Getting Started With Crystal Ball

In this tutorial

- What Crystal Ball Does
- How Crystal Ball uses Monte Carlo Simulation
- "Futura Apartments" spreadsheet example
- "Vision Research" spreadsheet example
- Defining assumptions
- Selecting and defining distributions
- Defining forecasts
- Running a simulation
- Interpreting the results

In this tutorial are two examples, one short, one long, providing an overview of Crystal Ball's features. The first example, the "Futura Apartments" spreadsheet, simulates profit/loss projections from apartment rentals. This example is ready to run so you can quickly see how Crystal Ball works. If you work regularly with statistics and forecasting techniques, this might be all the introduction you need before running your own spreadsheets with Crystal Ball.

The second example, the "Vision Research" spreadsheet, gives you a chance to enter data and set up a complete simulation for a major corporate expenditure decision. As you work through the second example, do not worry about making mistakes; recovery is as easy as backing up and repeating the steps. If you need additional help, see the Crystal Ball on-line help.

Now, spend a few moments learning how Crystal Ball can help you make better decisions under conditions of uncertainty.

What Crystal Ball does

Glossary Term:
spreadsheet model—
Any spreadsheet that represents an actual or hypothetical system or set of relationships.

Crystal Ball extends the forecasting capability of your **spreadsheet model** and provides the information you need to become a more accurate, efficient, and confident decision maker. As a spreadsheet user, you know that spreadsheets have two major limitations:

- You can change only one spreadsheet cell at a time. As a result, exploring the entire range of possible outcomes is next to impossible; you cannot realistically determine the amount of risk that is impacting your bottom line.
- "What-if" analysis always results in single-point estimates which do not indicate the likelihood of achieving any particular outcome. While single-point estimates might tell you what is *possible*, they do not tell you what is *probable*.

Crystal Ball overcomes both of these limitations:

Glossary Term:
assumption—
An estimated value or input to a spreadsheet model.

- You can describe a range of possible values for each uncertain cell in your spreadsheet. Everything you know about each **assumption** is expressed all at once.

Glossary Term:
Monte Carlo simulation—
A system which uses random numbers to measure the effects of uncertainty in a spreadsheet model.

- Using a process called **Monte Carlo simulation**, Crystal Ball displays results in a forecast chart that shows the entire range of possible outcomes and the likelihood of achieving each of them.

Starting the first example

The best way to quickly understand this process is to start Crystal Ball and work on the first example: The Futura Apartments spreadsheet.

1. **Start Crystal Ball.**

2. **Open the Futura Apartments spreadsheet file from the Crystal Ball Examples folder. You can find this folder by selecting Start > Programs > Crystal Ball > Examples.**

   The Futura Apartments spreadsheet appears, as in Figure 1.

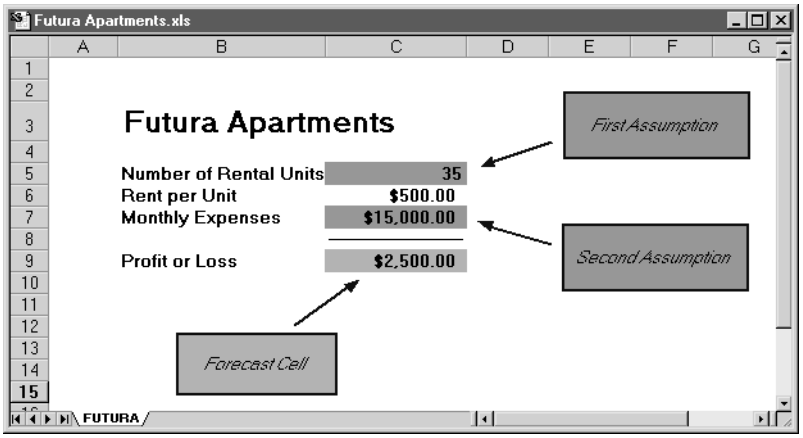


Figure 1 Futura Apartments spreadsheet

In this example, you are a potential purchaser of the Futura Apartments complex. You have researched the situation and created the above spreadsheet to help you make a knowledgeable decision. Your work has led you to make the following assumptions:

- $500 per month is the going rent for the area.
- The number of units rented during any given month will be somewhere between 30 and 40.
- Operating costs will average around $15,000 per month for the entire complex, but might vary slightly from month to month.

Based on these assumptions, you want to know how profitable the complex will be for various combinations of rented units and operating costs. This would be difficult to determine using a spreadsheet alone. As useful as spreadsheets are, you cannot reduce the last two assumptions to single values as required by the spreadsheet format. If you tried all the combinations, you would need to spend a great deal of time working through what-

if scenarios, entering single values and recording the results. Even then, you would likely be left with a mountain of data instead of the overall profit and loss picture.

With Crystal Ball, this kind of analysis is easy.

Running the simulation

Use the following steps to run the simulation:

1. **Select Run > Run.**

   Crystal Ball runs a simulation for the situation in the Futura Apartments spreadsheet and displays a **forecast** chart as it creates it.

   After the simulation has run for at least 500 **trials**, as displayed on your spreadsheet status bar.

Glossary Term:
forecast—
A statistical summary of the simulation results in a spreadsheet model, displayed graphically or numerically.

Glossary Term:
trial, *also* **iteration**—
A three-step process in which Crystal Ball generates random numbers for assumption cells, recalculates the spreadsheet modes, and displays the results in a forecast chart.

2. **In the forecast window, select Run > Stop.**

Excel Note: *If the forecast window disappears behind Excel's window during a simulation, you can bring it back to the front by pressing <Alt>-<Tab>.*

The forecast window appears, as in Figure 2.

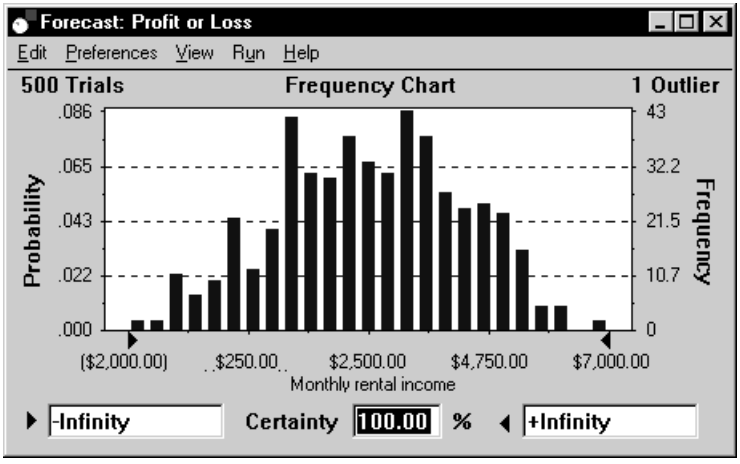


Figure 2 Futura Apartments profit/loss forecast

Glossary Term:
probability—(Classical Theory) The likelihood of an event occurring.

