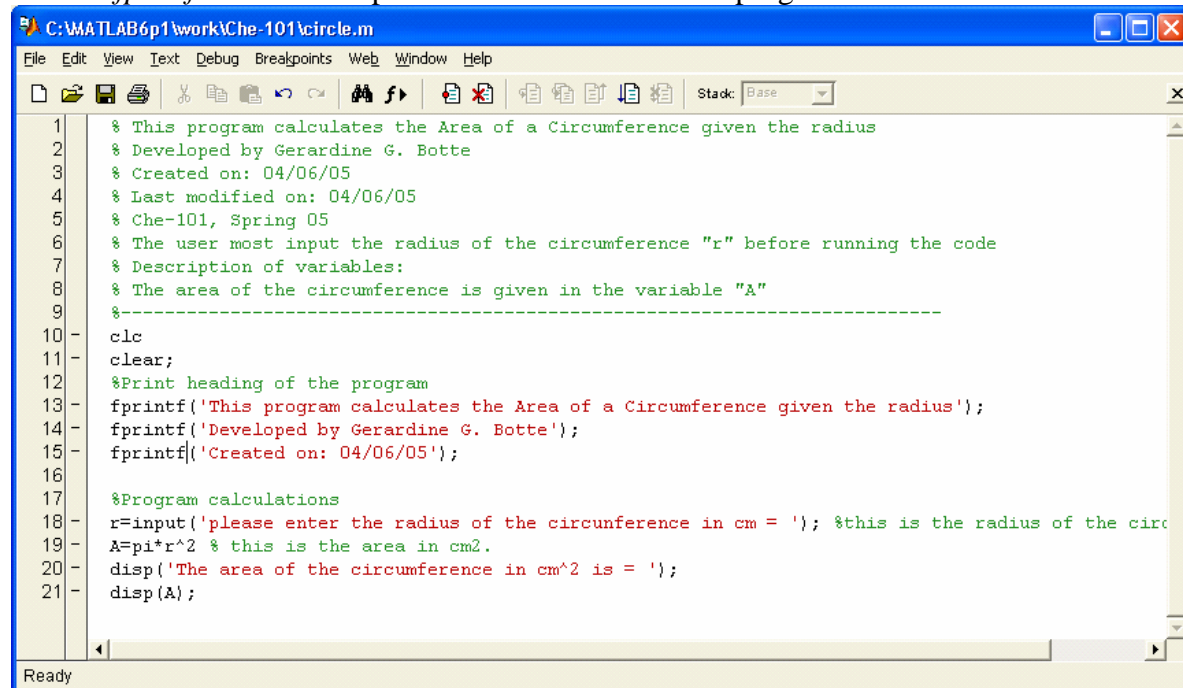
```
MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101
Developed by Gerardine G. Botte
Created on: 04/06/05
please enter the radius of the circumference in cm = 2
A =
    12.5664
The area of the circumference in cm^2 is =
    12.5664
>>
Ready
```

### 1. Using the fprintf command to display text

The syntax is,

**fprintf('text to be displayed')**

Use the *fprintf* command to print the text in the circle.m program:



```
C:\MATLAB6p1\work\Che-101\circle.m
File Edit View Text Debug Breakpoints Web Window Help
Stack: Base
1 % This program calculates the Area of a Circumference given the radius
2 % Developed by Gerardine G. Botte
3 % Created on: 04/06/05
4 % Last modified on: 04/06/05
5 % Che-101, Spring 05
6 % The user must input the radius of the circumference "r" before running the code
7 % Description of variables:
8 % The area of the circumference is given in the variable "A"
9 %-----
10 - clc
11 - clear;
12 %Print heading of the program
13 fprintf('This program calculates the Area of a Circumference given the radius');
14 fprintf('Developed by Gerardine G. Botte');
15 fprintf('Created on: 04/06/05');
16
17 %Program calculations
18 r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circ
19 A=pi*r^2 % this is the area in cm2.
20 disp('The area of the circumference in cm^2 is = ');
21 disp(A);
Ready
```

Execute your program. What do you see on the screen?

When a program has more than one *fprintf* command the display that they generate is continuous (it does not automatically start a new line). We can take advantage of this property as needed.

The following are a list of useful space characters for *fprintf*

`fprintf('text to be types\n')`

Jumps a line after the displayed text

`fprintf('text to be types\b')`

Leaves backspace after the displayed text

`fprintf('text to be types\t')`

Leaves tab after the displayed text

Do the following changes in the m-file and look at the display:

```

1 % This program calculates the Area of a Circumference given the radius
2 % Developed by Gerardine G. Botte
3 % Created on: 04/06/05
4 % Last modified on: 04/06/05
5 % Che-101, Spring 05
6 % The user must input the radius of the circumference "r" before running the code
7 % Description of variables:
8 % The area of the circumference is given in the variable "A"
9 % -----
10 -
11 -
12 -
13 %Print heading of the program
14 fprintf('This program calculates the Area of a Circumference given the radius\n'); %this format will add a line
15 fprintf('Developed by Gerardine G. Botte\t'); %this format will add a tab
16 fprintf('Created on: 04/06/05\n'); %this format will add a line
17 fprintf('\n'); %this will add an empty line
18 -
19 %Program calculations
20 r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circumference
21 A=pi*r^2 % this is the area in cm2.
22 disp('The area of the circumference in cm^2 is = ');
23 disp(A);
    
```

This is the display:

```

MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101
This program calculates the Area of a Circumference given the radius
Developed by Gerardine G. Botte Created on: 04/06/05

please enter the radius of the circumference in cm = 2

A =

    12.5664

The area of the circumference in cm^2 is =

    12.5664

>>
    
```

## 2. Using the fprintf command to display numbers

syntax:

