Defining and Measuring Risk Capacity

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Abstract

New generation models of assessing a client's profile for investment purposes differentiates among factors like the client's tolerance for risk which is a psychological trait, the client's required risk which is a how much risk a client might be required to take to achieve desired goals, and risk capacity which is how much risk the client can afford to take.

Risk tolerance assessments have taken significant strides forward with the introduction of psychometrics, but when it comes to defining risk capacity, the approach remains anecdotal. Client profiling questionnaires may ask one or two questions like "How much risk can you afford to take?", but what is "risk capacity" and how do we measure it?

This paper outlines:

- A definition and explanation of risk capacity.
- An explanation of the variables that contribute to risk capacity – specifically, ability to adjust goals; revenue expected from external sources like pensions; and downside flexibility of the investment portfolio based on withdrawal strategies and portfolio construction.
- A proposed mechanism and new metric to measure the "risk capacity" inherent in the client's ability to adjust lifestyle or goals, the portfolio construction and the use of guarantee products.
- Development of a model using Monte Carlo randomization and mortality randomization that allows us to isolate sub-factors of risk capacity. Many models use the succeed/fail ratio from the simulation and terminal wealth as the primary measure. This paper looks at two additional factors; the number of periods with a shortage and the depth of the gap based on the percentage of the target that is achieved. It explains why these are important for our consideration.
- The impact of decisions like purchasing a life annuity or a Guaranteed Minimum Withdrawal Benefit (GMWB) does not improve the risk capacity of a client unless treated as fixed income and initial equity allocations are maintained.
- Individual mortality expectations where we assumed longer life resulted in reduced risk capacity with no seeming advantage of guarantee products.

What is Risk Capacity?

Risk capacity is defined as how much risk the client can afford – but what does that mean? First, the concept "afford to take" means we must have a specific goal in mind to provide context. It is not possible to measure "afford to take" unless we have this. For the sake of context let's assume that 0 means no risk capacity and 100 means the client has unlimited risk capacity.

A recent guidance paper by the FSA in the United Kingdom has provided the most clarity:

> *By 'capacity for loss' we refer to the customer's ability to absorb falls in the value of their investment. If any loss of capital would have a materially detrimental effect on their standard of living, this should be taken into account in assessing the risk that they are able to take.* [i]

Let's look at some examples:

- If a client needs $60,000 a year of income, has pensions that total $60,000 a year, and an investment portfolio, by definition they have unlimited risk capacity as any behaviour in the portfolio is irrelevant to achieving their annual income goal. Clearly external pensions and government benefits can increase risk capacity as it relates to the portfolio.
- A client has a desired goal of $60,000 and of this, $50,000 a year is required or essential. They have also indicated that if required, to maintain lifestyle they could do some consulting work during the first 10 years of retirement and generate $10,000 a year in supplemental income. The willingness of the client to make these adjustments to lifestyle, if necessary, means the client has greater risk capacity, but how do we quantify it?

Building a Model

For the analysis in this paper a Monte Carlo model was constructed to model the portfolio option of the client. The following assumptions were used:

- A randomization using a 9.26% arithmetic mean and 8.07% standard deviation generated simulations that averaged 8.96% geometric means.
- All calculations were done on a pre-tax basis.
- Mortality tables were used to randomize mortality assumptions for each separate Monte Carlo simulation.[ii]
- The client's requirement or goal less any pension income generates the required withdrawal from the portfolio.
- Each year the new portfolio value is calculated by subtracting withdrawals first, then applying the return from the simulation.

Using the model, let's look at two trials:

	Trial #1	Trial #2
Capital	1,000,000	500,000
Goal	70,000	70.000
Pensions	0	35,000
Shortage Scenarios	35.3%	35.3%
Negative Periods	13.9%	13.9%
Average % of Target when Negative	6.0%	53.0%
Average % of Target Overall	86.9%	93.5%
Estate Scenarios	64.7%	64.7%
Average Estate	1,130,259	565,129

Table 1: Metrics from Initial Trials

In Trial #1 the client has $1,000,000 and will withdraw $70,000 a year. We have used a more aggressive withdrawal intentionally to generate failed scenarios.

- **Shortage Scenarios:** These are scenarios where the client capital went to zero before the client died, a typical Monte Carlo measure of success or failure. In this case 35.3% of scenarios failed.
- **Negative Periods:** The number of periods when there was a shortage, where a period is any year in a simulation that the client still survived. For this case 13.9% of all periods were negative. An example of this would be a scenario where a client lived to age 108 but ran out of money at age 107. This would be classified as a failure (Shortage Scenario) and one "Negative Period". Another client might have negative periods starting at age 70 and live to 100 in which case it is one Shortage Scenario but 30 Negative Periods.
- **Average % of Target When Negative:** Previously we saw that 13.9% of periods had a gap. This metric goes one step further and measures how "deep" the gap was on average. In this case, on average, the clients only achieved 6.0% of the targeted $70,000 income during the negative periods. This is because on the first negative year there might be some residual capital but thereafter all the capital is gone. Because there are no other income sources (e.g. pensions) once the capital is gone the gap is total. We will periodically refer to this as the "Depth of the Gap".
- **Average % of Target Overall:** This identifies the total revenue received divided by the total revenue required for every period the client was alive based on the randomized mortality.
- **Estate Scenarios:** This identifies the inverse of the Shortage Scenarios. If there was no Shortage there was an estate.
- **Average Estate:** An average of the estate residue only across those scenarios that had a residual estate value.

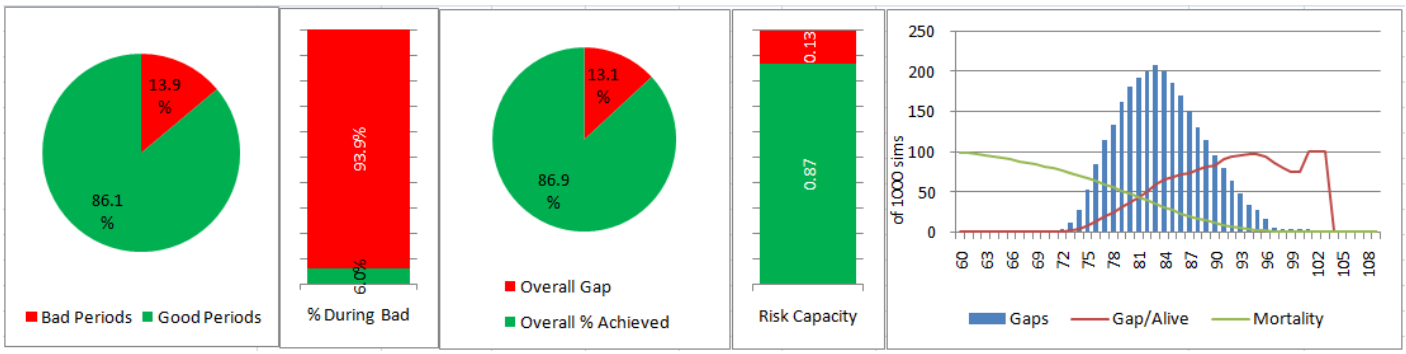

Figure 1: Metrics from Trial #1

The Risk Capacity metric in Figure 1 will be covered in more detail as we proceed. In its simplest form it is the same as the Average % of Target Overall.

