

## **ATTACHMENT 4 – SUPERANNUATION MODELLING: ACCUMULATION PHASE**



## **Superannuation Modelling - Accumulation Phase**

### **Challenger Group Services Pty. Ltd.**

14 December 2009

This page is intentionally blank

# Table of contents

<b>Section 1 : Introduction .....</b>	<b>1</b>
<b>Section 2 : Methods and Assumptions .....</b>	<b>3</b>
<b>Section 3 : Key Concepts and Metrics .....</b>	<b>7</b>
<b>Section 4 : Analysis of Results .....</b>	<b>9</b>
<b>Section 5 : Reliances and Limitations .....</b>	<b>17</b>
<b>Appendix 1 : Modelling Assumptions .....</b>	<b>19</b>
<b>Appendix 2 : A summary of the Watson Wyatt asset modelling assumptions as at 31 March 2009 .....</b>	<b>23</b>
<b>Appendix 3 : Supporting Tables .....</b>	<b>29</b>
<b>Appendix 4 : Supporting Charts .....</b>	<b>33</b>



This page is intentionally blank



# Section 1: Introduction

- 1.1 Watson Wyatt has been commissioned by Challenger Group Services Pty. Ltd. (“Challenger”) to carry out a detailed investigation to assist in further understanding the impact of different asset allocations in the pre-retirement accumulation phase of an individual's life. This investigation focuses on the use of term annuities as a replacement for bonds and cash as the defensive element of an individual's asset allocation.
- 1.2 The scope of Watson Wyatt's investigation is set out in this section.

## Previous work

- 1.3 In April 2009 Watson Wyatt issued a report entitled “Investment and Spending in Retirement – the Longevity Risk Impact”<sup>1</sup>. This report considered the risks associated with various investment and spending strategies in retirement. The investment strategies considered were portfolios of “growth” and “defensive” assets in varying proportions.
- 1.4 At the request of Challenger in September 2009, Watson Wyatt extended its earlier work and provided Challenger with a report titled “Retirement Income Modelling” to support their submission to the Henry Review. This report considered the impact of using lifetime annuities in place of the current defensive component of a retiree's investment portfolio.

## Project objectives

- 1.5 Challenger has asked us to extend our existing research and modelling capabilities in the following ways:
- to extend the modelling to focus on the accumulation phase of an individual's superannuation savings;
  - to consider the use of term annuities in place of the current defensive component of an individual's investment portfolio; and
  - to allow for the impact of different levels of platform and administration fees in the model.
- 1.6 This report sets out the results of certain scenarios obtained using our projection model.

---

<sup>1</sup> Available at [www.watsonwyatt.com](http://www.watsonwyatt.com)



This page is intentionally blank



# Section 2: Methods and Assumptions

## Methods

- 2.1 We have created a stochastic model which allows us to perform projections of an individual's accumulated superannuation savings over time based on a given scenario and projection assumptions. For each projection scenario, the initial starting conditions required to perform the projection modelling are:
- the earnings of the model individual;
  - the level of superannuation contributions (as a percentage of earnings);
  - the individual's initial account balance (if any) at the commencement of the projection;
  - an asset allocation strategy (i.e. a growth and defensive portfolio allocation) assumed to be constant throughout the projection period – applicable to both accumulated balances and ongoing contributions;
  - a term annuity purchasing strategy; and
  - an assumed level of superannuation fees.
- 2.2 Each scenario is then run through the projection model twice. Once with the defensive allocation invested in a diversified bonds and cash portfolio and then repeated with the defensive allocation used to purchase term annuities during the period to retirement. These are referred to as the “non-annuity” strategy and “annuity” strategy respectively.
- 2.3 Underlying the retirement income model is the Watson Wyatt Global Asset Model. This is a projection tool which generates stochastic rates of investment returns and other market indicators such as the level of Consumer Price Indexation (CPI) and Average Weekly Ordinary Time Earnings (AWE). The model includes most of the major global asset classes and a correlation matrix has been developed as part of this model to ensure results are as consistent as possible with real world outcomes. In order to price the term annuities used in the projections, a term dependent yield curve has been generated by the asset model.
- 2.4 As agreed with Challenger, Watson Wyatt's standard asset model has been modified to remove some short-term effects which have been recently incorporated to reflect the current state of financial markets. These adjustments were deemed appropriate as this research is intended to reflect a long-term view on the performance of term annuities in providing for retirement and therefore should avoid any bias in outcomes as a result of the recent financial crisis.
- 2.5 The stochastic nature of the underlying investment model means that our accumulation model results in a probabilistic range of account balances over time and at retirement, which we are then able to use to draw conclusions.





