Chapter 1 Getting Started—Installation and General Information

1.1 Installation

In the accompanying CD, you will find a file named **Enter_Lab.htm**. By clicking on this file, a screen will appear as shown in Fig. 1.1. Launch any experiment by clicking on its name. To run the programs without the CD, first create a folder on the hard disk. Then copy **Enter_lab.htm** and the folder **LabExperiments** into the new folder on the hard disk. It is important to keep the file structure same as on the CD to maintain correct links. Please refer to the License Agreement (page 207) prior to making any copy.

If the computer you are using is part of a network, then you will need the assistance of a System Administrator to first save certain *.dll and *.ocx files in the System folder of the server. Instructions for the System Administrator are available on the Read_Me.txt file. Once the *.dll and *.ocx files are saved in the system folder of the server, you will be able to run the programs directly from the CD on the network computers. Program files must not be copied on the network server.

If you get the following message during start up,

> *"A file being copied is not newer than the file currently on your system. It is recommended that you keep your existing file …… Do you want to keep this file?"*

select **YES** option for this message.

Figure 1.1. A partial list of virtual experiments.

1.2 Startup

Each program runs like any other Windows application starting with a Start-up screen (Fig. 1.2). The Start-up screen loads the program in 2 to 3 seconds, or you may click anywhere on this screen to start the program instantly.

1.3 Menu Bar

In the menu bar of each program (Fig. 1.3), there are four options:

- **Overview**: To open the laboratory overview at any time
- **MyJournal**: To open a Notepad® file to enter any data or to take notes during the experiment
- **Print**: To print the active screen
- **Exit**: To exit the program. Use this option to exit the program. **Caution**: You should stop any running program before using **Exit.**

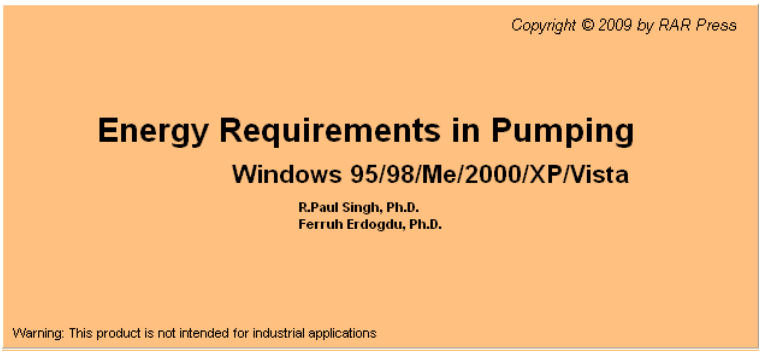


Figure 1.2. Start-up screen for an experiment on energy requirements in pumping.

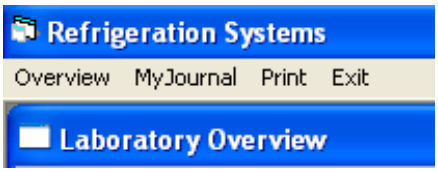


Figure 1.3. The four options of the menu bar (Overview, MyJournal, Print and Exit).

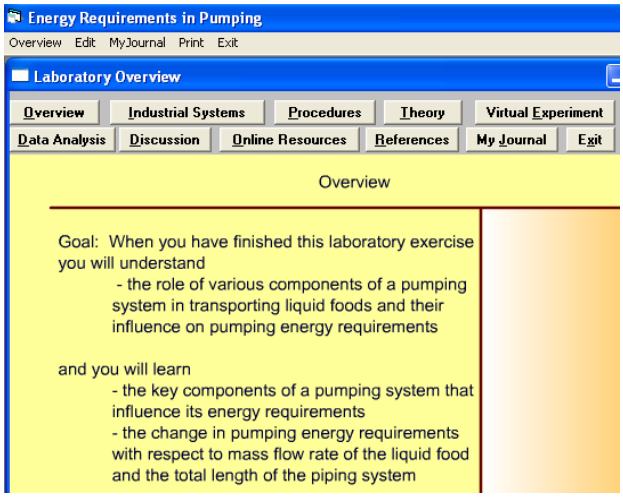


Figure 1.4 Overview screen with tab buttons to access all components of a laboratory exercise.

