RMIT BUSINESS
SCHOOL OF ECONOMICS AND FINANCE

COOPERATIVE EDUCATION
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Stochastic Projections
& Illustrations to
SMSF Clients

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1. Executive Summary

Empirical studies of economic projection have discussed different methods and accuracy of results between deterministic and stochastic projection methods. The main difference between these two methods is how they treat volatility. Deterministic methods involve no random elements their values are known, stochastic methods incorporate random methods.

The primary objective of this report is to establish the differences between these two projection methods, explaining the benefits or disadvantages they create within the superannuation industry in particular defined benefit pensions. The secondary objective is to show Allen L Truslove Actuary & Statistician can utilise these stochastic advantages within its pension projections and calculation, and how a stochastic projection maybe illustrated to clients.

A few sections have been dedicated to explaining the ‘best estimate’ and how actuaries and financial economist distinguish this controversial variable within a deterministic environment and how stochastic can eliminates the need to quantify ‘best estimate’.

2. Australian Superannuation System

2.1 Superannuation Fund Aim and Incentives

Superannuation is a long-term savings arrangement primarily to provide benefits for members on their retirement, resignation, death, disablement or other specified events or alternatively to the members beneficiaries upon death. Superannuation is a key element in the government's long-term objective of moving retired Australians off dependence on the age pension and increasing the level of national savings, the government rewards super schemes with taxation concessions.[1]

Although super funds are in all different shapes and size, this report concentrates on Self Managed Superannuation Funds.

2.2 Self Managed Superannuation Fund (SMSF)

Self Managed Superannuation Funds have been in operation since 1999. Flexibility of operation, tax concessions and greater member control of their superannuation money has made SMSFs very popular. Below are advantages and disadvantages of having a SMSF:

Advantages:

- Investment choice – enables trustees to choose the desired and suitable investment strategy for their fund.
- Tax concessions – if the fund meets the taxation criteria it will be eligible for substantial taxation concessions.
- Age pension accessibility – SMSFs may enable members even if large amount of asset size fund to access one of these age pension entitlements.

[1] The Association of Superannuation Funds of Australia Ltd 2005, ASFA Dictionary of Superannuation, viewed July 6 2005, http://www.superannuation.asn.au/dictionary/dict_main.htm .

- Family tailored – SMSF can be structured to benefit future family members in the fund.
- Income security – by providing a series of pension options SMSF can match an income stream for the expected life of a member without the need for life annuities.

Disadvantages:

- Managing costs – relativity versus high costs including is accounting, financial planning and actuarial certification.
- Time consuming – continuous reporting is required i.e. actuarial certificate, financial reporting.
- Vulnerable - Not as secure as life office annuities.
- Small scale - No professional investment management as would be found in large super funds.

Self managed superannuation funds cater specifically for those who wish to manage their own superannuation assets. They can be classified as accumulation or defined benefit funds.

2.3 Accumulation Funds

An accumulation fund (also known as a defined contribution fund) is a fund where the member's benefit is the total of contributions to the fund plus earnings on those contributions, minus expenses and tax. Most new superannuation funds and almost all industry funds are accumulation funds because benefits depend on fund earnings, the members carry the investment risk if the investments perform poorly, member benefits are directly affected.[2]

Advantages:

- Simplicity – simple to understand operate similar to a bank account.
- Choice – choice of investment strategy.
- Lower costs – well suited for short term or part time employees as it involves lower costs setting up and managing.

[2] The Association of Superannuation Funds of Australia Ltd 2005, ASFA Dictionary of Superannuation, viewed July 6 2005, <http://www.superannuation.asn.au/dictionary/dict_main.htm >.

Disadvantage:

- Uncorrelated – benefits uncorrelated to members needs, older and younger members have different needs i.e. conservative and aggressive strategies.
- Unequal – inequality between generations. A 10 year accumulation between two generations might be different significantly.
- Investment Risk – members carry the investment risk.

Two types of accumulation funds are:

- Allocated pensions – a pension arrangement where members have their own account and regularly draw down an amount from the account, within certain legislated limits.
- Market linked pensions – a fixed term income stream, annual pension payments may vary.

2.4 Defined Benefit Pensions

An alternative to accumulation funds are defined benefit pensions, insured death and disability benefits. The employer-sponsor of a defined benefit fund carries the investment risk if investment returns are low, the employer may need to increase company contributions to enable the fund to meet its required payouts. Advantages and disadvantages of defined benefit pensions are:

Advantages:

- Correlated - benefits correlated to members needs.
- Independent - the defined benefits that the members of the fund receive do not depend on the investment performance of the fund.
- Rewarding – fair for all members and all generations.

Disadvantages:

- Uncertainty – payments can vary.
- Complexity – harder to understand.

Two forms of SMSF defined benefit pensions are:

- Complying Pension/Annuity: An SMSF pension/annuity (Complying or Non-Complying) is a pension or annuity that is payable for the lifetime of the recipient, regardless of the recipients age. This means that an income stream is paid for the whole life of the recipient or the reversionary beneficiary.

- Term Certain/Fixed Term Pensions: A Term Certain/Fixed Term Pension can be paid from 1 to 25 years, and as the name indicates the payments are guaranteed to be payable.

3. Pension Projections

Pensions are a series of cash flows; the present value is projected by deterministic and stochastic methods. Actuarial present value is the value of an amount or series of amounts payable or receivable at various future dates, determined at a given date by application of a set of assumptions:

- Economic:
    - Interest
    - Salary scale
    - inflation
- Demographic:
    - Termination
    - Death
    - Disability
    - Retirement

3.1 Deterministic Projections

Under deterministic method, parameters have their values known at the outset and these values usually remain known for the period over which the model is applied. These parameter values are non- random.

Advantages of deterministic models are:

- Tractable – can be expressed in a formula.
- Traditional - represent the traditional actuarial approach to solving long term financial problems.
- Comprehensive – deterministic models are very easy to understand as they are significantly controlled and predictable.
- Quantifiable - able to quantify the effect of changing one or more parameters. Hence they may be used for sensitivity testing, eg for profit testing a life insurance product.
- Basic – deterministic can involve recursion i.e. calculate 1 year, then next etc until life time.