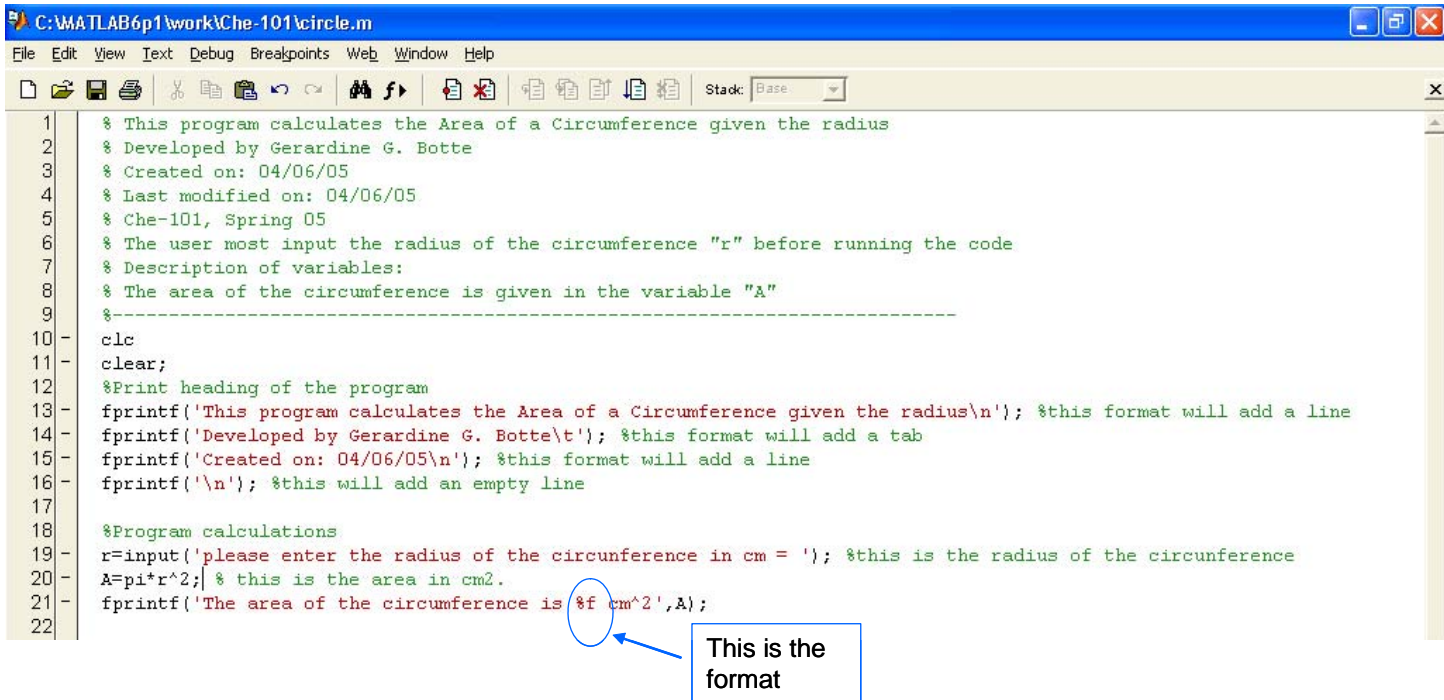
**fprintf('formatting structure commands', values to be displayed)**

Inside the format statement the **%f**, **%e**, and **%g** specifiers are used to show where and how the output values are displayed.

**%f** \_ decimal format  
**%e** \_ exponential format  
**%g** \_ whichever is shorter

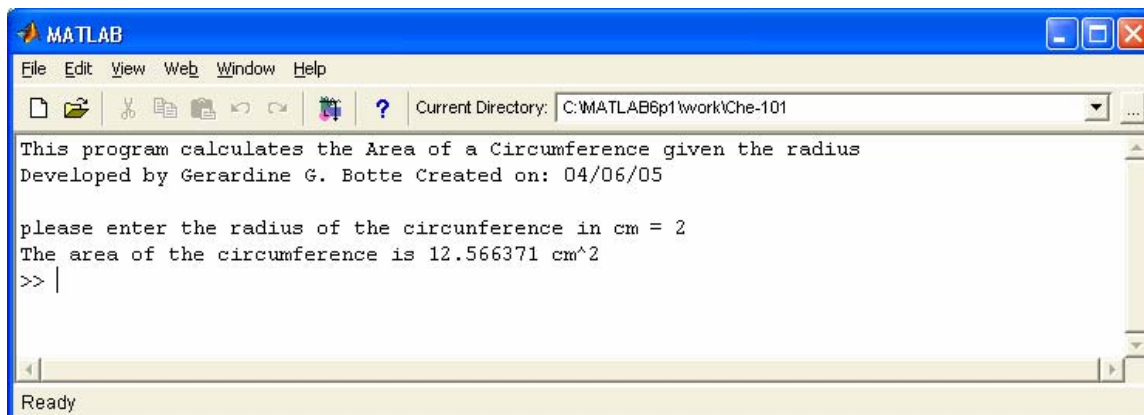
If **\n** appears in the string the display skips down a line and continues. The format statement almost always ends with one or more **\n** statements, to create the desired on-screen appearance.

Example, modify the circle.m file according to:



```
1 % This program calculates the Area of a Circumference given the radius
2 % Developed by Gerardine G. Botte
3 % Created on: 04/06/05
4 % Last modified on: 04/06/05
5 % Che-101, Spring 05
6 % The user must input the radius of the circumference "r" before running the code
7 % Description of variables:
8 % The area of the circumference is given in the variable "A"
9 %-----
10 clc
11 clear;
12 %Print heading of the program
13 fprintf('This program calculates the Area of a Circumference given the radius\n'); %this format will add a line
14 fprintf('Developed by Gerardine G. Botte\t'); %this format will add a tab
15 fprintf('Created on: 04/06/05\n'); %this format will add a line
16 fprintf('\n'); %this will add an empty line
17
18 %Program calculations
19 r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circumference
20 A=pi*r^2; % this is the area in cm2.
21 fprintf('The area of the circumference is %f cm^2',A);
22
```

