Question & Answer

Member's Default Utility Function

VERSION 1 | MDUF v1

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Question	Answer
What is a utility function?	A utility function is a mathematical formula that reflects the preferences of an individual. It can reduce the dimension of problems to something that is easier to measure and compare through ranking alternatives according to an individual's utility outcomes.
Why do we consider MDUF v1 superior to other retirement outcome metrics used in the industry?	The below table compares different retirement outcome metrics in terms of the key aspects in retirement modelling.

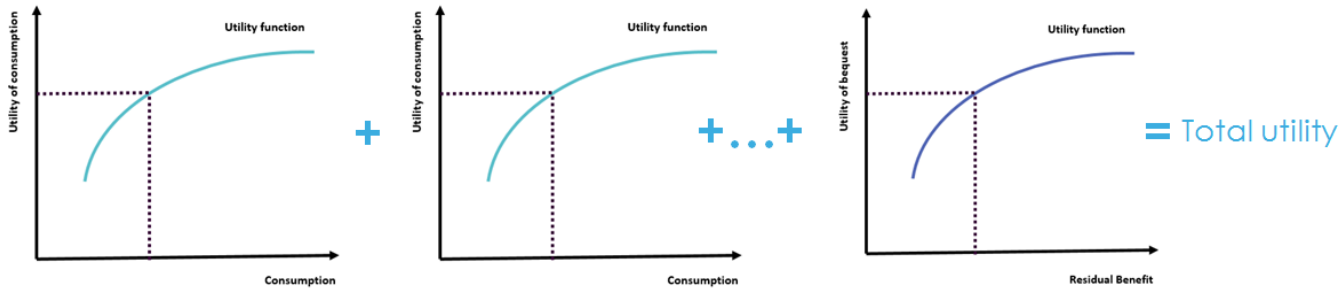
Statistic	Income	Income volatility	Longevity risk (outliving)	Residual benefit	Risk aversion
Replacement rate	Considered	Ignored	Ignored	Ignored	Ignored
Shortfall risk	Considered	Somewhat captured	Considered	Ignored	Ignored
Funded ratio	Considered	Somewhat captured	Somewhat captured	Ignored	Ignored
MDUF v1	Considered	Considered	Considered	Considered	Considered

Why aren't any behavioural biases incorporated into MDUF v1?	MDUF v1 incorporates rational behaviour such as risk aversion, residual benefit motive and some degree of income smoothing. MDUF v1 does not account for behavioural biases. We have a concern that catering to behavioural biases could be detrimental to sustainable retirement outcomes. Where possible we stay close to the mainstream academic literature and choose a simpler approach to increase the ability for the industry to make use of MDUF v1. We believe MDUF v1 provides an appropriate framework as the basis of a sensible objective for trustees to assume on behalf of super fund members on which they have little insight. Trustees can choose to step away from MDUF v1 if they want to allow for behavioural biases or if they believe they have greater member insight.
Explain the "straw man" role that MDUF v1 can perform for super funds and regulators.	Super funds could begin with MDUF v1 as the starting point for determining and reflecting default member objectives, from which they could then consider and justify if and how they would step away to their own tailored objective.
How has credibility been established in MDUF v1?	We believe that credibility in MDUF v1 has been achieved in a number of ways: 1. The breadth and depth of relevant experience across the panel. Collectively there is over 200 years of relevant experience amongst panel members. The panel was diversified by role (academic, consultant and asset owner). 2. The timeframe of the project, 18 months, allowed for a large amount of discussion and robust debate on key areas. 3. The testing of MDUF v1 through developed models (included in the Working Paper) produced results which broadly reconciled with existing research (examples include an estimation of the value of the Age Pension and determination of appropriate age-based percentage drawdown rates for account-based pensions). Broadly all results and implications were considered to be intuitively sensible to the panel. 4. The design of MDUF v1 is supported by a large amount of academic literature. Academic literature itself goes through a strong review process. Overall there is a path of research which supports MDUF v1. 5. Through further engagement with industry, regulators and policymakers, we have been able to gauge whether there are any gaps or conflicting beliefs in the design of MDUF v1. 6. We are seeking to produce an academic paper and have the MDUF v1 published in an academic journal.