Disadvantages of deterministic models:

- Non-probabilistic - failing to assign probabilities to events and outcomes i.e. for a given investment earnings assumption a premium rate is either adequate or inadequate.
- Ambiguity Consideration - uncertainty is calculated artificially via normal or similar approximation.
- Point estimate– doesn't deal in ranges of feasible inputs or ranges of acceptable outputs.
- Simplistic – assumptions and results may not bear resemblance to real life.

3.2 Stochastic Projections

Stochastic projections attempt to incorporate random elements to projections by manipulating statistical distributions. A simulation is a subset of stochastic.
The uses of simulations allow an empirical distribution for the results of a model to be found when it is difficult or impossible to directly specify mathematically the distribution of the result. For simulation to be used the distributions of the stochastic parameters of the model must be known or postulated. By sampling the parameter distributions and running the model, one result or set of results can be obtained. By repeating this many times an empirical distribution of the results can be obtained.

If the parameter distributions are assumed, then the effects of using different assumptions can be examined though care needs to be exercised in interpreting results due to the inherent uncertainty of the simulation approach (Fitzherbert 2001).

One form of achieving an equivalent result is to use simulations; other methods include Lattice, Symbolic i.e. Mathematica. Under stochastic values vary according to random or non-deterministic events. Stochastic methods are becoming more prominent in actuarial literature and practise in all fields of actuarial work.

Advantages of stochastic simulations are:

- Probabilistic - probabilities can be attached to outcomes.

- Descriptive - results obtained from stochastic simulations provide range of answers from which more information can be derived.
- Realism - factors affecting actuarial problems eg in insurance and superannuation do vary stochastic models can be designed to take this variability in to account.
- Complex simulations - Complex financial problems can be modelled, as the frame work maybe extended to encompass more complex behaviour.
- Clarity - the dilemma of using mean, median etc also is excluded when stochastic estimations are made.

Disadvantages:

- Intractable – can not be expressed in a formula
- Innovative - does not represent traditional actuarial approach.
- Quasi randomness - as the random numbers are computer generated the variables are not perfectly random.
- Development Complexity - harder initial framework to develop and time consuming there is more programming but less mathematical derivation.

3.3 Best Estimate

Statistics is a method of decision making in the face of uncertainty, on the basis of numerical data, and calculated risks (Chou, Ya-lun. (1969). Statistical Analysis with Business and Economic Applications. New York, NY: Holt, Rinehart and Winston.) there are two branches of statistics:

- Descriptive Statistics – it encompasses numbers that describe or characterise groups i.e. mean, median, mode, total, range, standard deviation, proportion, etc.
- Inferential Statistics – it makes use of numbers from samples to provide generalisations (inferences) about the population from which the samples came.

Under descriptive statistics there is a significant ambiguity in use of the term 'best estimate' as it does not have any particular tie to scientific foundation. Within the actuarial profession there is a scope to interpret the term 'best estimate' differently. The word "best" implies a particular point (i.e. better than others) within the range of reasonable estimates. "Best" is a loaded word which leads to the question: "best by what or whose standard?" .Thus, while the concept of "best estimate" may elicit an intuitive understanding, this understanding will not necessary be the same from one person to the next, something more is needed (Hossack, Pollarad & Zehnwirth 1983).

When considering alternative investment propositions or investigating empirical evidence, there are a number of potential definitions of the expression 'Best Estimate'. Best estimate can represent the "median" or "mean" there is a significant ambiguity between uses of both.

3.3.1 The Median

The median is the point on the distribution which equally divides the probabilities it provides us with the "50% probability of adequacy". The median is appealing as a best estimate in situations where the goal is to have an estimate which is equally likely to be high as too low. Advantages and disadvantages of the median are:

Advantages:

- Stable Reference Value – it assists with the aim of finding a reliable location.
- Robust Statistic – it offers considerable resistance to the effects of isolated outliers.

Disadvantages:

- Statistical inefficiency - it takes no account of the dollar amounts associated with the probabilities other than for the purpose of ranking the values.
- Existence - For discrete distribution, the point does not necessarily exist.

3.3.2 The Mean

The mean or expected value is the probability weighted average of all possible outcomes. The mean has a number of characteristics which make it the most useful target statistic for determining the best estimate, advantages and disadvantages have been described below:

Advantages:

- Reflective - The mean incorporates information regarding both the probability distributions and the dollars associated with each probability. Even the most unlikely outcome is reflected and given appropriate weight.
- Unique - The mean provides a point which is unique and determinable for most distributions.
- Analytic - The mean provides a foundation for calculating other statistics such as variance about the mean.

Disadvantages:

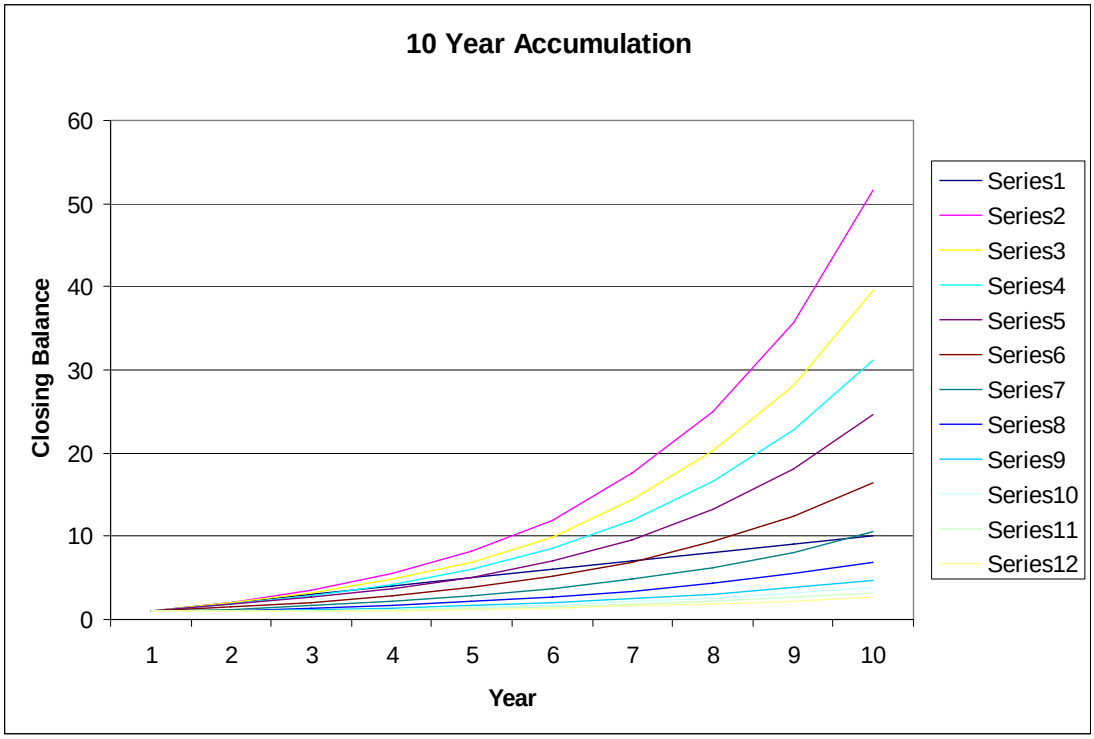
- Additive - the means of independent distributions are both additive and multiplicative.
- Distorted – it can be affected significantly by extremely large or extremely small values.