1.4 Laboratory Overview

When a program is launched, a laboratory overview screen is shown as in Fig. 1.4. It includes several buttons that may be selected to view various components of the laboratory exercise. The function of each button is as follows:

- **Overview**: To view the goal and objectives of the experiment
- **Industrial Systems**: To view the industrial use of equipment related to a given experiment.
- **Procedures**: To view key procedural steps that are carried out in actual laboratory conditions, or when conducting a virtual experiment.
- **Theory**: To view key theoretical concepts governing the experiment.
- **Virtual Experiment**: To conduct a virtual experiment.
- **Data Analysis**: To view a general description of the methods used to analyze the data obtained from the virtual experiment.
- **Discussion**: A list of discussion questions related to the results and data analysis.
- **Online Resources**: Web addresses of manufacturers of industrial equipment related to the experiment
- **References**: A list of suggested references.
- **MyJournal**: To open a Notepad® file to enter any data or to take notes during the experiment (Fig. 1.5), this file may

be saved at the end of the experiment before exiting the program.

- **Exit**: To exit the program.

The **Overview**, **Industrial Systems**, **Procedures**, **Theory**, **Data Analysis**, **Discussion**, **Online Resources** and **References** options include visual and text description of the experiment. For example, in **Industrial Systems**, the user will find the working principle of selected industrial equipment, photographs and animations (Fig. 1.6). In **Data Analysis**, one may find ways to analyze the data (Fig. 1.7).

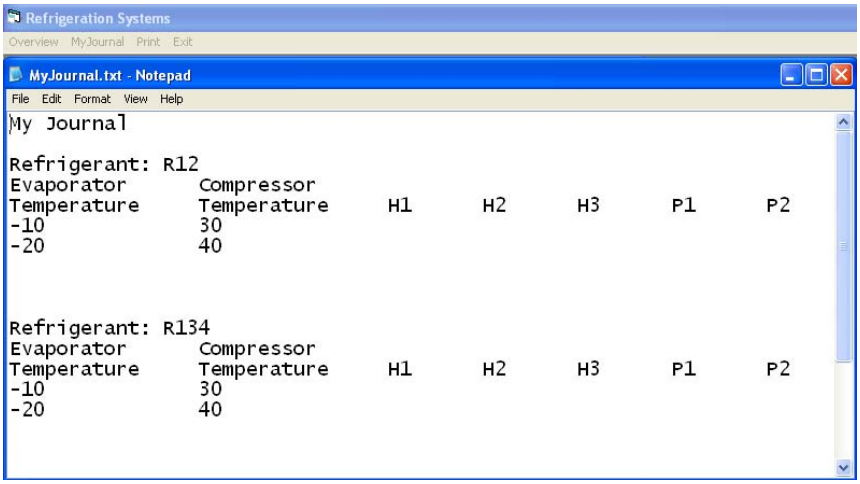


Figure 1.5. The Laboratory **Overview** Screen and the **MyJournal** text file.

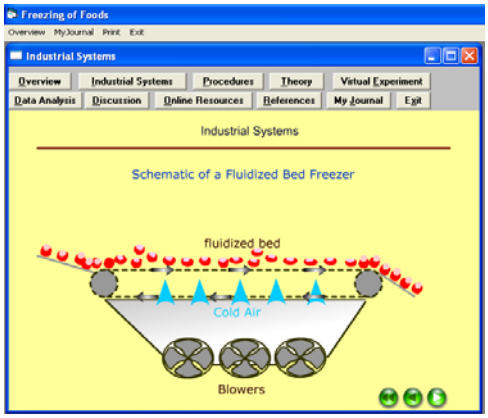


Figure 1.6. An animated view of an industrial fluidized bed freezing system.