What preferences are reflected in the design of MDUF v1?	The panel determined that, from a retirement outcomes perspective, the following are a sensible set of preferences: 1. Members prefer high (rather than lower) income in retirement; 2. Members would prefer a smooth rather than a volatile income stream; 3. It would be undesirable for a member to outlive their retirement savings (or the income stream it generates); 4. Members place some value on the residual benefit at death; 5. Members are economically risk averse: this means that the size of the joy experienced from a higher level of consumption is less than the size of the pain experienced by an equivalently sized reduction in consumption.
How do you justify that the residual benefit at death has some value?	We believe that there are (at least) four arguments which justify placing some value on any residual benefit at death: 1. There is a distinct risk of dying early in retirement. Assuming one were to retire today at age 65: then for a male (female) there is a 1.1% (0.6%) chance of dying in the first year of retirement and a 15.6% (9.9%) chance of dying in the first decade of retirement. In these cases we believe that it would be inappropriate for a trustee to design a post-retirement solution which places no value on any residual benefit; 2. The superannuation system is designed around the individual, not the household, yet over 65% of people retire with a partner. For households with a significant income difference between the two partners the residual account value provides the retirement outcome for the surviving (low income) partner; 3. Empirical research suggests that people do place value on the bequest aspect associated with a residual benefit; 4. Residual benefit acts as a reserve pool for many life events related to aged care, healthcare, travelling and family.
Does the MDUF v1 encourage "bequest hoarding" i.e. living on Age Pension and maximising a bequest?	No. MDUF v1 is calibrated in such a way that it places a lower value on the residual benefit than the long-term income stream that it could generate. This prevents the development of bequest prioritisation strategies – "live on a low level of income and maximise the residual benefit". See the "**MDUF v1 Working Paper**" and "**MDUF v1 Technical Paper No. 1: MDFU v1 Design**" for more detail.

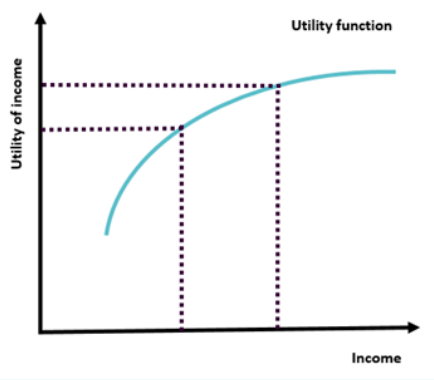
Does MDUF v1 capture liquidity preferences i.e. reflect additional value on having access to capital?	MDUF v1 does not incorporate access to capital (i.e. liquidity) as a preference. There is currently no dominant stream of research on how to incorporate liquidity preferences into a preference function. This would be a valuable consideration in a version 2 project. In the meantime we would advise that super funds consider incorporating formal liquidity limits (modelled through life) into their retirement solution design. We note that in some cases the residual benefit (if provided through an account-based pension) provides some access to liquidity.
What is the benefit of expressing these preferences into a mathematical formula?	By expressing preferences into a formula we have what is known as a utility function. This is a particularly useful formula which has many different uses. For instance when we consider the example of super fund design: 1. MDUF v1 can be used to rank competing retirement solution designs. See **"Technical Paper No. 2: Static Models"** for more detail. 2. MDUF v1 can be used to estimate the difference in value (to the member) between two competing solutions. See **"Technical Paper No. 3: Optimal Dynamic Strategies"** for more detail. 3. The solution which maximises expected utility (using MDUF v1) can be identified (though the modelling for this is complex). A worked optimisation example is included in the "**MDUF v1 Working Paper" or** See **"Technical Paper No. 3: Optimal Dynamic Strategies"** for more detail.
How did you manage to calibrate and estimate the model parameters if you did not conduct your own surveys?	The parameterisation of MDUF v1 was undertaken through extensive literature reviews and model calibrations: — The parameter value of residual benefit motive strength is determined based on a large number of academic studies. — The choice of the parameter value of risk aversion is a combined result of literature reviews and model calibration. The selected value of risk aversion parameter delivers fairly reasonable variability in year-to-year consumption changes that are consistent with our view. The value is also within the range used in many academic studies. — The subjective discount factor is set to 1, based on the grounds that we focus on a sustainable retirement income strategy through life rather than catering to potential myopic (short-sighted) biases which could place retirement outcomes at risk. In addition, from the view of trustees that represent many members of different cohorts, the intergenerational equity is an important issue, i.e. having a utility discount factor less than 1 would mean less value given to those who survive to older ages. — Mortality probabilities in the model are sourced from the Australian Life Tables 2010-12 prepared by Australian Government Actuary. See the "**MDUF v1 Working Paper"** and "**MDUF v1 Technical Paper No. 1: MDFU v1 Design"** for more detail.

Can MDUF v1 be simply represented in a diagram?



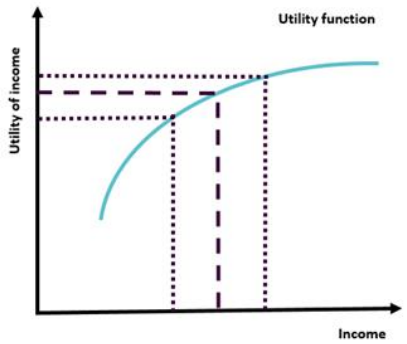
Total lifetime utility calculated using MDUF v1 is equal to the summation of the utility score of each consumption cash flow and the utility score of the residual benefit at the time of death.

How can we show that higher income generates greater utility?