4. “Inheritance” Case Study

To further demonstrate the difference between deterministic and stochastic models, a simple stochastic simulation has been produced by simulating a bank balance which will at time of death pay out the inheritance.

This simulation caters for the amount of interest accumulated through a 10 year range, it encompasses 10,000 simulations. The random variables are the interest rate and time until inheritance is claimed (See Appendix A).

Interest rates have been log normally randomised artificially to have an earning of a 10% mean and 5% standard deviation in each year. Year of Death has been randomised between a range of a person living a minimum of 1 year or a maximum of 10 years. Graph 4.1 has been generated to better illustrate our model (See below). It is a representation of the lognormal interest rate simulation, it shows 12 of the random simulations that we have generated if the 10000 simulations were shown we can easily detect the most occurrence range by the darker area.



Graph 4.1

With stochastic simulations we can produce ranges i.e. 95% of the wealth is accumulated between $1.00- $3.58.

When using stochastic models it is often desired to convert assumptions and/ or models results from rates to forces and vice versa and to combine the results from a number of sectors to form or approximate results for a portfolio or composite sector. Such changes are often based on the assumption, or implied assumption, of a normal distribution for the forces and lognormal distribution for the rates. However if non-zero values for skewness and kurtosis are used as input to a stochastic model, then the formula based on the normal distribution for the forces and a lognormal distribution for the rates will not hold.

Stochastic simulations of economic scenarios involve:

- Analyses of the long term nature and term of the underlying assets.
- Developing stochastic model for simulation.
- Estimating model parameters from market data.
- Maintaining consistency and reproducibility of the generated scenarios.
- Ensuring sufficient frequency and severity of tail events for the projected scenarios.
- Determining a number of scenarios to establish reasonable convergence in the results.
- Checking data integrity and validation.
- Performing grouping of data on similar characteristics for projection purposes.
- Determining model assumptions from policy holder behaviour
- Reflecting critical product features and management strategies in liability model.
- Performing sample checking to verify the mechanics of the model and reasonableness of results.
- Factors should be updated frequently to reflect changes in the characteristics of business.

5. Complying Pension Calculation

Currently at Allen L Truslove Actuary and Statistician there are two comprehensive excel spread sheets that are used to produce the actuarial reports for defined benefit pensions, COMMAN_2005 and Quote CP_120. Currently Quote CP_120 is used to produce all the reports as the COMMAN_2005 is under construction and testing.

Both COMMAN_2005 and Quote CP_120 use deterministic projections a brief description of how these two spread sheets function has been given in the next few sections.

5.1 Australian Equity Risk Premium

The Australian equity risk premium is applied in both our models Quote_CP120 and COMANN_2005. The risk premium also is an option of being modelled stochastically. Currently it is being utilised deterministically in both models.

The market risk premium is the reward that investors collectively expect for holding risky assets. Obviously, risk averse investors would not hold equities in preference to bonds if the returns from the demonstrably more risky equities only matched the returns from holding bonds. The extra return they expect that is enough to induce them to hold equities is the relative market risk premium of equities over bonds (Hathaway 1995).

5.1.1 MRP Returns a Deterministic Approach

MRP is estimated from historical data from a range of different holding periods. As the market expectation is based on past occurrences this makes it reasonable.
We calculate the geometric mean returns over n years holding periods as:

$$S_n = S_0(1+R)^n$$

These calculations are used to first build up an historical set of returns and then analyse these data for mean effects. Separation of these two steps is very important, For example, the mean of the historical distribution of these holding period returns is commonly used to estimate the expected MRP. Such a mean is calculated using an arithmetic average, Market risk in the

bond series means that two series are not independent. The overall impression is one of increasing correlation, albeit at a low level.

For a stochastic approach the risk premium for any period can be randomly generated, its volatility depending mainly on the volatility of returns on the equity market. We can describe its behaviour by a probability distribution and measure its statistical parameters such as its mean and standard deviation (Hathaway 1995).

5.2 COMANN_ 2005

The aim of COMANN_2005 is to parameterise interest to a log normal model. Also to show that the median exceeds the 30% probability value; we are trying to prove using the median is sensible.

Controls on Volatility have been accomplished by matching assets and liabilities:

1. Fixed Term: near end of term how fixed interest cannot accept volatilities.
2. Long Term: Shares because time averages out volatilities.

The Log normal model has been used extensively in producing this spreadsheet, Log normal is an approximation used to capture skewness, does not imply *ln (1+return)* is normal, that distribution is also skewed. Protection against a fall in interest rates is provided by long term fixed interest assets matching the term of liabilities.