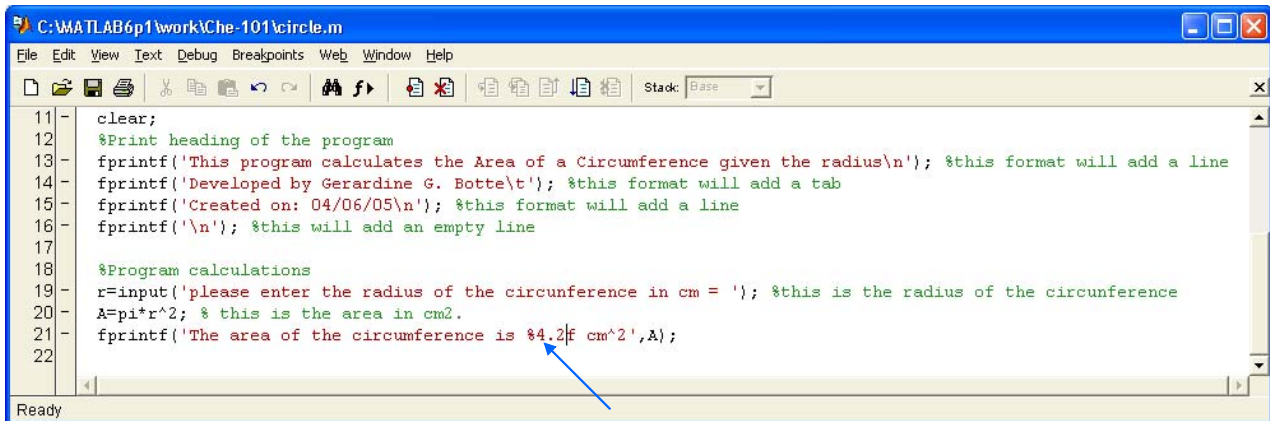
This is what will be displayed on the screen



```
MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101
This program calculates the Area of a Circumference given the radius
Developed by Gerardine G. Botte Created on: 04/06/05

please enter the radius of the circumference in cm = 2
The area of the circumference is 12.566371 cm^2
>> |
Ready
```

*To control the number of decimal places displayed within the %f or %e specifier. In the following example the 4.2 means allot four places for the value, 2 to the right of the decimal point.*



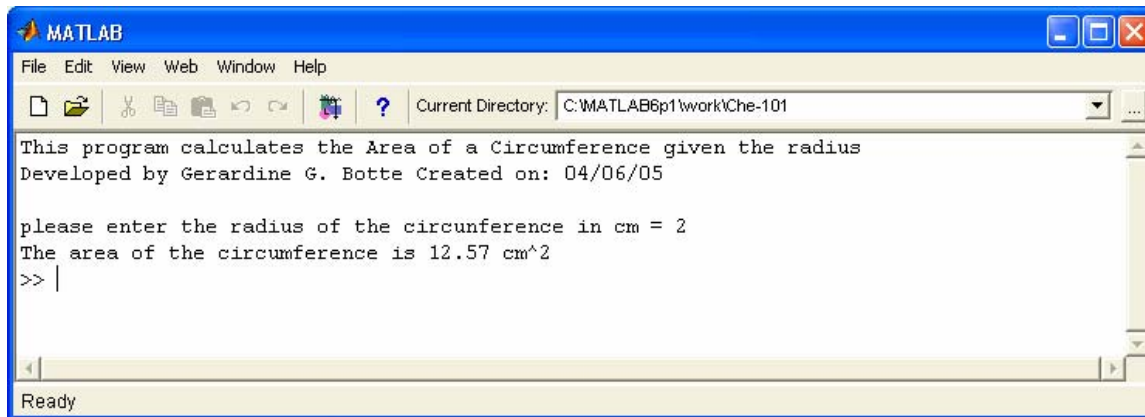
```

11- clear;
12- %Print heading of the program
13- fprintf('This program calculates the Area of a Circumference given the radius\n'); %this format will add a line
14- fprintf('Developed by Gerardine G. Botte\t'); %this format will add a tab
15- fprintf('Created on: 04/06/05\n'); %this format will add a line
16- fprintf('\n'); %this will add an empty line
17-
18- %Program calculations
19- r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circumference
20- A=pi*r^2; % this is the area in cm2.
21- fprintf('The area of the circumference is %4.2f cm^2',A);
22-

```

Formatting the number

This is what will be printed:



```

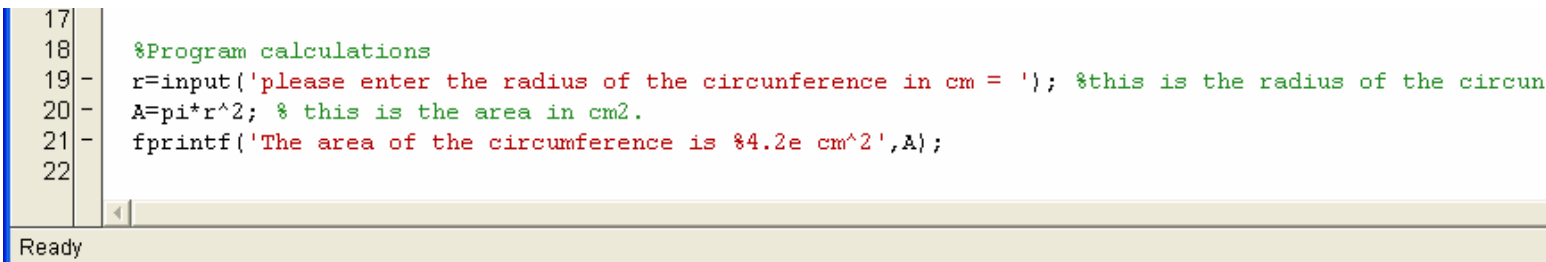
MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101

This program calculates the Area of a Circumference given the radius
Developed by Gerardine G. Botte Created on: 04/06/05

please enter the radius of the circumference in cm = 2
The area of the circumference is 12.57 cm^2
>> |