Some additional information of interest is the "timing" of the bad/negative periods. When we say "you have a 13.9% chance of a negative period", people might see this as a poor gamble, but it is important to remember that you always run out of money at the end. We can see in the distributions (right side of the dashboard/Figure 1 above) from the mid-70s to mid-90s there are gaps in a maximum of 200 of the 1000 simulations. Based on the mortality attrition, after age 80 about 50% of the simulations have gaps and by age 90 close to 100% have gaps.

In Trial #2 we illustrate what occurs for a client with a portfolio that is half that of Trial #1, funding half the requirement since there are pensions funding the rest of the goal. Not surprisingly the metrics are identical as far as failed scenarios and negative periods. The fact that the average estate is half the value is also consistent with expectations.

Although the portfolios are identical, the key metric that is very different is the fact that in the periods where there is a gap, the client has 53% of their target income compared to 6.0%. From the client's perspective this is a significant difference and not captured in a simple succeed/fail analysis.

Clearly, without looking at these metrics relative to the "depth of the gap" or average percent of target achieved in negative periods, we would be dealing with an incomplete view of the client circumstance.

Creating a Comparative Metric

If we are measuring a single metric then the ability to identify which option is the most desirable is relatively easy. Unfortunately, complex issues are never as simple and by their nature these decisions often involve tradeoffs. As we will see, purchasing an annuity will always lead to an increased number of negative periods but at the same time the depth of the gap when there is one is reduced. Is it possible to determine if the trade off of more frequent but less intense gaps is justified?

The new Risk Capacity metric combines the Negative Periods % with the depth of the gaps as we will see in Figure 2.

- If we have 0% Negative Periods and/or 0% Gap and achieved the desired target, then 100% is the outcome (great!)
- If we have 100% Negative Periods for 100% of the target income then 0 is the worst possible outcome. This should be impossible unless the client has no money whatsoever but is a threshold.
- Is a dollar just a dollar? Do we place a higher value on the first dollar we received in a catastrophic failure compared to the last dollar to achieve our target? Most people would say yes. If no weighting is placed on the depth, the overall metric result is the same as the Average % of Target Overall.

  New Metric = 100 – MINIMUM ((% Negative Periods* (100- Average % of Target When Negative) *AVERAGE(Value of the $ based on weighting)/100),100)

- Average Value of the $ based on weighting is always 1 if a catastrophic dollar is valued as a dollar. If it was valued as $2 then we prorate each dollar from $1 to $2 based on the depth of the average gap.
- If the client experiences a small shortage (say 10%), even if happens frequently the overall impact is not that bad.

		RISK CAPACITY											
		Gap	Wide %										
		Deep %	0	10	20	30	40	50	60	70	80	90	100
	$ 1.00	0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$ 1.10	10	100.0	99.0	97.9	96.9	95.8	94.8	93.7	92.7	91.6	90.6	89.5
	$ 1.20	20	100.0	97.8	95.6	93.4	91.2	89.0	86.8	84.6	82.4	80.2	78.0
	$ 1.30	30	100.0	96.6	93.1	89.7	86.2	82.8	79.3	75.9	72.4	69.0	65.5
	$ 1.40	40	100.0	95.2	90.4	85.6	80.8	76.0	71.2	66.4	61.6	56.8	52.0
	$ 1.50	50	100.0	93.8	87.5	81.3	75.0	68.8	62.5	56.3	50.0	43.8	37.5
	$ 1.60	60	100.0	92.2	84.4	76.6	68.8	61.0	53.2	45.4	37.6	29.8	22.0
	$ 1.70	70	100.0	90.6	81.1	71.7	62.2	52.8	43.3	33.9	24.4	15.0	5.5
	$ 1.80	80	100.0	88.8	77.6	66.4	55.2	44.0	32.8	21.6	10.4	0.0	0.0
	$ 1.90	90	100.0	87.0	73.9	60.9	47.8	34.8	21.7	8.7	0.0	0.0	0.0
Value $	$ 2.00	100	100.0	85.0	70.0	55.0	40.0	25.0	10.0	0.0	0.0	0.0	0.0

Figure 2: Risk Capacity Metric

This metric will be listed as Risk Capacity Metric as we proceed.

As stated, this metric equally weights the importance of the number of negative periods and the depth of the negative periods. Most people would agree that they would rather be short a little money more frequently than have catastrophic gaps, even if less frequently. The downside of a weighted factor is that it remains a judgemental approach and advisors can tweak the parameters to get the result they want.

I also tested a measure of the variance of income received. I attempted a downside deviation with the goal as 0 and the gaps as a negative value. Because the standard deviation is based on the mean of all periods, as the situation moved to 100% gap periods the standard deviation declined. Although lower it was consistently in being lower. A more straightforward variance from 0 is a more consistent approach.

Standard Portfolio Withdrawal Strategies

There is a wide body of research on sustainable withdrawal rates and the purpose of this paper is not to dwell on this topic. Nonetheless we want to establish a baseline looking at standard withdrawals.

With the integrated mortality randomization a client can die in the current year making it virtually impossible to have a situation where there are not some “successes”. As we can see in Figure 3, as the withdrawal rate declines the percentage of scenarios resulting in shortages declines with it. With a withdrawal rate of 4.5% we have only 3% of scenarios that fail and at 4%, less than 1% of scenarios fail. Using a 4% withdrawal rate there are only 2 periods out of 1,000 that have a gap, although when this occurs the gap is effectively complete. The Risk Capacity Measure equals the Average % of Target Overall as expected.