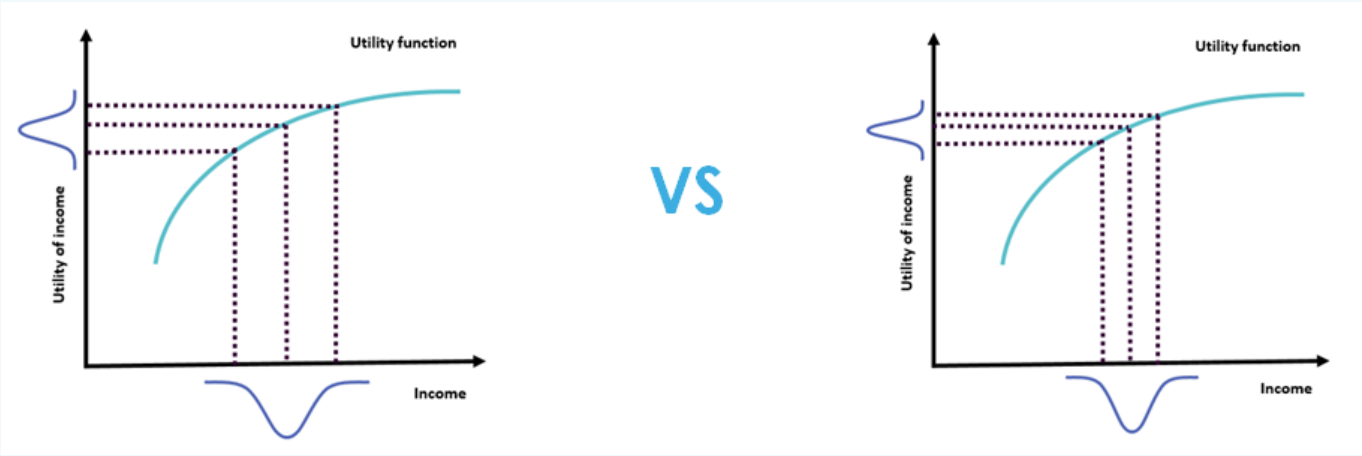
A higher income level on the horizontal axis corresponds to a higher utility score on the vertical axis.

How does MDUF v1 reflect the assumption that members are economically risk averse?



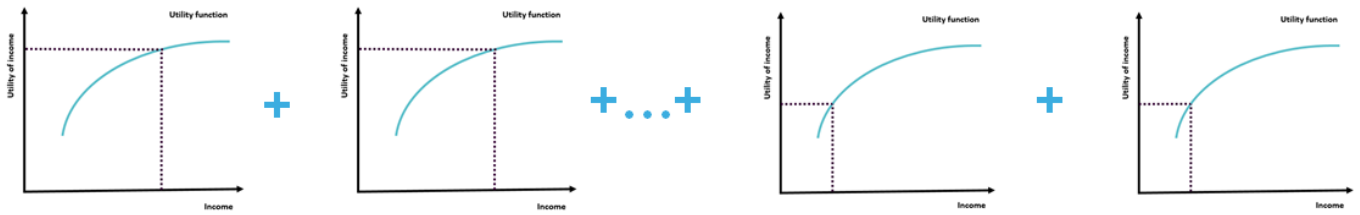
Risk aversion is reflected from the concave utility curve since marginal utility is decreasing as income increases. Risk aversion captures an individual's conservativeness towards risks. The more risk averse an individual is, the more pronounced is the utility loss resulting from a reduction in consumption relative to the utility gain from an increase in consumption of the same amount. i.e. the higher the risk aversion parameter, people are more afraid of loss.

How does MDUF v1 identify the value in a less volatile income stream?