The forecast chart reveals the total range of profit and loss outcomes predicted for the Futura Apartments situation. Each bar on the chart represents the likelihood, or probability, of earning a given income. The cluster of columns near the center indicates that the most likely income level is between $250 and $4,750 per month. Crystal Ball also forecasts that the worst case is a $2,000 loss and the best case is nearly a $7,000 gain.

Determining profit

Now you can use Crystal Ball to determine the statistical likelihood of making a profit and what is the most likely range.

To have Crystal Ball determine a statistical likelihood:

1. **Press <Tab> twice or select the left field in the forecast window.**
2. **Type 0 in the field.**
3. **Press <Enter>.**

   The value in the Certainty field changes to reflect the probability of an income level ranging from $0 to positive infinity—the probability of making a profit. With this information, you are in a much better position to make a decision on whether to purchase the Futura Apartments. As shown in Figure 3, there is roughly a 90% chance that you will make a profit.

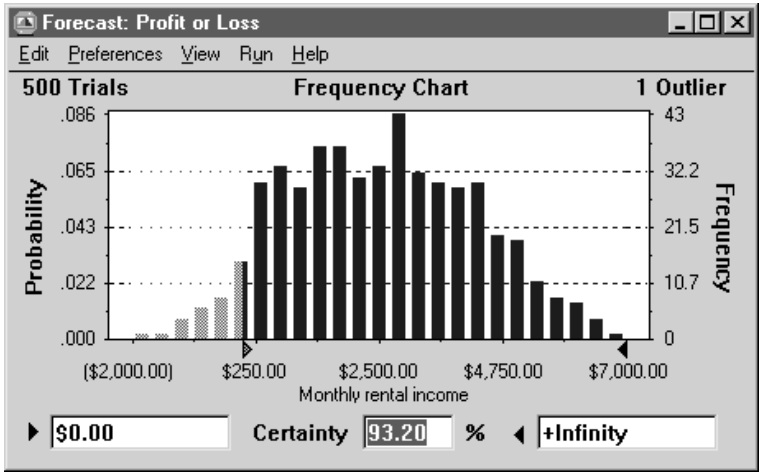


Figure 3 Chance of profit

Note that there is also a small chance of losing as much as $2000 per month.

How Crystal Ball uses Monte Carlo simulation

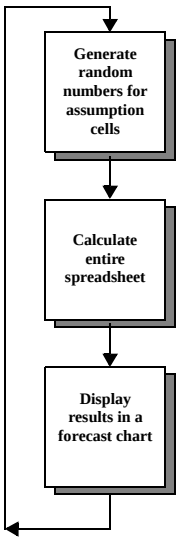
Glossary Term:
random number—
A mathematically selected value which is generated (by a formula or selected from a table) to conform to a probability distribution.

Glossary Term:
random number generator—
A method implemented in a computer program that is capable of producing a series of independent, random numbers.

Most real-world problems involving elements of uncertainty are too complex to solve analytically. There are simply too many combinations of input values to calculate every possible result. Monte Carlo simulation is an efficient technique that requires only a **random number** table or a **random number generator** on a computer.

This is an iterative process that continues until either:

- The simulation reaches a stopping criterion
- You stop the simulation manually



The final forecast chart reflects the combined uncertainty of the assumption cells on the model's output. Keep in mind that Monte Carlo simulation can only approximate a real-world situation. When you build and simulate your own spreadsheet models, you need to carefully examine the nature of the problem and continually refine the models until they approximate your situation as closely as possible.

Crystal Ball also provides statistics that describe the forecast results.

Closing the first example

To close the first example:

1. **Select Run > Reset.**

   A dialog appears, confirming the reset.

2. **Click on OK.**

   The simulation resets and the forecast window disappears.

3. **Close the Futura Apartments spreadsheet.**

Starting the second example

The remainder of this tutorial is for the Vision Research spreadsheet. This example provides a more realistic situation to let you examine Crystal Ball's features in greater depth.

The Vision Research spreadsheet models a business situation filled with uncertainty. Vision Research has completed preliminary development of a new drug, code-named ClearView, that corrects nearsightedness. This revolutionary new product could be completely developed and tested in time for release next year if the FDA approves the product. Although the drug works well for some patients, the overall success rate is marginal, and Vision Research is uncertain whether the FDA will approve the product.

Vision Research can use Crystal Ball to help decide whether to scrap the project or to proceed to develop and market this potentially profitable new drug. The ClearView project is a multimillion-dollar risk. Crystal Ball is a powerful decision-support program designed to take the mystery out of decisions like this.

To see how Crystal Ball works in a typical business decision:

1. **Open the Vision Research spreadsheet from the Crystal Ball Examples folder. You can find this folder by selecting (in Windows) Start > Programs > Crystal Ball > Examples.**

   The Vision Research spreadsheet for the ClearView project appears, as in Figure 4.

Take a look at the Vision Research spreadsheet. This spreadsheet models the problem that Vision Research is trying to solve.

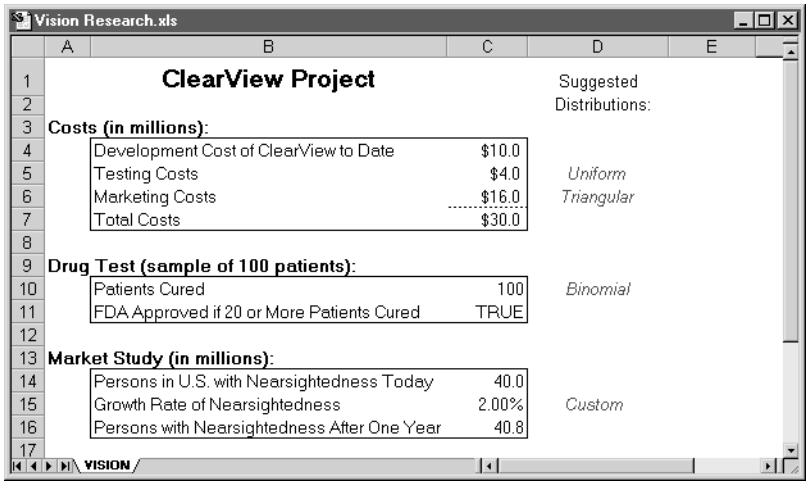


Figure 4 Vision Research's ClearView project spreadsheet

Defining assumptions

Glossary Term: **probability distribution**— A set of all possible events and their associated probabilities.

In Crystal Ball, you define an assumption for a value cell by choosing a **probability distribution** that describes the uncertainty of the data in the cell. To accomplish this, you select from the 17 distribution types in the Distribution Gallery (see Figure 5).

How do you know which distribution type to choose? This portion of the tutorial will help you understand how to select a distribution type based on the answer you are looking for. In the following examples, you select the assumption cells in the Vision Research spreadsheet and choose the probability distributions that most accurately describe the uncertainties of the ClearView project.

This example explains the reasons for choosing a particular distribution for each assumption.

Defining testing costs: the uniform distribution

So far, Vision Research has spent $10,000,000 developing ClearView and expects to spend an additional $3,000,000 to $5,000,000 to test it based on the cost of previous tests. For this variable, "testing costs," Vision Research thinks that any value between $3,000,000 and $5,000,000 has an equal chance of being the actual cost of testing.