According to GN 465 Section 11, APRA suggests that the high probability of payment should be at least 70%:

'It is not necessary that actuaries determine a precise probability of the found being able to meet its pension obligations. Instead, it is acceptable for the actuary to specify a range within which the probability is judged to fall or to indicate that the probability is "at least x%". Discussions with APRA have suggested that a probability of at least 70% should be represented as being a high degree of probability for the purpose of Regulation 9.31(1) (ba).'[3]

[3] Australian Prudential Regulation Authority, Superannuation Circulars and Guidelines, viewed July 14 2005, < http://www.apra.gov.au/Superannuation-Circulars-and-Guidelines.cfm#Guidance >

5.3 Quote_CP 120

Quote_CP 120 has been designed to provide a comprehensive analysis of defined benefit pension covering areas of solvency, taxation, pension payments and a range of projections of importance to the pension.
Quote_CP 120 is deterministic model that generates a stochastic result, but there is no guarantee what we are inputting is emerging; as we are making assumptions in the out puts therefore there is no guarantee it is accurate.

The intention of the valuation is to provide a high probability that the fund can meet its liabilities. The main issues that are addressed:

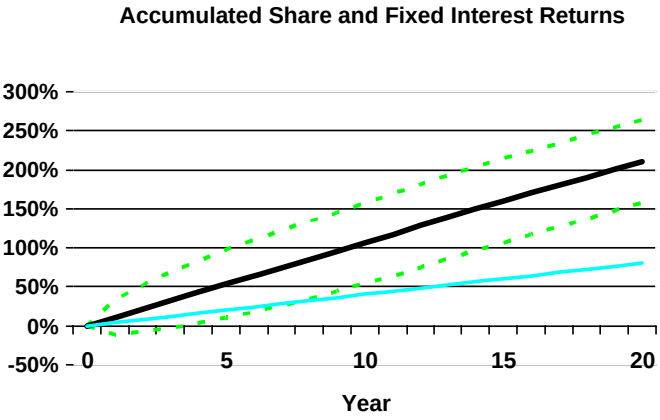
i) The market value of assets should exceed the market value of liabilities. In that case in the event of adverse experience the fund should have sufficient assets to reinsure the liability with a life office.
ii) The liabilities should be able to be funded from the capital value and expected income on the assets (Truslove 2005, Quote_CP Report P3).

5.3.1 Investment Return Calculations

The 70% probability of payment has been used to determine the “high degree of probability that the fund will be capable of paying the pension”, this is satisfactory for APRA in the Institute of Actuaries of Australia Guidance Note 465.

Within the investments of a self managed superannuation fund (SMSF) there could be exposure to shares and property. Giving rise to expectations of a higher income and future increases in pensions generated from the higher yield and expected capital growth of share and property assets.

Averaging of investment returns over time means that over the long term the higher returns expected from shares and property may be obtained by an SMSF. That outcome is illustrated in the graph 6.2.1. For short terms, assets should be confined to fixed interest securities to ensure that the pension payments may be met with high probability (Truslove 2005, P6).



Graph 6.2.1

Investment return for the funding is based on the assumptions that:

- Fixed interest securities earn the government bond rate.
- Mortgages earn 1% above the bond rate.
- Shares on average in future earn the historical excess of 6% above the bond rate, less the return reduction derived from historical serially correlated variability to give at least a 70% probability of accumulating each individual payment at the time required (Truslove 2005,Quote CP_120 Report p6).

To be able to support the first few years' pension payments it is necessary for the fund to hold adequate fixed interest securities or else a sufficient surplus must be available within the fund to cover the investment risk.

6. Pension Illustrations to SMSF Clients

Pensions are currently being illustrated in two occasions:

1. Quotations for initial pensions.
2. Actuarial Certificates prepared annually.

6.1 Quotations

Quotations are prepared before the initial actuarial certificate is issued. It basically sets out the investment strategy, pension payments, the opening balance and pension increase rates. It is a proposed pension strategy for the fund; an example can be seen overleaf.

The current quotation preparation has the following advantages and disadvantages:

Advantages:

- Assurance – as the quotes are calculate by the actuary the clients have assurance that it is the best strategy for the fund.
- Precision – the format of the quote is clear-cut and precise; the client by observing it knows what actions need to be taken.

Disadvantages:

- Time consuming – it takes a considerable amount of time to prepare the quote based on what the client requires which usually takes three to four quotes to come to an arrangement that satisfies both sides.
- Rigidity – the quote does not allow the pensioner any choice of different strategies.

Super Fund
Quote for Pensions prepared on 24 August 2004

Bond rate applicable: 5.635%

This Quote is valid for 30 days

Version: QuoteCP_89

Member Details	***First Member***	***Second Member***
Valuation date	10/08/2004	10/08/2004
Pensioner	John Smith	Judy Smith
Gender	Male	Female
Date of birth	31/07/1936	6/07/1938
Age next	69	67
Reversionary Name	Judy Smith	John Smith
Reversionary gender	Female	Male
Reversionary date of birth	6/07/1938	31/07/1936
Reversionary age next	67	69
Reversionary percentage	75%	75%
Centrelink entitlements	Yes	Yes
Income Stream	Lifetime	Lifetime
Complying?	Yes	Yes
Guaranteed Increases	CPI	CPI
Targeted Increases	None	None
Discretionary Increases	Yes	Yes
Guaranteed payment period	10	10
Frequency of payments	Monthly	Monthly
Expenses	expenses at $0 p.a and 1.125% of assets	expenses at $0 p.a and 1.125% of assets

Investment Strategy	**Asset Weighting-First member**	**Asset Weighting-Second member**
Cash	35%	35%
Bonds and interest deposits	0%	0%
Mortgages	0%	0%
Property	5%	5%
Shares	60%	60%
Purchase price	**$115,000**	**$115,000**
RBL Value	**N/A**	**N/A**
Residual Capital Value	**$0**	**$0**
Pension payable	**$7,200**	**$7,108**
Annual Deductible amount for tax purposes	**$0**	**$0**

6.2 Actuarial Certificates

Currently we are illustrating our pension projections as shown on the next page. Upon completion of the pension calculations for the SMSF a report is issued setting out how the fund is structured covering solvency and taxation issues. At the end of this report an illustration page is included. This Illustration sets out the pension projection details comprehensively for the pensioners within the SMSF.