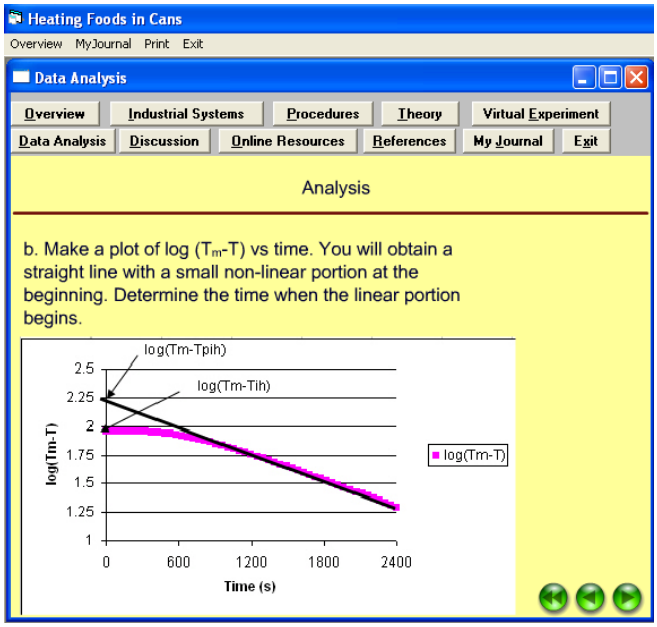


Figure 1.7. Data analysis for determining heat transfer parameters in foods during canning.

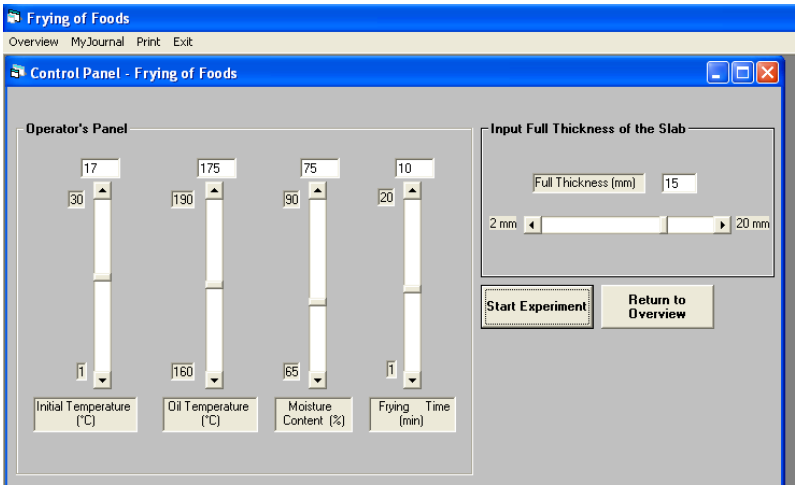


Figure 1.8. Control panel for an experiment to predict temperature in a food during frying.

1.5 Control Panel

When the **Virtual Experiment** button is clicked, a control panel screen of the selected experiment will be shown. The control panel includes the product and process variables that a user may change or select when a given experiment is run (Fig. 1.8). In some experiments, the control panel screen is also used to indicate the results of the experiment conducted (e.g. in Chapter 3, "Pumping Liquid Foods – Energy Requirements of Pumping Apple Juice"). In other experiments, the control panel screen opens another screen where some graphical outputs of the experiment are shown (e.g., in Chapter 13, Food Freezing – Determining Freezing Time of Potato).

