



NaviPlan Standard Online/Offline

Monte Carlo Sensitivity Analysis Self-Study Guide

USA version 11.2

EISI, Winnipeg

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Monte Carlo Sensitivity Analysis

The NaviPlan Standard Monte Carlo Sensitivity Analysis Self-Study Guide was created using NaviPlan Standard Offline with the Ibbotson Asset Allocation option. This option allows you to use actual Ibbotson return rates in NaviPlan's calculations.

The exercises in this module are based on a version of NaviPlan Standard Offline that includes the Ibbotson Asset Allocation option, which means that the asset allocation settings are set up for you. If your version of NaviPlan Standard Offline does not include the Ibbotson Asset Allocation option, you can modify the data.

Learning objectives

This module will enable you to

- Determine the probability of success of your clients' financial plan
 - Identify the purpose of Monte Carlo and scenario probability analyses
 - Compare the two analysis methods in NaviPlan: scenario probability vs. *Monte Carlo Sensitivity Analysis*
 - Identify Monte Carlo settings options
 - Understand the effects of deficit coverage
 - Analyze the results of a *Monte Carlo Sensitivity Analysis*

Learning tools

This module includes some practice exercises. We recommend that you use the Nick and Lisa Brown (Brown, Nick and Lisa.nps) client file in the data folder of your installation of NaviPlan Standard Offline (the default path is C:\Program Files\EISI\Data, but you may have installed it elsewhere). It will be available when you run NaviPlan Standard Offline, as well as on the central server if you prefer to work in the online application.

Note: If you are using a version of NaviPlan Offline without the Ibbotson Asset Allocation option, or if you are using NaviPlan Online, there will be some differences between the guide and your version of NaviPlan.

Hint: In NaviPlan Standard Offline, to find the location of your data directory, go to the **User Preferences** menu – **System Settings** selection – **User Preferences - System Settings** dialog box – **File Locations** tab.

Identify the purpose and key concepts of Monte Carlo

Purpose of Monte Carlo

What is Monte Carlo?

Monte Carlo is a simulation that you can use to determine the effect of market and longevity risk on a completed plan. It is intended to perform a risk analysis.

In NaviPlan, the term Monte Carlo refers to two similar yet distinct risk analysis methods: scenario probability and the *Monte Carlo Sensitivity Analysis*. Each analysis method uses the same calculation engine, however, results are presented differently. The *Monte Carlo Sensitivity Analysis* method assigns a pass or fail rating to a number of trials that exceed or fail to meet a particular cash flow threshold, whereas the scenario probability method illustrates the percentage of one or more goals that can be covered.

Hint: For a demonstration of the scenario probability and *Monte Carlo Sensitivity Analysis* methods, see the [Monte Carlo Help Video Clip at support.eisi.com](https://support.eisi.com)

A plan is based on the static assumptions you entered (e.g., fixed return rates and fixed life expectancies).

In reality these variables will not be static—market fluctuations will affect overall asset performance, and uncertain life expectancies may cause clients to outlive resources or they may not achieve the accumulation needed if they die early.

Monte Carlo helps assess the effect of risks on the plan by

- Randomizing return rates – this helps analyze the risk of market fluctuations (uses the standard deviation entered along with the account's return rate)
- Randomizing the life expectancy – this helps analyze the risk of dying too soon or outliving assets (uses the life expectancy defined in the plan or scenario)

Note: When using the scenario probability method, life expectancy is not randomized.

By randomizing these variables, Monte Carlo can help determine the effect of risk on a plan. You can answer questions such as

- Does the clients' plan provide enough flexibility to ensure goal success even if markets and life outcomes change?
- How well will the plan perform in situations where return rates and life expectancies are lower or higher than expected?

Understand the effects of standard deviation on assets

The figure below illustrates the effects of standard deviation on a Monte Carlo analysis.

Asset		Rate of Return	Standard Deviation	
Nick's 401(k)		6.00%	0.00%	
Goal	Success Rate	10th Percentile	50th Percentile	90th Percentile
Retirement Goal	100.00%	\$755,835	\$908,141	\$973,822

Asset		Rate of Return	Standard Deviation	
Nick's 401(k)		6.00%	10.00%	
Goal	Success Rate	10th Percentile	50th Percentile	90th Percentile
Retirement Goal	80.00%	(\$268,775)	\$836,835	\$1,925,527

The first plan has an account with a rate of return of 6% and standard deviation of 0%.

When you run a Monte Carlo analysis, notice that the change to the projected value between each percentile is small. This is because every iteration used a static 6% rate of return.

The second plan has an account with the same 6% rate of return but a 10% standard deviation.

Now the projected range of net worth has changed, and the differences between each percentile is much greater.

Interpretation of percentiles

- The 10th percentile reports that 10% of the results are lower than -\$250,000, or 90% of the results were above -\$250,000
- The 50th percentile reports that 50% of the results are lower than \$800,000, or 50% of results were above \$800,000
- The 90th percentile reports that 90% of the results are lower than \$1,900,000, or only 10% of results were above \$1,900,000

View the clients' standard deviation

On the *Plan Management* section – *Asset Allocation* category – *Profile* page, you can view the asset mix recommended for the clients' investor profile and the expected return rate and standard deviation associated with that profile. During Monte Carlo analyses, the standard deviation affects the range of return rates for the related account. The standard deviation is determined by asset class weightings information. If you are using NaviPlan Standard with the Ibbotson Asset Allocation option, the standard deviation cannot be edited.