This Illustration sets out in table format the projections for:

- Investment earnings
- The opening balance of the pension fund
- The amount of pension payment
- The administration expenses
- The closing balance
- The Annuity increase
- Reallocation amount to the Allocated pension (if available)

ILLUSTRATION - Pensioner 1 **Superannuation Fund**

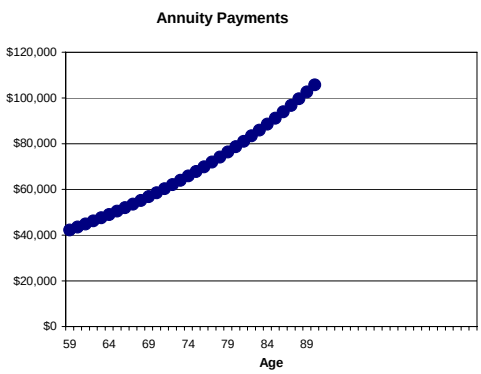
Age	**Female**	**Sex of pensioner**	**Lifetime Pension**
Age	**Male**	**Sex of reversionary life**	
Guaranteed Indexation @3%.			
Reversion	**100%**	**0.250%**	**Investment accounting expense as deduction from yield**
APRA 70% probability of payment.			**0%**

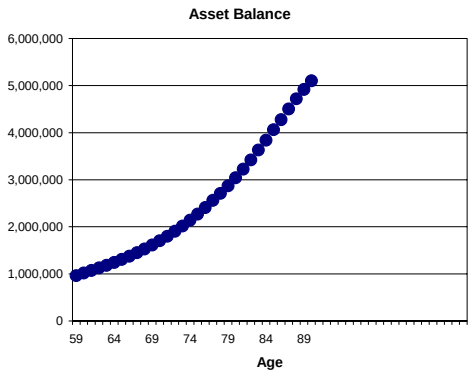
Note: Illustrated increases above any Guaranteed amount are payable at the trustees' discretion.

Age next b'day	Fin. Year Starting	Opening Balance	Asset % in Shares& Property	Investment Earnings	Payment	Admin. Expense	Closing Balance	Annuity Increase	% Increase	Reserve, used for future discret'ry increases and/or mortality strain	Balance of Non-Current Pension Liability Reserve
											$344,610
59	2005	$961,987	98%	$102,815	$42,279	$4,405	$1,018,119	$1,268	3.0%	$0	$343,353
60	2006	$1,018,119	88%	$103,015	$43,547	$4,585	$1,073,001	$1,306	3.0%	$0	$336,362
61	2007	$1,073,001	78%	$102,455	$44,853	$4,763	$1,125,839	$1,346	3.0%	$0	$372,899
62	2008	$1,125,839	78%	$107,500	$46,199	$4,937	$1,182,203	$1,386	3.0%	$0	$412,942
63	2009	$1,182,203	78%	$112,882	$47,585	$5,120	$1,242,380	$1,428	3.0%	$0	$456,817
64	2010	$1,242,380	78%	$118,628	$49,013	$5,314	$1,306,681	$1,470	3.0%	$0	$504,877
65	2011	$1,306,681	78%	$124,768	$50,483	$5,519	$1,375,447	$1,514	3.0%	$0	$557,511
66	2012	$1,375,447	78%	$131,334	$51,997	$5,736	$1,449,048	$1,560	3.0%	$0	$615,141
67	2013	$1,449,048	78%	$138,362	$53,557	$5,966	$1,527,886	$1,607	3.0%	$0	$678,230
68	2014	$1,527,886	78%	$145,890	$55,164	$6,210	$1,612,402	$1,655	3.0%	$0	$747,282
69	2015	$1,612,402	78%	$153,960	$56,819	$6,469	$1,703,073	$1,705	3.0%	$0	$823,468
70	2016	$1,703,073	78%	$162,617	$58,524	$6,744	$1,800,423	$1,756	3.0%	$0	$906,881
71	2017	$1,800,423	78%	$171,913	$60,279	$7,038	$1,905,018	$1,808	3.0%	$0	$998,192
72	2018	$1,905,018	78%	$181,900	$62,088	$7,350	$2,017,481	$1,863	3.0%	$0	$1,098,134
73	2019	$2,017,481	78%	$192,638	$63,950	$7,683	$2,138,486	$1,919	3.0%	$0	$1,207,509
74	2020	$2,138,486	78%	$204,192	$65,869	$8,038	$2,268,772	$1,976	3.0%	$0	$1,327,190
75	2021	$2,268,772	78%	$216,633	$67,845	$8,418	$2,409,142	$2,035	3.0%	$0	$1,458,134
76	2022	$2,409,142	78%	$230,036	$69,880	$8,823	$2,560,474	$2,096	3.0%	$0	$1,559,552
77	2023	$2,560,474	68%	$229,899	$71,977	$9,258	$2,709,140	$2,159	3.0%	$0	$1,703,467
78	2024	$2,709,140	68%	$243,248	$74,136	$9,686	$2,868,565	$2,224	3.0%	$0	$1,860,050
79	2025	$2,868,565	68%	$257,562	$76,360	$10,143	$3,039,624	$2,291	3.0%	$0	$2,030,400
80	2026	$3,039,624	68%	$272,921	$78,651	$10,630	$3,223,264	$2,360	3.0%	$0	$2,215,709
81	2027	$3,223,264	68%	$289,410	$81,010	$11,150	$3,420,513	$2,430	3.0%	$0	$2,417,276
82	2028	$3,420,513	68%	$307,120	$83,441	$11,705	$3,632,488	$2,503	3.0%	$0	$2,607,082
83	2029	$3,632,488	58%	$305,460	$85,944	$12,298	$3,839,706	$2,578	3.0%	$0	$2,827,977
84	2030	$3,839,706	58%	$322,885	$88,522	$12,880	$4,061,188	$2,656	3.0%	$0	$3,043,214
85	2031	$4,061,188	48%	$318,374	$91,178	$13,500	$4,274,885	$2,735	3.0%	$0	$3,282,230
86	2032	$4,274,885	48%	$335,127	$93,913	$14,101	$4,501,997	$2,817	3.0%	$0	$3,522,796
87	2033	$4,501,997	38%	$327,284	$96,731	$14,737	$4,717,814	$2,902	3.0%	$0	$3,765,151
88	2034	$4,717,814	28%	$316,098	$99,633	$15,346	$4,918,933	$2,989	3.0%	$0	$4,006,905
89	2035	$4,918,933	18%	$301,551	$102,622	$15,920	$5,101,943	$3,079	3.0%	$0	$4,245,348
90	2036	$5,101,943	8%	$283,706	$105,700	$16,450	$5,263,498				

Illustration Disclaimer

This page is an illustration only. The actual outcome will depend on the performance of the assets chosen by the trustees. Allen L Truslove Actuary & Statistician Pty Ltd does not provide advice on the selection of assets or their likely performance.





