

## MoneyGuidePro (MGP) Response to Wall Street Journal Article on Monte Carlo Simulations

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### Executive Summary

On May 2, 2009, The Wall Street Journal (WSJ) published an article titled "Odds-On Imperfection: Monte Carlo Simulation," with the tag line "Financial Planning Tool Fails to Gauge Extreme Events." While the WSJ article includes some accurate observations regarding Monte Carlo simulations (MCS), we believe MCS calculations are an important part of an overall financial plan. However, we also believe that MCS results, by themselves, are not sufficient. That's why MGP has always provided three results: Average Returns, Bad Timing, and MCS. With the release of MGP:G2, we added two new tests of the MCS results- Security Check and Loss Cushion- which specifically address the risks of a 2008-type event.

This response is divided into three sections. The first section provides an overview of MCS and their results. The next section is the heart of our response, summarizing how MoneyGuidePro (MGP) uses MCS, in conjunction with other key features, to provide a range of possible results for clients' plans. The final section supplies more details of the strengths and limitations of MCS, for those who are interested in the more technical details.

### Overview of MCS Results

Before describing MGP's use of MCS and other features, it is important to articulate several important facts about MCS results. First, MCS are mathematical models (not crystal balls) and, as such, are limited. Because market performance is complex and all the influencing factors are neither well-defined nor predictable, MCS limit their assumptions. Even when using the best available assumptions, MCS results will never accurately reflect the real world. At best, MCS results are an incomplete approximation of potential investment returns. Simplifying assumptions are made. Moreover, MCS results are calculated using indexes (not actual investment returns for any client), so are, at best, *an approximation of possible results for indexes*.

Secondly, as the article correctly states, most MCS results give a low probability to extreme events. We have imperfect data (less than 100 years of data for any index, and much less data for most indexes) on which to base MCS assumptions. And, at this moment in 2009, no one knows whether 2008 is an isolated extreme event (as most current MCS assumptions would reflect) or the beginning of a longer downturn. Our best assumptions for MCS are based on the historical data that's available.

Finally, no market model (MCS or any other) can accurately predict the behavior of investors. While investors' behavior is inherently included in historical returns, no one can predict the strength of investors' influence. Every market downturn is exacerbated when investors get scared, and every market uptick is enhanced by investor exuberance.

For these reasons, Monte Carlo simulations provide only a range of possibilities. They don't make predictions, and they won't provide a definitive answer for any individual client.

## How MoneyGuidePro Uses Monte Carlo Simulations (MCS) – AND Why MCS Results (Alone) Aren't Sufficient

- The MGP SmartCalc methodology calculates three sets of results: Average Returns, Bad Timing, and a Monte Carlo simulation (MCS).
- The Presentation section of MGP explains why no single result is sufficient for most plans. That's why MGP provides three sets of results.
- A Monte Carlo simulation provides a %Probability of Success+based on calculating the results for a plan under many different returns and many return sequences. With the MGP MCS assumptions, very poor returns (similar to those of 2008) would be expected in two or three years out of every hundred years. No one knows for sure whether these assumptions are accurate (because we have less than 100 years of investment market history AND there is no proven predictive model for investment returns), but, they are reasonable assumptions. However, even if the MGP assumptions are accurate, there is still uncertainty because no MCS can predict when such downturns might occur, or their exact magnitude. Moreover, the exact sequence of bad returns AND the timing of the bad returns (e.g., early in the accumulation phase vs. at retirement) can affect the results as much as the value of the bad returns. Getting two years of %moderately bad returns+the first two years in retirement can be worse than getting a single year of %really bad returns+earlier in the plan. MCS illustrates general trends; it doesn't pinpoint when bad returns might occur.
- The MGP Bad Timing feature calculates results using %poor returns+for one or two years. The MGP assumptions for these %poor returns+(using MGP standard portfolios) are shown below.