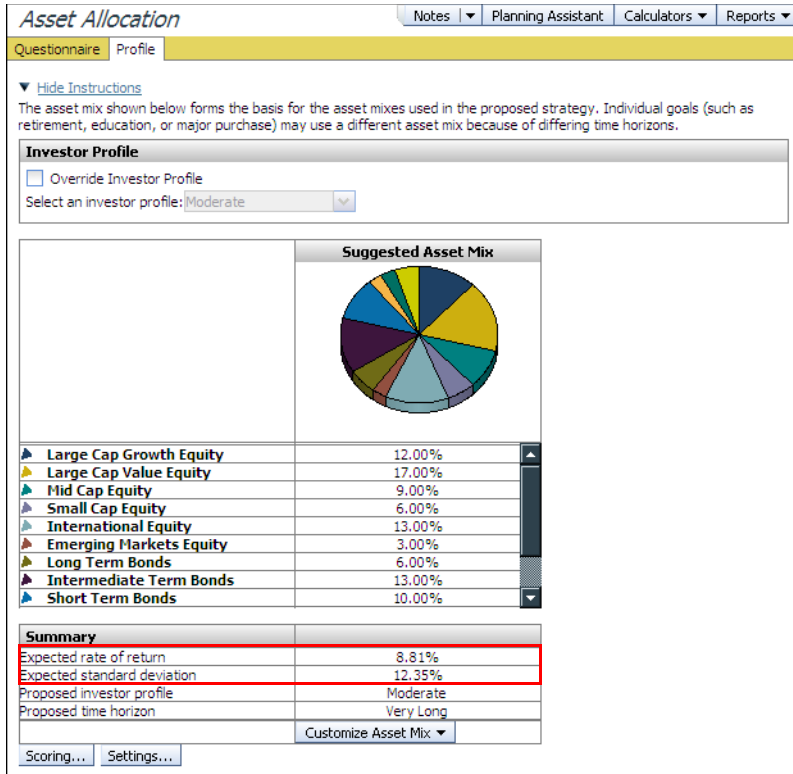


Figure 1: Plan Management section – Asset Allocation category – Profile page

Compare the scenario probability and Monte Carlo Sensitivity Analysis methods

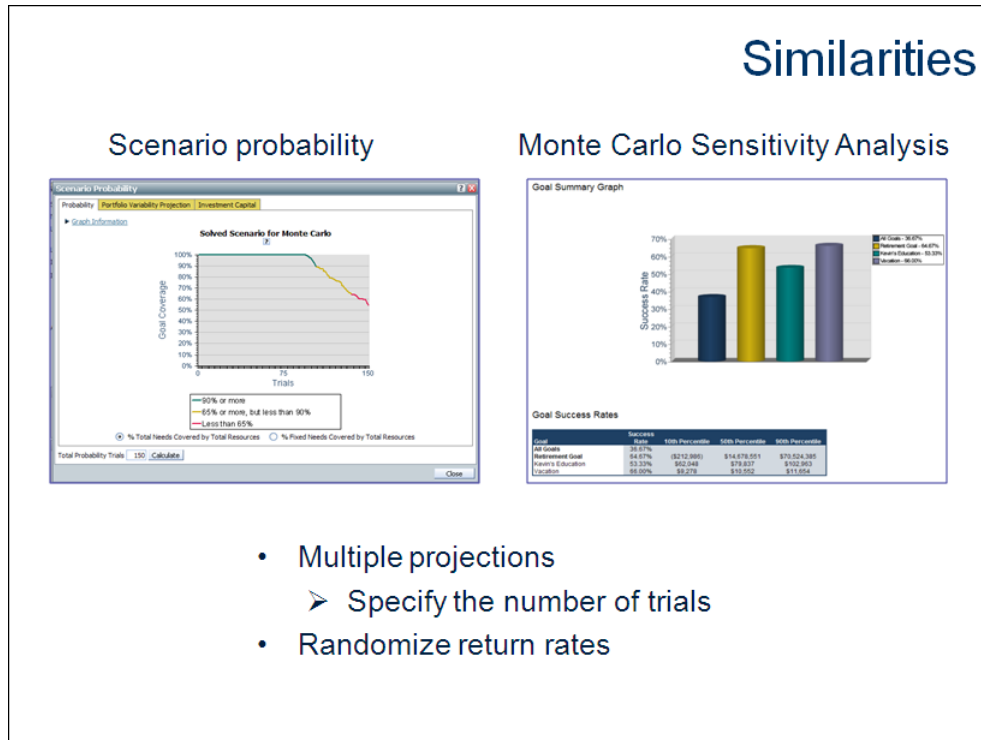


Figure 2: Similarities between the scenario probability and Monte Carlo analysis methods

In NaviPlan Standard, the scenario probability and *Monte Carlo Sensitivity Analysis* methods have the following similarities:

- Multiple projections – The plan’s results are projected a number of times (these projections are also referred to as trials or iterations). In a trial, NaviPlan runs one set of plan assumptions for life expectancy, varies the return rates, and then records whether the trial is a success or a failure. For each additional trial, NaviPlan runs the analysis again using a different set of variances.
- Specify the number of trials – You can specify the number of trials to run from 100 to 1,000.
- Randomize the return rates – During each trial, return rates in the plan are randomized on an annual basis. The randomizations are based on the standard deviation of individual accounts.
- Asset redemptions are automatic – During each trial, NaviPlan draws down resources as needed to cover the clients’ goals.

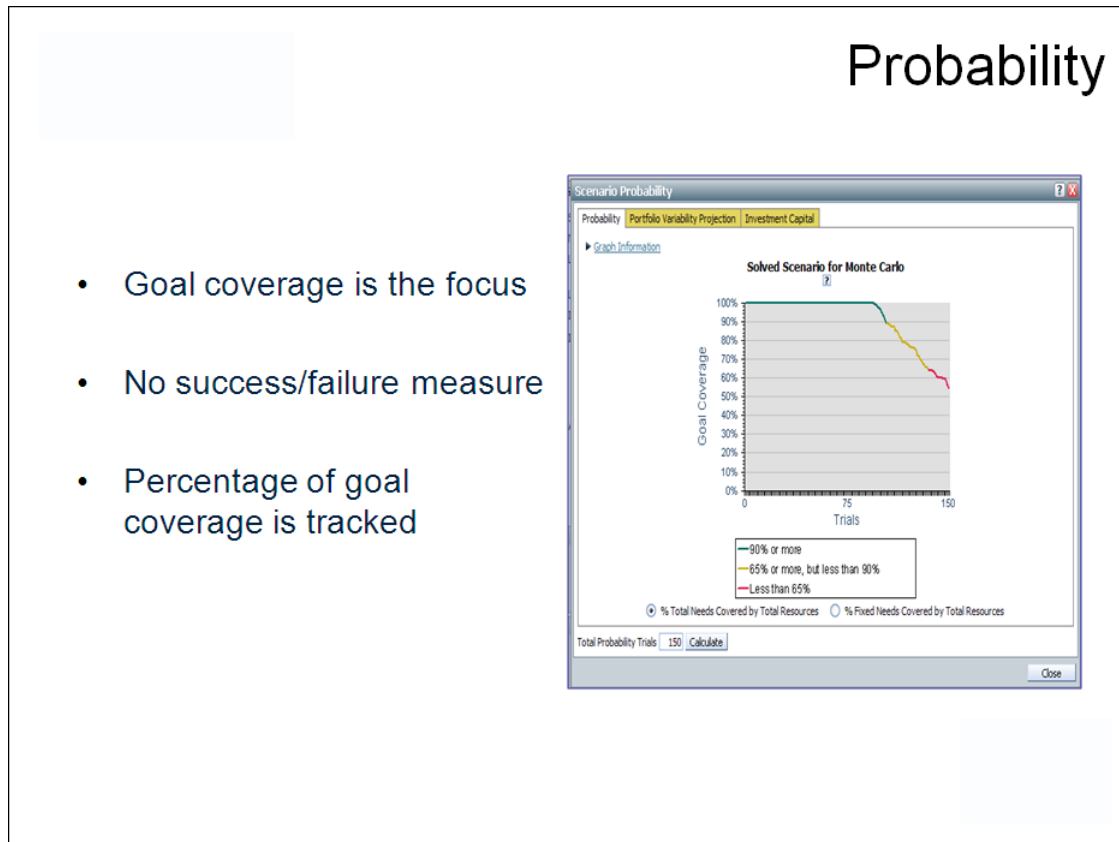


Figure 3: Scenario Probability dialog box (showing projected goal coverage)