Using Crystal Ball, Vision Research chooses the uniform distribution to describe the testing costs. The uniform distribution describes a situation where all values between the minimum and maximum values are equally likely to occur, so this distribution best describes the company's best guess for the cost of testing ClearView.

Once you choose the correct distribution type, you are ready to define the assumption cell.

To define the assumption cell for testing costs:

1. **Click on cell C5.**

2. **Select Cell > Define Assumption.**

   The Distribution Gallery dialog appears.

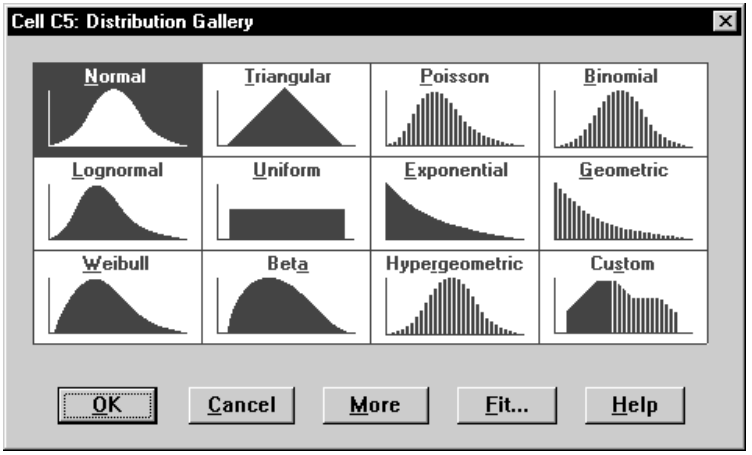


Figure 5 Distribution Gallery dialog

3. **Click on the Uniform distribution.**

4. **Click on OK.**

   The Uniform Distribution dialog appears.

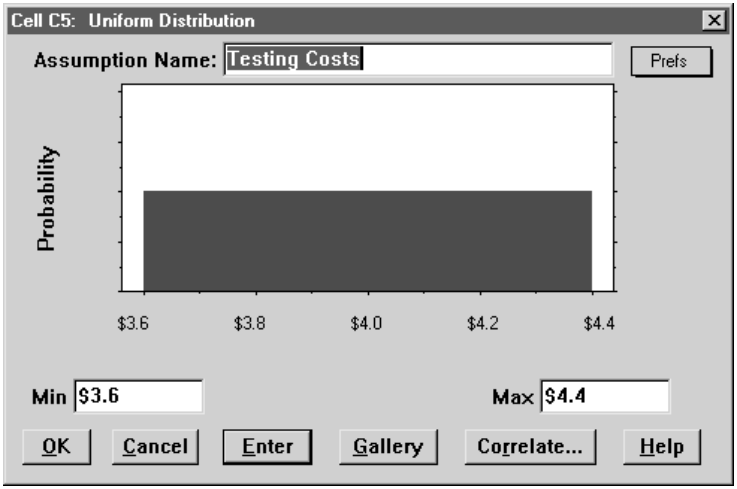


Figure 6 Uniform distribution for C5

Since cell C5 already has a name next to it on the spreadsheet, that name appears in the Assumption Name field. Use this name, rather than typing a new one. Also, notice that Crystal Ball assigns default values to the distribution.

The uniform distribution has two parameters—minimum and maximum. Vision Research expects to spend a minimum of $3,000,000 and a maximum of $5,000,000 on testing. Use these values in place of the defaults to specify the parameters of the uniform distribution in Crystal Ball, as described in the following steps:

5. **Type 3 in the Min field (remember that the numbers on the spreadsheet represent millions of dollars).**

   This represents $3,000,000, the minimum amount Vision Research estimates for testing costs.

6. **Press <Tab>.**

7. **Type 5 in the Max field.**

   This represents $5,000,000, the maximum estimate for testing costs.

8. **Click on Enter.**

   The distribution changes to reflect the values you entered, as shown in Figure 7.

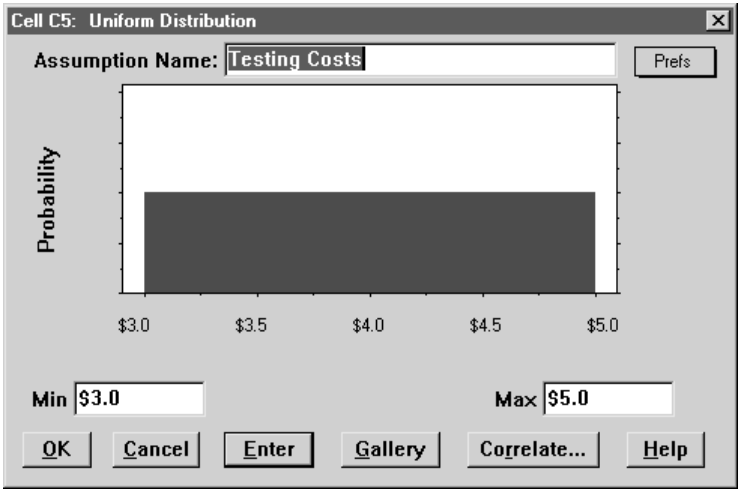


Figure 7 Changed distribution values

With the values from steps 5 and 7 entered correctly, your distribution looks like Figure 7. If not, repeat those steps. Later, when you run the simulation, Crystal Ball generates random values for cell C5 that are evenly spread between 3 and 5 million dollars.

9. **Click on OK to return to the spreadsheet.**

   The assumption cell is now green.

Defining marketing costs: the triangular distribution

Vision Research plans to spend a sizeable amount marketing ClearView if the FDA approves it. They expect to hire a large sales force and kick off an extensive advertising campaign to educate the public about this exciting new product. Including sales commissions and advertising costs, Vision Research expects to spend between $12,000,000 and $18,000,000, most likely $16,000,000.

Vision Research chooses the triangular distribution to describe marketing costs because the triangular distribution describes a situation where you can estimate the minimum, maximum, and most likely values to occur.

To define the assumption cell for marketing costs:

1. **Click on cell C6.**

2. **Select Cell > Define Assumption.**

   The Distribution Gallery dialog appears.

3. **Click on the Triangular distribution.**

4. **Click on OK.**

   The Triangular Distribution dialog appears for cell C6.

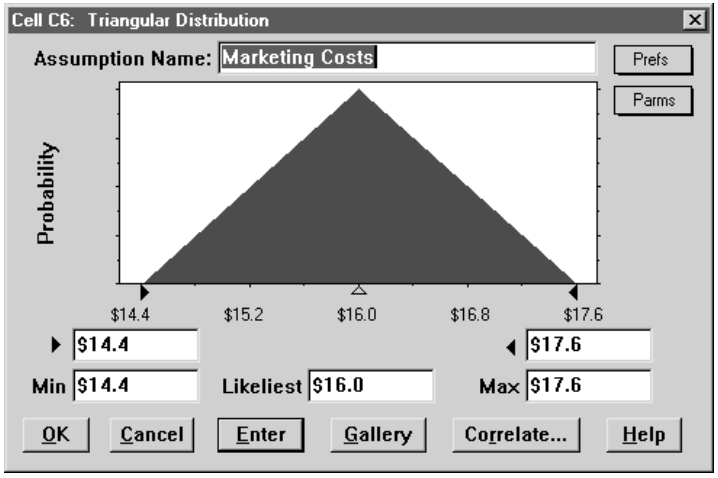


Figure 8 Triangular distribution for cell C6

Now specify the parameters for the triangular distribution. As you can see in Figure 8, the parameters for the triangular distribution are different from those specified earlier for the uniform distribution. The triangular distribution has three parameters—minimum, maximum, and likeliest. The following steps explain how to enter the parameters of the triangular distribution.

