

Primavera Risk Analysis - Risk Tutorials

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1 Risk Tutorial - Part 1

1.1 Introduction

This is the first part of the risk tutorial. It covers the fundamental concepts of risk analysis and looks at applying uncertainty and risk to task durations.


It will help you get up and running in about 45 minutes. Of course it may take you less time or more time. So as we are going to be looking at duration uncertainty we will start by expressing the time to complete the tutorial as a three point estimate:

Minimum duration = 30 minutes

Most likely duration = 45 minutes

Maximum duration = 90 minutes

The three point estimate assumes your computer does not crash! Take a look at the Risk Register tutorial for modeling this type of risk.

 If you are reading this in the on-line help you may want to print out this tutorial - see **Printing Help Topics and Chapters (Section 2.7)**

Part 1 covers:

1. A brief introduction to Risk Analysis
2. Modeling task durations
3. Entering uncertainty
4. Task existence risk
5. Running the risk analysis
6. Interpreting the results.
7. Copying the risk graph to the clipboard
8. Criticality Index
9. Creating a Risk Schedule

1.2 A brief introduction to Risk Analysis

If you have planned projects before it is likely that you will have had to estimate the task durations.

You may have said to yourself something like:-

"If it goes well we will have that hole dug in 10 days, but there is a chance the ground could be rocky and it may even take 20 days, though that is really the worst case and is unlikely. So my best guess is 13 days".

So in your project plan you enter 13 days against the task "Dig Hole". The other information (i.e. the best case estimate of 10 days and worst case estimate of 20 days) are not entered into the project at all.

By entering only the most likely duration a lot of additional information that would be of great benefit in producing a much more realistic plan is lost.

But this does not have to be the case...

Using risk analysis within Primavera Risk Analysis allows you to easily enter extra information about the uncertainty of the duration and cost of your tasks. This extra information can be used to produce more accurate and realistic plans. It can also help you manage your project more effectively by answering questions such as:

1. What is the chance of finishing the project on time?
2. What chance do I have of finishing the project on the 12th December?
3. What date can I be 80% confident of finishing by?
4. What tasks are most likely to cause project delay?

When using risk, instead of just entering your best guess at the task duration (i.e. the most likely) you also enter the minimum and maximum durations as well.

By entering minimum and maximum durations and applying risk analysis you are modeling your project more accurately.

Other risks such as cost can also be examined and these are looked at in the second part of the risk tutorial.

1.3 Modeling task durations

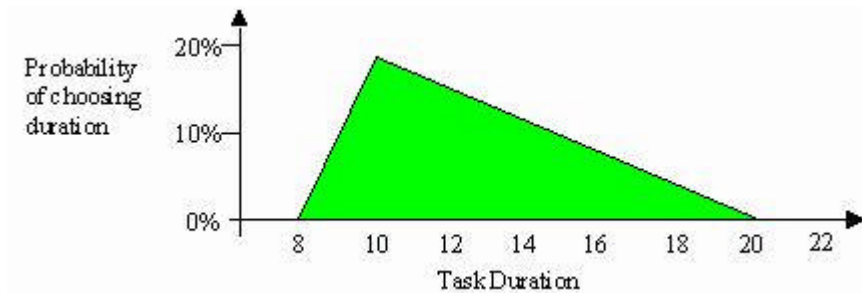
As we discussed previously using risk involves entering additional information about task durations.

Instead of just saying this task is x days long we describe it using a distribution. In this tutorial you will be using the triangular distribution for the tasks but we will take a brief look at the uniform distribution as well.

The Triangular Distribution

The distribution is called Triangular because it describes the shape of the probability graph for the task duration.

For example the graph below shows the triangular distribution for a task with a minimum duration of 8, most likely of 10 and maximum of 20.



From the graph above you can see that there is approximately an 18% chance of the duration being 10 days, approximately an 11% chance of the duration being 14 days and there is a 0% chance of the duration being 22 days.

A description of the above distribution:

"The task is likely to have a duration of 10 days. There is a very small chance of it taking 20 days, and a small chance of it taking 8 days. Realistically the task will be somewhere between 9 and 18 days long."

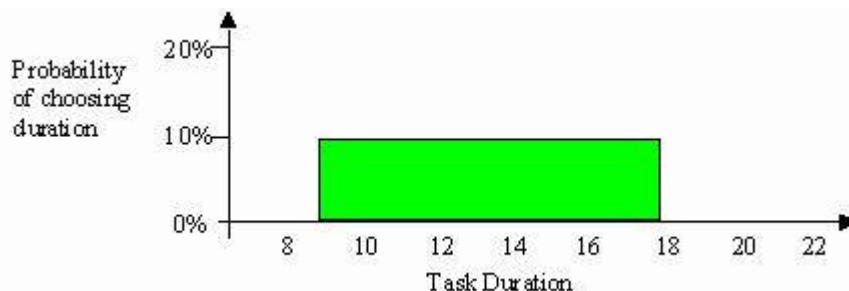
By thinking of your task in the above terms you can choose suitable values for the minimum, most likely and maximum durations.

✎ It has been found that the triangular distribution models the duration of many tasks that occur in real life.

The Rectangular or Uniform Distribution

The Rectangular or Uniform Distribution is not used as much as the Triangular but serves as a good example.

The graph shows the uniform distribution for a task with a minimum duration of 9 and a maximum of 18. With a uniform distribution there is no most likely duration as all the durations between the minimum and the maximum are equally as likely to occur.



When Primavera Risk Analysis performs a risk analysis it will randomly choose the duration for a task using the uniform distribution. From the graph above you can see that there is a 10% chance of Primavera Risk Analysis choosing a duration of 10 days. In fact there is a 10% chance of Primavera Risk Analysis choosing any particular duration as there are 10 values between 9 and 18 (9, 10, 11, 12, 13, 14, 15, 16, 17 and 18).

A description of the above distribution:

"The task will have a duration somewhere between 9 and 18 days. All durations being equally as likely."

The uniform distribution is not as common as the triangular as it does not model many real life situations.

✎ Other distributions such as Normal and BetaPert are available.

1.4 Entering uncertainty

- Start Primavera Risk Analysis.
- *Help | Open Samples...*
- Find and select "Risk Tutorial 1.plan". Click *Open*.

✎ The file will probably be marked as read only, click *Yes* to open a copy.

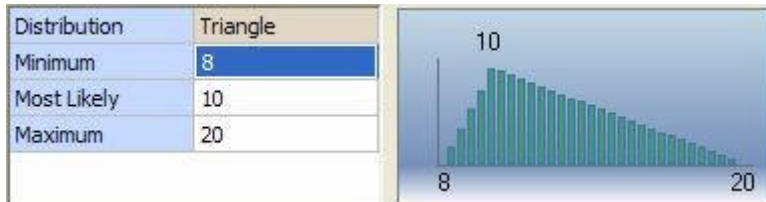
We will look at where the data for each task is stored and enter the uncertainty for a single task.