For historical returns, 2008 replaced 1974 as the worst single year, when using one year of %poor returns.+ The combined returns for 2007-2008 were better than the combined returns for 1973-1974, so the latter two years remain as the worst two-year historical sequence. Prior to 2008, if you showed your clients only one year of %poor returns+(using the MGP assumptions), their potential loss was understated compared to 2008. However, if you showed your clients two years of %poor returns,+the results are very close for the portfolios with the most equities, and a bit understated for those with more bonds. (If you want to illustrate different Bad Timing results, you have the option of entering your own %poor returns+.)

### Bad Timing using Historical Returns

Portfolio	One year of %poor returns+ (through 2007) (1974 returns)	One year of %poor returns+ (through 2008) (2008 returns)	Two years of %poor returns+ (through 2008) (1973-74 returns)
Capital Preservation I	-2.22	-4.46	-2.91
Capital Preservation II	-5.20	-9.11	-8.06
Balanced I	-7.25	-12.32	-11.51
Balanced II	-10.37	-17.20	-16.41
Total Return I	-12.19	-19.96	-19.45
Total Return II	-15.53	-25.13	-24.64
Capital Growth I	-18.56	-29.67	-29.52
Capital Growth II	-21.28	-33.80	-33.55
Equity Growth	-23.87	-38.16	-37.57

For projected returns, the portfolio standard deviation (SD) is used to calculate the %poor returns+, which are shown below, and compared to the actual 2008 returns. Similar to historical returns, if you showed your clients only one year of %poor returns+ (using the MGP assumptions and projected returns), the potential loss was understated compared to 2008. However, if you showed your clients two years of %poor returns+, the results are very close for most portfolios, even somewhat overstated for the most conservative portfolios.

### Bad Timing using Projected Returns

Portfolio	One year of %poor returns+ (two SDs)	Two years of %poor returns+ (two SDs, then one SD)	2008 Returns
Capital Preservation I	-6.16	-6.19	-4.46
Capital Preservation II	-9.16	-10.35	-9.11
Balanced I	-11.37	-13.36	-12.32
Balanced II	-14.70	-17.82	-17.20
Total Return I	-16.68	-20.44	-19.96
Total Return II	-20.41	-25.28	-25.13
Capital Growth I	-23.86	-29.65	-29.67
Capital Growth II	-26.94	-33.48	-33.80
Equity Growth	-30.31	-37.57	-38.16

(SD = Standard Deviation)

- All MGP results (average returns, bad timing, and Monte Carlo simulations) are calculated using current assumptions. As assumptions or clients' circumstances change, the results will also change. The results represent a snapshot based on a set of assumptions, not an indelible roadmap that must be followed for better or for worse.
- In addition to the three sets of results MGP calculates, there are other important features that provide clear information to your clients, allowing you to help them make appropriate choices.
  - For clients near or in retirement, MGP recommends you create Retirement Lifestyle Plans, with many discrete goals categorized as Needs, Wants, and Wishes. (Use the Goal Wizard for a step-by-step guide for creating Retirement Lifestyle Plans.)
  - In MGP, each financial goal has both an Ideal and an Acceptable amount (i.e., an Acceptable range). Using this range of satisfactory goal values allows you show clients a range of potential results.
  - When you have created a Retirement Lifestyle Plan with many goals, each with an Acceptable range, the results ALWAYS provide much more actionable information than a plan with a single retirement goal. When a plan cannot be fully funded, discretionary goals can be adjusted within their Acceptable ranges. MGP implements trade-offs among all the goals to maximize the client's satisfaction. This is possible because the trade-offs are based on the client's specifications, Acceptable ranges, importance of each goal, and willingness to make adjustments. With a Retirement Lifestyle Plan, the first several levels of trade-offs are automatically built into the plan.
  - MGP's new Security Check and Loss Cushion features (in the Presentation section) assess the impact of poor returns on the client's plan. The Security Check shows the client's results if all their financial goals were set to the Acceptable amounts. The Loss Cushion shows the maximum % loss the client's portfolio could absorb today while still funding their goals at the Acceptable level. With many clients, the Loss Cushion can help put 2008 in perspective.
  - The Inside the Numbers section of the Presentation illustrates a range of possible MCS results for the client's plan, including one of the best and one of the worst trials.
  - One hedge against an extreme event is the value in the client's home. When there's a relatively small probability of very poor returns in one or two years, you could include a reverse mortgage as a potential solution, rather than planning to reduce goal values below Acceptable levels throughout retirement, or encouraging additional sacrifices in the client's current lifestyle. This doesn't mean you make a decision today to implement a reverse mortgage. Rather, you include it as a potential solution (i.e., as a backstop), if the client needs additional funds at age 75 or 80. The probability of an event can affect the strategy you might use to mitigate it.
- As with all plans, you should review your client's assumptions and results periodically, and update the assumptions when the information or the client's circumstances change. Financial planning is a process, not a single event.