5. **Type 12 in the Min field.**

   This represents $12,000,000, the minimum amount Vision Research estimates for marketing costs.

6. **Press <Tab> to access the Likeliest field. If it doesn't contain the value 16, type 16.**

   This represents $16,000,000, the most likely amount for marketing costs.

7. **Press <Tab> and type 18 in the Max field.**

   This represents $18,000,000, the maximum estimate for marketing costs.

8. **Click on Enter.**

   The distribution changes to reflect the values you entered.

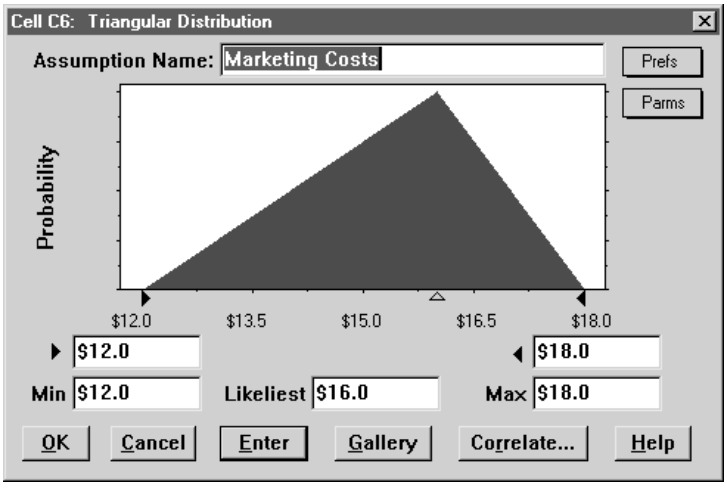


Figure 9 Distribution changed for new values

When you run the simulation, Crystal Ball generates random values that fall around 16, with fewer values near 12 and 18.

9. **Click on OK to return to the spreadsheet.**

Defining patients cured: the binomial distribution

Before the FDA will approve ClearView, Vision Research must conduct a controlled test on a sample of 100 patients for one year. Vision Research expects that the FDA will grant an approval if ClearView completely corrects the nearsightedness of 20 or more of these patients without any significant side-effects. In other words, 20% or more of the patients tested must show corrected vision after taking ClearView for one year. Vision Research is very encouraged by their preliminary testing, which shows a success rate of around 25%.

For this variable, "patients cured," Vision Research only knows that their preliminary testing shows a cure rate of 25%. Will ClearView meet the FDA standards? Using Crystal Ball, Vision Research chooses the binomial distribution to describe the uncertainties in this situation because the binomial distribution describes the random number of successes (25) in a fixed number of trials (100).

To define the assumption cell for patients cured, use the following steps.

1. **Click on cell C10.**

2. **Select Cell > Define Assumption.**

   The Distribution Gallery appears.

3. **Click on the Binomial distribution.**

4. **Click on OK.**

   The Binomial Distribution dialog appears (notice that the default value for the probability parameter is 0.5 or 50%).

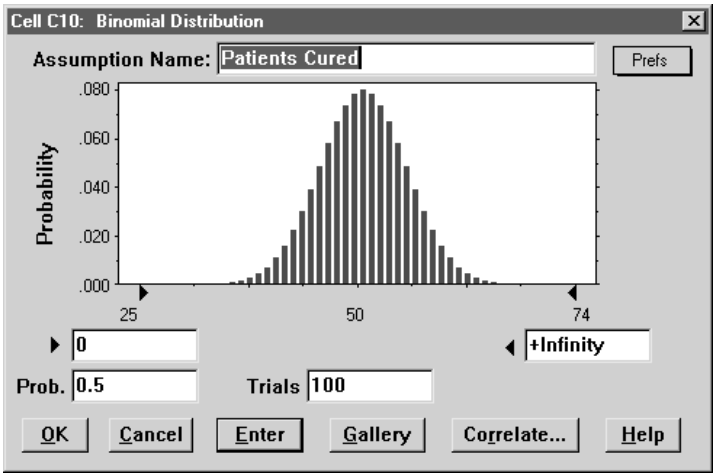


Figure 10 Binomial Distribution dialog

The binomial distribution has two parameters: probability (Prob) and trials. You know that Vision Research experienced a 25% success rate during preliminary testing, so use the value 0.25 for the probability parameter to show the likelihood or success.

Crystal Ball Note: *You can express probabilities either as decimal fractions between 0 and 1, such as 0.03, or as whole numbers followed by the percent sign, such as 3%.*

You also know the FDA expects Vision Research to test 100 people, so use the value 100 for the trials parameter. The following steps explain how to enter these parameters in the Binomial Distribution dialog.

5. **Type 0.25 in the Prob field.**

   This represents the 25% likelihood, or probability, of successfully correcting nearsightedness.

6. **If the Trials field doesn't contain the value 100, press <Tab>.**

7. **Type 100 in the Trials field.**

   This represents the 100 patients in the FDA test.

8. **Click on Enter.**

   The distribution changes to reflect the values you entered.

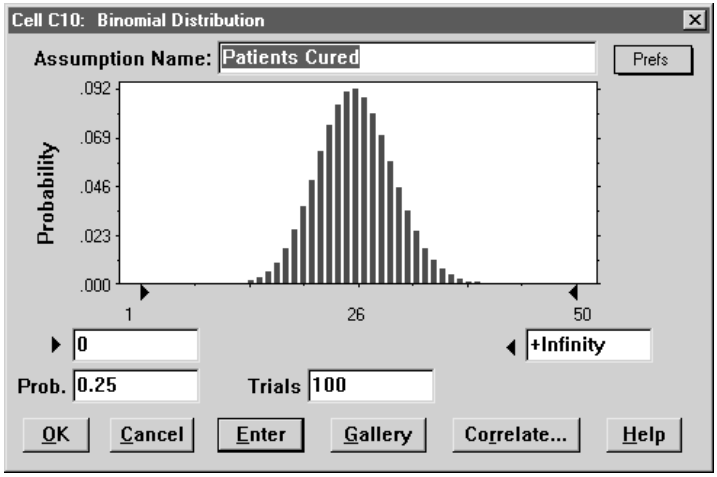


Figure 11 Changed binomial distribution

When you run the simulation, Crystal Ball generates random integers between 0 and 100, simulating the number of patients that would be cured in the FDA test.