On a control panel, a user generally has the following options (Fig. 1.9):

- **Start Experiment**: To start the experiment and collect the experimental data
- **View Data in Spreadsheet**: To view the data collected from the virtual experiment in a spreadsheet and then to save it in Microsoft Excel format
- **Return to Overview**: To return to the overview screen. The **Overview** option in the menu bar may also be used to return to the overview screen

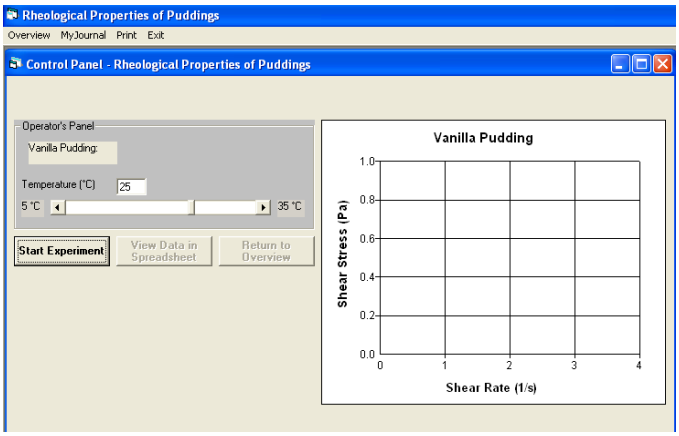


Figure 1.9. Options in the control panel (Start Experiment, View Data in Spreadsheet, and Return to Overview)

In some laboratory experiments, the **Return to Overview** button is not seen in the **Control Panel** screen. However, the follow-up screen, which is seen when the experiment is started, has these additional options (Fig. 1.10):

- **Stop**: To stop the experiment at any time. Since the data collection may be somewhat longer in these experiments compared with the others, the user may stop the experiment at any time. This option is especially useful when a correction of a wrong input of any process or product variable is required.
- **View Data in Spreadsheet**: To view the collected experimental data in a spreadsheet and then to save it in the Microsoft Excel format.
- **Return to Experiment**: To allow the user to return to the control panel to rerun an experiment with different input conditions.
- **Return to Overview**: To return to the overview screen. The **Overview** option in the menu bar may also be used to return to the overview screen.

For some of the virtual experiments, when the program is running, only the **Stop** option is enabled. To enable the use of the other three options, the experiment must be stopped first.

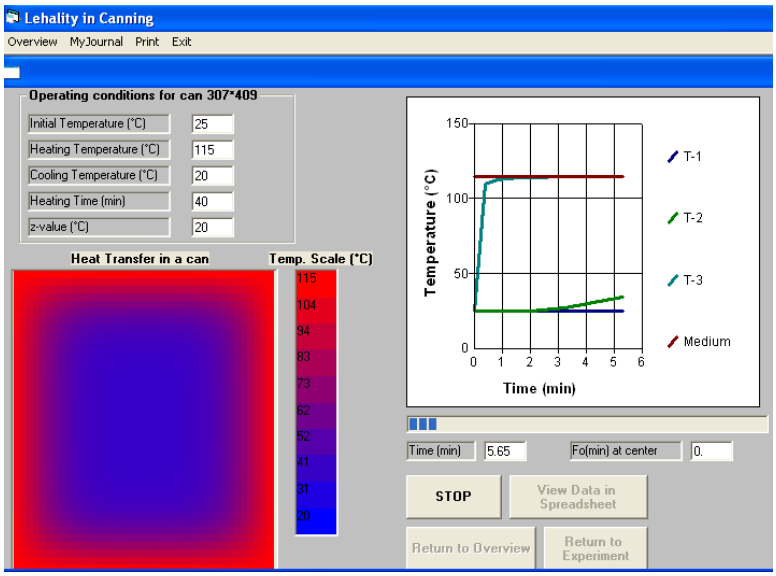
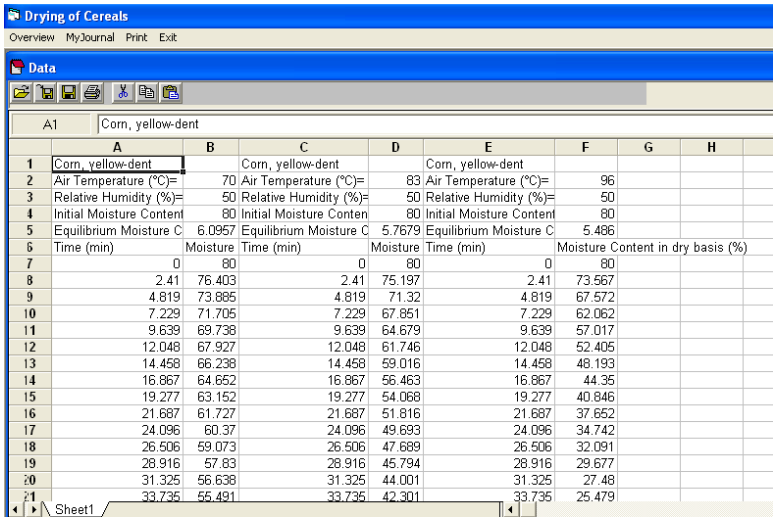