In many ways, the WSJ article is another example of how investor and media attitudes have swung from the irrational exuberance of the late 1990s to the unreasonable fear of late 2008 and early 2009. Prior to 2008, many clients thought they could have it all—retire at age 55, work part-time if they felt like it, travel as much as they wanted, fund 100% of college for children and grandchildren, and continue to buy and sell ever-appreciating real estate. Today, many clients are worried about running out of money for their basic living expenses. While there are people in dire financial straits, the actual financial situation for many investors is somewhere between their former irrational exuberance and their current unreasonable fear.

Monte Carlo simulations are not crystal balls. Because investment returns are neither certain nor predictable, there is no model, formula, or methodology that can predict either the exact value or the timing of future returns. Even when MCS results show the possibility of very low returns, they will never predict when such low returns will occur. Neither will Bad Timing. However, by using these tools, in combination with the other features in MGP, you can provide your clients with more information, more education, and a realistic range of possible results.

### **IMPORTANT DISCLOSURE INFORMATION**

The projections or other information generated by MoneyGuidePro regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results.

The return assumptions in MoneyGuidePro are not reflective of any specific product, and do not include any fees or expenses that may be incurred by investing in specific products. The actual returns of a specific product may be more or less than the returns used in MoneyGuidePro. It is not possible to directly invest in an index. Financial forecasts, rates of return, risk, inflation, and other assumptions may be used as the basis for illustrations. They should not be considered a guarantee of future performance or a guarantee of achieving overall financial objectives. Past performance is not a guarantee or a predictor of future results of either the indices or any particular investment.

MoneyGuidePro results may vary with each use and over time.

### **Additional Information on Monte Carlo Simulations (MCS) – Assumptions, Limitations, and Results**

- Monte Carlo simulations are mathematical models (not crystal balls) and, as such, are limited. It is easy to assume greater precision equals greater accuracy, or the results from a set of complex calculations are infallible. The more complex a system, the more complex the assumptions must be to model it. The mathematics (however complicated) cannot accurately model the combinations of variables found in the real world.
- Monte Carlo simulations calculate results by running a plan many times, using many different returns and many return sequences. Each trial is counted as a success or a failure, whether it failed (or succeeded) by \$1 or \$1,000,000. Obviously, MCS is a measure of results for a plan, but should not be the only measure.
- The 2008 annual return results were in the -3 SD range for most equity asset classes. Based on a normal (bell-curve) distribution, we would expect to see annual returns outside of 2 SDs 5% of the time, i.e., in five years out of 100. We don't have 100 years of data for most equity asset classes, and we don't know whether a normal (or log-normal) distribution is a good assumption. So, we don't know whether the 2008 equity returns were predictable outliers, black swans, or the event that will cause the financial industry to change its assumptions on modeling returns.