Entering uncertainty using the Task Details dialog

- Right click on the task "Recover Roof"
- Select *Duration Risk* from the pop up menu. This displays the task details dialog with the *Duration Uncertainty* tab selected.
- Check *On* and a triangular distribution is assigned as the default.

A triangular distribution requires a minimum, maximum and most likely duration.

- For the "Recover Roof" task enter a minimum duration of 8 days, most likely of 10 days and a maximum duration of 20 days.



You have entered uncertainty on the task duration.

You now need to continue with the other tasks in the project. You could use the Task Details dialog again but it is quicker to use the Gantt Chart columns to enter the information.

Entering uncertainty using the Gantt Chart columns

- Enter the minimum, most likely and maximum durations shown in the following table:

Description	Minimum Duration	Most Likely	Maximum Duration
Start			
Erect Scaffold	6	8	10
Drain off system etc.	3	4	4
Chimney rebuild	4	4	8
Demolish 50% brick	5	8	12
Drill out ties, etc.	4	8	10
Cut-off, route electric	3	4	6
Re-build 50% brick	6	12	20
Demolish 50% brick	5	8	12
Drill out ties, etc.	4	8	10
Cut-off, route electric	3	4	6
Re-build 50% brick	6	12	20
Strip off roof cover	3	3	6
Wasp nests found	1	1	2
Roof struct. work	4	6	12
Recover roof	8	10	20
Dismantle scaffold	3	4	6
Re-wire	4	4	6
Joinery	4	4	5
Plaster	4	4	5
Plumbing, etc.	4	6	8
Boundary wall, etc.	4	6	10
Exterior work	3	4	6
Inspect, snag, etc.	2	4	8
Finish			

- Save the plan using *File* | *Save*. If the original file was read-only choose a new name for the file.

1.5 Task existence risk

Task Existence Risk

There may be things in a project that have a probability of occurrence and an impact. For example there might be a 15% chance of finding obstructions during an excavation that could add 15 to 20 days to the project. You can model risks like this very easily.

In our tutorial project we know from experience that there is a 20% chance of finding a wasps nests after stripping of the roof-cover. This task has already been entered into our project so all we need to do is assign the chance of this event occurring.

Enter a 20% chance of discovering wasp nests

- Right click on the task "Wasp Nests Found".
- Select *Existence Risk* from the pop up menu.
- Check the *On* check box.
- Against *Probability this task exists* enter a value of 20.
- Choose the option: *Keep Links to other tasks*.

 This option ensures that the logic flowing through this task is not lost.

- You will see the 20% value appear in the column *Task Existence %*. You could change or enter the value using this column.
- Save the plan.

1.6 Running the Risk Analysis

Now you have all the information needed to risk analyze the project and start getting answers that will help you manage project risk.

During the analysis Primavera Risk Analysis looks at each task that has a distribution and sets its duration to a value between the minimum and maximum. Because you are using a triangular distribution Primavera Risk Analysis will set the duration to the most likely more often than any other value. The least likely values to occur will be the values that are at the extremes i.e. the minimum and maximum durations.

Once Primavera Risk Analysis has changed all the task durations it calculates and records the finish date. This process is repeated for the required number of iterations and the finish date of the project is stored each time.

What Primavera Risk Analysis is doing is simulating the project repeatedly and seeing how the finish date varies. Once the analysis is complete the first thing you can do is look at the chance of finishing by a certain date.

Two questions that are often asked about a project:

"What finish date can I be 80% confident of finishing by?" (the P80 finish date).

"What chance do I have of finishing by the 8th May?" (or any date that is relevant).

Both of these questions can be answered by running a risk analysis and simply reading the results from the Distribution Graph report. So let's run the risk analysis.

Run the Risk Analysis

- *Risk | Run Risk Analysis*.
- Make sure *Show Step through analysis option* is on.
- Set number of iterations to 1000 (it may already be 1000).
- Click *Analyze* and a dialog will appear with *Step*, *Go*, *Complete* and *Cancel* buttons.
- Drag the dialog out of the way of the Gantt Chart so you can see the tasks.
- Now click the *Step* button.

Here are some things to watch out for as you continue to click the step button:

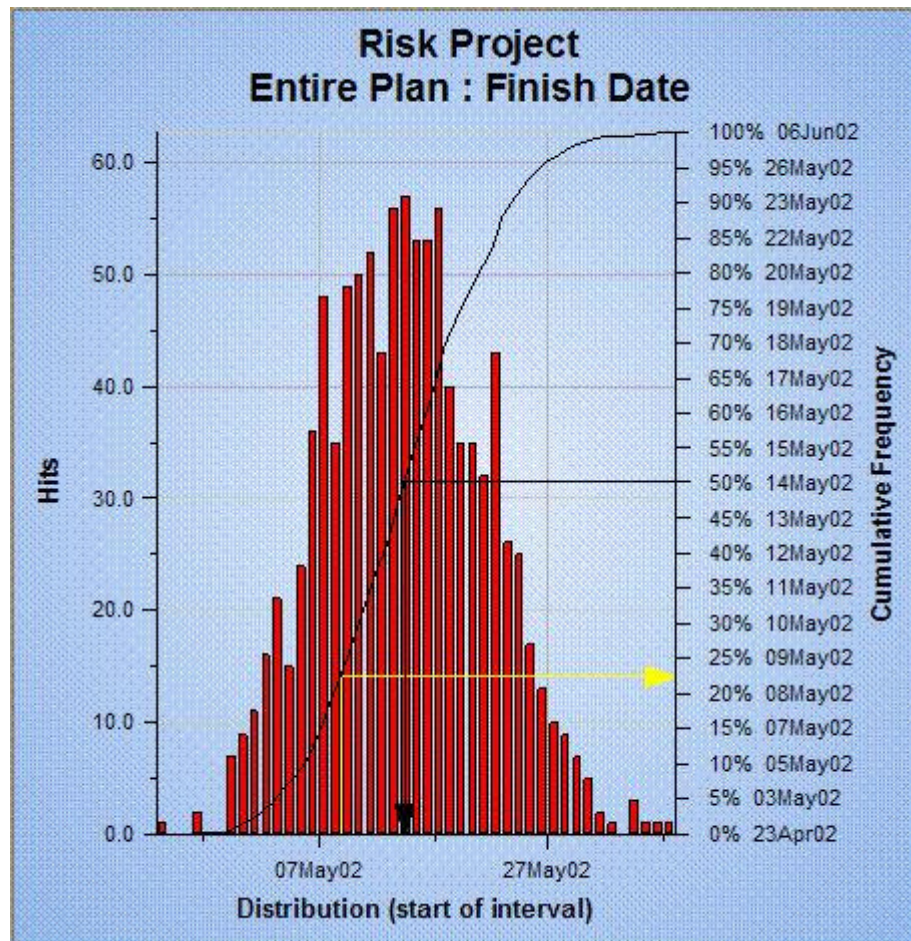
1. Each step is one iteration and you will see the Gantt Chart move around as Primavera Risk Analysis selects random durations for each task.
2. You will see some of the tasks change from red to blue and vice versa. This is the critical path changing.