## Annuity strategy

- 2.6 In order to construct a projection model, attention must be paid to a number of practical issues concerning the use of term annuities.
- 2.7 For this investigation, the term annuities are being used as an alternative vehicle for investing the defensive portion of an individual's superannuation savings during the pre-retirement (accumulation) phase. As no income is to be drawn during this period, it is appropriate to assume the annuities purchased do not provide incremental repayment of capital throughout their term. We have therefore assumed that all of the modelled term annuities have a Residual Capital Value (RCV) of 100%, i.e. 100% of the original purchase price is repaid at maturity.
- 2.8 Each term annuity provides a guaranteed rate of income until maturity based on the market price at its commencement. This income must be reinvested over the remaining period until the maturity of the annuity. In our modelling we have assumed that all annuity income is reinvested at the appropriate guaranteed rate of return applicable to the term annuity at date of purchase.
- 2.9 These two assumptions are supported by the availability of products in the market which have such features.
- 2.10 There are various approaches which could be taken to structuring a portfolio of term annuities. For example, a portfolio of annuities of differing terms could be purchased and managed over time, to provide some diversity across durations. Alternatively, a single annuity of a given term could be chosen at the outset, and upon its maturity the proceeds used to purchase another annuity of the same term (at the then prevailing rates), and so on over time until retirement. For simplicity we have adopted the latter approach in our modelling.
- 2.11 Under this approach, the individual is unable to invest any annual contributions allocated to the defensive portfolio in the annuity during its term, since the term annuity conditions do not allow supplemental contributions to be added to an existing policy. For the purpose of this investigation, we have assumed that the defensive allocation of annual contributions is invested temporarily in a cash fund until the next term annuity maturity date.
- 2.12 At each term annuity maturity date, the individual's total superannuation savings are assessed. This comprises of the accumulated growth fund, the maturing term annuity including the reinvested income (the RCV), and the defensive allocated contributions held in a cash fund. The total portfolio is then rebalanced in accordance with the original Growth/Defensive asset allocation and a new term annuity is purchased with the defensive allocation at the prevailing market rates determined by the model.

## Non-annuity strategy

- 2.13 Under the non-annuity strategy, the assets and contributions are allocated in accordance with the individual's original asset allocation strategy.
- 2.14 In order to maintain a degree of parity in asset allocation with the annuity strategy set out above, the non-annuity strategy portfolio will only be rebalanced at discrete time intervals to coincide with the maturity dates of the term annuities under the annuity strategy. This assumption is important for this investigation since, without a consistent rebalancing policy between the two strategies, one or other of the strategies may drift to a greater growth allocation which would be expected to generate more favourable outcomes.

## Assumptions

- 2.15 All investment returns and other market indicators used in the modelling in this report are generated using the Watson Wyatt Global Asset Model. Further details of that model and the underlying assumptions are contained in Appendix 2.
- 2.16 A summary of the non-investment related assumptions which drive the core results is set out below.