9. **Click on OK to return to the spreadsheet.**

Growth rate: the custom distribution

Vision Research has determined that nearsightedness afflicts nearly 40,000,000 people in the United States, and an additional 0% to 5% of these people will develop this condition during the year in which ClearView is tested.

However, the marketing department has learned that a 25% chance exists that a competing product will be released on the market soon. This product would decrease ClearView's potential market by 5% to 15%.

This variable, "growth rate of nearsightedness," cannot be described by any of the standard probability distributions. Since the uncertainties in this situation require a unique approach, Vision Research chooses Crystal Ball's custom distribution to define the growth rate. For the most part, the custom distribution is used to describe situations that other distribution types cannot.

The method for specifying parameters in the custom distribution is quite unlike the other distribution types, so follow the directions carefully. If you make a mistake, click on Gallery to return to the distribution gallery, then start again at step 3.

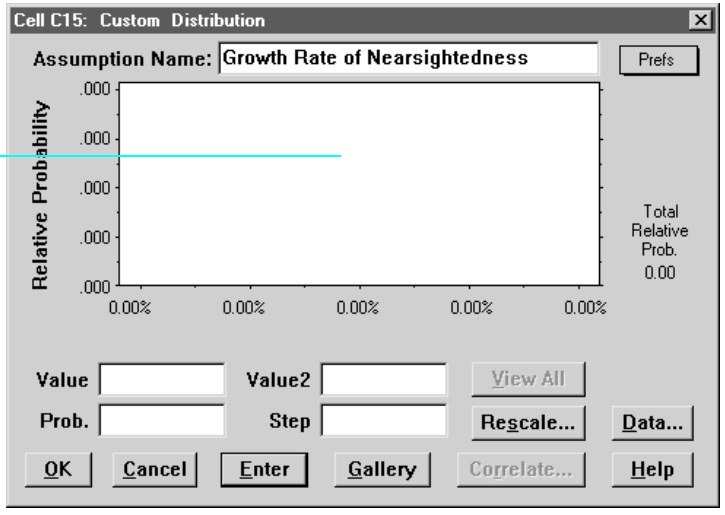
Use the custom distribution to plot both the potential increase and decrease of ClearView's market.

To define the assumption cell for the growth rate of nearsightedness:

1. **Click on cell C15.**
2. **Select Cell > Define Assumption.**

   The Distribution Gallery dialog appears.
3. **Click on the Custom distribution.**
4. **Click on OK.**

   The Custom Distribution dialog appears. Notice that in Figure 12 that the chart area remains empty until you enter the values for the distribution.



The area remains empty until you enter values.

Figure 12 Custom Distribution dialog

To enter the first range of values:

5. **Type 0% in the Value field.**

   This represents a 0% increase in the potential market.

6. **Press <Tab>.**

7. **Type 5% in the Value2 field.**

   This represents a 5% increase in the potential market.

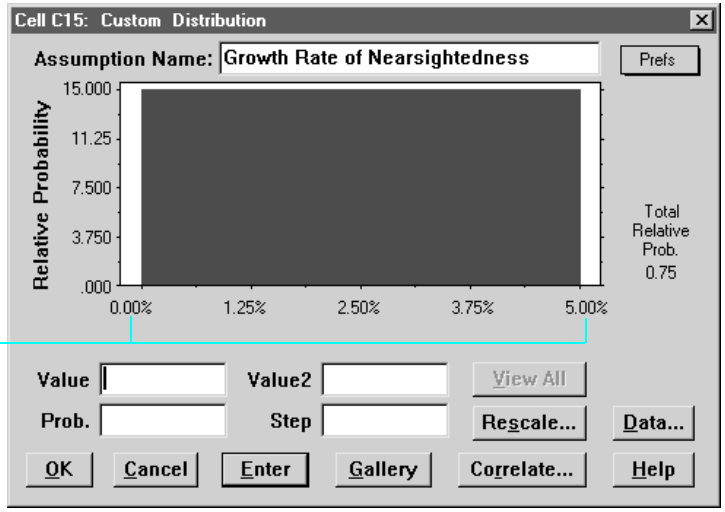
8. **Press <Tab>.**

9. **Type 75% in the Prob field.**

   This represents the 75% chance that Vision Research's competitor will not enter the market and reduce Vision Research's share.

10. **Click on Enter.**

    A uniform distribution for the range 0% to 5% appears.



Uniform distribution for the first range of values.

Figure 13 Uniform distribution range

To enter a second range of values:

11. **Type -15% in the Value field.**

    This represents a 15% decrease in the potential market.

12. **Press <Tab>.**

13. **Type -5% in the Value2 field.**

    This represents a 5% decrease in the potential market.

14. **Press <Tab>.**

15. **Type 25% in the Probability field.**

    This represents the 25% chance that Vision Research's competitor will enter the market place and decrease Vision Research's share by 5% to 15%.

16. **Click on Enter.**

    A uniform distribution for the range -15% to -5% appears. Both ranges now appear in the Custom Distribution dialog.

Crystal Ball displays both ranges.

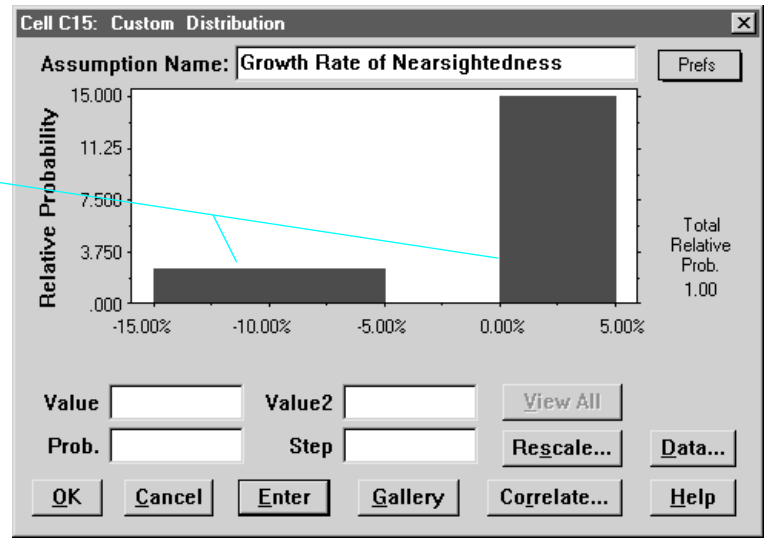


Figure 14 Customized uniform distribution

You can use the Data button to pull numbers from specified cell ranges on the spreadsheet rather than typing them in the Custom Distribution dialog. When you run the simulation, Crystal Ball generates random values within the ranges you specified.

17. **Click on OK to return to the spreadsheet.**

Glossary Term:
standard deviation—
The square root of the variance for a distribution. A measurement of the dispersion of values around the mean.

Glossary Term:
mean or mean value—
The familiar arithmetic average of a set of numerical observations (the sum of the observations divided by the number of observations).

Defining market penetration: the normal distribution

The marketing department estimates that Vision Research's eventual share of the total market for the product will be normally distributed around a mean value of 8% with a **standard deviation** of 2%. "Normally distributed" means that Vision Research expects to see the familiar bell-shaped curve with about 68% of all possible values for market penetration falling between one standard deviation below the **mean value** and one standard deviation above the mean value, or between 6% and 10%.