- When you have had enough of the *Step* button, try clicking the *Go* button - saves wear on your clicking finger! (a message is displayed describing the difference between *Go* and *Complete* buttons).
- This is still quite slow (because of all the re-drawing) so to speed things up click *Complete*.

There is no need to actually step through and redraw the plan for every iteration but it is very useful to check that things are proceeding as you expect.

Once the analysis is complete you should see a graph that looks something like this:

It may not be exactly the same as this is a statistical analysis that uses random numbers.



1.7 Interpreting the results

Now we will look at reading and generating useful information from the analysis that Primavera Risk Analysis has just performed.

Look at the graph that has been generated.

The bars on the graph represent how often during the analysis the plan finished on a certain date or between a certain date range.

Let's look at answering one of our questions:

What date can I be 80% confident of finishing by?

This is very easy. All you do is look at the right hand vertical axis and find 80% and read the date next to it - it's as simple as that.

If you click on the 80% date in the right hand vertical axis a line is drawn that hits the curve and then goes vertically down to the same date.

In our project there is an 80% chance of finishing before the 20th May - There may be a variation in your results as this is a statistical process.

So why is this the 80% date?


Find the approximate position of the 80% date on the horizontal axis.

You will notice that the majority of the hits are to the left of this date. In fact 80% of the hits are to the left and 20% are to the right. So during the analysis 80% of the finish dates were on or before the 20th May and 20% of the finish dates were after the 20th May. You can therefore say there is an 80% chance of the finish date being on or before the 20th May.

The accuracy of this statistic is of course dependent on having entered sensible information into your plan in the first place!!


So now onto our next question:

What is the chance of finishing on the 8th May?

 The 8th May is the date that the plan will finish by if all the tasks are completed in the most likely duration. It is often called the *Deterministic Finish* date.

To answer the question above read down the right hand vertical axis until you find the required date or a date is earlier. Then read the associated percentage.

In this case the chance of finishing on the 8th May is about 20%!!

 The exact value can be read from the statistics displayed to the right of the graph. The probability value is shown in the Highlighters: 22% (*Deterministic*).

This is a fairly low chance. This is how many projects are run when risk and uncertainty is not considered - i.e. it is assumed that because the planning software shows an end date of the 8th May then this is the date the project is likely to finish by. But you have seen that this is not always the case. In fact you have seen there is only a 22% chance of finishing by the 8th May.

So if this was your project plan you would now have some very useful information about the date you are likely to finish your project.

One of the things that makes a project risky is the number of tasks that run in parallel. With tasks in parallel it only takes one to be late and the project is late but all the parallel tasks must be early for the plan to be early.

1.8 Copying the risk graph to the clipboard

A useful feature is being able to copy the Risk Graph to the clipboard.

- If you are not already in the *Distribution Graph* then from the *Reports* menu choose, *Distribution Graph*.
- From *Edit* menu (while in the *Distribution Graph*) choose, *Copy Graph*.
- A copy of the graph is now in the clipboard. You can paste this into applications such as MS Word, MS PowerPoint etc.

Ok now let's look at some other useful figures including Criticality Index.

1.9 Criticality Index

Close the Distribution Graph dialog by clicking on the *OK* button.

We will now add the Criticality Index column to the Gantt Chart.

- *Format | Columns*.
- In *Grouped Fields* tab locate and select the column 'Risk Output – Criticality Index' under *Risk Outputs*.
- Add it to the *Right Columns* tab by selecting the *Right Columns* tab and pressing the *>* button.
- Use the *Up* and *Down* buttons to move your new column to the desired location and click *OK*.

You will notice it has been filled with values that vary from 0% to 100% (before the analysis they were all 0%).

The Criticality Index tells you how often a task was on the critical path during the risk analysis. The reason tasks can sometimes be on the critical path and sometimes not is because during the risk analysis the task durations vary and this can alter the critical path. You will have seen the critical path change if you watched the tasks during the step through analysis.

The interesting thing about the criticality index is that it helps you identify those tasks that are most likely to be critical during the project.

To make a bit more sense of this report we will sort the tasks by criticality.

- *View | Sort...*
- Select 'Criticality'
- Click *Apply*.
- Click *Close*.

The tasks should now be sorted in order of criticality. Tasks with the same criticality are sorted by start date.

The tasks that have 100% criticality are most likely to be on the critical path during the project and they therefore should be given the most attention.

- *Edit | Undo sort*.

This will undo the sort by criticality you have just applied. There are multiple levels of undo and redo should you need them.

Now let's look at another useful feature that allows us to display a risk schedule graphically.

1.10 Risk Schedule

Primavera Risk Analysis can calculate and display selected percentile dates as a risk schedule. For example the P80 start and the P80 finish can be displayed in the columns or graphically on the Gantt Chart.

These dates give you an indication of how far each task is likely to stray from its deterministic finish.

The example below shows tasks with an additional green and blue symbol that indicate the P50 and P80 dates.

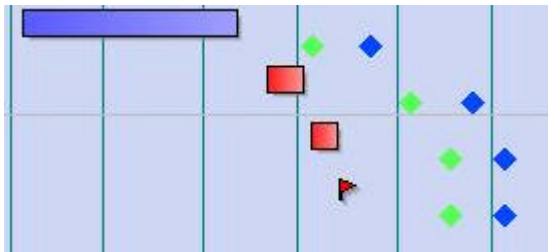


Figure: Diamonds representing the P50 and P80 schedule shown on the Gantt Chart.

Calculating the risk percentile dates

- *Risk | Risk Percentiles*
- Check the settings are as shown below:


Risk Percentiles

Type	Percentile	Task Field	Add Distribution Highlighter	Add PCF Highlighter	Add Column	...
Start	50	P50 Start	No	No	No	N
Finish	50	P50 Finish	No	No	No	N
Start	80	P80 Start	No	No	No	N
Finish	80	P80 Finish	No	No	No	N
Cost	50	P50 Cost	No	No	No	N
Cost	80	P80 Cost	No	No	No	N

Add columns and custom bars to this sheet: Risk Outputs ☒ Calculate Now

Help Calculate Now

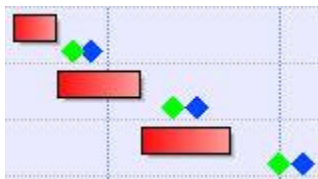
- Click the *Calculate Now* button. The risk percentiles are calculated.

 If the *Calculate Risk Percentiles after running Risk Analysis* is selected then the risk percentiles will always be calculated when the risk analysis is run.


The P50 and P80 dates have been stored in the task user fields P50 Start, P50 Finish, P80 Start and P80 Finish.

The risk percentile dates can be displayed using custom task bars. To save time we will retrieve a predefined view that has the custom task bars set up:

- View | View | Insert View.*
- Check the *'Insert View as New Sheet'* check box.
- Select *'Gantt chart: P50 - P80 Markers'*
- Click *OK*.