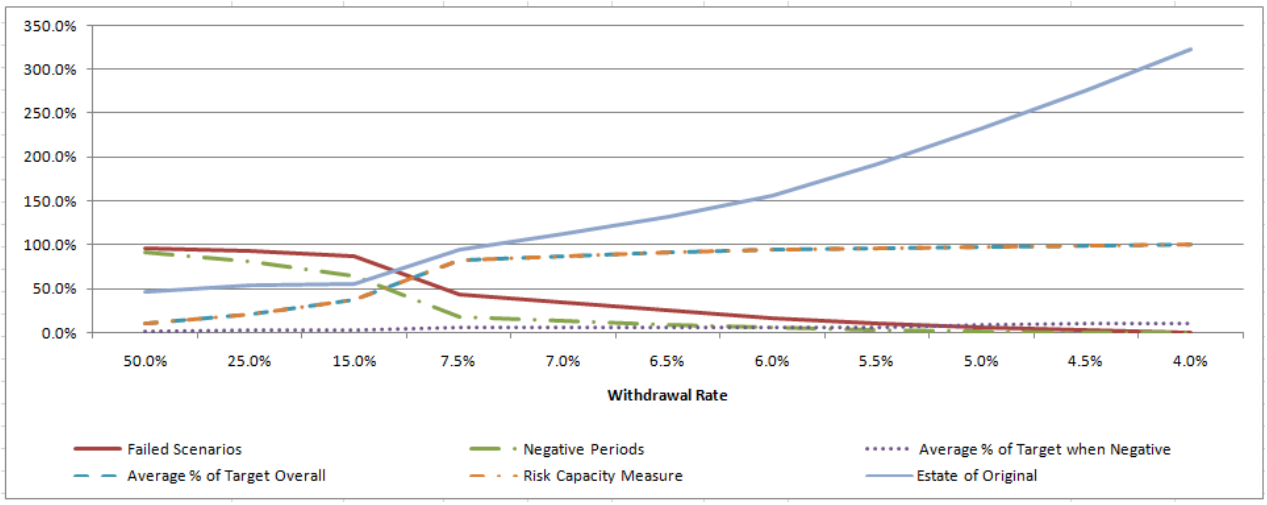

Figure 3: Altering Withdrawal Rates

Buying an Annuity

The decision to purchase a Life Annuity is the typical response to add more certainty in the revenue stream for the client. In the previous scenarios we altered the portfolio withdrawal rate. To evaluate annuities we will fix the income at $60,000 which will be funded from the annuity and a withdrawal from the residual of $1,000,000 portfolio after the impact of buying a Life Annuity.

One of the primary challenges here is that the ability to get an “annuity quote” is linked to specific short term market rates, whereas the capital market assumptions for the portfolio are based on the last 50 years of data. This leads to the valid observation that if the capital market assumptions are overstated it will bias the analysis against annuities.

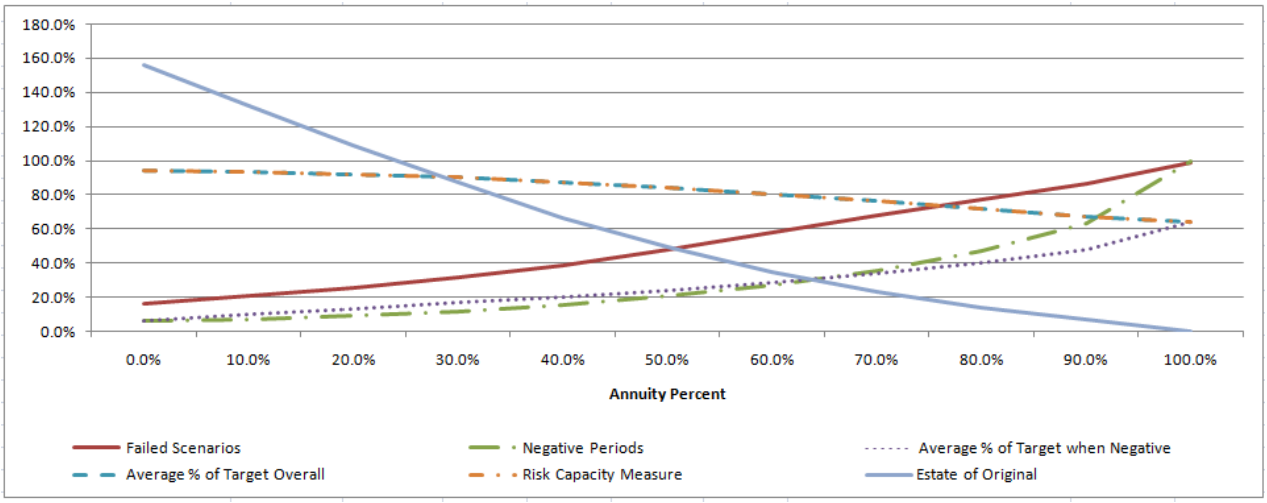

Figure 4: Adjusting % Purchasing Annuity

At an intuitive level when we start this analysis, we expect that reducing capital to purchase an annuity will in general increase the overall number of failures but also reduce the depth of the failures.

In Figure 4 we can see the traditional indicators behave exactly as expected. The X axis shows no money in an annuity in the far left (0%) up to purchasing a $1,000,000 annuity on the far right (100%).

- We used an internet annuity quotation system[iii] and selected a $5,700 per $100,000 life annuity with no guarantee period and not indexed for a 60-year-old male.
- Estate values drop from 160% of original capital to zero
- Shortage scenarios increase from just under 20% to 100% with a full annuity
- The average % of target when negative as expected increases from about 5% with no annuity to just over 60% with a full annuity.
- The Average % of Target Overall – what percentage of desired income we received over all scenarios declined from 95% to just over 60% with the full annuity.
- The current Risk Capacity Metric declined consistently as more capital was used to purchase the annuity.

As we can see, from a straight numeric analysis the client is sacrificing a large percentage of potential lifetime income (about 30%) which could be viewed as as the cost for adding more certainty in the bad years. As stated:

- Changing the weightings of the value of a catastrophic dollar will change the results, but how?
- Changing the capital market assumptions will change the results.

Applying a Value to a $ in Catastrophic Circumstance

One of the initial findings in the field of Behavioural Finance was that people would make judgements to control loss disproportionately to the chance of gain. In the case of downside protection we see similar behaviour with annuities and GMWBs. A GMWB (Guaranteed Minimum Withdrawal Benefit) is an insurance product where a client pays an additional guarantee fee and is guaranteed to receive a minimum benefit for life. If this was strictly a rational decision people might not purchase these products but they are in fact more popular now than in recent memory.

Annuity	0	100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000	1,000,000
Value $											
1.0	94.5	93.4	92.0	90.0	87.5	84.4	80.6	76.3	71.6	67.3	63.9
1.5	93.2	92.0	90.2	88.0	85.0	81.5	77.1	72.3	67.4	63.0	60.6
2.0	91.9	90.5	88.5	85.9	82.6	78.5	73.6	68.4	63.1	58.8	57.4
2.5	90.6	89.0	86.7	83.8	80.1	75.5	70.1	64.5	58.8	54.5	54.1
3.0	89.3	87.6	85.0	81.7	77.6	72.6	66.6	60.5	54.6	50.3	50.9
3.5	88.0	86.1	83.3	79.7	75.1	69.6	63.2	56.6	50.3	46.1	47.6

Table 2: Weight Gap Depth

In Table 2 we look at the introduction of alternate values on the value of a “catastrophic dollar” and the impact this has on the “Risk Capacity Metric”. This value is how much more we weight the value of a dollar when there is no other income. In the table the row with a “Value $” of 3.0 means that gaps with no income at all are 3 times more important than just being short a dollar when we are at our goal.