Figure 1.10. Second follow-up screen with additional options (Stop, View Data in Spreadsheet, Return to Experiment and Return to Overview).

When the **View Data in Spreadsheet** option is used, all the experimental data are shown on a spreadsheet (Fig. 1.11). This spreadsheet may be viewed after completing either one experiment, or preferably after running all experiments with different operating conditions. Every time a new experiment is run, the results will be appended to data from a previous experiment.

Note that the spreadsheet showing the results must be converted to Microsoft Excel format before saving using following procedure. To save the spreadsheet, the **Save file as** option from the toolbar () should be used. When this icon is chosen, the user sees the **Save file as** dialog (Fig. 1.12). It is important that in the **Save as type,** the **Excel 97 (*.xls)** option is selected as shown in Figure 1.12. Any file folder and file name may be chosen to save the experimental data file. In addition to the **Save as** icon, the spreadsheet has also a tool bar with icons for the **Open**, **Save**, **Print**, **Cut**, **Copy,** and **Paste** options. The user may use them in the same way they are used in a Microsoft Excel spreadsheet. However, keyboard shortcut options (such as **Crtl + X** for cut or **Ctrl + C** for copy, etc.) are NOT included in the features of these spreadsheets. Therefore, use the toolbar icons for these tasks.



	A	B	C	D	E	F	G	H
1	Corn, yellow-dent		Corn, yellow-dent		Corn, yellow-dent			
2	Air Temperature (°C)=	70	Air Temperature (°C)=	83	Air Temperature (°C)=	96		
3	Relative Humidity (%)=	50	Relative Humidity (%)=	50	Relative Humidity (%)=	50		
4	Initial Moisture Content	80	Initial Moisture Conten	80	Initial Moisture Content	80		
5	Equilibrium Moisture C	6.0957	Equilibrium Moisture C	5.7679	Equilibrium Moisture C	5.486		
6	Time (min)	Moisture	Time (min)	Moisture	Time (min)	Moisture Content in dry basis (%)		
7	0	80	0	80	0	80		
8	2.41	76.403	2.41	75.197	2.41	73.567		
9	4.819	73.885	4.819	71.32	4.819	67.572		
10	7.229	71.705	7.229	67.851	7.229	62.062		
11	9.639	69.738	9.639	64.679	9.639	57.017		
12	12.048	67.927	12.048	61.746	12.048	52.405		
13	14.458	66.238	14.458	59.016	14.458	48.193		
14	16.867	64.652	16.867	56.463	16.867	44.35		
15	19.277	63.152	19.277	54.068	19.277	40.846		
16	21.687	61.727	21.687	51.816	21.687	37.652		
17	24.096	60.37	24.096	49.693	24.096	34.742		
18	26.506	59.073	26.506	47.689	26.506	32.091		
19	28.916	57.83	28.916	45.794	28.916	29.677		
20	31.325	56.638	31.325	44.001	31.325	27.48		
21	33.735	55.491	33.735	42.301	33.735	25.479		

Figure 1.11. Viewing experimental results in a spreadsheet.