You should now be able to see the bars or markers that display the P50 and P80 risk schedule.

 Use *Format | Custom Task Bars* to view and modify the format of the colored diamonds.

 **Congratulations!!**

This completes the first part of the risk tutorial.


Risk analysis does not have to be complicated and you can get a lot out of it by just applying the techniques covered in this part of the tutorial.

If you want to find out more move on to the Part 2 of the tutorial.

2 Risk Tutorial - Part 2

2.1 Introduction

This is the second part of the risk tutorial. It will help you get up and running with some of the more exciting risk tools in about 30 minutes.

 If you are reading this in the on-line help you may want to print out this tutorial - see **Printing Help Topics and Chapters (Section 2.7)**

Part 2 covers:

1. Probabilistic branching
2. Adding costs to tasks
3. Adding uncertainty to task cost
4. Using hammock tasks
5. Correlation

2.2 Probabilistic Branching

The Project

The project is to dig a hole and fill it in again. Not too technical but ideal for this tutorial. This part of the tutorial shows you how risks in a project can be modeled using probabilistic branching.

Enter the Project

- Start a new plan.
- Create the following tasks and durations by typing directly into the *Description* and *Remaining Duration* columns:

Description	Remaining Duration
Start	0
Remove topsoil	3
Dig normally	3
Fill hole	5
Plant grass	1
End	0

Change 'Start' and 'End' to milestone tasks.

- Click on the task description 'Start'.
- In the *Task Details* click on the *General* tab.
- Change the *Type* to *Start Milestone*.
- Click on the task description 'End' and change the *Type* to *Finish Milestone*.

Add the task relationships

- Select the tasks that need to be linked.
- Select *Edit | Link Tasks...*
- Click *OK*.

Your project should now look like this:



Identifying probabilistic branches

You have been in contact with local experts and have found that in the area you are planning to dig the hole there are often archaeological remains.

Previous excavations in the area have shown that after removing the topsoil there are three possible outcomes:

Risk 1

Archaeological remains are found that need expert removal. Chance of occurring = 5%

Risk 2

Archaeological remains are found but can be discarded. Chance of occurring = 20%

Risk 3

No archaeological remains are found. Chance = 75%

So there are three possible outcomes when the hole is dug. This type of risk can be modeled using Probabilistic Branching. To use Probabilistic Branching a probability is assigned to each outcome or 'branch'. Then for every iteration during the risk analysis, only one of the branches is included, the others are ignored.

Adding new tasks to model the probabilistic branches

Now we have identified the probabilistic branches we need to add new tasks to model them.

- Right click on the task 'Dig normally' and choose *Insert Task* from the pop menu.
- Repeat above step twice more.
- Change the Descriptions of the three new tasks to:
Remains found that need expert removal
Expert removal
Remains found but can be discarded
- Change the task remaining durations to 4, 4 and 5 days respectively.

Link in the 3 new tasks

💡 While linking the tasks holding the CTRL key allows tasks that are not adjacent to be selected.

- Link the finish of 'Remove topsoil' to the start of 'Remains found that need expert removal'.
- Link the finish of 'Remains found that need expert removal' to the start of 'Expert removal'.
- Link the finish of 'Expert removal' to the start of 'Fill hole'.
- Link the finish of 'Remove topsoil' to the start of 'Remains found but can be discarded'.
- Link the finish of 'Remains found that can be discarded' to the start of 'Fill Hole'.

Now your plan should look like the one shown below:

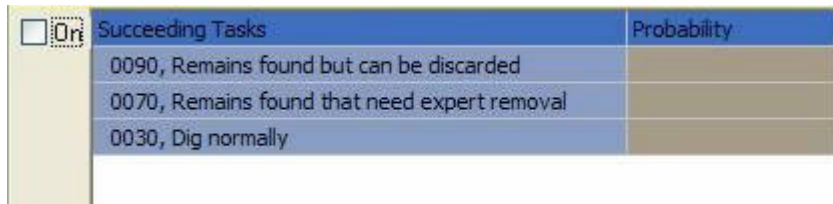


📌 Branch 1 is modeled with two tasks.

Adding the Probability for each branch

When the task 'Remove topsoil' is completed there are 3 ways the project can proceed. So the next step is to assign the probabilities.


- Right click on the task 'Remove topsoil' and choose *Probabilistic Branch Risk* from the pop up menu. The task details tab will be displayed as below:



Succeeding Tasks	Probability
0090, Remains found but can be discarded	
0070, Remains found that need expert removal	
0030, Dig normally	

As the 3 different branches are linked to 'Remove topsoil' they are listed in the dialog. All the branches currently have a 100% probability of occurring.

Changing the Probabilities

- First check the check box labeled *On*.
- In the list click on 'Remains found but can be discarded' and change *Probability* to 20%.
- Change 'Remains found that need expert removal' to 5%.
- Change 'Dig normally' to 75%.
-  The *Total % left to allocate* should now be zero.

That is it. It is very quick and easy to assign probabilities.

- Save your plan.

Running the analysis

At this point it is a good idea to run the risk analysis to see if the project is doing what you expect.

Before we run the analysis try and answer the following questions:-

1. How many possible finish dates are there?
2. What finish date will occur most frequently?
3. What finish date will occur least frequently?
4. What will the finish date distribution graph look like after the risk analysis?




There are 3 branches in the project and only one will occur each iteration.

Ok, let's run the risk analysis.

- Adjust the Gantt Chart so you can see most of your tasks.
- *Risk | Run Risk Analysis*.
- Make sure the *Show step through analysis option* is on.
- Set number of iterations to 1000 (it may already be 1000)
- Click *Analyze* and the *Primavera Risk Analysis* dialog will appear.
- Click and drag the *Primavera Risk Analysis* dialog out of the way of the Gantt Chart.
- Now click the *Step* button.

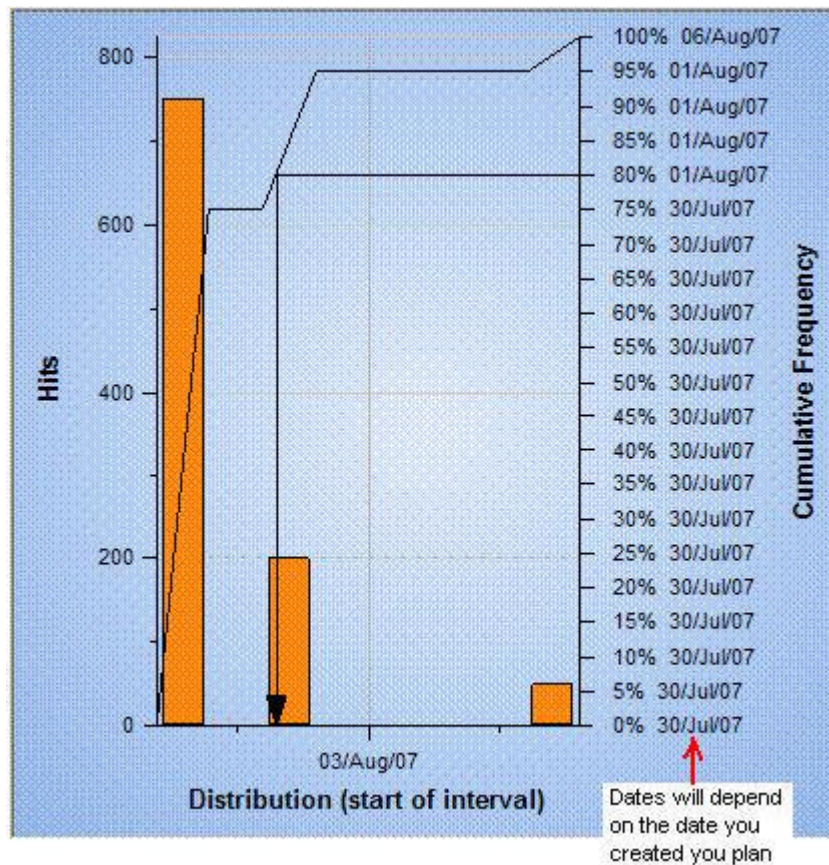
Here are some things to watch out for as you continue click the step button:

1. Notice tasks being temporarily deleted from the project.
2. Notice the finish date varying depending on which branch occurred.

 To see the 5% risk you may have to click step several times (statistically it will occur once every 20 iterations)

- Click *Complete* to speed through the rest of the analysis.

The finish date distribution will look something like this:



How often did each probabilistic branch occur during analysis?

You can see how often each probabilistic branch occurred during the analysis by adding the *Risk - % Iterations Existed* column.

- Close the *Distribution Graph* dialog.
- *Format | Columns*.
- In the right-hand pane, click on the *Right Columns* tab.
- From the left-hand pane, locate and add the column *Risk Output - % Iterations Existed* column.
- Click *OK*.

Conclusion

Probabilistic branching is used when you do not know what path of action you will have to take at a particular point in a project. You can enter all the possible outcomes and give them a probability of occurring.

For every iteration one action is chosen randomly using the assigned probabilities and the others are ignored.

Well done! Next we will have a look at cost risk.

2.3 Adding Costs to Tasks


This part of the tutorial continues on from the Probabilistic Branching.

In our project we have estimated the tasks will cost the following:

Task	Cost
Remove topsoil	\$300
Remains found that need expert removal	\$300
Expert removal	\$1,000
Remains found but can be	\$800

discarded	
Dig normally	\$400
Fill hole	\$200

There will also be a cost of \$100 a day for site management.

 Although the currency used in this tutorial is in dollars (\$), your computer's Regional Settings may be different and this will be the default currency used for new plans. This will not affect the tutorial. The currency symbol in a plan can be changed via *Plan | Plan Options | Currency* tab.

Create a resource to handle cost

Before you can assign a cost risk you must create a resource that will handle the cost.

- *Plan | Resources*.
- In the first free cell under *ID* type *COST*.
- Change the cost of *COST* to 1.
- Change the *Type* to *Expenses*.
- Change the *Default Loading* to *Spread*.

Why did you need to change the loading from normal to spread?

With a *Normal* loading the remaining units of resource assigned to a task proportional to the task duration. In this case the costs are not proportional to the task duration so the loading required is *Spread*.

- Close the *Resources* dialog.

You have now created a resource called *COST*. Every unit of the resource costs one dollar. So if you want a task to cost \$300 you simply assign 300 units of the resource *COST* to the task.

Assign 300 units of *COST* to 'Remove topsoil'

- Click on the task 'Remove topsoil' and in the *Task Details* section at the bottom of the screen click on the *Resources* tab.
- Select the first cell below *ID*.
- Select *COST - New Resource*.
- Select the cell below *Units | Remaining*.
- Enter 300.

Add a column to display task cost

So you can see the cost of each task we will add a cost column.

- *Format | Columns*.
- Add the column '*Cost (Total)*'
- Check the check box labeled *Total this column*.
- Check the check box labeled *Hide Zeros*.
- Check the check box to *Show Total Line*.
- Click *OK*.

You should now see a new column displaying the cost of the task 'Remove topsoil' and at the bottom of the column the total.

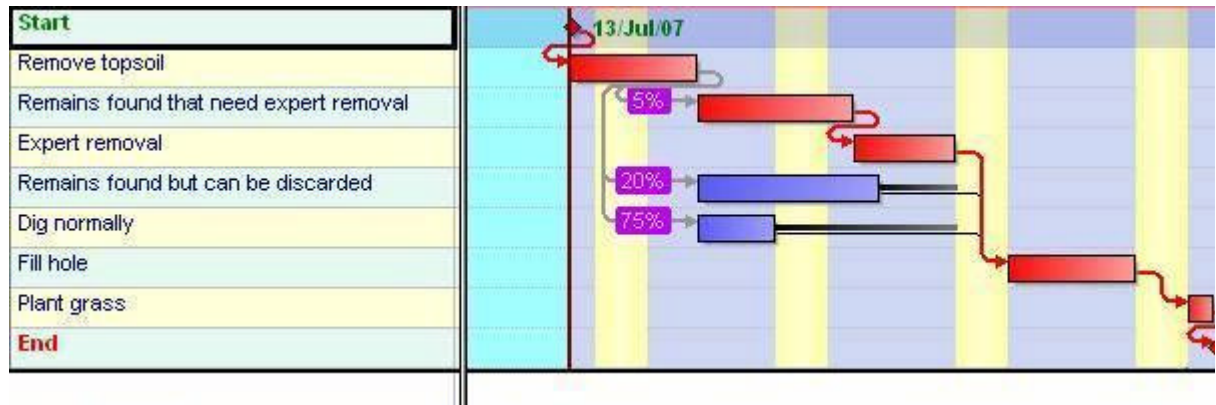
Assign the rest of the costs

- Assign the following units of *COST*:

Task	Units
Remains found that need expert removal	300
Expert removal	1000
Remains found but can be discarded	800
Dig normally	400
Fill hole	200

- Save the plan.

Your plan should look similar to this when you have finished:



Run the analysis

At this point it is a good idea to run the risk analysis to see if the project is doing what we expect.

Before we run the analysis try and answer the following question:

1. How will the total cost vary for each iteration?
2. What is the maximum total cost that any one iteration will produce?
3. What is the minimum total cost that any one iteration will produce?
4. What will the project cost distribution look like?