The results in Table 2 are unexpected. Although we knew that an annuity will increase the frequency of gaps, we expected that guaranteeing an income for the higher weighted catastrophic failures would more than offset this. This did not occur. If we look at the case when the dollar remains valued at a dollar, the Risk Capacity Metric drops from 94.5% to 63.9% which is over a 30% decline in “Average Overall % of Target” achieved. In other words the client has experienced a 30% likely decrease in income as the cost of the annuity. With the higher weighting on the value of a catastrophic dollar the decline is worse.

Let’s look at a specific scenario to see why. If we compare no annuity (column 2 with $0 in annuity) versus purchasing $100,000 (column 3) with a value for the catastrophic dollar of $3, why didn’t the purchase of an annuity improve the situation?

- With no annuity we had 5.9% negative or gap periods and 6.5% average value in negative periods. The weighted value of the currency is $1.934. (If we had 0% average value in negative periods we would expect a $2.000 average value - $3 for the extreme and $1 for the last dollar required.)
- With $100,000 annuity purchase we had 7.3% negative periods and 10.2% average % of target in negative periods. The weighted value of the currency is $1.898.

If this was a simple trade of the low valued dollars against the high valued dollars the impact of the factor would have been more substantial, but this is not the case. When

we have a gap (and we have more of them), the incremental difference from the additional income, even when weighted, is insufficient to offset the increased negative events.

Impact of Personal Longevity

Annuity rates are by definition linked to the mortality assumptions of a population and are sometimes referred to as a form of longevity insurance – protection against living too long. If a client believes their family history is such that they are longer lived than the norm or alternately shorter lived, this will have an impact on the value of the annuity.

The next stage was to analyse the impact of changes in individual mortality assumptions compared to the population, on both the portfolio and annuity purchase options.

In this analysis we assumed 50% of the capital would be used to purchase an annuity. We then altered the mortality assumption by adjusting the randomized mortality using a "personal longevity factor" – how many years more or less the client feels they would live than the norm.

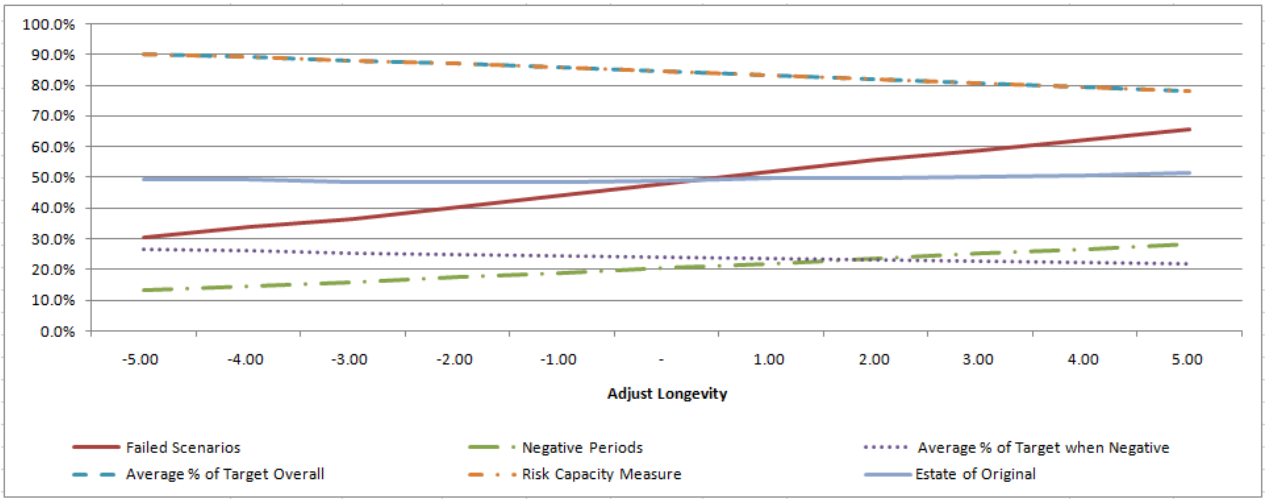

Figure 5: Impact of Personalized Mortality

In Figure 5 we can see that even with 50% of the capital in an annuity, as the client lives for longer periods, the number of negative periods increase, shortage scenarios increase and there is a modest decline in things like the size of the gap etc.

This makes sense intuitively since this is a non-indexed annuity, so for the annuity portion the gap increases the longer the client lives. As well, for the portfolio component, greater longevity will increase the number of failed scenarios.

Next let's look at how the straight portfolio fared. In Figure 6 we can see that with the variation in longevity by +- 5 years, the overall number of shortage scenarios increases from 9% to 29%. Again with a 100% invested in the portfolio the impact of failure is catastrophic as no alternate sources of income exist.

Based on our existing metric, there does not appear to be an improvement by holding an annuity in the event of increased longevity. We also tried the same analysis with 100% in an annuity and the Risk Capacity metric still declined with increased longevity. The additional negative periods from longer life resulted in a lower overall Average % 0f Target Overall.

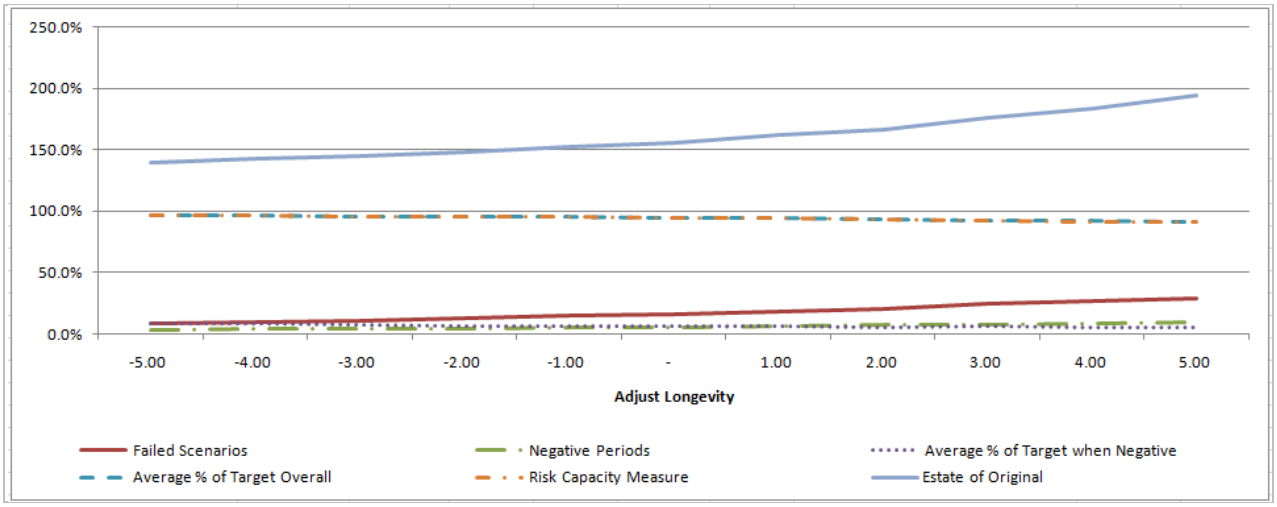

Figure 6: Longevity Impact on Portfolio

Guaranteed Minimum Withdrawal Benefits (GMWB)