The following details are unique to the scenario probability analysis method:

- NaviPlan focuses on goal coverage. Success is based on the clients' overall ability to meet the needs of the associated goal. NaviPlan considers the percentage of each goal that is covered and tracks this percentage across all trials.
For example, NaviPlan might report that out of 664 trials, 430 have a goal coverage of 90% or higher.
- No measure of success or failure is provided.
- Life expectancy is not randomized.
- The scenario probability method is meant for scenario risk analysis to determine the most appropriate scenario to recommend to your clients.

The following details are unique to the *Monte Carlo Sensitivity Analysis*:

- NaviPlan focuses on the cash flow results of the goal or plan. Using cash flow to determine success rather than terminal net worth allows you to emphasize the unpredictability and variability of financial markets.

For example, if your clients are projected to have millions of dollars at the end of the plan, but throughout the years, severe cash flow deficits occur due to bear markets, NaviPlan considers the plan as failed since the clients have been exposed to too much risk.

- Tolerance for cash flow deficits determines the threshold of plan success. For each trial, NaviPlan measures projected plan deficits against the clients’ allowable deficit tolerance.
- NaviPlan determines the plan success rating by calculating the percentage of successful trials. A trial is marked as successful when the cash flow deficit (if any) does not exceed the clients’ allowable deficit tolerance.

For example, if 300 of 645 trials show no significant deficits, NaviPlan reports a 46% success rate.

- Life expectancy randomization is optional.
- The *Monte Carlo Sensitivity Analysis* method is meant for plan risk analysis after the plan has been completed.

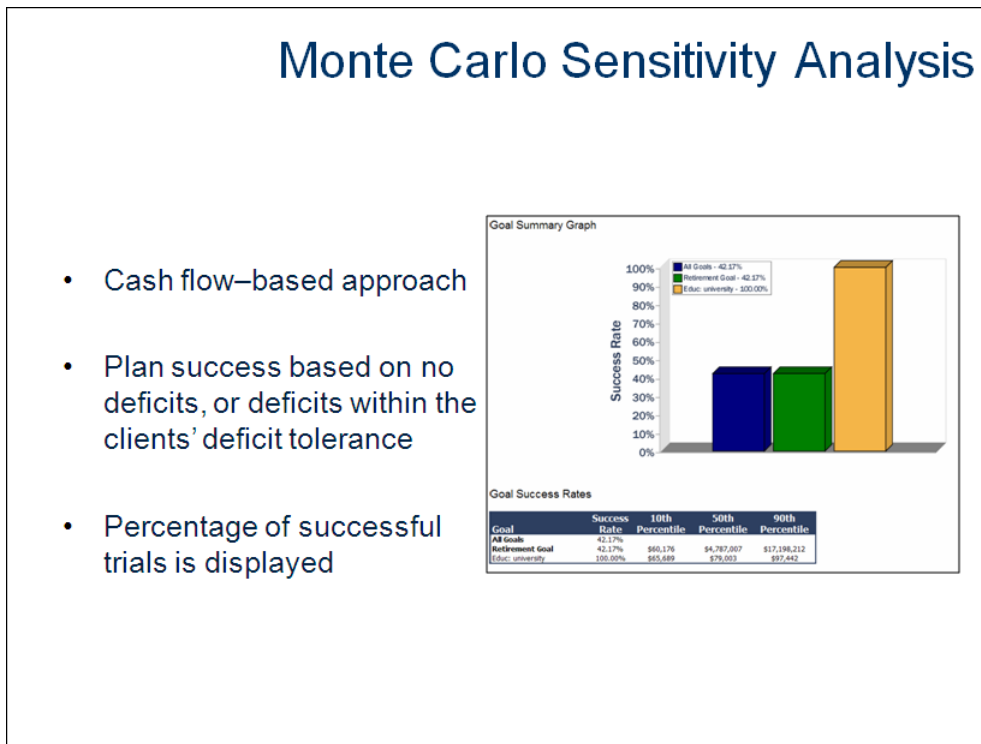


Figure 4: Monte Carlo Sensitivity Analysis results (showing goal success rates)

Identify the settings options available for a Monte Carlo Sensitivity Analysis

The options you set for the *Monte Carlo Sensitivity Analysis* determine the criteria for success for each projection of the clients' plan.

Activate Monte Carlo

In order to access the Monte Carlo feature, it must be selected as one of the modules to be included in the plan.

1. Go to the **Plan Management** section – **Modules** category – **Modules** page, and then click the **Select Modules** button. The *Select Modules* dialog box opens.

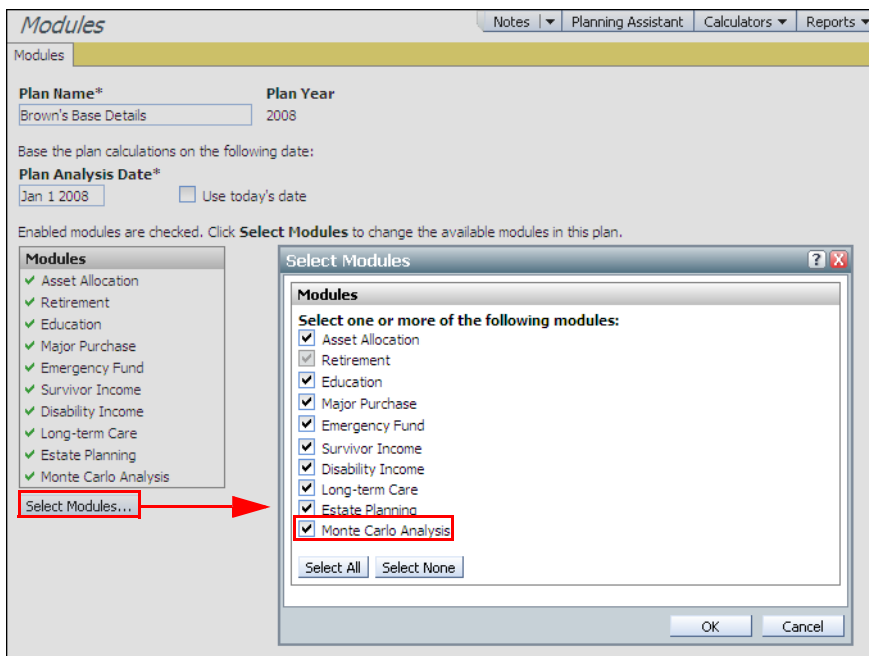


Figure 5: Plan Management section – Modules category – Modules page – Select Modules dialog box