The low mean value of 8% is a conservative estimate that takes into account the side effects of the drug that were noted during preliminary testing. In addition, the marketing department estimates a minimum market of 5%, given the interest shown in the product during preliminary testing.

Vision Research chooses the normal distribution to describe the variable "market penetration."

To define the assumption cell for market penetration:

1. **Click on cell C19.**
2. **Select Cell > Define Assumption.**

   The Distribution Gallery dialog appears.
3. **Click on the Normal distribution.**
4. **Click on OK.**

   The Normal Distribution dialog appears.

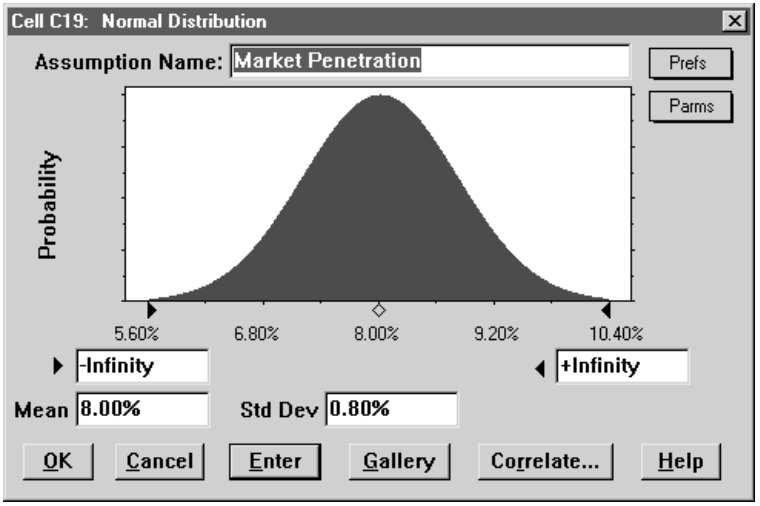


Figure 15 Normal distribution for cell C19

Now specify the parameters for the normal distribution: the mean and the standard deviation.

5. **If the Mean field doesn't contain 8.00%, type 8% in the Mean field.**

   This represents an estimated average for market penetration of 8%.

6. **Press <Tab>.**

7. **Type 2% in the StdDev field.**

   This represents an estimated 2% standard deviation from the mean.

8. **Click on Enter.**

   The normal distribution scales to fit the chart area, so the shape of the distribution does not change. However, the percent range at the bottom of the chart does change.

9. **Press <Tab> twice.**

10. **Type 5% in the left truncation grabber field.**

    This represents 5%, the minimum market for the product.

11. **Click on Enter.**

    The distribution changes to reflect the values you entered.

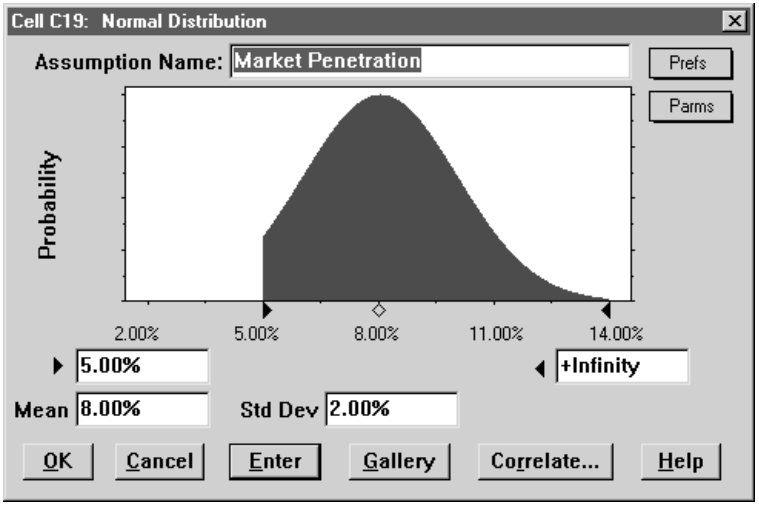


Figure 16 Changed distribution for the new values

When you run the simulation, Crystal Ball generates random values that follow a normal distribution around the mean value of 8%, and with no values generated below the 5% minimum limit.

12. **Click on OK to return to the spreadsheet.**

Defining forecasts

Now that you have defined the assumption cells in your model, you are ready to define the forecast cells. Forecast cells contain formulas that refer to one or more assumption cells.

The president of Vision Research would like to know both the likelihood of achieving a profit on the product and the most likely profit, regardless of cost. These forecasts appear in the gross profit (cell C21) and net profit (cell C23) for the ClearView project.

Calculating gross profit

Crystal Ball can generate more than one forecast during a simulation. In this case, you can define both the gross profit and net profit formulas as forecast cells. First, look at the contents of the cell for gross profit.

1. **Click on cell C21.**

   The cell contents appear in the formula bar near the top of your spreadsheet. The contents are C16*C19*C20. Crystal Ball uses this formula to calculate gross profit by multiplying Persons With Nearsightedness After One Year (C16) by Market Penetration (C19) by Profit Per Customer (C20).

Glossary Term:
forecast formula—
A formula that has been defined as a forecast cell.

Now that you understand the gross profit formula, you are ready to define the **forecast formula** cell for gross profit.

To define the forecast cell for gross profit:

2. **Select Cell > Define Forecast.**

   The Define Forecast dialog appears. You can enter a name for the forecast. Since the forecast cell has a name next to it on the spreadsheet, that name appears in the dialog by default.

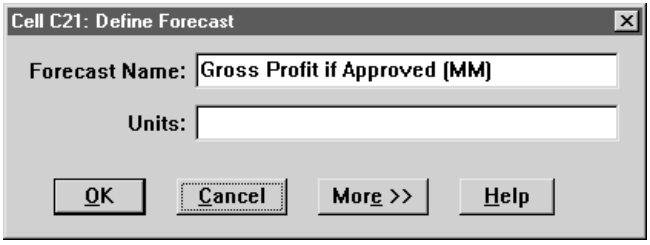


Figure 17 Define Forecast dialog - Gross Profit If Approved

   Use the forecast name that appears, rather than typing a new name.

   Since the spreadsheet model involves millions of dollars, indicate that in this dialog.

3. **Press <Tab>.**
4. **Type Millions in the Units field.**
5. **Click on OK to return to the spreadsheet.**

Calculating net profit

Before defining the forecast cell formula for net profit, look at the contents of the cell for net profit:

1. **Click on cell C23.**

   The contents appear in the formula bar above the spreadsheet. The contents are: IF(C11, C21-C7, -C4-C5).

   The formula translates as follows:

   If the FDA approves the drug (C11 is true), then calculate net profit by subtracting total costs (C7) from gross profit (C21). However, if the FDA does not approve the drug, (C11 is false), then calculate net profit by deducting both development costs (C4) and testing costs (C5) incurred to date.