```

*Or using scientific notation with the %e specifier.*

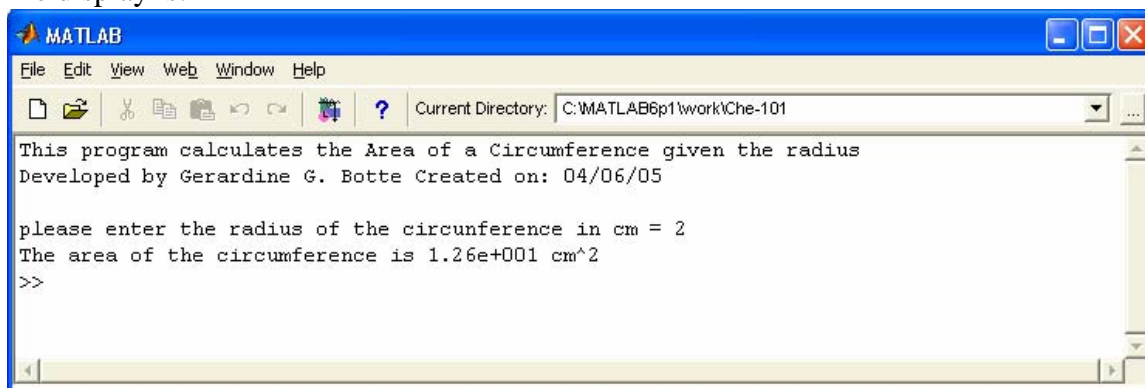


```

17-
18- %Program calculations
19- r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circumn
20- A=pi*r^2; % this is the area in cm2.
21- fprintf('The area of the circumference is %4.2e cm^2',A);
22-

```

The display is:



```

MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101

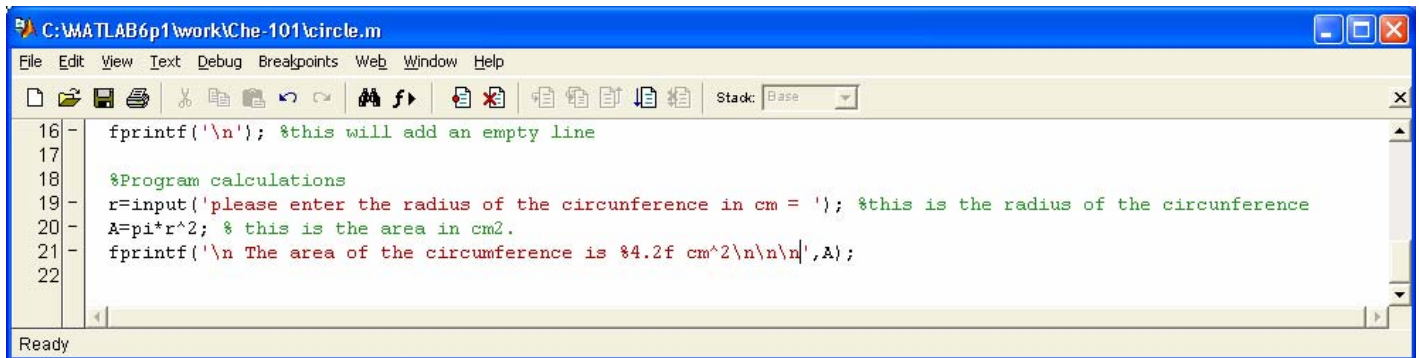
This program calculates the Area of a Circumference given the radius
Developed by Gerardine G. Botte Created on: 04/06/05

please enter the radius of the circumference in cm = 2
The area of the circumference is 1.26e+001 cm^2
>>

```

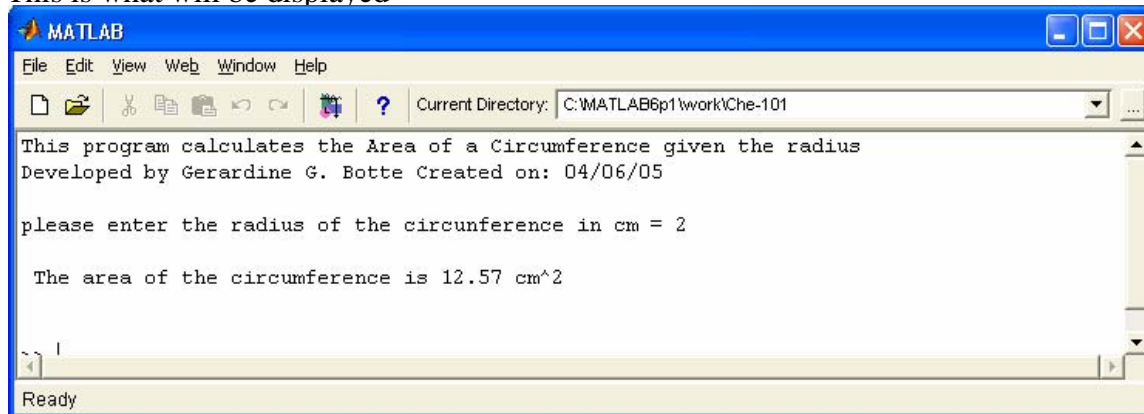


You can include `\n` multiple times including before any text is printed. Note the added line spacing.



```
C:\MATLAB6p1\work\Che-101\circle.m
File Edit View Text Debug Breakpoints Web Window Help
[Icons] Stack: Base
16 - fprintf('\n'); %this will add an empty line
17
18 %Program calculations
19 - r=input('please enter the radius of the circumference in cm = '); %this is the radius of the circumference
20 - A=pi*r^2; % this is the area in cm2.
21 - fprintf('\n The area of the circumference is %4.2f cm^2\n\n\n',A);
22
Ready
```