2. Select the **Monte Carlo Analysis** check box, and then click **OK**.

Note: Monte Carlo is available in Level 2 and Level 3 Plans.

Access the Monte Carlo Sensitivity Analysis

There are two ways to access the *Monte Carlo Sensitivity Analysis*:

- As a stand-alone graph (*Reports* menu – *Monte Carlo* – *Monte Carlo*)
- As a part of a client report (*Results* section – *Client Reports* category – *Client Report* page – *Financial Needs Summary* report or *Financial Needs Analysis* report)

Access scenario probability

You can determine the probability of any scenario by clicking the *Scenario Probability* link beside the *Goal Coverage* graph.

To determine the scenario probability of the retirement goal

1. Go to the **Goals** section – **Retirement** category – **Scenarios** page – **Objectives** tab.
2. For one of the displayed scenarios, under *Goal Coverage*, click the **Scenario Probability** link. The *Scenario Probability Details* dialog box opens.

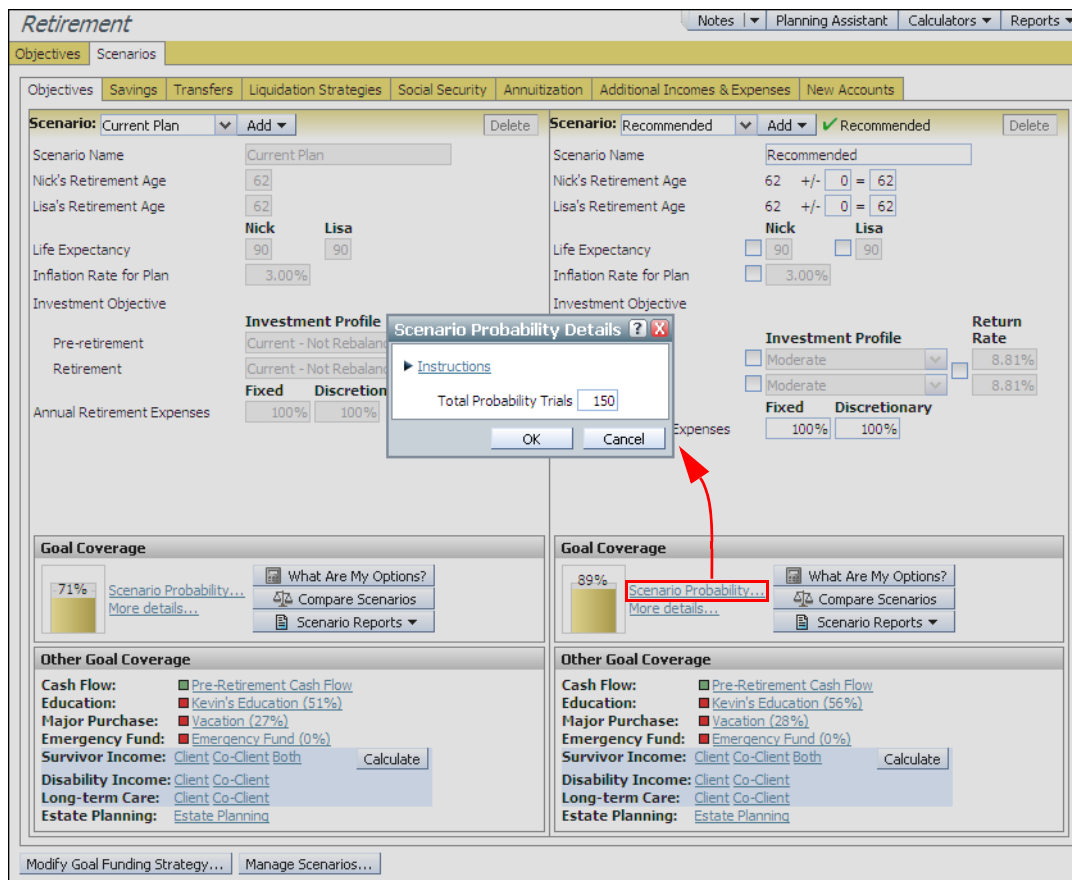


Figure 6: Goals section – Retirement category – Scenarios page – Objectives tab – Scenario Probability link – Scenario Probability Details dialog box

3. In the *Total Probability Trials* field, enter the number of scenario probability trials you want NaviPlan to run.

Note: Entering more trials results in a more accurate probability distribution but will take more time to process. The minimum number of trials you can run is 100.

After NaviPlan finishes running the trials, the dialog box appears as *Scenario Probability* dialog box and opens to the *Probability* tab. The *Portfolio Variability Projection* and *Investment Capital* tabs are also available. The tabs are used as follows:

- *Probability* tab – A *Plan Probability* graph appears and displays the goal coverage for each scenario trial. You can compare goal coverage for fixed or total needs by selecting either *% Total Needs Covered by Total Resources* or *% Fixed Needs Covered by Total Resources*.
- *Portfolio Variability Projection* tab – A *Portfolio Variability Projection* graph appears and illustrates the assumed rate of return for each year in the plan, and displays the 10th percentile, the 50th percentile, and the 90th percentile. You can display results according to the compound rate of return or the annual rate of return.
- *Investment Capital* tab – An *Investment Capital* graph appears and illustrates the ending net worth value for each year in the plan, and displays the 10th percentile, the 50th percentile, and the 90th percentile.

4. Click **Close**. The *Scenario Probability* dialog box closes.

Assign Monte Carlo Sensitivity Analysis settings

The *Assign Settings* dialog box allows you to define the assumptions upon which the *Monte Carlo Sensitivity Analysis* will be based. The settings entered in this dialog box determine the criteria for passing or failing each generated trial.

Note: The *Monte Carlo Sensitivity Analysis* assumptions and results are used for reporting purposes only and are not implemented in the plan.