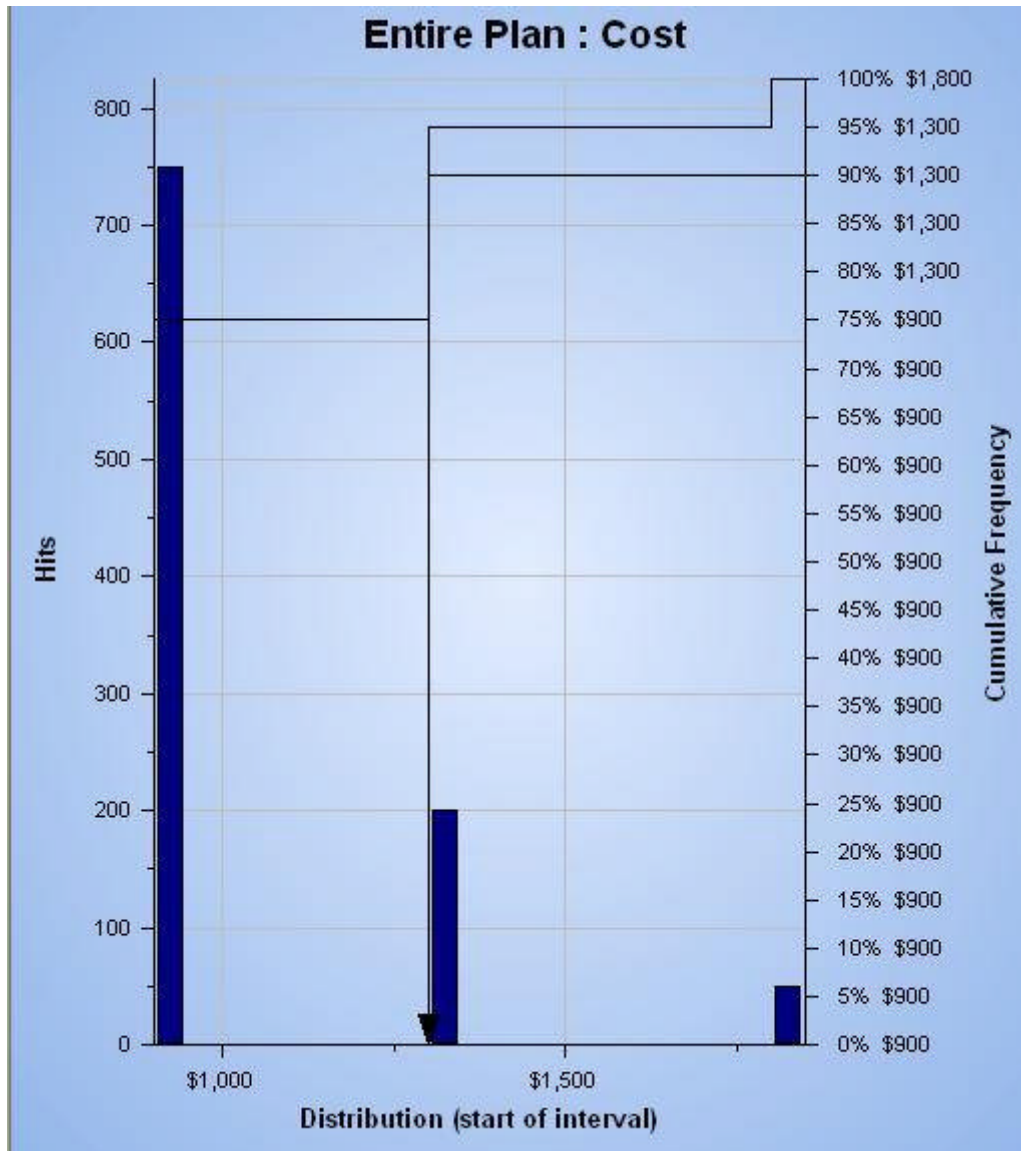
Ok, let's run the risk analysis.

- Adjust the Gantt Chart so you can see most of your tasks.
- *Risk | Run Risk Analysis.*
- Click *Analyze.*
- Click the *Step* button. Notice the total cost of the project varying for each step.
- Click *Complete* to zoom through the rest of the analysis.

At the end of the analysis the *Finish Date* distribution will be displayed as the default. You have already looked at this and we are now interested in the *Cost Distribution*.

- Click on the *Costs* tab to display the cost distribution.

The cost distribution will look something like this:



During the risk analysis the cost of the plan varies depending on which probabilistic branch is occurs. As there are 3 branches there are 3 project costs.

Great! We have now applied some cost risk to our plan.

Next we will look at applying risk to the task cost.

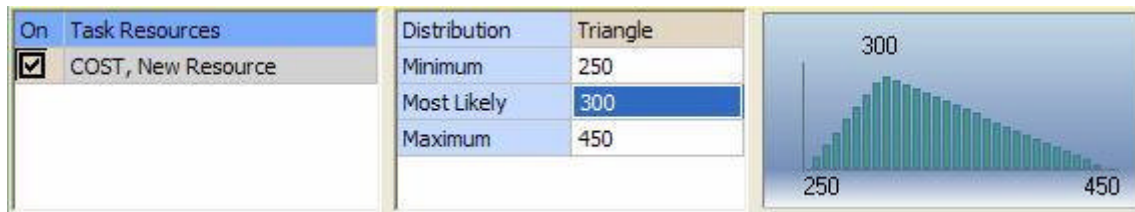
2.4 Adding uncertainty to task cost


The costs you have assigned to the tasks are best estimates. Similar tasks run in the past can give you an indication of the cost variation that can occur. For example the cost of removing the topsoil is estimated to be \$300. But let's say experience shows that this cost can range from \$250 to \$450. We would therefore like to model this cost uncertainty in the project.

Add a distribution to the cost of 'Remove topsoil'

- If the *Distribution Graph* dialog is open then close it.
- Right-click on 'Remove topsoil' and choose *Resource Risk* from the pop up menu.
- Check the check box labeled *On for the Resource 'COST, New Resource'* and the default distribution is displayed.
- Enter *Minimum*, *Most Likely* and *Maximum* values of 250, 300 and 450 respectively.

The dialog should look like this:



 You will notice that the distribution for the cost is skewed. This often happens with cost and duration risks. The reason is that there are not that many things that can cause a task to be completed more quickly or more cheaply than expected. But there are plenty of things that can delay a task. Fortunately these adverse things are usually more unlikely and the thin tail of the triangular distribution models this well.

Add the rest of the task cost uncertainty

- Add the following risk distributions to the resource assignments:

Task	Distribution	minimum	most likely	maximum
Remains found that need expert removal	Triangular	225	300	450
Expert removal	Triangular	800	1000	1400
Remains found but can be discarded	Triangular	700	800	1000
Dig normally	Triangular	300	400	550
Fill hole	Triangular	175	200	250

Run the analysis

Yes you have guessed it! This is another good time to run the risk analysis.

And for your enjoyment(!) here are a few questions:

1. How will the cost of each task vary for each iteration?
2. What will the project cost distribution look like?

These questions are a lot harder now as there are many more risks being analyzed in the project. This is why we get the computer to do the work. So let's run the risk analysis.

- Adjust the Gantt Chart so you can see most of your tasks.
- *Risk | Run Risk Analysis.*
- Click *Analyze*.
- Now click the *Step* button.

Here is something to watch out for as you continue click the step button:

1. Notice the total cost of the project varying.
 2. Notice the cost of individual tasks varying.
- Click *Complete* to whizz through the rest of the analysis.

Excellent! You have now added probabilistic branching, task costs and task cost risk.