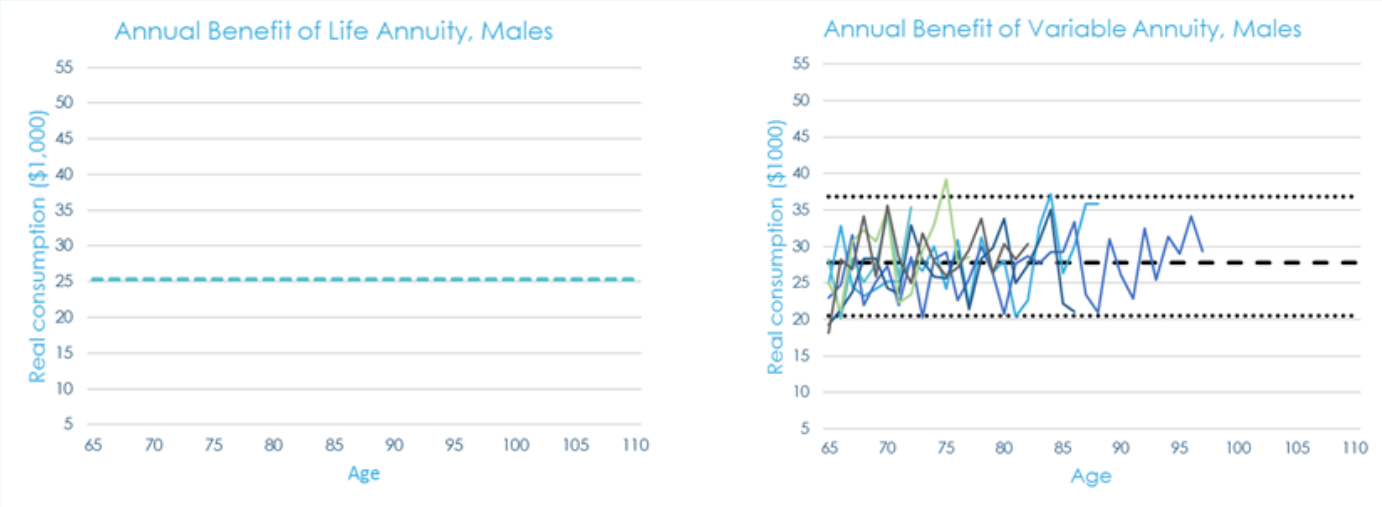
The chart on the right represents a less volatile income stream – the distribution of income is narrower in the right chart (horizontal axis) compared with the left (we assume the two distributions have the same mean level of income). In MDUF v1, lower income experiences are 'penalised' more heavily relative to higher income scenarios (explained in question above). As the distribution of income scenarios widens the size of this relative penalty becomes larger. The overall expected (or average) utility, the probability weighted sum of utility across all possible outcomes, is therefore lower when, all else equal, volatility is greater.

How does the MDUF v1 reflect the poor outcome of outliving retirement savings?



The charts above consider a lifetime of income for an individual who exhausts their retirement savings and lives off the Age Pension for the remaining years of their life. MDUF v1 penalises this possible outcome because the additional utility generated from a higher level of income is less than the loss of utility which comes from experiencing some years solely on the Age Pension.

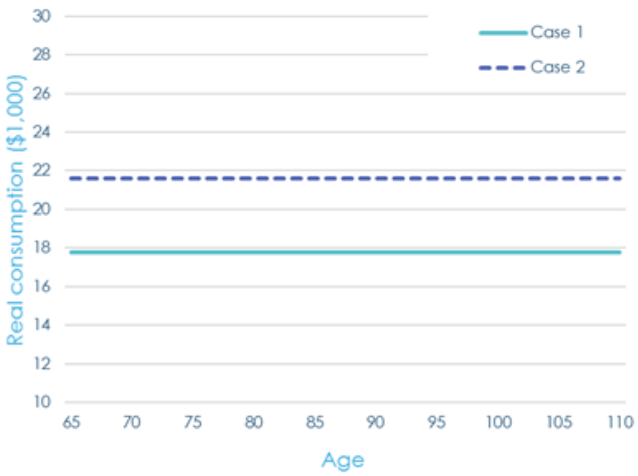
What does MDUF v1 imply about the trade-off between income and volatility of income?

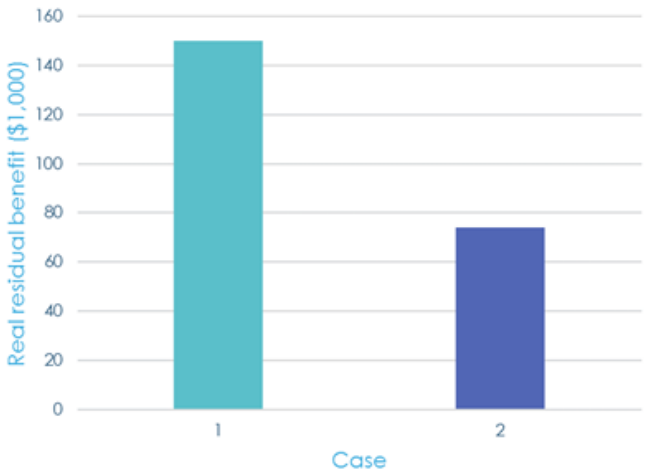


One implication of MDUF v1 is that we can establish a trade-off between expected level and volatility of income. The two income streams represented above generate equivalent expected utility for a member. Effectively our homogenous, generic default member would be indifferent between these two income streams.

Of the charts above, the left shows a life annuity with a guaranteed for life, fixed inflation-indexed income stream. The right chart is of an income stream which is guaranteed for life but the income payments have some variability. The investor is being rewarded for this greater volatility through a higher expected outcome (dashed line). The two dotted lines represent a 95% confidence interval (so only 5% of yearly income experiences should lie outside of this range). The coloured lines represent some randomly simulated income streams.

What does MDUF v1 imply about the trade-off between the level of income and the size of residual benefit at death?





Another implication of MDUF v1 which we illustrate is the ability to identify the trade-off between different combinations of income stream and residual benefit. The charts above illustrates two combinations of (guaranteed-for-life) income streams and guaranteed residual benefit profiles. The combinations represented above generate equivalent expected utility for a member. Under MDUF v1 our homogenous, generic default member would be indifferent between these two 'products'.