To assign Monte Carlo Sensitivity Analysis settings

1. Go to the **Reports** menu, and then select **Monte Carlo – Monte Carlo**. The *Assign Settings* dialog box opens.

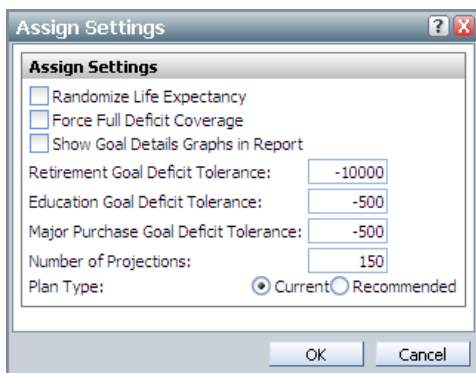


Figure 7: Reports menu – Monte Carlo – Monte Carlo – Assign Settings dialog box

2. To randomly select life expectancies for each iteration of the simulation, select the **Randomize Life Expectancy** check box. Monte Carlo theory suggests that using random life expectancies results in more realistic simulations. Life expectancies are based on a GAM 83 table (1983 Group Annuity Mortality table).
3. To automatically redeem available assets throughout the entire plan (not just the retirement period, which is the default) to cover annual cash flow deficits, select the **Force Full Deficit Coverage** check box.

Selecting this check box does not change the plan in any way, but may result in a higher number of failures. For example, if assets funding retirement are depleted to cover deficits in the pre-retirement period, the likelihood that deficits occur during retirement increases. If a deficit is greater than the success tolerance, a failure is triggered. By default, any available non-qualified assets owned by the client or co-client are used to cover these deficits.

4. To include graphs that show the details about retirement, major purchase, and education goals at the end of the report, select the **Show Goal Details Graphs in Report** check box. Selecting this check box is recommended if you want to see how individual projections are distributed or if you are interested in seeing the highest or lowest results that occurred during the *Monte Carlo Sensitivity Analysis* simulation.
5. In the *Retirement Goal Deficit Tolerance*, *Education Goal Deficit Tolerance*, and *Major Purchase Goal Deficit Tolerance* fields, enter the deficit tolerance your clients feel comfortable with for each goal type, expressed as a negative number.
6. In the *Number of Projections* field, enter the number of trials that you want NaviPlan to run. The number must be between 100 and 1,000. The higher the number of trials, the longer NaviPlan takes to complete the simulation. Although the default is 150 trials, it is not usually a representative sample of all possible outcomes.
7. Select either the **Current** or **Recommended** plan type to identify which plan or scenario is to be analyzed.
 - *Current* – Analyzes the clients' current financial situation, identified as the *Current Plan* on the *Scenarios* pages in the *Goals* section
 - *Recommended* – Analyzes the scenarios marked as *Recommended* on the *Scenarios* pages in the *Goals* section

Note: If possible, ensure that all *Recommended* scenarios have 100% goal coverage. If scenarios fail to meet that level of coverage, a large percentage of projections are likely to fail.

8. Click **OK**. The *Monte Carlo* dialog box opens and displays the results of the *Monte Carlo Sensitivity Analysis*.

Appreciate the effects of deficit coverage

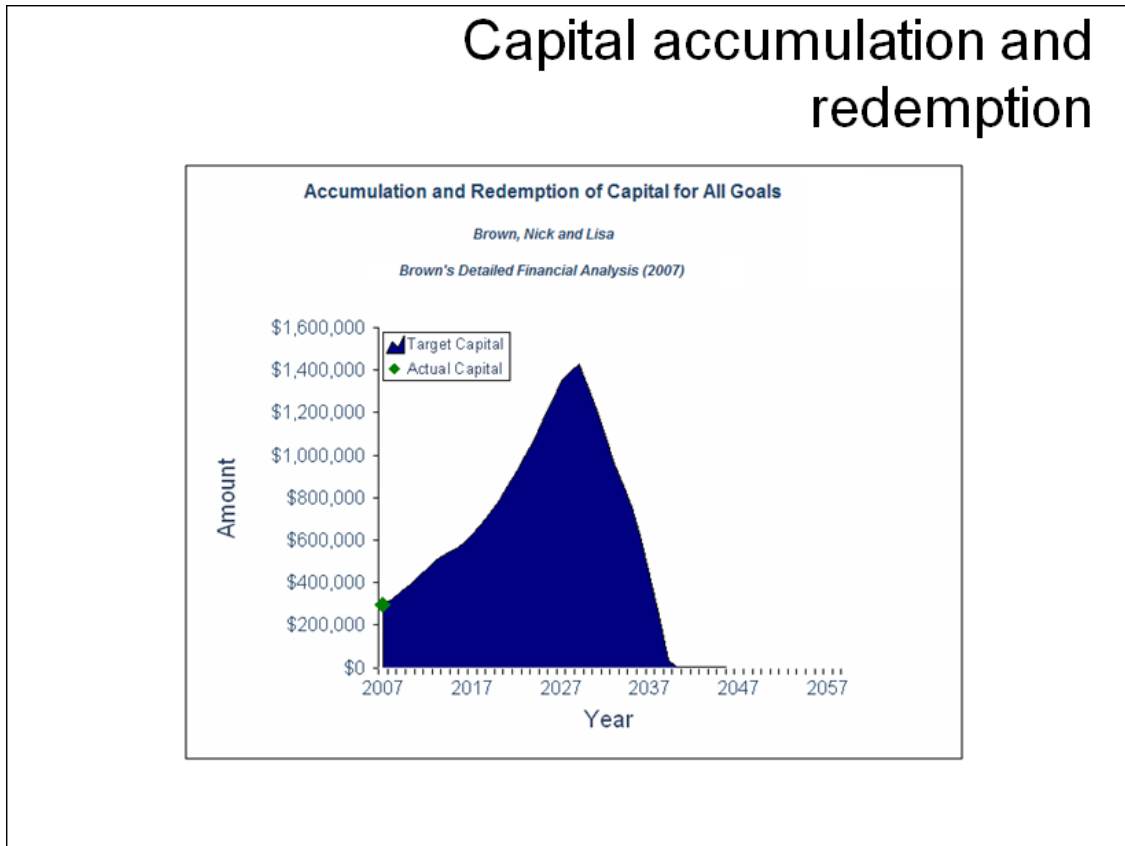


Figure 8: Accumulation and Redemption of Capital for All Goals graph (showing depletion of assets due to deficits in the plan)

The graph above shows the accumulation and redemption of assets over time with assets depleting completely after 2037. Pre-retirement expenses are the likely cause of these deficits.