### *Core Results*

- The core results consider an individual who is aged 30 and retires at age 65;
- The initial account balance (before annuity purchase) is \$30,000;
- The individual's gross of tax earnings is assumed to be \$45,000 pa (approximately Median Weekly Ordinary Time Earnings). The earnings are assumed to increase in line with Average Weekly Ordinary Time Earnings (AWE) each year;
- The assumed asset allocation is 70% growth asset classes and 30% defensive asset classes. Under both strategies the assets are rebalanced every 5 years;
- The defensive allocation is assumed to be invested entirely in 5 year back-to-back term annuities with 100% RCV under the annuity strategy, or in a diversified bonds and cash portfolio under the non-annuity strategy;
- Superannuation platform and administration fees are in line with the Personal Super Open Products administration and platform fees in the Superannuation Fees Report 2008 published by Rice Warner Actuaries. These have been labelled as "High Fees" for the purpose of this report;
- The term annuity rates have been based on a pricing structure provided by Challenger and are determined by reference to interest rates generated by the investment model. A summary of the pricing structure and a more detailed description of this process is set out in Appendix 1; and
- All dollar amounts have been discounted at AWE in order to present results in today's dollars.

### *Other Scenarios*

Apart from the core scenario outlined above, we have also considered other scenarios to determine the sensitivity of the core result to variations in certain assumptions. The assumptions varied are:

- Earnings;
- Initial account balance;
- Asset allocation; and
- Superannuation fee levels.

Further details of assumptions used are contained in Appendix 1.



This page is intentionally blank



## Section 3: Key Concepts and Metrics

### Accumulated account balance at retirement age

- 3.1 The fundamental metric which will be examined in this report is the accumulated account balance at retirement age (65). With this metric it is possible to differentiate between two accumulation strategies to identify which produces the greater average outcome at retirement age.
- 3.2 In order to provide a comparable measure of the downside (and upside) risks associated with each strategy, we have also considered the more extreme outcomes from our projection modelling. The outcomes defined as 'Best', Median and 'Worst' outcomes represent the 95<sup>th</sup>, 50<sup>th</sup> and 5<sup>th</sup> percentile outcomes from all simulations, respectively. These metrics give an indication of the spread of outcomes generated in addition to their absolute values.

### Equivalent additional pre-tax contribution rate

- 3.3 A second metric we have considered is the equivalent additional pre-tax contribution rate. We have defined this metric to be the additional annual pre-tax contribution (on top of the basic 9% level) that is required under the non-annuity strategies in order for the average account balance at retirement to be equal to that under the annuity strategies. This additional annual pre-tax contribution is expressed as a percentage of earnings.
- 3.4 The equivalent additional pre-tax contribution rate will be a positive (negative) rate when the accumulated account balance at retirement age under the annuity strategy is greater (less) than the non-annuity strategy.
- 3.5 This rate is effectively the additional pre-tax contribution rate which an individual would on average be required to make each year under the non-annuity strategy in order to generate the same balance at retirement as under the annuity strategy. It indicates the magnitude of improved outcomes that can be obtained through investing in term annuities, based on the modelling assumptions.



This page is intentionally blank



# Section 4: Analysis of Results

## Impact of purchasing an annuity (Core scenario results)

- 4.1 Our initial (core) results look at the impact of utilising term annuities as the defensive allocation of the individual's superannuation savings. The results analysed here are based on the initial starting conditions set out in 2.16.
- 4.2 The results for the core scenario are shown in Table 1 below and Figure 1.1 in Appendix 4.
- 4.3 Table 1 below shows the 'Best' (95<sup>th</sup> percentile), Median (50<sup>th</sup> percentile) and 'Worst' (5<sup>th</sup> percentile) outcomes of the accumulated account balance at retirement age (as discussed in sections 3.1 and 3.2) for our core scenario retirement age of 65.

Table 1: Core scenario results – impact of investing in a term annuity strategy

Strategy	Earnings (\$ pa)	Initial Balance (\$)	Contribution Rate	Accumulated account balance at retirement age 65 (\$)		
				Worst	Median	Best
Non-Annuity	45,000	30,000	9%	155,825	265,359	503,539
Annuity				176,512	302,965	570,094

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.