This is what will be displayed



```
MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101
This program calculates the Area of a Circumference given the radius
Developed by Gerardine G. Botte Created on: 04/06/05

please enter the radius of the circumference in cm = 2

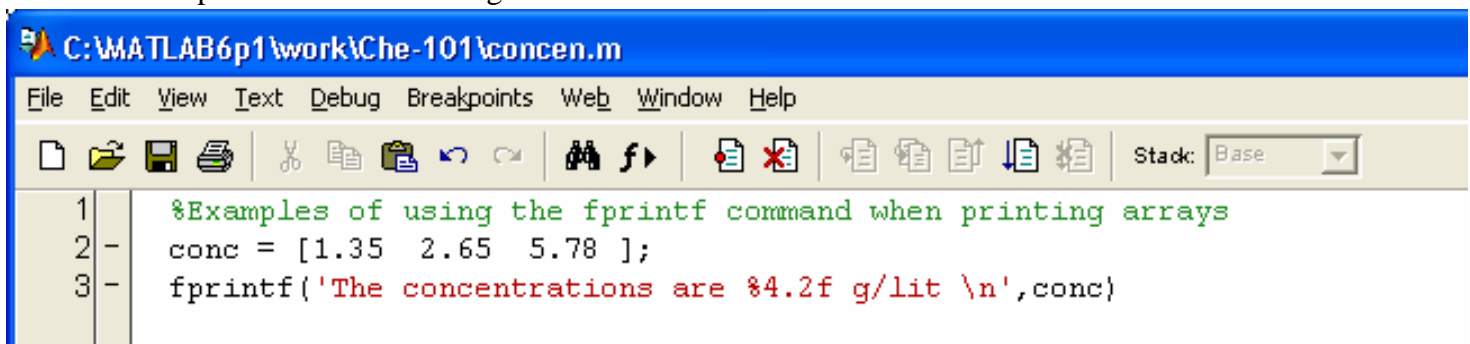
The area of the circumference is 12.57 cm^2

Ready
```

### 3. Using the `fprintf` command to display arrays

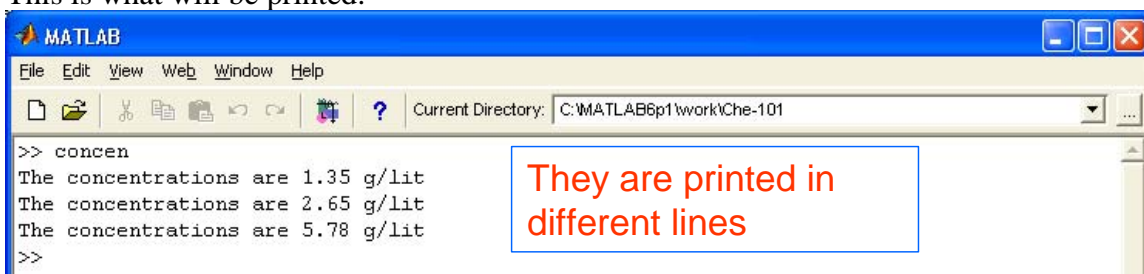
How you use the specifiers when printing an array depends on how you wish the array to print, either as multiple lines or all on one line.

Examples write the following m-file



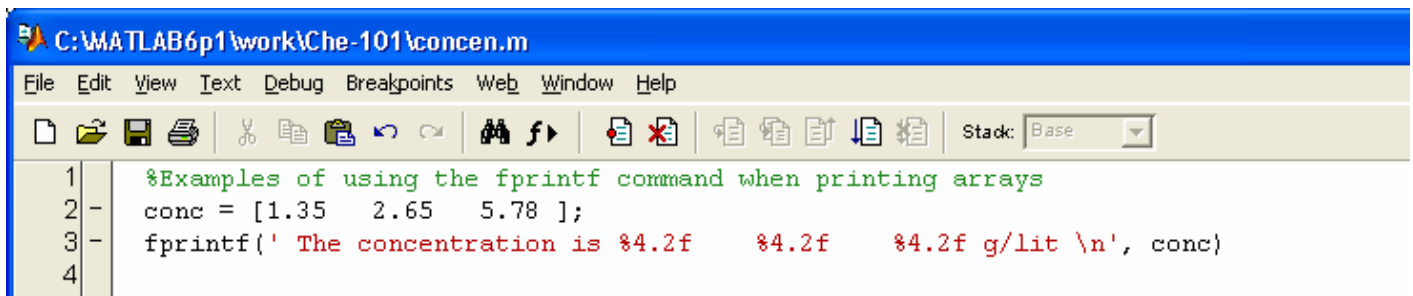
```
C:\MATLAB6p1\work\Che-101\concen.m
File Edit View Text Debug Breakpoints Web Window Help
[Icons] Stack: Base
1 %Examples of using the fprintf command when printing arrays
2 - conc = [1.35 2.65 5.78 ];
3 - fprintf('The concentrations are %4.2f g/lit \n',conc)
```

This is what will be printed:



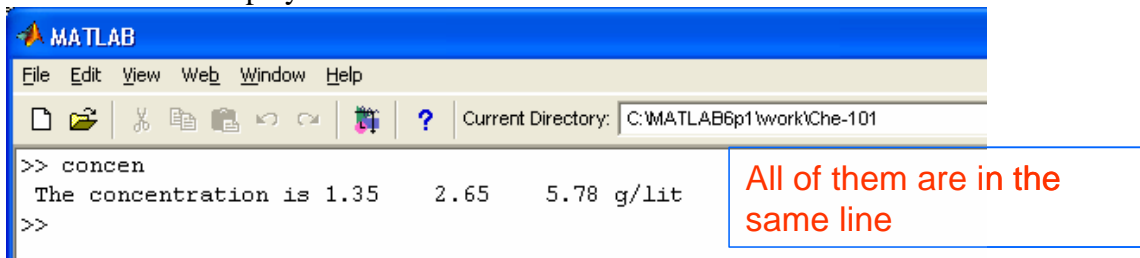
```
MATLAB
File Edit View Web Window Help
Current Directory: C:\MATLAB6p1\work\Che-101
>> concen
The concentrations are 1.35 g/lit
The concentrations are 2.65 g/lit
The concentrations are 5.78 g/lit
>>
```

They are printed in different lines



```
C:\MATLAB6p1\work\Che-101\concen.m
File Edit View Text Debug Breakpoints Web Window Help
[Icons] Stack: Base
1 %Examples of using the fprintf command when printing arrays
2 - conc = [1.35 2.65 5.78 ];
3 - fprintf(' The concentration is %4.2f    %4.2f    %4.2f g/lit \n', conc)
4
```