To try and remove the concern of the capital market assumptions versus current rates for an annuity, we next tried to look at GMWBs. In this case the mechanism is:

- A portion of the capital is used to purchase the GMWB
- The client is guaranteed a withdrawal of 5% of the guaranteed value in perpetuity. The value was based on current rates from two major insurers.
- We track the actual accumulated value of the GMWB as the capital less the withdrawal then apply the same market return as for the portfolio less an "additional fees" factor, assumed at 1.75% for this analysis. This fee is an assumed higher expense ratio related to the nature of the product. I was not able to find fee information on these sites.
- Annually we set the guaranteed value to the greater of what it is currently or the then current market value.
- Any restrictions within products that limit the guarantee resets could result in a lesser result.

As we can see in Figure 7, like the annuity, the introduction of GMWB increases the overall likelihood of failure, but the percentage of the target achieved in negative period increases to about 70%, slightly higher than the annuity purchase.

The key difference between the annuity and the GMWB is the behaviour of the estate. Especially since the capital in GMWBs has a forced conservative withdrawal strategy which will cause increased gaps while the residual capital in most cases will continue to grow.

If we look at the specific metrics of this situation, out of 1,000 simulations there were 6 where the capital of the client went to zero and the client still lived, requiring the "guarantee" to be invoked. In other words the structure of the withdrawal resulted in only 0.6% of the scenarios where the product provider was out of pocket.

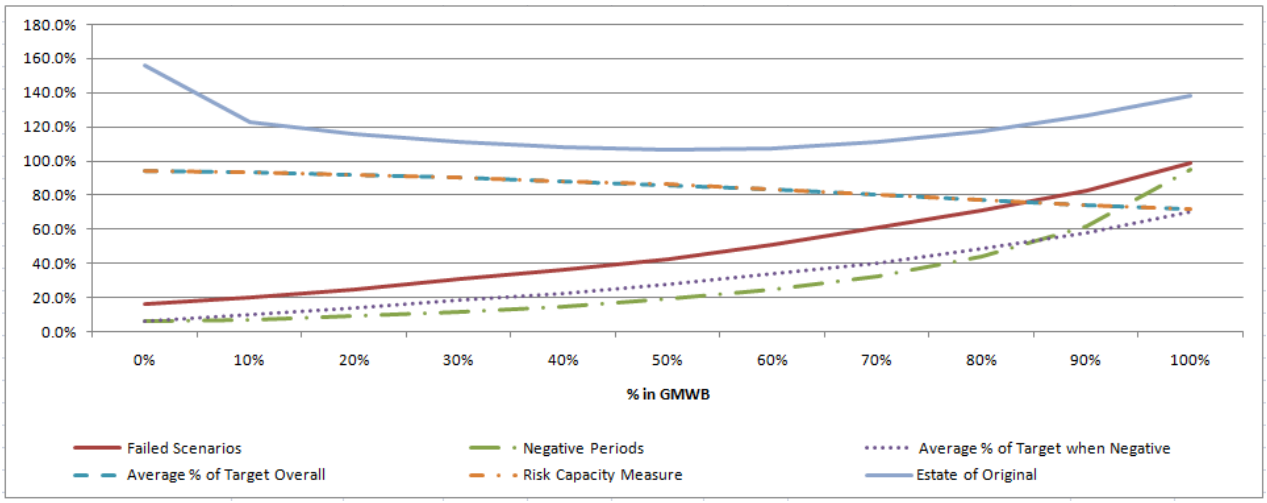

Figure 7: GMWB Purchase

The behaviour of the "Estate of Original" line (it drops then increases again) is a result of the fact that with the GMWB added, 100% of scenarios will have an estate of some amount. This results in a drop of the average estate size. The more money placed in GMWB with the limitation of 5% withdrawals the more we see larger estate residuals.

Impact of Capital Market Assumptions

Expected Return Adjustment	-2	-1.5	-1	-0.5	0	-0.5	-1	-1.5	-2
Inflation Adjustment	0	0	0	0	0	-0.5	-1	-1.5	-2
Failed Scenarios	37.60%	32.90%	27.60%	22.10%	16.10%	15.90%	15.80%	15.70%	15.50%
Negative Periods	14.60%	12.30%	9.90%	7.80%	5.90%	5.80%	5.80%	5.80%	5.70%
Average % of Target when Negative	6.20%	6.80%	6.80%	6.80%	6.50%	6.10%	6.40%	6.30%	6.40%
Average % of Target Overall	86.30%	88.60%	90.80%	92.80%	94.50%	94.50%	94.60%	94.60%	94.60%
Total With Estate	62.40%	67.10%	72.40%	77.90%	83.90%	84.10%	84.20%	84.30%	84.50%
Average Estate	890,955	1,011,053	1,154,728	1,337,127	1,560,274	1,433,587	1,319,725	1,215,874	1,119,763
Risk Capacity Measure	86.30	88.50	90.80	92.70	94.50	94.60	94.60	94.60	94.70
Downside Deviation	36.60%	33.40%	30.00%	26.60%	23.30%	23.20%	23.10%	23.00%	22.90%

Table 4: Adjusting Return Assumptions

The return and inflation assumptions were based on a 70 equity 30 fixed income portfolio and historical data from the last 60 years. Research has shown that using the longest histories available is preferable[iv] and that our forecasting ability is questionable, but invariably people will argue that the times ahead will be different – we cannot expect the same rates of return, inflation will be lower (or some say higher) and so on.

In Table 4 we have adjusted the rate of return assumption by reducing the expected return from the simulations but with no change in the standard deviation. In trials 6 to 9 we have reduced the return and inflation equally so maintained the same real rate of return expectation.

As we would expect intuitively, when the real return remains the same the impact on the analysis is minimal. There is a slight downward trend as we have increased the number of negative return periods and we know a 10% decline requires an 11% positive return to recover, which accounts for the decline. In the scenarios where we reduce the expected return and leave inflation stable the number of failed scenarios increases and the measures for the New Metric are reduced.