Can you explain the MDUF v1 formula

$$E_0\left[\sum_{t=0}^{T}\left\{{}_tp_x\left(\frac{c_t^{1-\rho}}{1-\rho}\right)+{}_{t-1|}q_x\left(\frac{b_t^{1-\rho}}{1-\rho}\left(\frac{\phi}{1-\phi}\right)^{\rho}\right)\right\}\right]$$

- x: the inception age of a particular cohort,
- T: the retirement planning horizon ($x+T$ is the maximum age),
- c_t: consumption in year t,
- b_t: level of wealth at time t which equals the amount of residual account value if the person dies between $t-1$ and t,
- ${}_tp_x$: probability of being alive at age $x+t$ conditional on being alive at age x
- ${}_{t-1|}q_x$: probability of dying between age $x+t-1$ and $x+t$ conditional on being alive at age x
- ρ: level of risk aversion
- ϕ: strength of residual account motive

How can we calculate alternative measures of value such as certainty equivalent consumption (CEC) wealth gap (WG) and extra annual return (EAR)?

Utility can be used as a scoreboard of an individual's lifetime welfare, which is a ranking instead of an absolute score. It is difficult to perform quantitative comparisons directly based on utility scores. We need to use other measures to investigate welfare gains or losses of different retirement strategies.

CEC is calculated as the consumption level in the one-period utility function, i.e. equating $\frac{c_t^{1-\rho}}{1-\rho}$ to the lifetime utility calculated for the strategy. CEC, in essence, is a monotonic transformation of the lifetime utility. A higher level of the lifetime utility also corresponds to a higher CEC level. Note that CEC does not necessarily convey information of the actual level of consumption.

For a pair of two cases, the wealth gap is calculated as the additional amount in the initial wealth in one case that can result in the same level of lifetime utility in the other case. We can compare cases with and without a certain retirement product (e.g. life annuity) in order to measure the dollar amount welfare gains of having access to this product.

For a pair of two cases, the extra annual return is calculated as the additional annual return of the fund investment performance in one case that can result in the higher level of life-time utility in the other case. We can compare cases with and without a certain retirement product (e.g. life annuity) in order to measure the welfare gains of having access to this product, in terms of annual investment returns.

How would you compare MDUF v1 against the replacement rate measure?

We can compare how the two measures incorporate income, income volatility, longevity risk, residual benefit and risk aversion into the metrics. Replacement rate captures the level of income in retirement in comparison to pre-retirement income. Replacement rate measure ignores the two major risks in retirement: investment and mortality risk. It does not consider income volatility due to different investment outcomes or longevity risk due to the possibility of outliving retirement savings. In addition, it does not place value of any residual benefit at the time of death. It also does not reflect the risk aversion preference of members. All of the aspects mentioned above are all captured in MDUF v1.

How would you compare MDUF v1 against the shortfall risk statistic?

We can compare how the two measures incorporate income, income volatility, longevity risk, residual benefit and risk aversion into the metrics. Shortfall risk measure captures the level of income through setting an income goal through retirement. An income shortfall is defined as not being able to achieve the income goal. This normally happens in later retirement and it can be a combined result of poor investment outcomes and living longer than expected. As a result, it somehow captures the income volatility and longevity risk aspects by realising the impacts at the end of retirement. However the income goal is fixed: there is no flexibility around changing consumption levels in response to investment outcomes over time like MDUF v1 allows. In addition, it does not place value of any residual benefit at the time of death. It also does not reflect the risk aversion preference of members. All of the aspects mentioned above are all captured in MDUF v1.

How would you compare MDUF v1 against the funded ratio measure?

We can compare how the two measures incorporate income, income volatility, longevity risk, residual benefit and risk aversion into the metrics. The concept of funded ratio measure comes from a defined benefit fund heritage. It is a ratio of a pension /annuity assets to its liabilities. Since there is no liability in defined contribution schemes, the liability side can be considered as the present value of the members' retirement income goal. Some important assumptions on discount rate, investment returns and mortality need to be made for the calculation of this ratio. As a result, it partially (likely inexactly) captures the income volatility and longevity risk aspects through mortality rate and the choice of discount rate. In addition, it does not place value of any residual benefit at the time of death. It also does not reflect the risk aversion preference of members. All of the aspects mentioned above are all captured in MDUF v1.

How could MDUF v1 be used by super funds?

It may not be a surprise that we believe MDUF v1 has strong application to super fund and post-retirement solution design! There is nearly an unlimited list of projects in which MDUF v1 could perform an important role. Examples beyond product and solution design include:

1. Valuing investment strategies such as portfolio protection and low volatility strategies.
2. Estimating the benefits of projects such as personalised accounts (whereby a member's solution is designed based on their personal situation), and digital financial advice strategies.