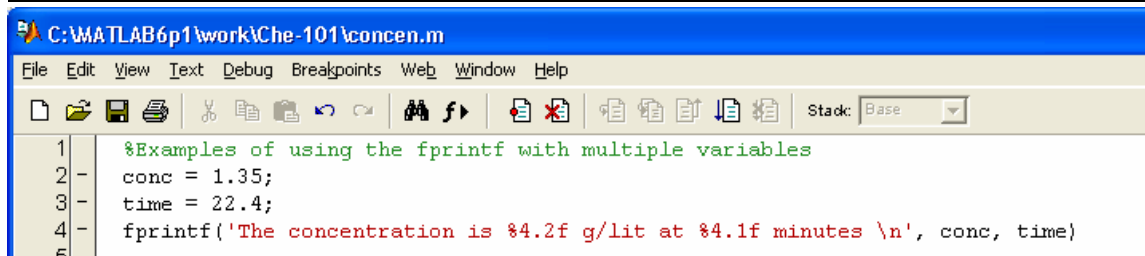
This is the displayed



```
MATLAB
File Edit View Web Window Help
[Icons] Current Directory: C:\MATLAB6p1\work\Che-101
>> concen
The concentration is 1.35    2.65    5.78 g/lit
>>
```

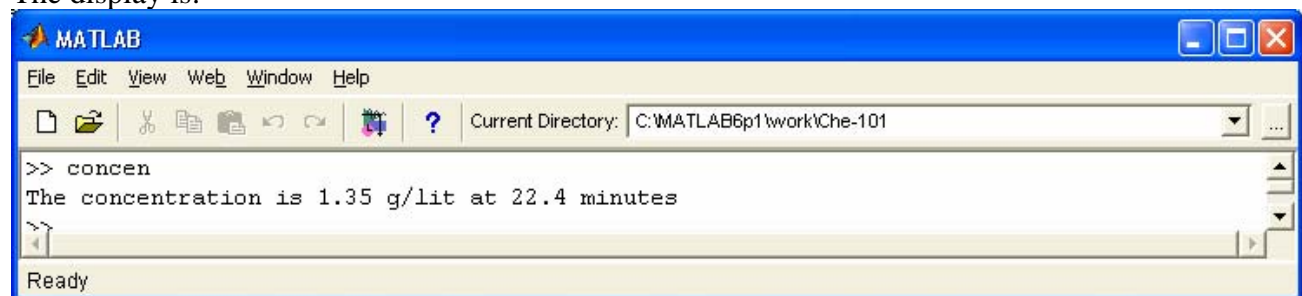
All of them are in the same line

Multiple variables can be printed with a single statement. See the example



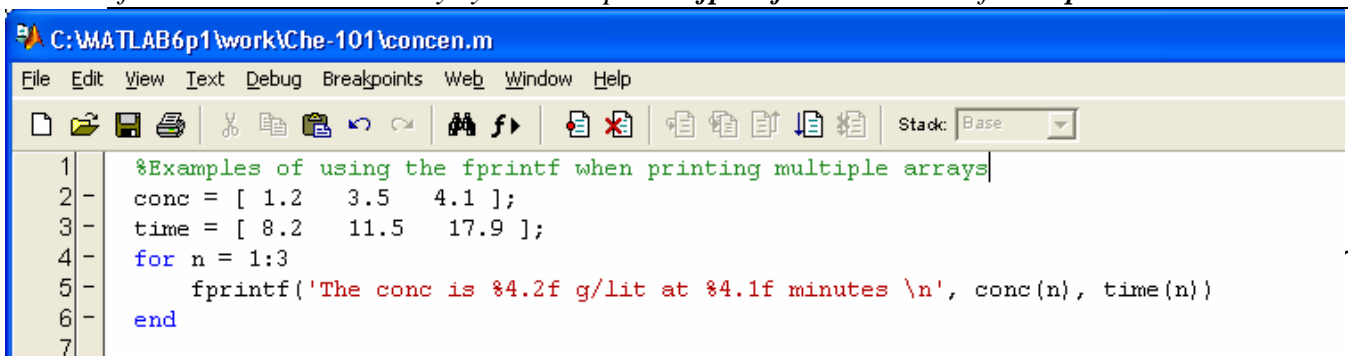
```
C:\MATLAB6p1\work\Che-101\concen.m
File Edit View Text Debug Breakpoints Web Window Help
[Icons] Stack: Base
1 %Examples of using the fprintf with multiple variables
2 - conc = 1.35;
3 - time = 22.4;
4 - fprintf('The concentration is %4.2f g/lit at %4.1f minutes \n', conc, time)
5
```

The display is:



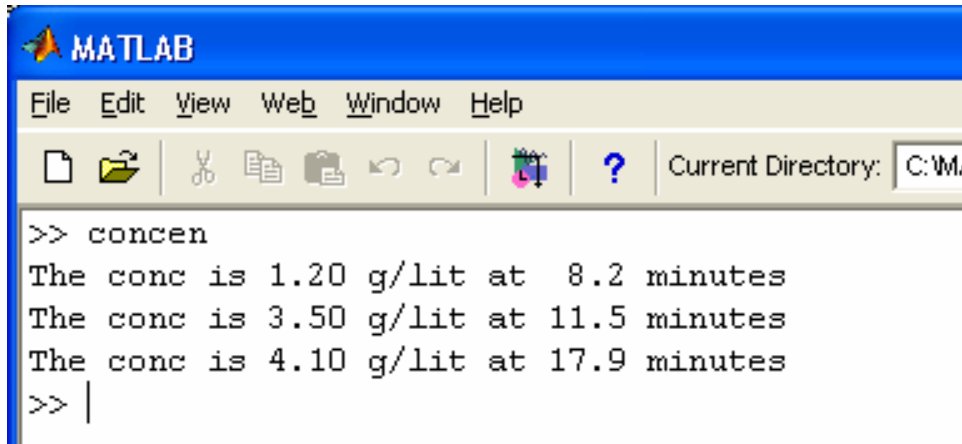
```
MATLAB
File Edit View Web Window Help
[Icons] Current Directory: C:\MATLAB6p1\work\Che-101
>> concen
The concentration is 1.35 g/lit at 22.4 minutes
Ready
```

If *conc* and *time* are arrays you could put the *fprintf* statement in a *for loop*.