We regain the scenarios for the Annuity and the GMWB options reducing inflation by 1% and the expected returns by 2%, so a 1% decline in real return. These changes should clearly play to the advantage of the life annuity as a non-indexed instrument and to some extent the lowered lifestyle expectation could positively impact the GMWB although the lower real return works against it. Compared to 60-year history, we feel these lower values are extreme forecasts.

In Figure 6 we can see that the lower real returns and inflation make the scenarios with larger portfolio amounts on the left experience more failures and lower estate as we would expect, and on the other extreme the annuity covers more of the required lifestyle so we move from 60% of target lifestyle to close to 70%. All that said, every metric seems to worsen as we introduce additional amounts in the annuity.

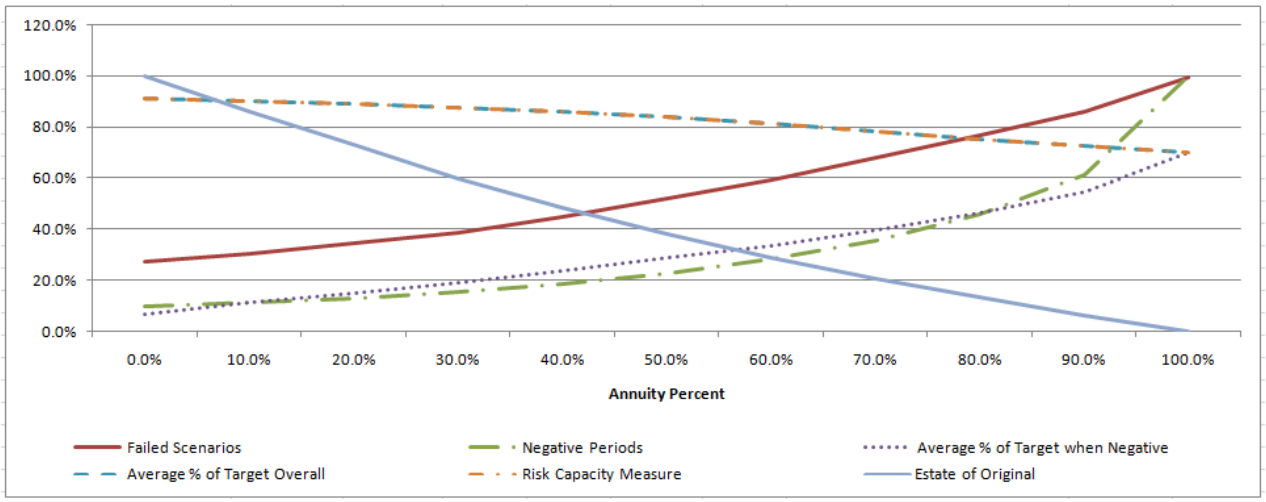

Figure 8: Annuity, Lower ROI

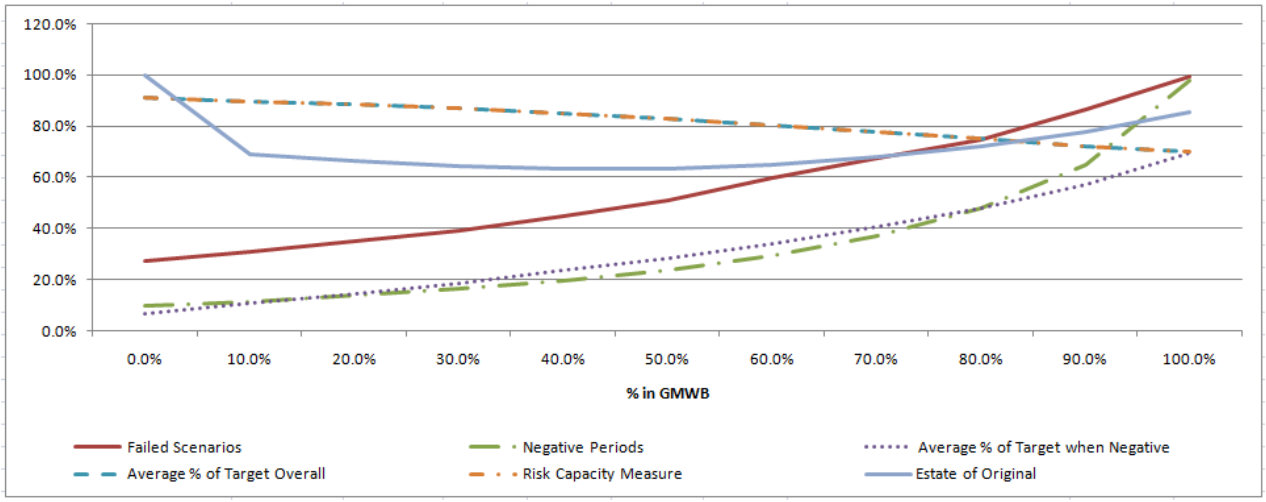

Figure 9: GMWB, Lower ROI

Like the annuity, with a lower return and lower inflation, the portfolio experiences more failures. In this case the GMWB triggered the guarantee in 5.6% of the cases. We still see increasing failures as the GMWB percentage increases and the metrics still result in poorer overall results.

This should not come as a surprise. If a GMWB pays 5% of the capital 1 in 20 times but the customer pays an increased 1.75% 19 of 20 times, no form of straight mathematical formula will likely demonstrate that the client position is improved.

This does raise the question of why so many papers published indicate the positive performance of annuities or GMWBs as an option. If we look closely at some of these we find comments like:

> "*a 96.8 percent success rate isn't bad, especially considering the fact that age 100 is used for the life expectancy. If age 95 had been used, or if historical mortality experience were considered, an even larger success ratio would have been obtained*."[v]

My longevity test looked at a variance of +/- five years from expected mortality. This could easily provide a different outcome than assuming a fixed mortality of about 18 years more than the norm. Assuming everyone lives to 100 with products that pay a lifetime income places a totally unrealistic bias to make these products look good.

A recent letter to the editor in the Journal of Financial Planning in response to "Real-World Index Annuity Returns**"** by Geoffrey VanderPal, Jack Marrion and David Babbel[vi], points out:

> *"[What] we find are the usual problems with these kinds of comparisons--the dividends from stocks are left out of the S&P returns, and the insurance carriers are allowed to cherrypick their annuities without interference, which the authors acknowledge in the article. The article leaves out surrender fees, never mentions sales commissions, and acknowledges that the internal fees of these contracts*

are not disclosed--even to them. … The editors of the Journal, probably without having any idea, published a clever sales pitch disguised as real research."

Trying to find "analytical proofs" that an annuity or GMWB will improve the client position overall may be impossible when compared to a complete funds in a portfolio. By definition the insurer must be compensated, must generate income from the same markets as the client, and to mitigate their own risks will likely have more conservative assumptions for expected returns.