However we believe MDUF v1 has the potential to perform a more important role within a super fund, that of acting as a guide for the allocation of capital and resources. Consider that a super fund's objective is to deliver very good retirement outcomes, and that we believe the MDUF v1 is a superior metric for assessing outcomes. A super fund could conceivably make MDUF v1 a core part of their business decisions i.e. a metric used in the creation of business cases. Industry participants are aware of how difficult it is to compare and prioritise projects from different parts of the business. MDUF v1 may provide a framework which can assist and elevate the decision making process of super funds to be more consistent with the broad objective of the system.

How could MDUF v1 be used by policymakers and regulators?	MDUF v1 is highly valuable for policymakers and regulators. Currently, policymakers use deterministic (i.e. assume the mean expected outcome is achieved) techniques when estimating welfare benefits of policy changes. In doing so they are potentially ignoring the issue of risk: a risky dollar of retirement income and a sure dollar of retirement income be valued equivalently. Other highlighted features of MDUF v1, notably consideration of residual benefits and risk aversion, are features which may not be presently acknowledged by policymakers. For regulators MDUF v1 raises the bar by providing open architecture access for all industry to a well-considered set of retirement outcome preferences formulated into a metric. Perhaps, as a result, MDUF v1 has a "straw man" role to play for regulators: maybe regulators could compare how well-formed a super fund's preferences and objectives are against an accessible industry benchmark such as MDUF v1.
How could MDUF v1 be used by investment managers?	MDUF v1 provides a great opportunity for fund managers to demonstrate the value of products and services in a manner empathetic with the objectives of their potential clients. In particular, MDUF v1 has strong application in quantifying the benefits of reduced volatility, diversification, and solutions with reduced downside risk profile.
How could MDUF v1 be used by life companies?	Life companies can use MDUF v1 to assist in examining and explaining the benefits of their products and as an aid in product design.
How could MDUF v1 be used by super fund ratings groups?	MDUF v1 highlights that people have multiple important preferences when it comes to retirement outcomes. Currently the industry and ratings groups are heavily focused on the level of investment returns. Overall solution design as well as risk management also have a significant impact on retirement outcomes. Super fund ratings groups have open architecture access to all of the MDUF v1 materials. It would promote industry change and focus on retirement outcomes were ratings groups to incorporate MDUF v1 into their fund assessment.
How could MDUF v1 be used by industry bodies?	Industry bodies produce research which is presented to policymakers but face similar challenges to policymakers (described above) when it comes to assessing retirement outcomes. Given the integrity of research and preferences incorporated into MDUF v1, it is relevant for industry bodies to consider, where relevant, how MDUF v1 can be used in their research.

How could MDUF v1 be used by academics?	There is a substantial amount of academic research that applies utility functions to address retirement outcome research questions. However there remains broad subjectivity over the choice of utility function. MDUF v1 may provide a more standardised utility function accessible to the academic community, particularly for Australian-focused research. The plan to have MDUF v1 published in an academic journal adds further credibility to other academics. Academic research which utilises MDUF v1 has a greater likelihood of being understood, hence accepted and applied, by industry. As an emerging trend in universities is to seek more industry relationships, MDUF v1 potentially represents a standardised link between industry and academia regarding retirement outcome objectives.
How could MDUF v1 be used by financial planners?	Can MDUF v1 be applied to financial planning? The answer is yes, especially in the technology (pertaining to utility functions) which MDUF v1 brings to the industry. The super fund industry and financial planning industry both face similar problems, notably they commonly err in not considering the range of outcomes that their members / clients may experience. MDUF v1 forces one to focus on the range of outcomes, an important reflection for both industries. A key (current) difference between super funds and financial planners is that planners explore the preferences of each of their individual clients. An exciting future development may be one where financial planners develop individual utility functions for each of their clients.
Why is utility as calculated by MDUF v1 a negative number?	This is simply the way that the formula works. It needs to be this way to reflect the preferences we believe are important to an individual. This means however that the measurement itself can only be used to rank solutions – the numbers themselves have no economic interpretation. To create more useful measures we recommend that you estimate alternative measures such as certainty equivalent consumption, wealth gap or extra annual return.
If one used MDUF v1 to quantitatively determine the optimal post-retirement solution, what other analysis would you suggest?	We would suggest an analysis on the impact of parameter values on the optimal results, including consumption, asset allocation, annuitisation ratio, and Age Pension entitlement. See the **"MDUF v1 Working Paper"** for more detail. MDUF v1 does not capture liquidity preferences. There is currently no dominant stream of research on how to incorporate liquidity preferences into a preference function. This would be a valuable consideration in a version 2 project. In the meantime we would advise that super funds consider incorporating formal liquidity limits (modelled through life) into their retirement solution design.

Why do you typically use simulation techniques when calculating utility?