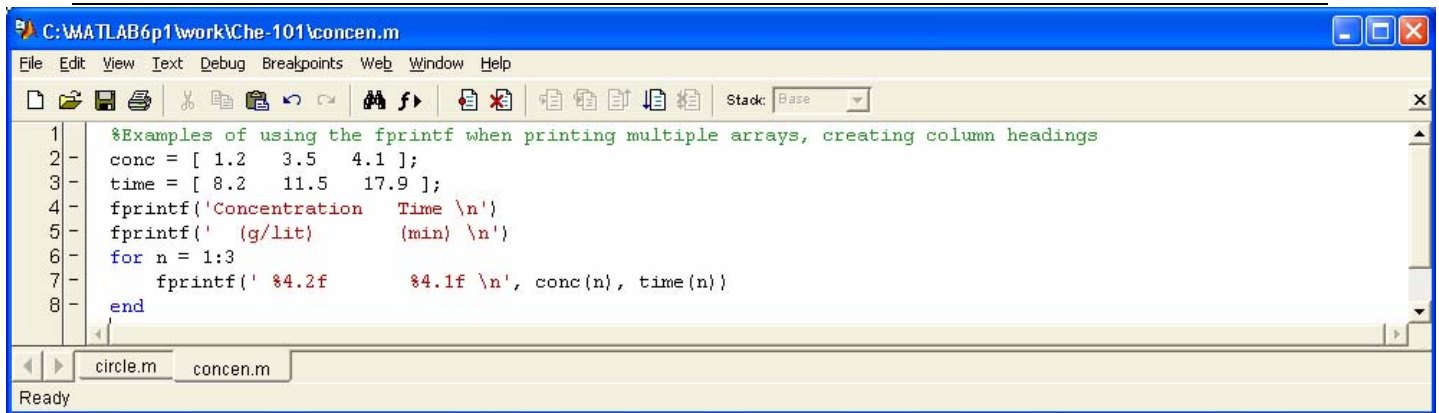
```
C:\MATLAB6p1\work\Che-101\concen.m
File Edit View Text Debug Breakpoints Web Window Help
[Icons] Stack: Base
1 %Examples of using the fprintf when printing multiple arrays
2 - conc = [ 1.2 3.5 4.1 ];
3 - time = [ 8.2 11.5 17.9 ];
4 - for n = 1:3
5 -     fprintf('The conc is %4.2f g/lit at %4.1f minutes \n', conc(n), time(n))
6 - end
7
```

This is what will be displayed



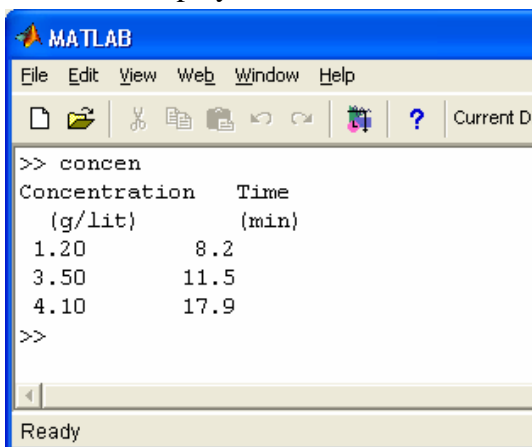
```
>> concen
The conc is 1.20 g/lit at 8.2 minutes
The conc is 3.50 g/lit at 11.5 minutes
The conc is 4.10 g/lit at 17.9 minutes
>> |
```

Alternately you could set up columns with headings. By using spaces, see example



```
1 %Examples of using the fprintf when printing multiple arrays, creating column headings
2 conc = [ 1.2 3.5 4.1 ];
3 time = [ 8.2 11.5 17.9 ];
4 fprintf('Concentration Time \n')
5 fprintf(' (g/lit) (min) \n')
6 for n = 1:3
7     fprintf(' %4.2f %4.1f \n', conc(n), time(n))
8 end
```

See the display



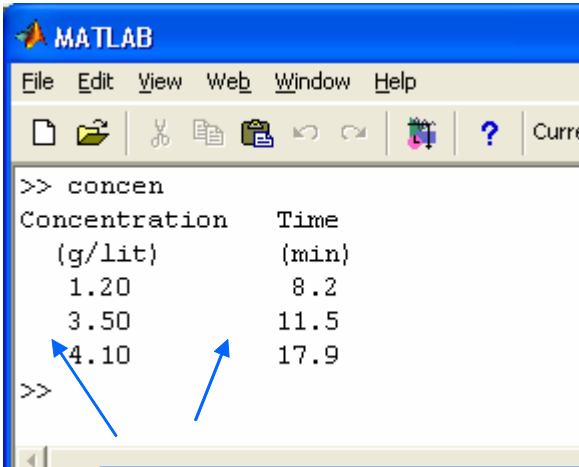
```
>> concen
Concentration Time
(g/lit) (min)
1.20 8.2
3.50 11.5
4.10 17.9
>>
```



**This is great! Now you can make tables**

Notice that the numbers are not well aligned. You need to add spaces until they are centered (this is a trial an error thing). I usually do it by showing a display and them counting the number of additional spaces that I have to add. See the new print out:





Two additional spaces were added

This is how you will modify the program if you want lines to be printed:

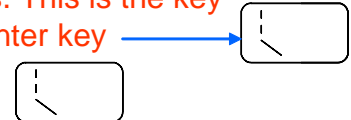
```

1  %Examples of using the fprintf when printing multiple arrays as a table with the borders
2  conc=[1.2 3.5 4.1];
3  time=[8.2 11.5 17.9];
4  fprintf('_____ \n') %This will make the top border
5  fprintf('Concentration | Time\n') %This is the heading of the table
6  fprintf(' (g/l) | (min)\n') %In the next row we show the units
7  fprintf('_____ \n') %This will complete the heading border
8  for n=1:3
9      fprintf(' %4.2f | %4.1f\n', conc(n), time(n))
10 end
11 fprintf('_____') %This will complete the low border
12

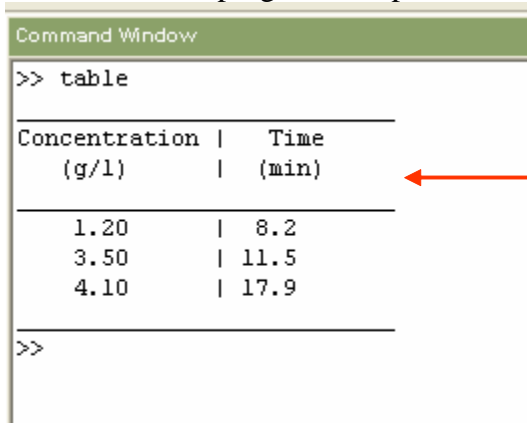
```