A more viable approach for guarantee product providers is if the annuity can be evaluated against the fixed income portion of the portfolio, so if an annuity is purchased it allows the client to maintain more of the standard portfolio in equities.

Table 5 below is a basic illustration of the concept, although the method used for return adjustments does not include the increased standard deviation we would anticipate comes with the higher return. It applies a 2% reduction in the return expectation and a 1% reduction in inflation. Let's assume the client has a 30% fixed income portfolio earning 3% and 70% in equities earning 9% for a combined 7.2%. If we used 10% of the fixed income portfolio to purchase annuities, the remaining portfolio will now have 20/70 resulting in a 0.47% increase in return. The next $100,000 of annuity will result in a 10/70 portfolio and a 1.05% increase in return and finally if we purchased $300,000 in annuity the remainder would be in all equities with a 1.8% expected return adjustment.

In this case, the overall Risk Capacity measure for the client improves. The negative periods increase by a tiny amount but the "Average % of Target when Negative" increases more dramatically. When we look at alternate values for "the catastrophic dollar", the impact of the weights is more what we expected intuitively with an increased Risk Capacity Measure.

Return Adjustment	-2.00%	-1.53%	-0.95%	-0.20%
Failed Scenarios	44.50%	44.80%	44.50%	44.00%
Negative Periods	18.90%	19.00%	19.10%	19.10%
Average % of Target when Negative	5.90%	9.60%	13.30%	17.30%
Average % of Target Overall	82.20%	82.80%	83.50%	84.20%
Total With Estate	55.50%	55.20%	55.50%	56.00%
Average Estate	769,777	725,719	680,044	643,609
Risk Capacity Measure	82.2	82.8	83.5	84.2
Downside Deviation	41.70%	40.20%	38.80%	36.80%
Annuity	0	100,000	200,000	300,000
Value $				
1.0	82.2	82.8	83.4	84.2
1.5	78.0	78.9	79.9	80.9
2.0	73.8	75.1	76.3	77.7
2.5	69.7	71.2	72.7	74.4
3.0	65.5	67.3	69.1	71.1
3.5	61.3	63.4	65.5	67.9

Table 5: Annuity for Fixed Income

Although analytically correct, the problem with this approach will be how it is perceived in a regulatory framework. What tends to happen is that if a client with a 30/70 portfolio was sold $300,000 in annuities, compliance would disregard this entirely when then measuring the portfolio and would force the client with his remaining $700,000 to invest 30/70 so the client now effectively has 49% invested into equities. In these circumstances the annuity will always result in a poorer position for the client.

Moshe Milevsky made a similar observation that the annuity decision should be considered as an alternative to the fixed income portion of the portfolio in one of the definitive works in this area that looked at the role of variable and fixed-income annuities:

> *Fixed-payout annuities substitute for bonds, and variable-payout annuities substitute for stocks, although more aggressive equity mixes can be invested in once longevity risk has been diminished.*[vii]

A side benefit for the Risk Capacity Measure if properly utilized would be a methodology that incorporates these “guarantee products” into the portfolio construction in a manner that can be good for the client and the firm.

Lifestyle Change and Risk Capacity

The intent of the paper is not to provide judgements on the value of annuities or GMWB products in a client’s life but rather to try and establish a metric that allows an objective

and consistent measure of the value of the increased downside protection against the overall increase in shortage scenarios and wealth throughout the life of the client.

One of the other concepts outlined earlier was the role of lifestyle flexibility in adjusting the client's situation when required by poor markets. Some authors have approached this as a dynamic recalculation of the sustainable withdrawal rate[viii]. Some mechanism is required in practice to manage the withdrawals for the client, but the approach I am taking here is to look at the "worst case" from the client perspective – the difference between required lifestyle and desired lifestyle as a component of risk capacity.

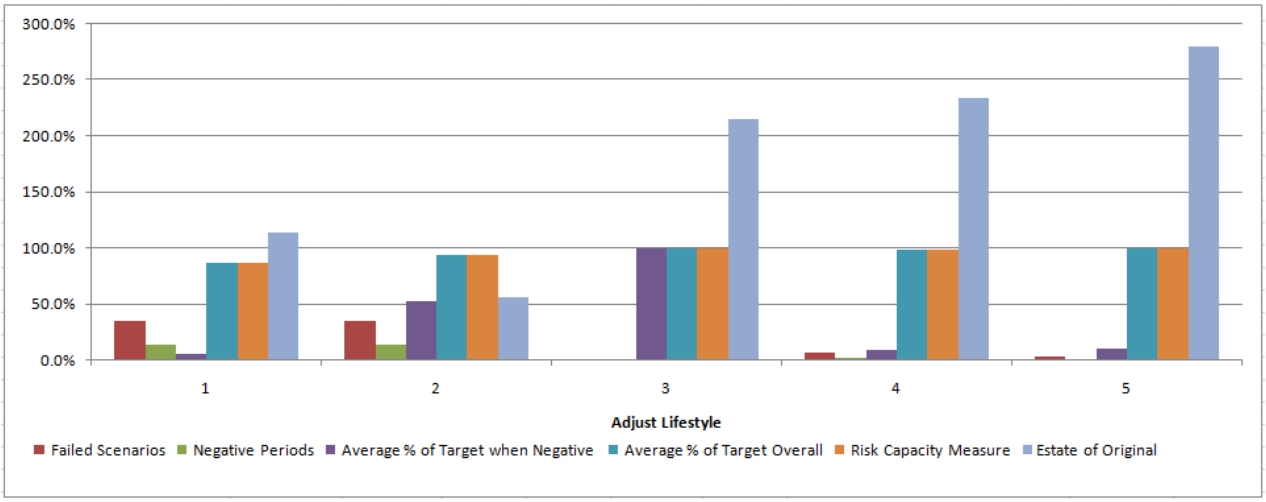

Figure 10: Adjust Lifestyle

Scenario One shows the standard $1,000,000 portfolio with a $70,000 withdrawal that has been referenced throughout this paper. The second scenario is a client with half the capital but a pension for $35,000. The failed scenarios, number of negative periods are the same, estate is half what it is in scenario one, but the average percentage of goal achieved, in negative and overall is improved as is the Risk Capacity metric.

Scenario 3 is a simple lifestyle case is which the client says that they want $70,000 a year income, $500,000 capital and a $35,000 pension, but they could live with $50,000 – a 28.6% reduction in the goal. In this case there is never a shortage and the Risk Capacity Metric is 100%.

Other examples that become more complex to measure are things like "we could sell our house and move to a smaller home if things are bad", or "I could go back to work as a part time consultant and make $10,000 a year to supplement our income for the first 10 years of retirement." In this example (or any revenue offset), we can take a mortality weighted value of the goal and the proposed change in the income goal to calculate the overall impact.