To define the forecast cell for net profit:

2. **Select Cell > Define Forecast.**

   The Define Forecast dialog appears, as in Figure 18.

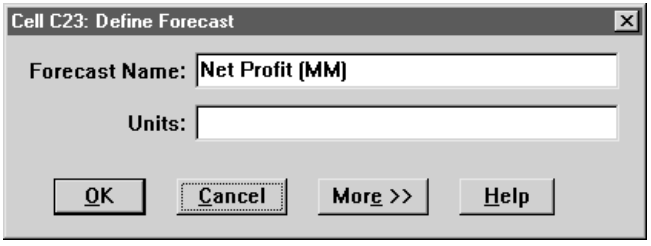


Figure 18 Define Forecast dialog - Net Profit

Again, use the forecast name that appears in the Forecast Name field and specify millions in the Units field.

3. **Press <Tab>.**
4. **Type Millions in the Units field.**
5. **Click on OK to return to the spreadsheet.**

You have defined assumptions and forecast cells for the Vision Research spreadsheet, and are now ready to run a simulation.

Running a simulation

When you run a simulation in Crystal Ball, you have the freedom to stop and then continue the simulation at any time. The Run, Stop, and Continue commands appear on the Run menu as you need them. For example, when you are running a simulation, the Stop command appears at the top of the menu. If you stop the simulation, the Continue command takes its place. Practice using these commands when you run the simulation for the ClearView project.

Glossary Term:
seed value—
The first number in a sequence of random numbers. A given seed value produces the same sequence of random numbers every time you run a simulation.

Before you begin the simulation, specify the number of trials and initial **seed value** so your simulation will look like the forecast charts in this tutorial.

To specify the number of trials and initial seed value:

1. **Select Run > Run Preferences > Trials.**

   The Run Preferences Trials dialog appears.

2. **In the Maximum Number Of Trials field, type 500.**
3. **Click on Sampling.**
4. **Click the Use Same Sequence Of Random Numbers option.**
5. **In the Initial Seed Value field, type 999.**
6. **Click on OK.**

Practice routines

In the next few sections, practice a few basic routines.

Run, Stop, and Continue

To practice using the Run, Stop, and Continue commands:

1. **Select Run > Run.**

   The Net Profit forecast window appears, neatly stacked on top of the Gross Profit forecast window. As the simulation proceeds, the forecast charts reflect the changing values in the forecast cells.

2. **Select Run > Stop.**

Crystal Ball Note: *You can also stop the simulation by pressing <Alt>-u,o.*

3. **In the front forecast window, select Run > Continue.**

Crystal Ball Note: *Each forecast window has its own menu bar.*

The simulation continues.

Crystal Ball Note: *You can also continue the simulation by pressing <Alt>-u,u.*

View the forecast charts

You might not see two complete forecast charts at the same time. However, there are several ways to bring individual forecast windows to the front of the window stack. The easiest way is to click on the forecast window if it is visible.

1. **Click on the Gross Profit If Approved forecast window.**

The Gross Profit chart appears, as in Figure 19.

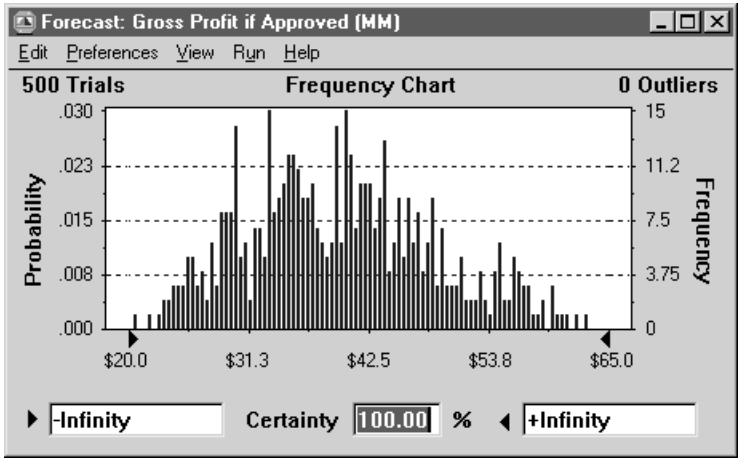


Figure 19 Gross Profit If Approved forecast

2. **Select Run > Forecast Windows.**
3. **Click on Open All Forecasts to move the Net Profit forecast window to the front again.**

While the simulation is running, a frequency distribution for each forecast appears to reflect the changing values in the forecast cell. The frequency distribution appears as columns.

4. **Continue to run the simulation until it stops at 500 trials.**

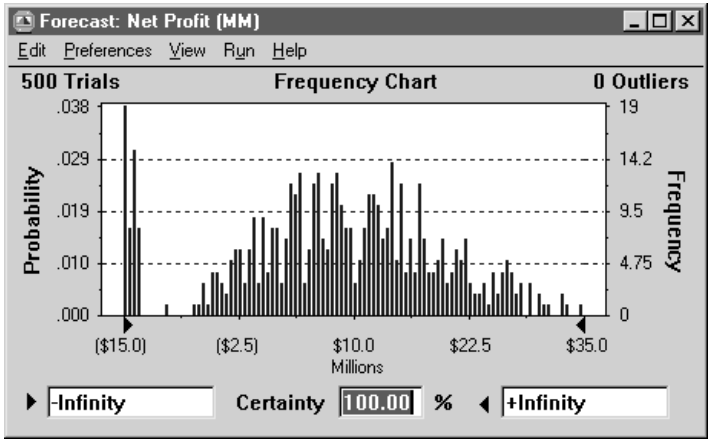


Figure 20 Net Profit forecast

A frequency distribution shows the number or frequency of values occurring in a given group interval. In Figure 20, the frequency distribution on the Net Profit forecast chart shows a frequency of 19 for the group interval that contains the most values. That means 19 values occurred in the group interval.

Remember that the forecast chart graphs the forecast results and shows how the forecast values are distributed. As the simulation progresses, Crystal Ball continues to update the frequency distribution for each forecast cell, and the forecast results become more accurate.

Interpreting the results

Now that you have run the simulation, you are ready to interpret the forecast results in more depth. The president of Vision Research faces a difficult decision—should the company scrap the ClearView project or proceed to develop and market this revolutionary new drug? To examine this question in more detail you need to look at the forecast chart in more detail.

Excel Note: *Crystal Ball windows are separate from Excel windows. If Crystal Ball's windows disappear from your screen, they are usually simply behind the main Excel window. To bring them to the front, click on the Crystal Ball icon in the Windows taskbar or press <Alt>-<Tab>.*

Understanding the forecast chart

Crystal Ball forecasts the entire range of results for the Vision Research project. However, the forecast charts show only the display range that, by default, is set to exclude the most extreme values (outliers).

In Figure 21, the display range includes the values from minus $15.00 to $35.00, as shown on the Net Profit forecast chart.

The forecast chart also shows the certainty range for the forecast. By default, the certainty range includes all values from negative infinity to positive infinity.

Crystal Ball compares the number of values in the certainty range with the number of values in the entire range to calculate the certainty level. The example above shows a certainty level of 100%, since the initial certainty range includes all possible values.