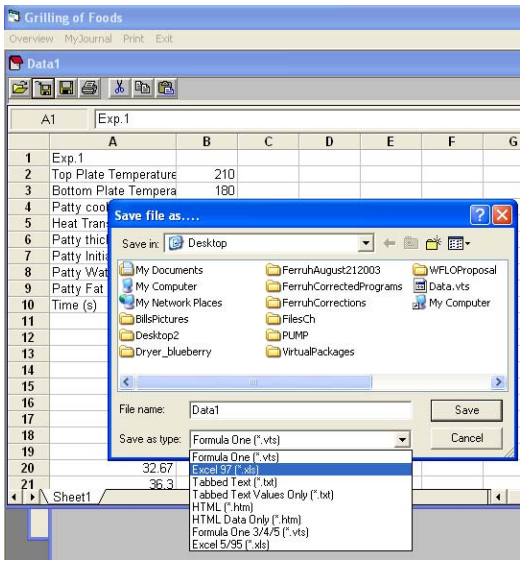


Figure 1.12. The **Save file as** dialog to save the spreadsheet in Excel format.

To analyze the saved data with Microsoft Excel, some features require special attention. For example, in the data analysis of some experiments, you may be asked to determine the slope of a linear portion of a curve. The use of the **Trendline** option in Microsoft Excel is the easiest way to accomplish this task.

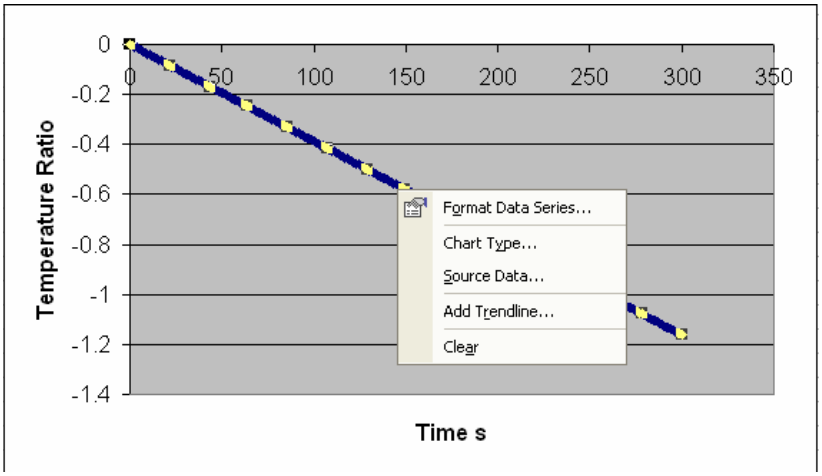


Figure 1.13. Using **Trendline** analysis of a plot of temperature ratio vs. time.

1.6 Trendline Option in Microsoft Excel

To analyze the data in some experiments, you may need to determine the slope of a linear portion of a curve. To accomplish this, you may use the following steps using a Microsoft Excel spreadsheet:

- To determine the slope of this line, use the **Trendline** feature of Microsoft Excel.
- For the **Trendline** feature, right click mouse when pointing on the line. A list of options will be displayed as shown in Figure 1.13. Select **Add Trendline...** (Fig. 1.13). A window showing the **Type of Trend/Regression** will be shown, select the default option **Linear**. (Fig. 1.14). Next, select the second tab in this window named **Options.** In the next window, select **Display equation** and **Display R-squared value on chart** (Fig. 1.15), continue by selecting **OK** button to display the regression equation on the chart with its R^2 value as shown in Figure (1.16).