Measuring the change in the goal (required versus desired) is interesting but has no value relative to the risk capacity measure. A decrease of lifestyle targets by 10% may make minimal difference for one client but for another remove almost all downside risk.

In scenario 4 we return to no base pension and a $1,000,000 capital with the $70,000 a year target income then apply the Lifestyle Adjustments of a reduced target to $50,000.

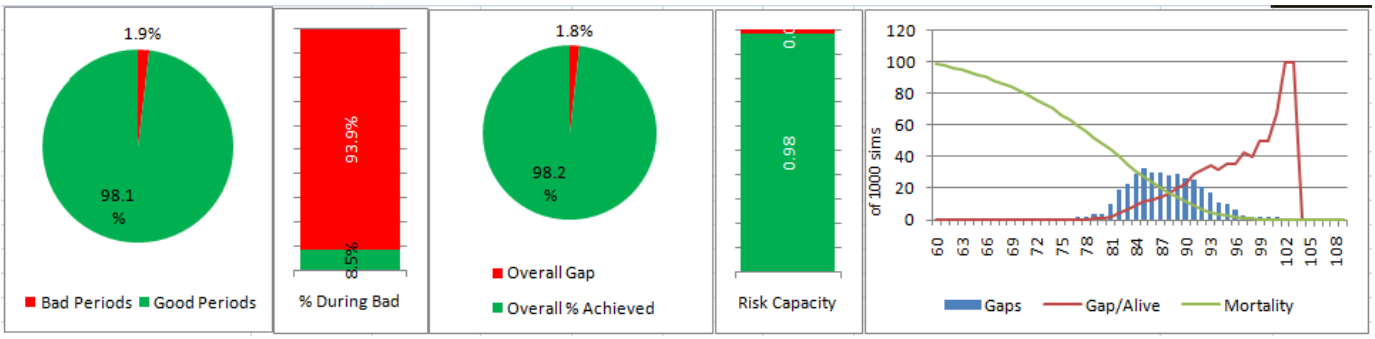

Figure 11: Reduced Income

In Figure 11 we see the metrics for this scenario and although we still have a "deep hole" when it occurs, the frequency is under 2%. On the distribution chart to the right we can see that between the 80s to mid-90s we have about 30 simulations (0.3%) with a gap. Even then it represents fewer than 40% of the simulations in which the client is still alive. Only after the age one hundred do we see that move than 50% of the remaining simulations resulted in a gap.

In scenario 5 we add the supplemental income of $10,000 for the first 10 years of retirement.

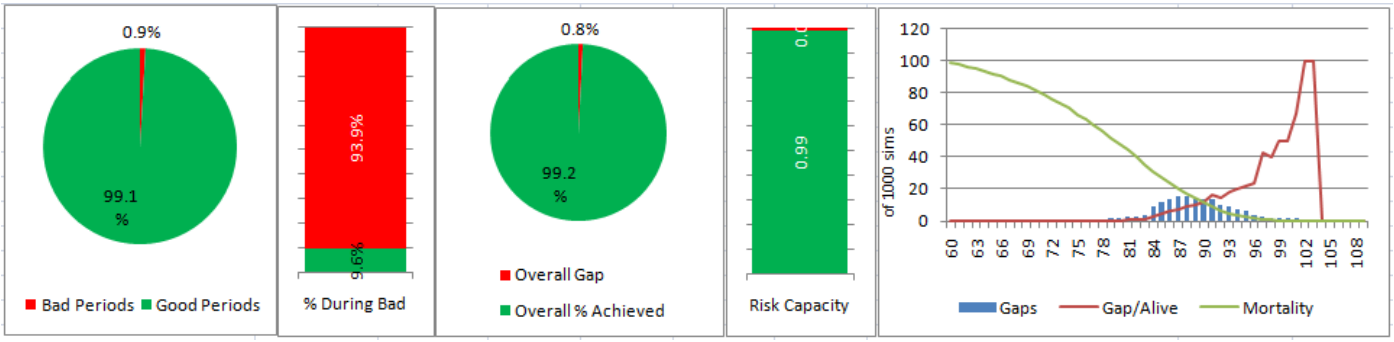

Figure 12: Reduced Income plus Additional Revenue

Figure 12 shows the result of adding the additional income and the "bad/negative periods" falls to under 1% of the time and we can see the number of simulations with a gap falls to under 0.2% of the simulations between the mid-80s and mid-90s.

Summary

We have seen that there are a number of factors that must be combined for a client to understand true downside impact. Traditional Pass/Fail Monte Carlo analysis does not reflect these. The two most critical factors are the number of negative periods and the average % of the target income achieved during negative periods.

These factors can be combined to create a "Risk Capacity Metric" that can be weighted by valuing a first dollar (catastrophic dollar) versus a last dollar to achieve a goal. When valued at $1 the result is the same as the "% of overall target achieved".

When applying this Risk Capacity Metric, even with significant weighting to the value of a catastrophic dollar, the increased cost of the annuity or GMWB is not offset by increased stability in revenue in negative periods. Integrating the annuity as an alternative to fixed income (which is in fact more realistic) demonstrated their value in increasing risk capacity, but only in the event the remaining client portfolio was thereby proportionately invested in more equities. This is a challenge from a compliance perspective.

Adjustments based on personal longevity and altered capital market assumptions that would be more favourable to the guarantee products still did not create situations in which they were preferred over a traditional portfolio.

The Risk Capacity Metric reflects the impact of changes in these various parameters as well as lifestyle adjustment considerations – a viable measure of overall risk capacity.

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[i] Financial Services Authority Guidance consultation Assessing suitability**:** Establishing the risk a customer is willing and able to take and making a suitable investment selection, January 2011

[ii] Based on Statistics Canada tables from 1997, assuming 100,000 lives at birth.

[iii] www.**lifeannuities**.com

[iv] "How Inefficient is the 1/N Asset-Allocation Strategy", DeMiguel, Victor, Lorenzo Garlappi & Raman Uppal May 31, 2005

[v] "Achieving Sustainable Retirement Withdrawals: A Combined Equity & Annuity Approach" Lemoine, Cordell, Gustafson, January 2010 *Journal of Financial Planning*

[vi] "Real-World Index Annuity Returns**"** by Geoffrey VanderPal, Jack Marrion and David Babbel March 2011, *Journal of Financial Planning*

[vii] "Lifetime Financial Advice: Human Capital, Asset Allocation, and Insurance**"** *Roger G. Ibbotson, Moshe A. Milevsky, Peng Chen, Kevin X. Zhu April 2007,* Research Foundation of CFA Institute

[viii] "A Dynamic & Adaptive Approach to Distribution Planning & Monitoring" Blanchett & Frank April 2009 *Journal of Financial Planning*