Technically the retirement outcomes problem can be defined as "A dynamic, integrated consumption and investment decision problem." We cannot ignore the fact that consumption levels over time and residual benefit value can vary due to investment risk and mortality outcomes. Investment outcome in one period can in fact impact consumption not only in the next period but also all subsequent periods' outcomes. As a result, it is not easy to find an analytical solution for the lifecycle problem. Simulation of investment outcomes over time are typically used to calculate the total lifetime utility. For mortality outcomes, we can either use simulation or apply the lifetable mortality rate directly to the utility function as what is shown in the recommended form of MDUF v1.

MDUF v1 assumes constant relative risk aversion (CRRA) rather than constant absolute risk aversion (CARA). Why was this assumption made?

For investors who are CARA, as their consumption level increases, the dollar amount they invest in risky assets would not change. For investors who are CRRA, as their consumption level increases, the percentage of their wealth invested in risky assets does not change. We believe the implications of CRRA are more intuitive.

Utility functions with constant risk aversion, i.e. CARA or CRRA, are the most commonly used in academic literature on maximization of expected utility of terminal wealth in DC accumulation phase. Some papers that discuss about using CARA utility function include Devolder et al. (2003) and Battocchio and Menoncin (2004). There are a lot of papers which discuss CRRA as the most widely used utility function especially when it is defined over life-cycle consumption. These include Tobin and Dolde (1971), Mehra and Prescott (1985), Gourinchas and Parker (2002), Chetty (2006), Schechter (2007), Yogo (2009), Ameriks et al. (2011), and Lockwood (2014). As a result, we chose CRRA over CARA for the design of MDUF v1.

See **"Technical Paper No. 1: MDFU v1 Design"** and **"MDUF v1 Working Paper"** for more detail.

Why hasn't industry made more use of utility functions in the past?

Academia is ahead of industry when it comes to research on retirement outcomes. For a number of decades academics in retirement outcome research have used utility functions to reflect different objectives in retirement. One of the reasons that industry has not made more use of utility functions is due to its complexity. The focus of the superannuation industry has historically been on maximising lump sum at retirement. This is a straight forward objective which is less complex. However, there has been a shift of focus from lump sum to retirement income streams in recent years. This changed the nature of the problem from a one dimensional to a multi-dimensional problem as now we need to consider the trade-off between different preferences that are pulling against each other. Examples for the different preferences include higher income through life, smoother income over time, not outliving savings, value on residual benefit and the risk aversion nature of members. A utility function is useful for capturing multiple preferences.

How does MDUF v1 interact with mean variance efficient portfolios?	The assumption of risk averse investors is consistent under both the MDUF v1 framework and the mean-variance efficient portfolio theory. Theoretically individuals would still select portfolios which sit on the Capital Markets Line. See the **"MDUF v1 Working Paper"** for more detail.
MDUF v1 does not discount distant cashflows (relative to near cashflows), something which is common in the academic literature. Why was this decision made?	The value of the subjective utility discount factor has received a number of debates in the academic literature. Some argue that a rational individual should place equal value throughout life, so they believe that the subjective utility discount factor should be equal to 1 (see, e.g., Broome, 1991; Elster, 1986; Rawls, 2009; Becker and Murphy, 1988). Looking from an individual's point of view, some philosophers (such as Zemach, 1987; Parfit, 1993) describe an individual as "a succession of overlapping selves related to varying degrees of memories" so they believe it is rational to discount future utility. The values of subjective utility discount factor used in the literature are largely variable. Through the lens of a trustee, it is appropriate to not discount distant utilities. This means we focus on a sustainable retirement income strategy through life rather than catering to potential myopic (short-sighted) biases which could place retirement outcomes at risk. In addition, from the view of trustees that represent many members of different cohorts, the intergenerational equity is an important issue, i.e. having a less than 1 utility discount factor would mean less value given to those who survive to older ages.
Does MDUF v1 target a smooth consumption stream through time?	In MDUF v1 it is assumed that the dollar amount of financial risk taken is proportional to wealth. The level of income is then calculated as the sustainable level of income by spreading the expected consumption evenly on a basis which accounts for the distribution of investment returns and mortality outcomes and maximises total expected utility. If investment returns and mortality outcomes were known with certainty then MDUF v1 would recommend a constant consumption path. However investment and mortality outcomes are variable. As a result a change in wealth due to market movements results in a change in sustainable income. This is an important message for trustees: the risk that is taken at a fund level at any time will impact the sustainable level of income not just this year but for all future years. Our MDUF v1 provides a strong focus on sustainable income in retirement, taking into consideration the trade-offs between high income preferences and smooth consumption stream through time.