Furthermore to illustrate to the pensioner or the financial adviser of the fund two graphs are included at the end, graphing Annuity Payments and the Asset balance through out the expected life of the pensioner. Advantages and disadvantages of current illustration are:

Advantages:

- Informative - it sets out the projections of the necessary factors within a fund.
- Comprehensible – very easy to understand everything is set out clearly.

Disadvantages

- Non-probabilistic – no range of probability of payments and earnings is provided.
- Uncertainty – does not show range of failure or ruin.
- Controlled – no option or choice is given to the user.

6.3 Illustrations of Stochastic Projections to SMSF Clients

Two changes to illustrations are proposed:

1. Interactive Quotations - initial actuarial quotes to be made interactive.

2. Stochastic Illustrations – with the proposed changes to projection methods a new illustration page is required to show its effects.

6.3.1 Interactive Quotations

A sample has been illustrated on the next page. The markers and input boxes represent the input page used for creating the quotation.

The main rationales that have lead to this proposal are as following:

- Variety – current style does not give the pensioner a vast amount of choice.
- Interactivity – assists the pensioners understanding on how different factors affect their fund.
- Informative – through simplicity and interactivity the pensioner is able to make more informative decisions.
- Clarity – it clearly sets out the important variables of the fund, without creating confusion for the pensioner.

Illustration Input:

Pensioner: John Smith

Sex:	Male	Reversionary Age:	64	Type of Pension: Life Time
Age:	65	Sex:	Female	

This is your current pension status:

At your current age of 65 the following pension range is available to you(based on details provided:

$35,000 $40,000

Move cursor to desired pension payment.

For the payment of $37,000 you require the following asset balance: $959,000

Your current asset balance range

$950,000 $960,000

Move cursor to choose asset balance:

You have chosen amount of $959,000 it has a probability of 80%

of lasting you till age 82 .

Having an asset allocation of:

Shares:	15%
Bonds:	20%
Cash:	35%
Property:	30%
Total:	100%

Move cursor to see the effect of different investment structures on your pension payment

The probability of receiving this payment of $37,000 is 80%

Note: it is recommended by APRA to have a 70% probability of payment.

6.3.2 Stochastic Illustrations

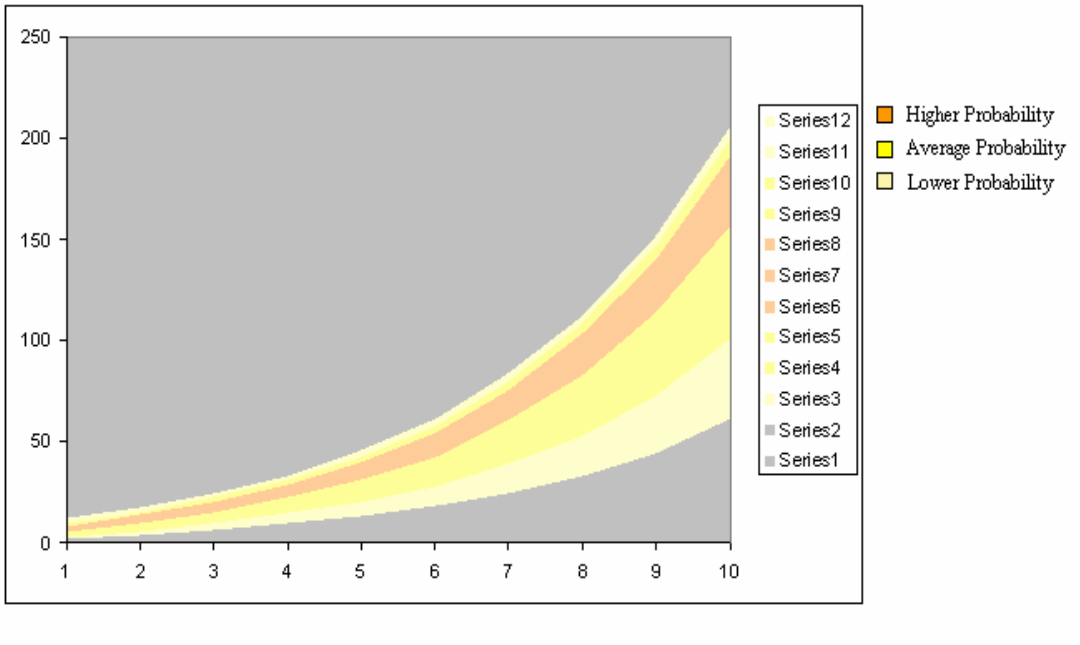
An illustration page can be generated at the end of each actuarial report see over leaf. The interactivity is omitted as when the pension has started the status can not be change. But the illustration of ranges and graphs can be shown.

Advantages:

- Informative - can be utilised to better inform the pensioner of what is occurring in the future.
- Probabilistic - probabilities assigned to each payment and strategy can be shown assisting the pensioner in making more informed decisions.
- Realistic - the situation is more real compared to the deterministic illustration (Pg22).

Illustration

The following graph illustrates the range of pension available:



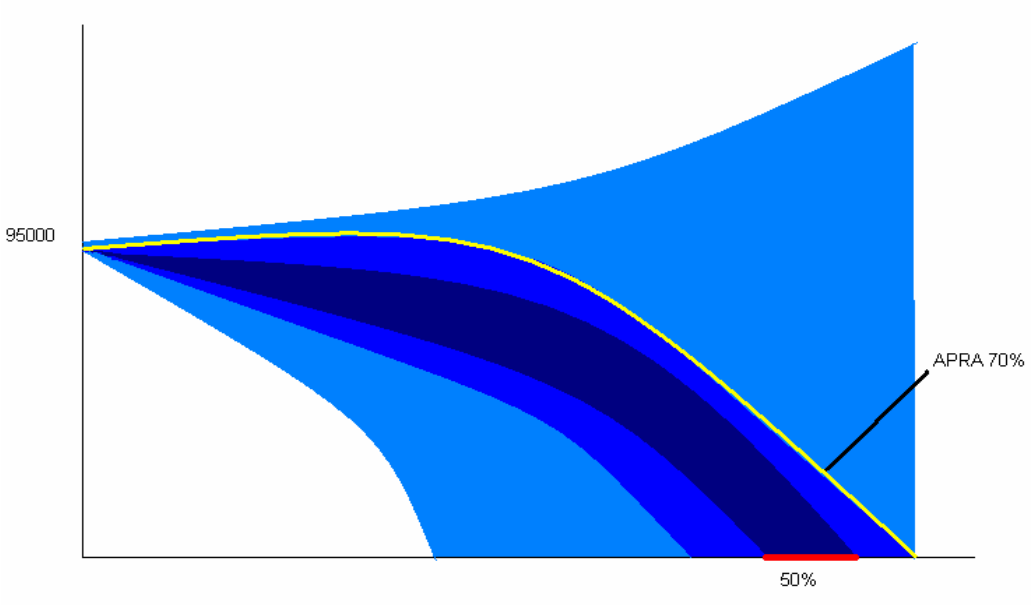
Pension range: [$35000,$40000]

Probability of payment: [70%,85.5%]

Accepatable asset range:[$950000,$960000]

Asset allocation range:

Shares:	10% - 15%
Bonds:	15% - 20%
Cash:	30% - 35%
Property:	25% - 30%
Total:	100%



The above graph represents your current asset balance range.

7. Conclusion

Most Economic variables are dynamic. The economists who analyse these variables study the current state of an economic system and ask how various models can be used to move the system from its present status to a future more desirable state.

Concluding on what has been illustrated in this report stochastic projections are not better than deterministic projections as both can be modelled to cater the needs of the user but have the capacity to provide more accurate and informative illustrations to clients. The main argument is if the costs of setting up a stochastic model out weighs its benefits compared to a deterministic model, this falls to the attitude of the user.

Allen L Truslove Actuary & Statistician will be able to add value to client illustration through stochastic method within its calculations for defined benefit pensions, this might be taken in to account in setting up COMANN_2005.

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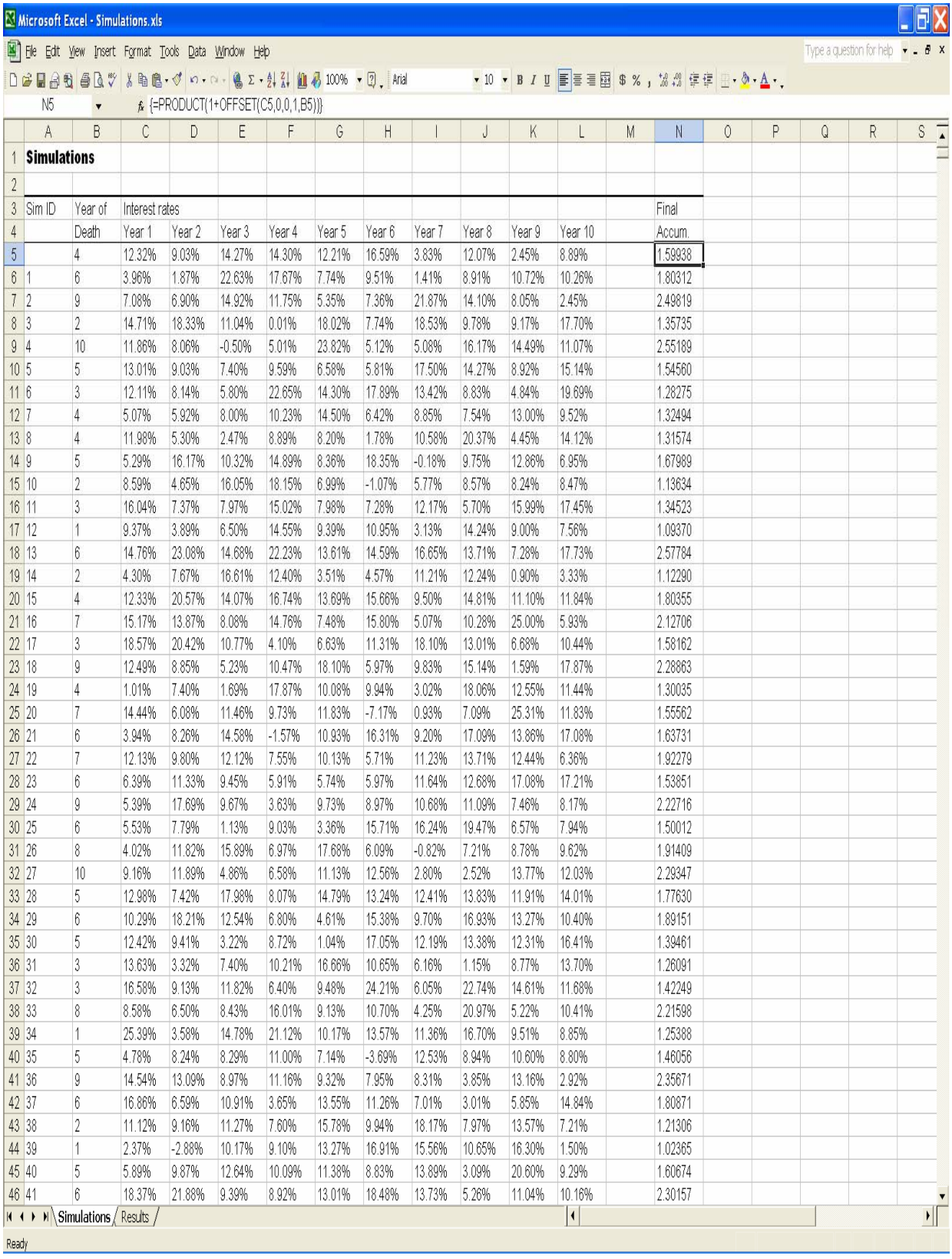
9. Appendices