- 4.4 These core results indicate that incorporating term annuities on the terms modelled into the accumulation phase portfolio to replace a diversified bonds and cash allocation improves accumulated account balance outcomes at retirement age by around 14%.
- 4.5 The table below shows the approximate breakdown of this improvement under the 'best', median and 'worst' outcomes. There are two drivers of this improvement:
- the reduction in overall fees incurred by the portfolio, due to the absence of platform and administration fees applied to the term annuities; and
  - the increased investment return achieved by the term annuities relative to the defensive portfolio of bonds and cash.



Table 5: Core scenario results –approximate breakdown of improvement

Reason for improvement	Percentage improvement		
	Worst	Median	Best
No Administration or Platform Fees on term annuities	4%	4%	4%
Higher return achieved by term annuities relative to defensive portfolio	9%	10%	9%
<b>Total increase in core scenario</b>	<b>13%</b>	<b>14%</b>	<b>13%</b>

- 4.6 Figure 1.1 in Appendix 4 shows the progression of the accumulated account balance over time under both the annuity and non-annuity strategies. The bars represent the 90% confidence interval with the 'worst'/'best' outcomes in Table 1 being the bottom/top of the bar at age 65. The average modelled outcome is identified by the solid line.
- 4.7 From Figure 1.1, we can see that in the early stages of accumulation, there is very little difference in the accumulated account balance under each strategy. The blue and orange bars almost exactly overlap (producing the green coloured bar). However, as the dollar value of the portfolio increases, we can observe that the orange bar representing the annuity strategy begins to increase faster than the blue bar for the non-annuity strategy.
- 4.8 The result at age 65 is that the annuity strategy has generated a greater average outcome while also improving the 'best' and 'worst' outcomes. While the improvement observed in the chart appears only to be marginal, the figures in Table 1 show a dollar improvement under the 'worst' and 'best' outcomes of around \$21,000 and \$66,000, respectively.
- 4.9 Under this scenario, investing in term annuities generates an average accumulated account balance at age 65 equivalent to a non-annuity strategy investor making an annual additional pre-tax contribution of 1.7% of earnings for 35 years.

## Sensitivity to earnings

- 4.10 We have considered the effect of varying the earnings of the model individual. We have looked at a second scenario with an individual earning \$120,000 per annum and with an initial account balance of \$80,000.
- 4.11 Table 2 below shows the same metrics as Table 1 for this scenario. The results for the core scenario individual are repeated for easy comparison.



Table 2: Sensitivity to earnings

Strategy	Earnings (\$ pa)	Initial Balance (\$)	Contribution Rate	Accumulated account balance at retirement age 65 (\$)		
				Worst	Median	Best
Non-Annuity	45,000	30,000	9%	155,825	265,359	503,539
Annuity				176,512	302,965	570,094
Non-Annuity	120,000	80,000	9%	426,196	730,100	1,386,013
Annuity				479,930	826,787	1,555,428

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.

- 4.12 As with the core scenario, incorporating term annuities into the investment mix improves the outcomes by around 13%. The ratio of improvement is very similar since, with the exception of the level of fees incurred in the portfolios, the results are proportional to the core scenario.
- 4.13 Figure 1.2 of Appendix 4 shows the progression of the accumulated account balance over time and clearly shows a similar pattern to the core scenario result. However, in dollar terms the improvement under this scenario ranges from around \$54,000 under the 'worst' outcome to \$169,000 under the 'best' outcome.
- 4.14 Under this scenario, investing in term annuities generates the individual an average accumulated account balance at age 65, equivalent to a non-annuity strategy investor making an annual additional pre-tax contribution of 1.6% of earnings for 35 years.