Remember that the certainty level is an approximation, since the spreadsheet model can only approximate the elements of the real world.

In the upper left corner of the forecast chart, Crystal Ball shows the total number of trials that were run for this forecast. In the upper right corner, the number of trials outside of the display range appear. Since the display range is initially set by default to exclude outlying values, the number of "outliers" is usually greater than zero when your simulation stops.

Determining the certainty level

Now the Vision Research president wants to know how certain Vision Research can be of achieving a profit and what are the chances of a loss.

To determine the certainty level of a specific value range:

1. **In the Net Profit forecast chart, press <Tab> twice.**
2. **Type 0 in the range minimum field.**
3. **Press <Enter>.**

   Crystal Ball moves the left certainty grabber to the break-even value of $0.0 and recalculates the certainty level.

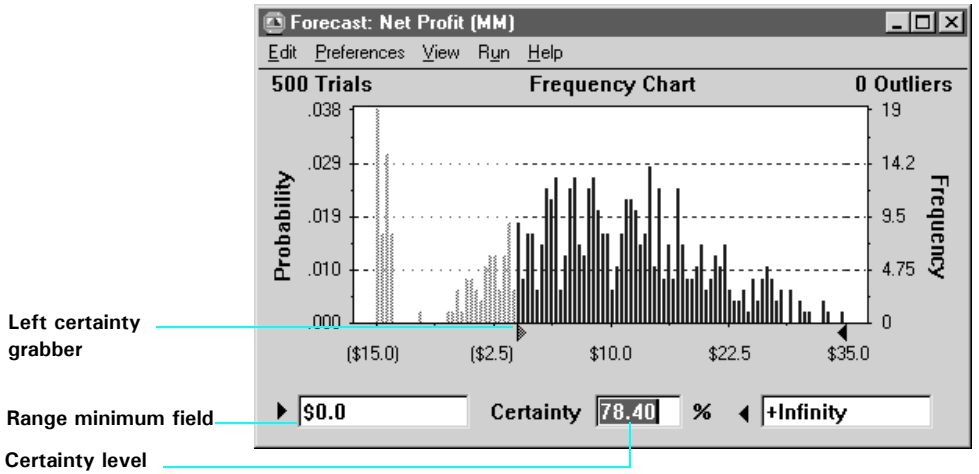


Figure 21 Net Profit forecast—$0 minimum

Analyzing the Net Profit forecast chart again, you can see that the value range between the certainty grabbers shows a certainty level of 78.4%. That means that Vision Research can be 78.4% certain of achieving a net profit. You can therefore calculate a 21.6% chance of suffering a net loss (100% minus 78.4%).

Now the president of Vision Research would like to know the certainty of achieving a minimum profit of $2,000,000. With Crystal Ball, you can easily answer this question.

4. **Type 2 in the range minimum field.**
5. **Press <Enter>.**

   A Figure 22 shows, Crystal Ball moves the left certainty grabber to $2.0 and recalculates the certainty level.

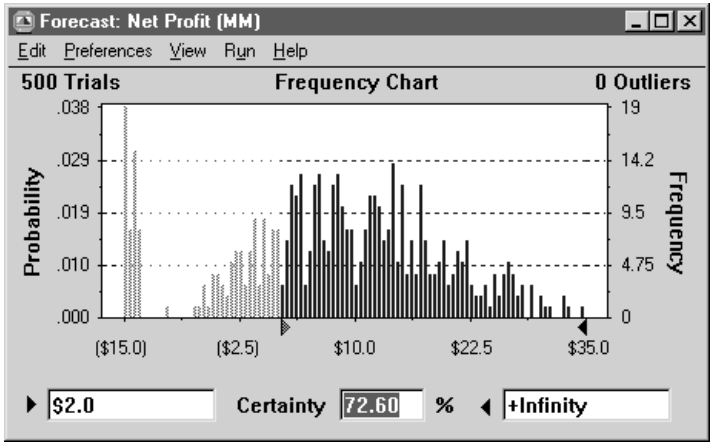


Figure 22 Recalculated certainty level

Vision Research can be 72.6% certain of achieving a minimum net profit of $2,000,000.

Vision Research is very encouraged by the forecast result. The president now wants to know how certain Vision Research can be of achieving a minimum net profit of $4,000,000. If Crystal Ball shows that Vision Research can be at least two-thirds certain of a $4,000,000 net profit, the president is ready to go ahead with the ClearView project. Again, Crystal Ball can easily answer this question.

6. **Type 4 in the range minimum field.**

7. **Press <Enter>.**

   Crystal Ball moves the left certainty grabber to $4.0 and recalculates the certainty level.

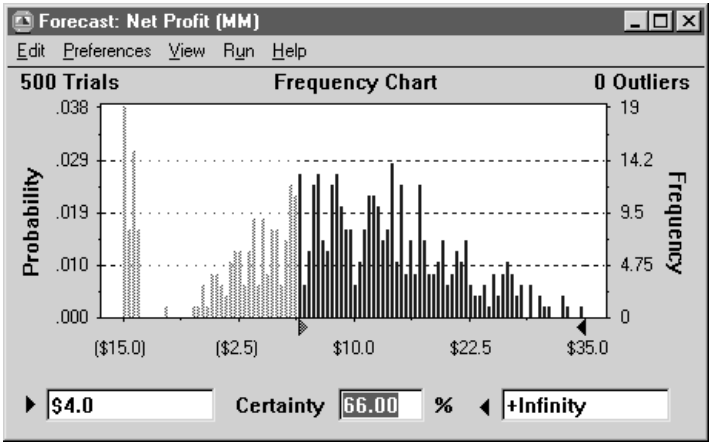


Figure 23 net Profit forecast—$4.0 minimum

The Net Profit forecast chart in Figure 23 shows a certainty level of 66%. With a two-thirds certainty of a minimum net profit of $4,000,000, Vision Research decides to go ahead with the ClearView project and proceed to develop and market this revolutionary new drug.

The president of Vision Research also is interested in the most likely profit regardless of cost. You now can analyze the gross profit forecast chart as you did the net profit chart.

Summary

In this example, you explored only a few questions that Vision Research might ask as they analyze the results of the simulation. As you read through this manual, you will learn to explore the forecast results in more depth. For example, you can customize the forecast charts, create overlay charts, create trend charts, analyze the sensitivity of the model, interpret the descriptive statistics, and print comprehensive reports for any simulation. Crystal Ball provides these features so that you can quantify the risk inherent in your assumptions.

Crystal Ball keeps your assumption and forecast definitions (but not the forecast values) with the spreadsheet. When you save your spreadsheet, the definitions are saved with it.

Closing Crystal Ball

To close Crystal Ball without exiting Excel, in Excel, select Run > Close Crystal Ball.

A dialog appears asking you to confirm the decision. Click on OK to close Crystal Ball and remove the Cell, Run, and CBTools menus and the Crystal Ball toolbar from Excel. The Vision Research spreadsheet remains open in Excel.

Crystal Ball Note: *Crystal Ball also closes automatically when you exit Excel.*