Appendix A


Microsoft Excel - Simulations.xls

File Edit View Insert Format Tools Data Window Help

N5 {=PRODUCT(1+OFFSET(C5,0,0,1,B5))}

Simulations

Sim ID	Year of Death	Interest rates Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Final Accum.
	4	12.32%	9.03%	14.27%	14.30%	12.21%	16.59%	3.83%	12.07%	2.45%	8.89%	1.59938
1	6	3.96%	1.87%	22.63%	17.67%	7.74%	9.51%	1.41%	8.91%	10.72%	10.26%	1.80312
2	9	7.08%	6.90%	14.92%	11.75%	5.35%	7.36%	21.87%	14.10%	8.05%	2.45%	2.49819
3	2	14.71%	18.33%	11.04%	0.01%	18.02%	7.74%	18.53%	9.78%	9.17%	17.70%	1.35735
4	10	11.86%	8.06%	-0.50%	5.01%	23.82%	5.12%	5.08%	16.17%	14.49%	11.07%	2.55189
5	5	13.01%	9.03%	7.40%	9.59%	6.58%	5.81%	17.50%	14.27%	8.92%	15.14%	1.54560
6	3	12.11%	8.14%	5.80%	22.65%	14.30%	17.89%	13.42%	8.83%	4.84%	19.69%	1.28275
7	4	5.07%	5.92%	8.00%	10.23%	14.50%	6.42%	8.85%	7.54%	13.00%	9.52%	1.32494
8	4	11.98%	5.30%	2.47%	8.89%	8.20%	1.78%	10.58%	20.37%	4.45%	14.12%	1.31574
9	5	5.29%	16.17%	10.32%	14.89%	8.36%	18.35%	-0.18%	9.75%	12.86%	6.95%	1.67989
10	2	8.59%	4.65%	16.05%	18.15%	6.99%	-1.07%	5.77%	8.57%	8.24%	8.47%	1.13634
11	3	16.04%	7.37%	7.97%	15.02%	7.98%	7.28%	12.17%	5.70%	15.99%	17.45%	1.34523
12	1	9.37%	3.89%	6.50%	14.55%	9.39%	10.95%	3.13%	14.24%	9.00%	7.56%	1.09370
13	6	14.76%	23.08%	14.68%	22.23%	13.61%	14.59%	16.65%	13.71%	7.28%	17.73%	2.57784
14	2	4.30%	7.67%	16.61%	12.40%	3.51%	4.57%	11.21%	12.24%	0.90%	3.33%	1.12290
15	4	12.33%	20.57%	14.07%	16.74%	13.69%	15.66%	9.50%	14.81%	11.10%	11.84%	1.80355
16	7	15.17%	13.87%	8.08%	14.76%	7.48%	15.80%	5.07%	10.28%	25.00%	5.93%	2.12706
17	3	18.57%	20.42%	10.77%	4.10%	6.63%	11.31%	18.10%	13.01%	6.68%	10.44%	1.58162
18	9	12.49%	8.85%	5.23%	10.47%	18.10%	5.97%	9.83%	15.14%	1.59%	17.87%	2.28863
19	4	1.01%	7.40%	1.69%	17.87%	10.08%	9.94%	3.02%	18.06%	12.55%	11.44%	1.30035
20	7	14.44%	6.08%	11.46%	9.73%	11.83%	-7.17%	0.93%	7.09%	25.31%	11.83%	1.55562
21	6	3.94%	8.26%	14.58%	-1.57%	10.93%	16.31%	9.20%	17.09%	13.86%	17.08%	1.63731
22	7	12.13%	9.80%	12.12%	7.55%	10.13%	5.71%	11.23%	13.71%	12.44%	6.36%	1.92279
23	6	6.39%	11.33%	9.45%	5.91%	5.74%	5.97%	11.64%	12.68%	17.08%	17.21%	1.53851
24	9	5.39%	17.69%	9.67%	3.63%	9.73%	8.97%	10.68%	11.09%	7.46%	8.17%	2.22716
25	6	5.53%	7.79%	1.13%	9.03%	3.36%	15.71%	16.24%	19.47%	6.57%	7.94%	1.50012
26	8	4.02%	11.82%	15.89%	6.97%	17.68%	6.09%	-0.82%	7.21%	8.78%	9.62%	1.91409
27	10	9.16%	11.89%	4.86%	6.58%	11.13%	12.56%	2.80%	2.52%	13.77%	12.03%	2.29347
28	5	12.98%	7.42%	17.98%	8.07%	14.79%	13.24%	12.41%	13.83%	11.91%	14.01%	1.77630
29	6	10.29%	18.21%	12.54%	6.80%	4.61%	15.38%	9.70%	16.93%	13.27%	10.40%	1.89151
30	5	12.42%	9.41%	3.22%	8.72%	1.04%	17.05%	12.19%	13.38%	12.31%	16.41%	1.39461
31	3	13.63%	3.32%	7.40%	10.21%	16.66%	10.65%	6.16%	1.15%	8.77%	13.70%	1.26091
32	3	16.58%	9.13%	11.82%	6.40%	9.48%	24.21%	6.05%	22.74%	14.61%	11.68%	1.42249
33	8	8.58%	6.50%	8.43%	16.01%	9.13%	10.70%	4.25%	20.97%	5.22%	10.41%	2.21598
34	1	25.39%	3.58%	14.78%	21.12%	10.17%	13.57%	11.36%	16.70%	9.51%	8.85%	1.25388
35	5	4.78%	8.24%	8.29%	11.00%	7.14%	-3.69%	12.53%	8.94%	10.60%	8.80%	1.46056
36	9	14.54%	13.09%	8.97%	11.16%	9.32%	7.95%	8.31%	3.85%	13.16%	2.92%	2.35671
37	6	16.86%	6.59%	10.91%	3.65%	13.55%	11.26%	7.01%	3.01%	5.85%	14.84%	1.80871
38	2	11.12%	9.16%	11.27%	7.60%	15.78%	9.94%	18.17%	7.97%	13.57%	7.21%	1.21306
39	1	2.37%	-2.88%	10.17%	9.10%	13.27%	16.91%	15.56%	10.65%	16.30%	1.50%	1.02365
40	5	5.89%	9.87%	12.64%	10.09%	11.38%	8.83%	13.89%	3.09%	20.60%	9.29%	1.60674
41	6	18.37%	21.88%	9.39%	8.92%	13.01%	18.48%	13.73%	5.26%	11.04%	10.16%	2.30157

Simulations / Results

Ready