Force Full Deficit Coverage invokes NaviPlan's automatic asset redemption where assets are redeemed throughout the entire plan period (not just the retirement period) to cover annual cash flow deficits.

Selecting this option does not change the plan in any way, but may result in a higher number of failures.

For example, if assets funding retirement are depleted to cover deficits in the pre-retirement period, the likelihood that deficits occur during retirement increases.

Before deciding whether to run the *Monte Carlo Sensitivity Analysis* with *Force Full Deficit Coverage* selected, it is important to understand how deficit coverage works, and how it can influence the analysis results.

Asset availability when *Force Full Deficit Coverage* is selected:

- Any available investment assets owned by the client or co-client are used to cover deficits for the pre-retirement and retirement periods
- Qualified assets are not available until the clients retire
- Lifestyle and real estate assets are not available
- Assets are redeemed in the most tax-efficient order

Since Monte Carlo in NaviPlan is based on cash flow as opposed to terminal net worth, this prevents cash flow deficits from causing projections to fail when the clients still have enough assets to cover the deficits.

When the *Force Full Deficit Coverage* check box remains cleared (not selected):

- Assets will only be redeemed throughout the retirement period when the first person retires until death to cover annual cash flow deficits.
- During pre-retirement, deficits and surpluses accumulate until the first person retires, and then are reset to zero. Therefore, any pre-retirement deficits accumulate until retirement and don't carry on into the retirement period.
- The *Force Full Deficit Coverage* option only affects the retirement goal.
- Any non-qualified assets that are owned by the clients that are linked to other goals will become available once the goal to which the asset is linked is satisfied.

Note: For more information about deficit coverage in retirement, see the *Retirement Goal Analysis* training module and the application Help.

Determine how success is measured

Each projection in the *Monte Carlo Sensitivity Analysis* is determined to be either a success or failure according to specific criteria dependent on the goal type.

Success or failure is based on cash flow and a negative net worth test. Terminal net worth appears in the *Monte Carlo* report but is not a contributing factor to the success or failure of projections unless it is negative. For example, a portfolio with low net worth but adequate cash flow can result in a high success rate. If a projection results in negative net worth in any year beyond the deficit tolerance for the goal, the projection is a failure. If a projection shows no deficits, or deficits do not exceed the deficit tolerance, the projection is considered a success. For example, if in 85 out of 100 trial projections deficits are within the specified tolerance, the *Monte Carlo Sensitivity Analysis* reports an 85% success rate. The success rate is calculated by dividing the number of successful trials by the total number of trials run.

The success rate of all goals (education, major purchase, and retirement) is determined only after the success rates have been determined for all goals of the same type. A trial is successful if all goals are successful. If one or more goals fail, then the trial fails for all goals of that type.

For each type of goal, there are some differences in how a goal is deemed successful:

- Retirement goals – Only the retirement years of each projection are examined. All cash flow sources in each year of retirement are used. If accumulated cash flow deficits are within the specified deficit tolerance, the goal succeeds. By default, the deficit tolerance amount for retirement is -\$10,000. For any year in a trial, if the accumulated retirement deficit exceeds \$10,000, the trial is considered a failure. For all goals, success is determined when all goals succeed in a given trial.

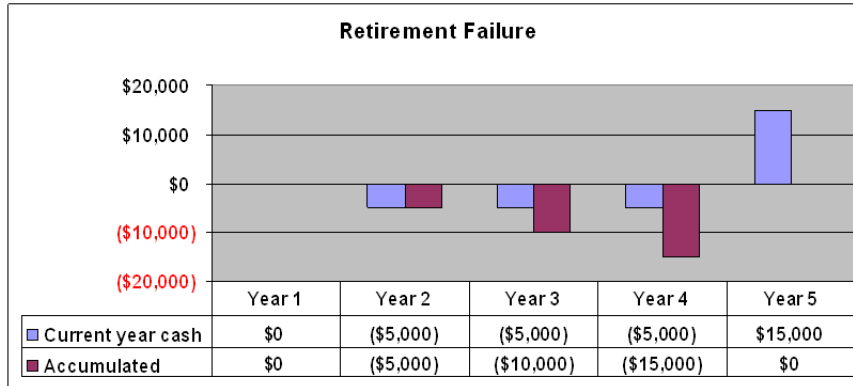


Figure 9: Retirement goal failure due to accumulated retirement deficit exceeding \$10,000 in Year 4.

- Major purchase goals – A separate analysis is done for each goal. Only the major purchase expense and any major purchase funding account redemptions in the purchase year are examined. If the funding amount either meets the goal amount or is within the specified deficit tolerance, the goal is successful. By default, the deficit tolerance for major purchase goals is -\$500.
- Education goals – A separate analysis is done for each goal. Cash flows are examined on a year-by-year basis only during years when the education expenses occur. For an education goal to succeed, in every year of the education goal, cash flow must either cover the goal expense or must be within the specified deficit tolerance. By default, the accumulated deficit tolerance for education goals is -\$500.

Analyze the results of a Monte Carlo Sensitivity Analysis

In order to analyze the results of a *Monte Carlo Sensitivity Analysis*, generate the analysis, and then examine different parts of the results. For this case, use the *Recommended* plan type.

To generate a Monte Carlo Sensitivity Analysis

1. Go to the **Reports** menu, and then select **Monte Carlo – Monte Carlo**. The *Assign Settings* dialog box opens.
2. Select **Randomize Life Expectancy**, **Force Full Deficit Coverage**, and **Show Goal Details Graphs in Report**.
3. Leave the other settings at their defaults, and then select the **Recommended** plan type.
4. Click **OK**. The *Monte Carlo* dialog box opens.