Next we will look at handling the site management cost of \$100 per day.

2.5 Hammocks

Every day on site costs us \$100.

A good way of handling costs that are not attributable to any one task is to use a hammock task. The duration of hammock stretches automatically as the plan changes. It is called a hammock because it is stretched between two points in a plan which apparently is a bit like a hammock stretched between two trees (you may have to stand 10 feet from the computer and squint to see the resemblance!).

Create a hammock task

- Create a new task at the end of the project plan with a description 'Site management'
- Click on the task and choose the *General* tab in the *Task Details*.
- Change *Type* to *Hammock*.

You will see that the hammock stretches from the start to the finish of the project and its duration is automatically calculated for you.

Assign a cost to the hammock

- Click on the hammock task and choose *Resources* tab in the *Task Details*.
- Select the first cell below *ID*.
- Enter COST - New Resource.
- Select the cell below *Units | Remaining*.
- Enter 100.

Is there a problem?

Yes !!

You will see that the total cost for the task 'Site Management' is being displayed as \$100. This is not what we want. The site management cost is \$100 **per** day, i.e. the cost is dependent on the duration.

You may remember that you had the opposite problem earlier and fixed by changing the loading of the resource COST on the assignments to spread.

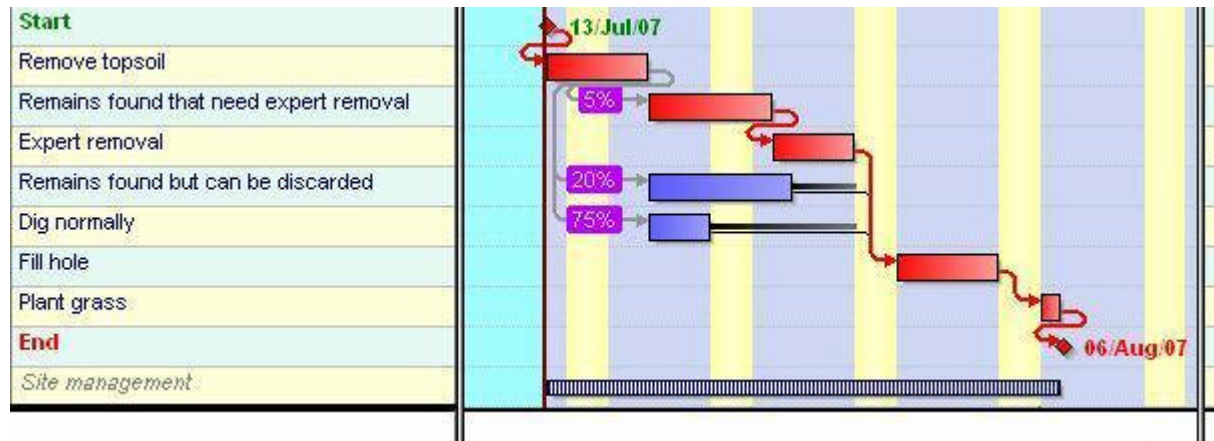
So you need to change the loading on the assignment from the default of Spread to Normal.

Change resource assignment loading

Change the resource assignment on 'Site management'

- Click on the task 'Site management' and choose *Resources* tab in the *Task Details*.
- Change the *Loading* from *Spread* to *Normal*.
- Save your plan.

Now that looks better! Your plan should look like this:



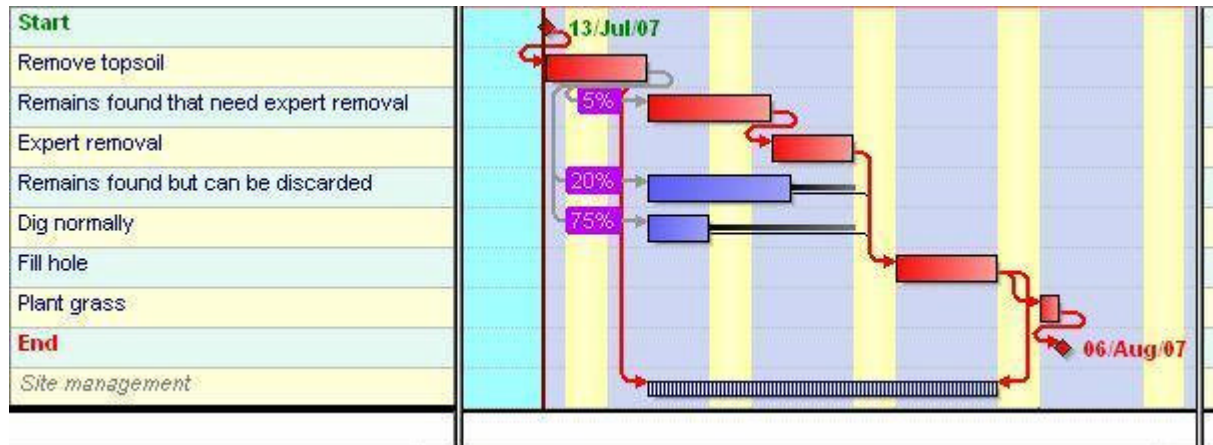
We have some more accurate information: the Site management cost is only needed from the finish of the task 'Remove topsoil' to the finish of the task 'Fill hole'.

This can be modeled by linking the hammock into these tasks.

Link up the hammock

- Link from the finish of the task 'Remove topsoil' to the start of the hammock.
- Link from the finish of the task 'Fill hole' to the finish of the hammock.

The hammock now stretches between the required parts of the plan:



Run the analysis

What again? Yes again - it does not take long and it's fun!

Only one question this time:

1. How will the cost of the hammock vary for each iteration?

Remember the cost of the hammock is directly related to its duration and its duration is dependent on how far the hammock is stretched.

- Risk | Run Risk Analysis.
- Click Analyze.
- Now click the Step button.

As you step through you will see the duration and hence the cost of the hammock change.

- Click Complete to zip through the rest of the analysis. Have a look at the Cost distribution that is displayed.

As a final step let's add some duration risks to the tasks using Quick Risk.

Run a Quick Risk

- Close the Distribution Graph dialog.
- Risk | Duration Quick Risk.
- Select All tasks in the plan.
- Ensure the checkbox to Overwrite existing estimates and duration distribution notes is checked. This will remove any existing data before adding the current data.
- Select Triangle distribution.
- Change Minimum to 50%.
- Change Most likely to 100% (this may already be this value).
- Change Maximum to 200%.
- Click OK

These percentages have quite a wide spread but we want to easily see the impact.

Duration Quick Risk applies a risk to the task durations in the project (except the milestones, which are always zero duration, and the hammock whose duration is dependent on other tasks).

Run the Risk Analysis one more time and watch how the plan varies for each iteration.

Conclusion

Cost risks can be modeled using resources that are independent and dependent on the task duration.

Hammocks can be used to measure the duration between any two points in a plan and can have costs associated with them.

Good work! Next let's look at correlating risks.