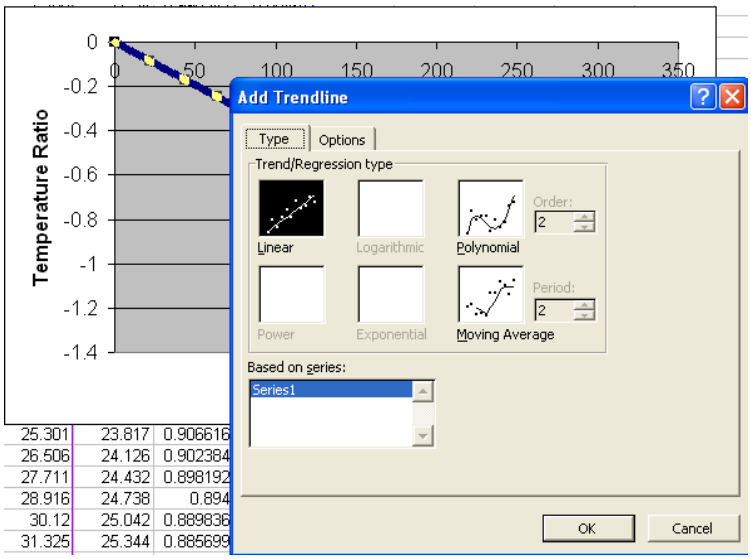


Figure 1.14. The *Trend/Regression type* window of the **Trendline** feature in Microsoft Excel. *Linear* trend is highlighted as a default option.

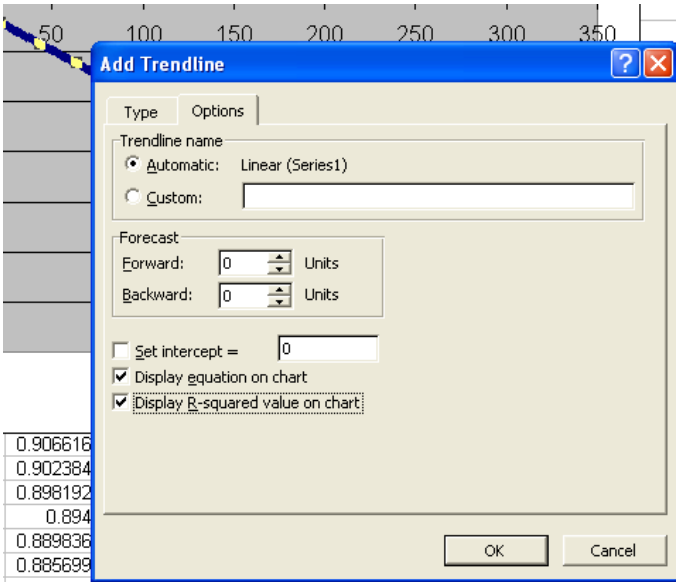


Figure 1.15. The *Options* tab of the **Trendline** feature in Microsoft Excel, and selection of *Display equation* and *R-squared value on chart*.

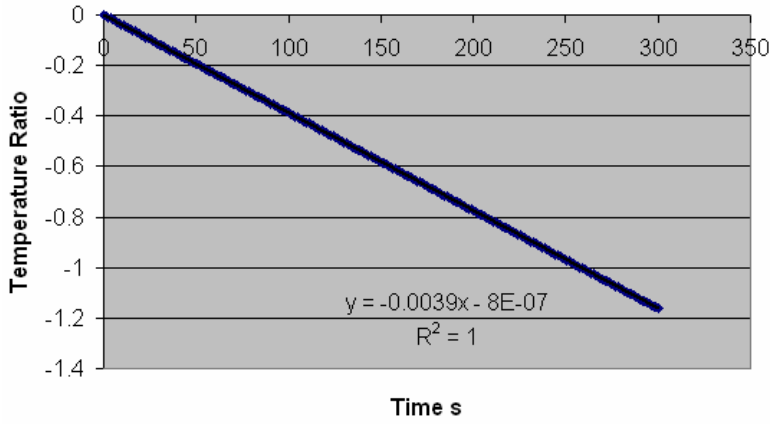


Figure 1.16. Displaying equation and R-squared value on chart for the plot.

- The equation shown on the chart has the form of a straight line equation:

$$y = mx + c$$

where m is the slope and c is the intercept. For example, for the equation shown in Fig. 1.16,

slope, $m = -0.0039$

and, intercept, $c = -8 \times 10^{-7}$

You may use the slope and intercept values for further analysis.