Assumptions table

Assumptions

Assumptions	
Life Expectancy Randomized	Yes
Force Full Deficit Coverage	Yes
Retirement Goal Success Tolerance	(\$10,000)
Education Goals Success Tolerance	(\$500)
Major Purchase Goals Success Tolerance	(\$500)
Number of Projections	150

Figure 10: Assumptions table (showing the settings you entered in the Assign Settings dialog box)

Asset Standard Deviations table

Asset Standard Deviations

Asset	Rate of Return	Standard Deviation
500 Smith Street (Joint/Real Estate)	3.50%	15.00%
Nick's Annuity (Non-Qualified)	8.66%	12.23%
25% of Joint Savings Account (Non-Qualified)	8.66%	12.23%
75% of Joint Savings Account (Non-Qualified)	8.66%	12.23%
Emergency Fund (Joint/Non-Qualified)	3.13%	3.01%
Lisa's Brokerage Account (Non-Qualified)	8.66%	12.23%
Nick's Brokerage Account (Non-Qualified)	8.66%	12.23%
Retirement Fund (Joint/Non-Qualified)	8.66%	12.23%
Lisa's Roth 401 (k/Roth IRA)	8.66%	12.23%
Nick's 403(b)	8.66%	12.23%
Kevin's 529 (Nick/529 Plan for Kevin)	8.66%	12.23%

Figure 11: Asset Standard Deviations table (showing the rate or return and standard deviation assigned to every asset in the plan)

Goal Summary graph

Goal Summary Graph

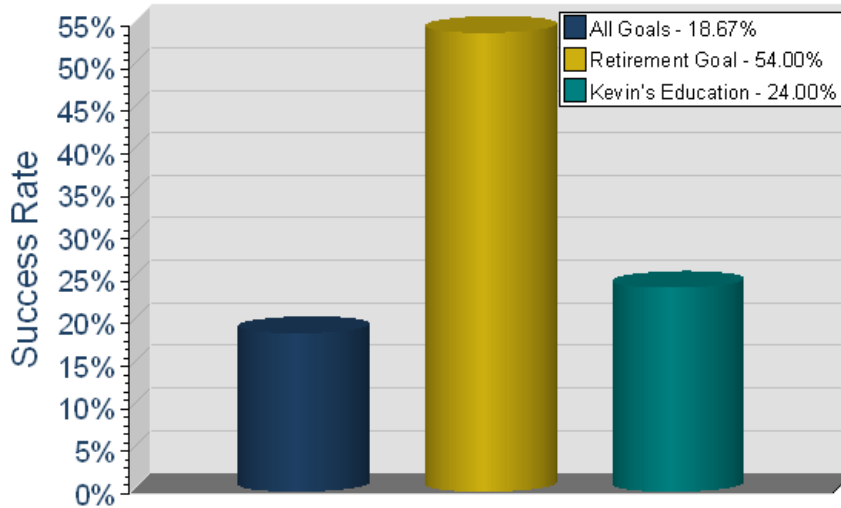


Figure 12: Goal Summary graph (showing the success rates for all goals, retirement, and education)

This graph shows how successful each of the goals are.

The success rate identified for all goals is assessed differently.

- If all of the goals succeeded in a projection, the entire projection is considered a success
- If at least one goal did not succeed in a projection, then the entire projection is a failure

For each type of goal there are some differences on how success is determined:

- Retirement goal – only retirement years are tested for success or failure
- Education goal – a deficit in any of the years that the education goal applies (for example, within four years) indicates that the trial has failed
- Major purchase goals – the trial must be successful at the goal's purchase date

For all goals, success is determined when all goals succeed in a given trial.

Goal Success Rates table

Goal Success Rates

Goal	Success Rate	10th Percentile	50th Percentile	90th Percentile
All Goals	18.67%			
Retirement Goal	54.00%	(\$2,154,881)	\$3,380,800	\$24,672,098
Kevin's Education	24.00%	\$57,765	\$67,931	\$94,831

Figure 13: Goal Success Rates table

- *Success Rate* – percentage of successful projections shown in the *Goal Summary* graph

- Percentiles for retirement goal – represent terminal net worth or net worth at last death (after estate expenses) which includes lifestyle and real estate assets
- Percentiles for education and major purchase – represent the total after-tax asset values accumulated as of Dec. 31 of the year prior to the last year of the goal (includes residuals)

The percentiles represent the following:

- The 10th percentile reports that 10% of the results are lower than this amount; 90% of results are higher
- The 50th percentile reports that 50% of the results are lower than this amount; 50% of results are higher
- The 90th percentile reports that 90% of the results are lower than this amount; 10% of results are higher

Retirement Goal and education goal graphs

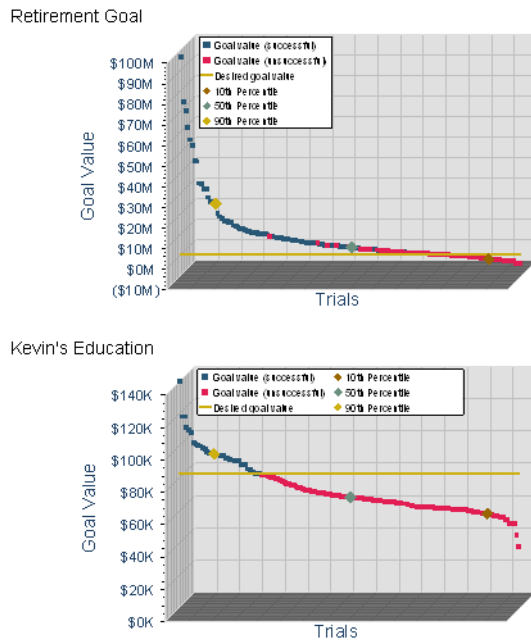


Figure 14: Retirement Goal and education goal graphs (showing the projected goal value for each trial)

These graphs appear if the *Show Goal Details Graphs in Report* check box is selected in the *Assign Settings* dialog box prior to generating the *Monte Carlo Sensitivity Analysis*.

The graphs plot the goal value related to the corresponding goal for each projection.

- For example: If you have 100 projections, you will see 100 squares plotted on the graph. All projections are plotted from highest goal value, starting at the left, to the lowest goal value at the right.

Exercises

The exercises have been designed specifically for this module and assume that you are working with the original data in the *Brown Base Details* plan. Before starting the exercises, duplicate the **Brown Base Details** plan, rename the duplicate with a meaningful name (e.g., *Monte Carlo analysis training*), and use it to complete the following exercises.

Hint: All copies of plans are managed in the *Plan Management* section – *Plan List* category.

Exercise 1: Identify the purpose of Monte Carlo and scenario probability analyses

To find the answers, see “Answers to Monte Carlo analysis exercises” on page 23.

1. You have completed Nick’s and Lisa’s financial plan and would like to determine the plan’s success and identify whether their investments performed poorly for a number of years, or whether the clients may outlive their assets. Which of NaviPlan’s two analysis tools should you use to examine the plan’s success?
 - a) scenario probability
 - b) *Monte Carlo Sensitivity Analysis*
2. What are the plan risks NaviPlan analyzes using the *Monte Carlo Sensitivity Analysis*?
 - a) Clients outliving resources by living longer than expected
 - b) Clients not accumulating the needed resources if one dies earlier than expected
 - c) Insufficient resources for goals as a result of poor asset performance in early years
 - d) All of the above


Exercise 2: Understand the effects of deficit coverage

To find the answers, see “Answers to Monte Carlo analysis exercises” on page 23.