2.6 Correlation

Looking at previous holes that have been dug and filled the following observations have been noted:

1. When it takes a long time to remove the topsoil, it also tends to take a long time to fill the hole.
2. There is a positive correlation between the cost of filling the hole and how much time it takes.

These observations can be modeled in Primavera Risk Analysis using correlation. Using correlation prevents the risk analysis modeling unrealistic situations.

Add a correlation between task durations

- If the *Distribution Graph* dialog is open then close it.
- *Risk | Correlation*.

You will see a list of the duration and resource risks in your project.

- Find and click on the duration distribution for the 'Remove topsoil' task - it may already be selected.
- Click *Select Distributions*.
- Find and selected the duration distribution for the 'Fill hole' task.
- Click on *Add >>*
- Click *OK*.

We estimate there is a 75% correlation between the durations.

- Enter 75% as the *Coefficient*.

You will see the correlation graph in the bottom right hand corner of the *Risk Summary and Correlation* dialog. This gives you an indication of how correlated the durations are. You can see the minimum and maximum durations displayed on the axes of the correlation graph.

The *Risk Summary and Correlation* dialog should look something like this:

Risk Summary and Correlation

Type	Description	Details	On	Correlation
branch	0020 - Remove topsoil	0090[20%];0070[...	Y	
duration	0020 - Remove topsoil	Triangle(2;3;6)	Y	(75%) durat
duration	0030 - Dig normally	Triangle(2;3;6)	Y	
duration	0040 - Fill hole	Triangle(3;5;10)	Y	(75%) durat
duration	0050 - Plant grass	Triangle(1;1;2)	Y	
duration	0070 - Remains found th...	Triangle(2;4;8)	Y	
duration	0080 - Expert Removal	Triangle(2;4;8)	Y	
duration	0090 - Remains found b...	Triangle(3;5;10)	Y	
resource	0040 - COST[200], New ...	Triangle(175;200;...	Y	

☒ On Delete

Correlation

Select Distributions...

Correlated To	Coefficient
duration: 0040 - Fill hole	75%

Sample Scatter Plot:
 Pearson's: 68% Spearman's: 70%

The scatter plot shows a positive correlation between two durations. The x-axis ranges from 2 to 6, and the y-axis ranges from 3 to 10. Data points are represented by yellow diamonds.

Help OK Cancel

Add correlation between task duration and task cost

- Click on the duration risk for the 'Fill hole' task in the top panel.

As you have already correlated the duration of 'Fill hole' it will be displayed in the bottom panel.

- Click *Select Distributions*.
- Under *Available Distributions* find and click on the resource risk for the 'Fill hole' task. It will be listed as 'resource: 0040 - COST[200], New Resource'. 0040 refers to the task ID of the 'Fill Hole' task.
- Click on *Add >>*
- Click *OK*.

It's estimated that there is a 95% correlation between the task cost and its duration.

- Enter 95% as the *Coefficient*.

Risk Summary and Correlation

Type	Description	Details	On	Correlation
branch	0020 - Remove topsoil	0090[20%];0070[...]	Y	
duration	0020 - Remove topsoil	Triangle(2;3;6)	Y	(75%) durat
duration	0030 - Dig normally	Triangle(2;3;6)	Y	
duration	0040 - Fill hole	Triangle(3;5;10)	Y	(95%) resou
duration	0050 - Plant grass	Triangle(1;1;2)	Y	
duration	0070 - Remains found th...	Triangle(2;4;8)	Y	
duration	0080 - Expert Removal	Triangle(2;4;8)	Y	
duration	0090 - Remains found b...	Triangle(3;5;10)	Y	
resource	0040 - COST[200], New ...	Triangle(175;200;...	Y	(95%) durat

☒ On Delete

Details Notes **Correlation**

Select Distributions...

Correlated To	Coefficient
duration: 0020 - Remove topsoil	75%
resource: 0040 - COST[200], New Resource	95%

Sample Scatter Plot:
Pearson's: 93% Spearman's: 91%

Help OK Cancel

That's it. It's straightforward to add correlations.

To see the effect of the correlation you can run the risk analysis.

Run the analysis

- Click *OK* to close the *Risk and Correlation Summary* dialog.
- Risk* | *Run Risk Analysis*.

- Click *Analyze*.
- Now click the *Step* button.

As you step through you will see:

1. The duration of the task 'Fill hole' tends to follow the duration of the task 'Remove topsoil'.
2. The task 'Fill hole' has a high cost when its duration is long and a low cost when its duration is short.

Conclusion

Adding correlation helps you model risks more accurately.

Congratulations!!

This completes the second part of the risk tutorial, we hope you have found it useful and informative.

The tutorials do not cover all the risk features. Other techniques such as task existence, probabilistic calendars, sensitivity and schedule sensitivity index may be of interest to you.

To find out more about creating plans directly in Primavera Risk Analysis see the **Planning Tutorial ('Planning Tutorial - Introduction' in the on-line documentation)**.

To find out more about risk please use the contents page and index in the help system or contact us.

2.7 PDF Documentation and Printing Help

PDF Documentation

Some of the on-line help (e.g. tutorials) can be found in the *Documentation* folder that is created when the Primavera Risk Analysis software is installed. The documentation is saved in the Adobe PDF format.

The default installation folder for the documentation is:

C:\Program Files\Oracle\Primavera Risk Analysis\Documentation

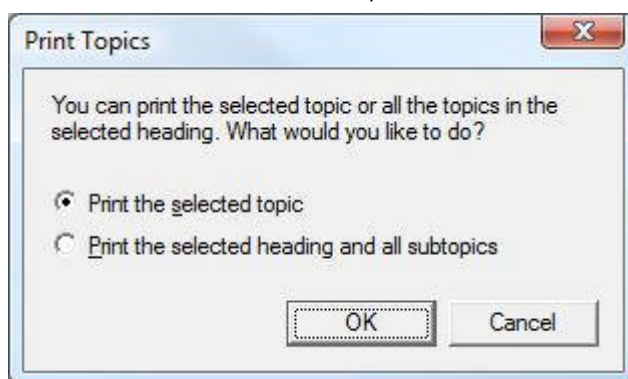
Printing an individual help topic

- ✎ After printing a help topic, Windows can sometimes freeze the help file. If this occurs, right-click on the Primavera Risk Analysis help application icon in Windows Start menu Taskbar (usually located at the bottom of the screen) and choose *Restore*.

1. Select the required topic.
2. Click on the *Print* button.



3. Choose *Print the selected topic*.



Printing a chapter of the help

- ✎ After printing a chapter of the help, Windows can sometimes freeze the help file. If this occurs right-click on the Primavera Risk Analysis help application icon in Windows Start menu Taskbar (usually located at the bottom of the screen) and choose *Restore*.

1. Select the required chapter.
2. Click on the *Print* button
3. Choose *Print the selected heading and all the subtopics*.

The example below has the Risk Tutorial - Part 1 selected. Clicking on the *Print* button and selecting *Print the selected heading and all the subtopics* will print out the whole of the 'Risk Tutorial - Part 1'.