1.7 Analysis ToolPak add-in option

In some experiments, the data analysis may also require the use of some mathematical functions, e.g. error function or Bessel functions. Microsoft Excel's **Analysis ToolPak add-in** option includes the application of these functions. These features are available to use if the **Analysis ToolPak add-in** feature was added during the custom installation of Microsoft Office or Microsoft Excel.

1.7.1 Error Function

The application syntax for the error function is **=erf(lower_limit, upper_limit)** or **=erf(upper_limit)** if the lower_limit is zero. For example **erf(0.745)** returns the error function value (0.707929) of the integration between 0 and 0.745.

1.8 Goal Seek option

In some experiments, the data analysis may also require the use of **Goal Seek** option of the MS Excel. The **Goal Seek** option is used to get a specific result in a cell by adjusting the value of another cell. The following is an example for this option.

Consider that we would like to know the value of the cell B2 which is used with the value of A2 in calculating a value of cell C2 where C2=0.4×A2+0.6×B2. Assuming that the value of C2 should be at least 50, we will try to find the value of B2 which will make it to 50 with the value of A2 (Figure **1)**.

For this purpose:

- Enter 30 in cell A2, and the formula =0.4*A2+0.6*B2 in cell C2. Then, highlight cell C2 and from the **Tools** menu, click on **Goal Seek** (Figure 1.17).
- In the **Set cell** box, enter the reference for the cell that contains the formula (C2 for this example) you would like to resolve.
- In the **To value** box, type the result you want (50 for this example).

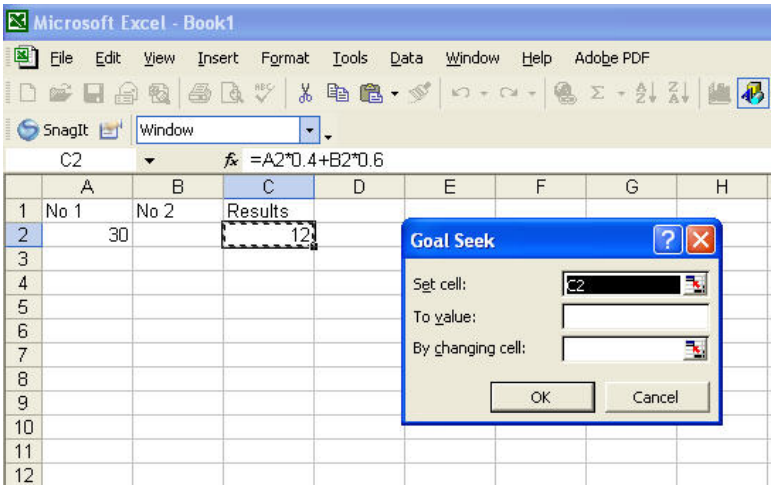


Figure 1.17. **Use of Goal Seek** option in MS Excel.

- In the **By changing cell** box, enter the reference for the cell that contains the value you would like to adjust (B2 for this example). This cell, as explained above, must be referenced by the formula in the cell you specified in the **Set cell** box.
- Click **OK**. The result (63.33) will be shown in the cell selected as **By changing cell** (cell B2 for this example) (Figure 1.18).
- You may also refer to other examples given in Excel help.

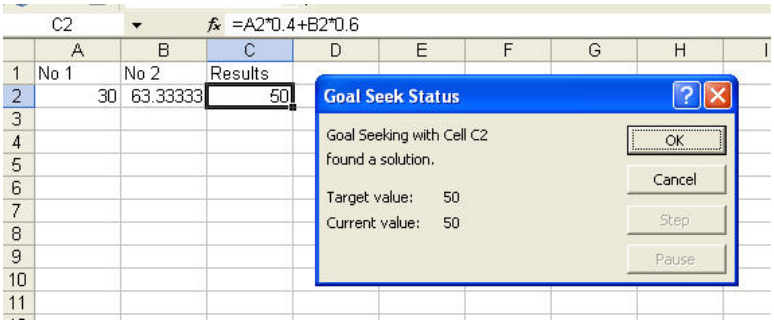


Figure 1.18. Obtaining results with the use of **Goal Seek** option.