1. Which factors should be considered when defining the deficit tolerance for a goal?
 - a) The clients’ overall risk tolerance
 - b) The clients’ net worth and ability to meet goal shortfalls by other means
 - c) The clients’ cash flow
 - d) All of the above

2. Generate the scenario probability analysis for the *Recommended* retirement goal scenario (you can determine scenario probability on the *Goals* section – *Retirement* category – *Scenarios* page). With the *% Total Needs Covered by Total Resources* option selected, answer the following questions:

- a) In exactly how many trials was the goal covered at 90% or more?

Hint: Click  at the top of the graph for more details.

-
- b) What is the earliest age at which Nick and Lisa will not be able to cover their fixed retirement expenses?

-
- c) What effect do pre-retirement cash flow deficits have on the results of the scenario probability analysis?
-

Exercise 3: Determine how success is measured

To find the answers, see “Answers to Monte Carlo analysis exercises” on page 23.

1. Monte Carlo determines a goal’s success based on which of the following?
 - a) The goal’s deficits
 - b) The plan’s terminal net worth
 - c) Both a) and b)

HANDS-ON EXERCISES

2. Complete the following questions regarding scenario probability by indicating whether each statement is true or false. If false, please indicate why.

Scenario probability	True or false?
a) Results are expressed in percentage ranges of the goal success (for example, 78 out of 100 trials were between 60% and 90%)	
b) Life expectancy is randomized	
c) Results are the same as Monte Carlo results	
d) Only located and available on the <goal> category – <i>Scenarios</i> page for each What-if scenario	

3. Complete the following questions regarding Monte Carlo by indicating whether each statement is true or false. If false, please indicate why.

Monte Carlo	True or false?
a) Success for the retirement goal is based on the clients' terminal net worth	
b) <i>Randomize Life Expectancy</i> uses a maximum life expectancy of 120 years	
c) Deficit tolerance is the amount the clients are willing to spend	
d) <i>Force Full Deficit Coverage</i> implies that non-qualified assets are available in pre-retirement if necessary	

Exercise 4: Analyze the results of a Monte Carlo Sensitivity Analysis

Use the *Monte Carlo Sensitivity Analysis* sample below to answer the following questions. To find the answers, see “Answers to Monte Carlo analysis exercises” on page 23.

Assumptions	
Life Expectancy Randomized	Yes
Force Full Deficit Coverage	No
Annual Cash Flow Deficit Tolerance	(\$10,000)
Education Goals Success Tolerance	(\$500)
Major Purchase Goals Success Tolerance	(\$500)
Number of Projections	100

Goal Success Rates				
Goal	Success Rate	10th Percentile	50th Percentile	90th Percentile
All Goals	33.00%			
Retirement Goal	63.00%	\$4,498,186	\$8,510,752	\$19,319,810
Kathy's Education	62.00%	\$134,977	\$160,351	\$196,628
Charles' Education	61.00%	\$126,043	\$192,787	\$296,371
Family European Vacation	68.00%	\$40,530	\$71,243	\$118,023

1. What are these Monte Carlo sample results telling us about this plan?

2. What could be done to modify the results?

3. The results are showing that even in the lowest percentile, or the worst situation, the clients have a high net worth. Why is the success rate so low?

Conclusion

This module has enabled you to

- Determine the probability of success of your clients' financial plan
 - Identify the purpose of Monte Carlo and scenario probability analyses
 - Compare the two analysis methods in NaviPlan: scenario probability vs. *Monte Carlo Sensitivity Analysis*
 - Identify Monte Carlo settings options
 - Understand the effects of deficit coverage
 - Analyze the results of a *Monte Carlo Sensitivity Analysis*

Answers to Monte Carlo analysis exercises

Exercise 1: Identify the purpose of Monte Carlo and scenario probability analyses

1. b) *Monte Carlo Sensitivity Analysis* – Monte Carlo is the tool you should use to examine the plan’s success.
2. d) All of the above – Using the *Monte Carlo Sensitivity Analysis*, NaviPlan analyzes all the listed risks.

Exercise 2: Understand the effects of deficit coverage

1. d) All of the above – You should consider all the listed factors when defining the deficit coverage tolerance for a goal.
2. a) Answers will vary.
 b) Answers will vary.
 c) Pre-retirement deficits will not affect scenario probability results, since the analysis is not cash flow-based. Instead, the results will express the degree to which each trial can cover goal expenses by using available resources.

Exercise 3: Determine how success is measured

1. a) The goal’s deficits – NaviPlan determines a goal’s success based on the goal’s deficits.
2. See the answers in the table below.

Scenario probability	True or false?
a) Results are expressed in percentage ranges of the goal success (for example, 78 out of 100 trials were between 60% and 90%)	True
b) Life expectancy is randomized	False – NaviPlan projects the plan using the life expectancies defined in the plan or scenario
c) Results are the same as Monte Carlo results	False – Results will be different <ul style="list-style-type: none"> • Monte Carlo works on a pass/fail basis • In probability analysis, the client and advisor determine goal success
d) Only located and available on the <goal> category – <i>Scenarios</i> page for each What-if scenario	True

3. See the answers in the table below.

Monte Carlo	True or false?
a) Success for the retirement goal is based on the clients' terminal net worth	False – Success is based on cash flow deficit tolerances
b) <i>Randomize Life Expectancy</i> uses a maximum life expectancy of 120 years	False – 110 is the maximum based on the GAM 83 actuarial tables
c) Deficit tolerance is the amount the clients are willing to spend	False – Deficit tolerance is the amount the clients are willing to borrow
d) <i>Force Full Deficit Coverage</i> implies that non-qualified assets are available in pre-retirement if necessary	True

Exercise 4: Analyze the results of a Monte Carlo Sensitivity Analysis

- All goals are coming up short. While the clients have a high net worth, the plan fails because it is susceptible to market fluctuations and life expectancy changes. Increasing the amount of income that is fixed or safer from market fluctuations may improve the plan.
- Here are two solutions:
 - Change the assumption to force full deficit coverage. Assets are redeemed to cover deficits in pre-retirement.
 - Increase the deficit tolerance. An annual cash flow deficit tolerance of \$10,000 and a \$500 deficit tolerance for the education and major purchase goals may be too insignificant if the clients are easily able to borrow much more than this to cover shortfalls.
- Non-liquid assets such as real estate assets and lifestyle assets make up a large portion of the clients' net worth. The clients' liquid assets may not be sufficient to meet their goals.