This symbol “|” will make the side borders. This is the key above the enter key

Press shift+



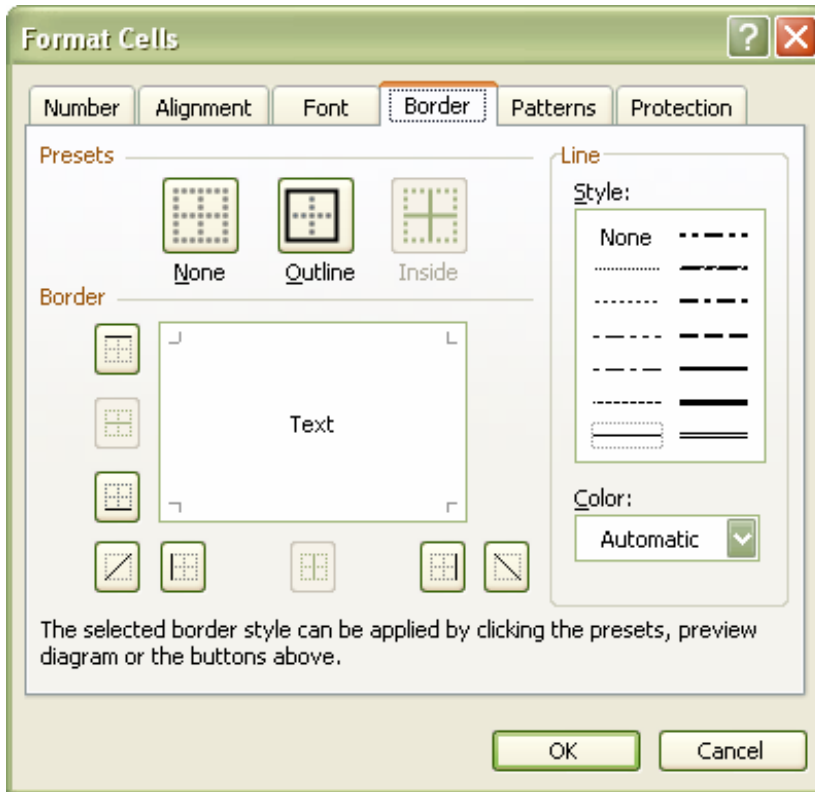
This is what the program will print:



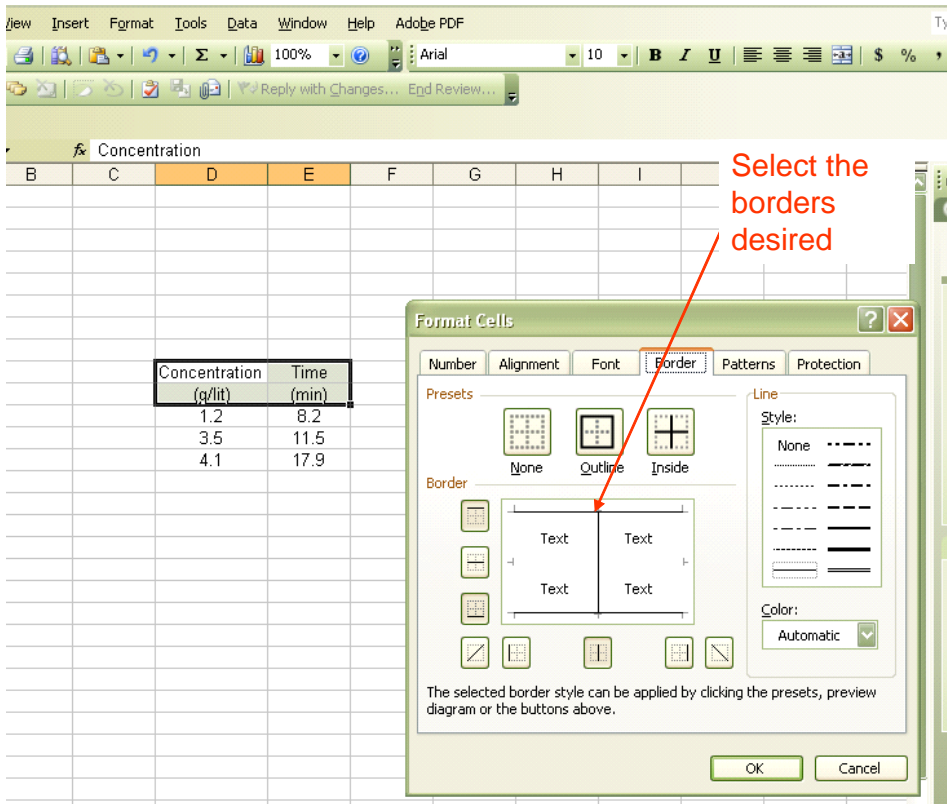
Notice that the borders follow the quality guidelines discussed in H-4

### Example Using Excel:

As discussed in tutorial VIII each cell in Excel will be an element of the table. You can use the borders menu under “format” “cells” “borders”



For example if we want to create a table with the information shown on p. 9, this is how we do it:



	A	B	C	D	E	F	G	H
1								
2								
3								
4								
5								
6								
7								
8								
9				Concentration	Time			
10				(g/lit)	(min)			
11				1.2	8.2			
12				3.5	11.5			
13				4.1	17.9			
14								
15								
16								
17								

This is how the table will look