- The WSJ article references a recent paper by Moshe Milevsky, associate finance professor at York University's Schulich School of Business in Toronto, which proposes a calculation that Monte Carlo tools could use to show a retirement plan's vulnerability to extreme market events. (For a summary, see: [www.investmentnews.com/article/20090503/REG/305039988](http://www.investmentnews.com/article/20090503/REG/305039988). For the entire paper, see: [www.ifid.ca/pdf\\_newsletters/PFA\\_2009APR\\_BlackSwan.pdf](http://www.ifid.ca/pdf_newsletters/PFA_2009APR_BlackSwan.pdf).) Milevsky suggests we improve MCS results by adding an additional calculation, the Sequence of Returns Downside Exposure (SORDEX) Ratio, to indicate the vulnerability of the plan to statistical outliers. We believe the MGP Loss Cushion provides such an indicator and does so using a methodology that's much easier for clients to understand.
- The WSJ article also notes that some firms are considering revising Monte Carlo models to reflect a world where big market swings happen more often . . . allowing users to choose a bell-curve-shaped distribution or a fat-tailed distribution, which assigns higher probabilities to extreme market events. Assigning a higher probability to an extreme event (whether it's extremely positive or negative) tells us that it might occur more often, but still doesn't tell us when it may occur. The sequence of returns often matters as much as the value of the returns. (For a refresher on this fact, play the *Monte Carlo Card Game* on the Main Menu of MGP.)

In addition, by how much should we increase the probability of an extreme event? Is there another statistical distribution that should be used? Or should we continue to use a normal (or log-normal) distribution with fatter tails? Suppose we decide to keep the normal distribution and double the probability of the extreme events. Is that enough? In a 50-year retirement plan, for example, doubling the probability of the extremes could change the Monte Carlo result by 5% or less in many plans. In most cases, that difference should be considered a rounding error because MCS results are not that precise.

- Suppose we increase the probability of the extreme events. It still begs the question: How do you most appropriately address low-probability extreme events in long-term planning? Do you increase savings and decrease goal amounts so that the plan works regardless of what happens? That's an extreme solution -- which may be appropriate for some clients, and not for others. With or without extreme events, there is no one Monte Carlo number that is right for every client. As with all other factors in planning, the appropriate Monte Carlo probability is dependent on the specifics of the client's situation. MGP provides a default Confidence Zone that is reasonable, on average, for many clients. You should adjust it when appropriate.
- One of the simplifying assumptions made by MCS is that standard deviation (SD) accurately represents a portfolio's risk. SD can be easily quantified, so is an easy way to specify the relative risks of different portfolios. Risk, in a more inclusive definition, is the chance that the actual return of an investment, asset class, or portfolio will be different from its expected or average return. All investments have several different types of risk, both systematic and unsystematic.

Investing in fixed income securities involves interest rate risk, credit risk, and inflation risk. Investing in stock securities involves volatility risk, market risk, business risk, and industry risk. International investing involves additional risks including, but not limited to, changes in currency exchange rates, differences in accounting and taxation policies, and political or economic instabilities that can increase or decrease returns.

- The WSJ article asserts that: "The ideal models run tens of thousands or hundreds of thousands of scenarios, which help gauge extreme events at the tail end of the distribution, observers said. Yet some tools run only 1,000 scenarios or just several hundred. It is correct that enough trials must be run to produce a reasonably accurate picture, i.e., to adequately represent the entire range of the distribution. Once you've run a sufficient number of trials to fully illustrate the tails, additional trials do not increase the accuracy of the MCS results. The key is to determine how many trials are needed to fully represent the distribution. (It's probably not tens or hundreds of thousands.) After that, additional trials do not change the probability of getting an outlier (or any other single result) on any one trial."

- The WSJ article includes this paragraph: "These [MCS] models were supposed to help quantify and manage the risks of mortgage-backed securities, credit-default swaps and other complex instruments. But given the events of the past couple of years, it appears that the models often gave big institutions, as well as small investors, a false sense of security. We haven't analyzed the details of the models used by institutions for these complex instruments. It is likely they included MCS. However, how MCS was used in these situations has no relationship to how MCS is used in financial planning for clients. It's similar to equating golf and baseball because they both use a stick to hit a ball, regardless of the differences in intent and assumptions. Unless you've loaded your clients' portfolios with mortgage-backed securities and credit-default swaps, this paragraph isn't relevant or helpful in understanding how MCS are used in financial planning applications."
- For more information on MCS, including limitations, see "Monte Carlo Mania," by Robert D. Curtis, in *Retirement Income Redesigned: Master Plans for Distribution*, edited by Harold Evensky and Deena Katz, Bloomberg, 2006.