Did you consider assuming a more specific consumption pattern in retirement e.g. active (higher consuming) early retirement, a more steady mid-retirement, and then a more costly late retirement?	We did consider this but guidance from MDUF panel members was that the size and timing of consumption patterns was not consistent across the population. Incorporating specific consumption patterns based on different retirement phases can be a possible extension for MDUF v2.
Did you consider incorporating a minimum income floor into the design of MDUF v1?	Yes, the working group initially incorporated a minimum income floor in the design, but we found that it was rather subjective to put a value on this floor. It is also likely that the floor would be personalised to the member, making it difficult to apply to a default strategy applied to many members. The structure of MDUF v1 inherently considers a sustainable level of retirement income, rather than subjectively selecting a value. We also note that the Age Pension implicitly guarantees a floor.
What were some of the tests undertaken to ensure that MDUF v1 produces sensible results?	We performed model calibration of the MDUF v1 and analysed the results amongst the working group to make sure it deliver sensible outcome. We also performed sensitivity analysis of the model parameters to check the model robustness. In MDUF v1's applications to optimal dynamic retirement strategies, the recommended optimal ABP drawdown rates are compared with the minimum drawdown rules and other recommendations. A back-testing can be performed to evaluate how the optimal dynamic strategy recommended in MDUF v1 delivers better retirement outcome than other strategies. We are also able to evaluate the welfare improvement of the Age Pension and this is quite comparable to the value of the Age Pension that is provided by the Treasury.
Did you use discretion in designing the MDUF v1 or did you solely leverage existing research?	Test cases were developed and worked through for consideration by the MDUF working group. These insights supplemented our analysis of existing empirical research in coming to our design of MDUF v1. The most notable example was our investigation into how the risk aversion parameter would impact year-to-year consumption changes. We believe the potential for year-to-year changes in retirement income of more than 10% would not be palatable to super fund members. This type of discretion overlay is used in the parameterisation of MDUF v1.

How could MDUF v1 be used to estimate the opportunity cost of having a homogenous (one solution for all) post-retirement solution?	The expected utility under the MDUF v1 framework can be calculated for a representative mix of retirees using a homogeneous solution and using a tailored optimal solution, respectively. We then calculate the Wealth Gap, which is the additional amount in the initial wealth in the homogeneous solution case that can result in the same level of lifetime utility in the tailored solution case. In both cases we would scale each retiree by the number of similar members to calculate a wealth gap at a whole-of-fund level. See further description in **"Technical Paper No. 1: MDUF v1 Design"** and **"Technical Paper No. 3: MDUF v1 Design"**.
If two super funds have identical members and used MDUF v1 to help design their retirement solutions, would they end up with the same solution design?	Most likely no, since different assumptions around the distribution of investment returns and different quality of modelling and consideration of factors would result in differences in the recommended retirement solutions.
Does MDUF v1 recommend the same solution for every individual?	No, MDUF v1 can be localised to the individual's situation, e.g. age, gender, account balance, etc.
Does MDUF v1 capture the Age Pension?	Yes, it captures the mean-tested rules of the Age Pension. It is up to the user to model the Age Pension accurately. The **Excel Model (Static Solutions)** includes Age Pension.
Does MDUF v1 capture home ownership?	It is up to the user to model the Age Pension accurately. The **Excel Model (Static Solutions)** includes Age Pension and makes an assumption that people own their homes. In our modelling any other assets outside super including home asset are not considered when recommending retirement strategies due to the lack of information collected by super funds at this stage.
Is there a limit to the complexity or number of candidate products which could be considered as part of the optimal solution (using MDUF v1)?	MDUF v1 can be used to rank different static retirement strategies or to find the optimal dynamic retirement strategy. When it is used for ranking static retirement strategies, there is no limit to the complexity or number of candidate products that can be considered. In its applications to finding the optimal dynamic solution, the computation becomes highly complex if any candidate products have path-dependent cash flow returns, such as a variable annuity with ratchet features.

How could you contribute to improving upon MDUF v1?	Anyone can contribute via research on improving MDUF v1. We encourage the use of MDUF v1 in academic research and industry applications. The research does not need to be supportive of MDUF. Critiques are welcome. One example of contribution could be behavioural research into members' preference for residual benefit or our assumption around their degree of risk aversion. This could allow for more insight into the parameterisation and the development of future MDUF v2 or higher.
What type of academic background would help you do some of the complex calculations using MDUF v1?	Postgraduate courses on optimisation or stochastic modelling or similar experience would be helpful in understanding and performing the optimisation techniques to find the optimal retirement strategies. Post-graduate actuarial students are very well trained for this type of work.
How could you modify MDUF v1?	MDUF v1 is sophisticated and flexible to be tailored to fit better with specific institutions. After determining a final set of parameter values, we can apply MDUF v1 for better retirement fund design. The MDUF v1 is not perfect and there are some aspects that the function cannot address. We will need to understand these limitations when we apply the function. As a result, there are cases when a trustee may want to step away from the "straw man" concept. The reasons could be the trustees: 1. want to allow for behavioural biases; or 2. have greater member insight. The trustees that wish to account for these aspects can choose to step outside MDUF v1 through a number of ways: 1. Changing parameter values. For example, the trustee can turn off residual account motive. 2. Adding in additional constraints to the function, such as consumption floor.
What is not captured in MDUF v1?	Explicit liquidity preferences, health states and aged cared costs, and preference over specific consumption patterns are some features not captured in MDUF v1.