## Sensitivity to asset allocation

- 4.15 We have considered the effect of varying the underlying asset allocation in our core scenario. The alternative allocations we have investigated are:
- 100% Defensive;
  - 30% Growth / 70% Defensive;
  - 50% Growth / 50% Defensive; and
  - 90% Growth / 10% Defensive.
- 4.16 In each scenario the defensive allocation is either entirely invested in term annuities or entirely invested in a diversified bonds and cash portfolio. All other assumptions in the core scenario as set out in 2.16 have been retained.
- 4.17 The results to these sensitivities are set out in Table 3 which shows the usual metrics but under these asset allocation sensitivity scenarios. The results for the core scenario are repeated and shaded for easy comparison. Table 3.1 in Appendix 3 also shows the corresponding results for the individual with the larger earnings of \$120,000. The corresponding charts showing all of these results are in Figures 1.1 to 5.2 of Appendix 4.





Table 3: Sensitivities to variation in asset allocation - Earnings of \$45,000 pa

Asset Allocation			Accumulated account balance at retirement age 65 (\$)			
Growth	Defensive	Strategy	Earnings (\$ pa)	Worst	Median	Best
0%	100%	Non-Annuity	45,000	113,224	156,780	221,794
		Annuity	45,000	166,341	239,228	353,544
30%	70%	Non-Annuity	45,000	137,049	198,778	298,264
		Annuity	45,000	182,246	267,456	407,507
50%	50%	Non-Annuity	45,000	147,912	229,944	383,950
		Annuity	45,000	182,406	284,429	475,965
70%	30%	Non-Annuity	45,000	155,825	265,359	503,539
		Annuity	45,000	176,512	302,965	570,094
90%	10%	Non-Annuity	45,000	159,203	303,903	660,344
		Annuity	45,000	166,499	317,654	687,625

Assumptions: 9% pa Contribution Rate; \$30,000 Initial Account Balance; High Fees.

- 4.18 The results set out in Table 3 show that investing in term annuities during the accumulation phase results in a greater accumulated account balance at retirement age under all asset allocations. The relative improvement is greater for portfolios with higher defensive asset allocations.
- 4.19 Looking at the extreme case of investing 100% of the portfolio in defensive assets, we can see that the changing from the non-annuity strategy to the annuity strategy improves the accumulated account balance at retirement by around 50% or more. This scenario isolates the impact of investing in term annuities on the accumulated account balance.

## Sensitivity to level of fees

- 4.20 We have considered the effect of varying the level of fees associated with the superannuation fund. The core scenario allowed for administration and platform fees on invested assets in line with the Rice Warner Superannuation Fee Report 2008. We have also looked at the impact of using fees which are lower than those set out in the Rice Warner Report, and a no fee environment. Further details of the fees assumed are set out in Appendix 1. In each case we have retained all other assumptions as in the core scenario as set out in 2.16.
- 4.21 The scenarios modelled to demonstrate the fee sensitivity are a repeat of our core scenario and the variation in earnings. This sensitivity has been modelled in order to capture the dependency of fees on the size of the account balance. We note that, under the annuity strategy, the term annuity component of the defensive portfolio does not attract administration and platform fees.

- 4.22 Table 4 shows the fee sensitivity based on our core scenario. The sensitivity scenario under the alternate earnings variation is contained in Table 4.1 of Appendix 3. The corresponding charts for the figures set out in Table 4 are contained in Figures 6.1 to 7.2 of Appendix 4.

Table 4: Sensitivities to variation in superannuation fees - Earnings of \$45,000 pa

Fee Level	Strategy	Earnings (\$ pa)	Accumulated account balance at retirement age 65 (\$)		
			Worst	Median	Best
High	Non-Annuity	45,000	155,825	265,359	503,539
	Annuity	45,000	176,512	302,965	570,094
Low	Non-Annuity	45,000	173,445	297,956	568,293
	Annuity	45,000	191,110	330,333	624,728
None	Non-Annuity	45,000	178,847	307,309	586,646
	Annuity	45,000	195,243	338,108	638,965

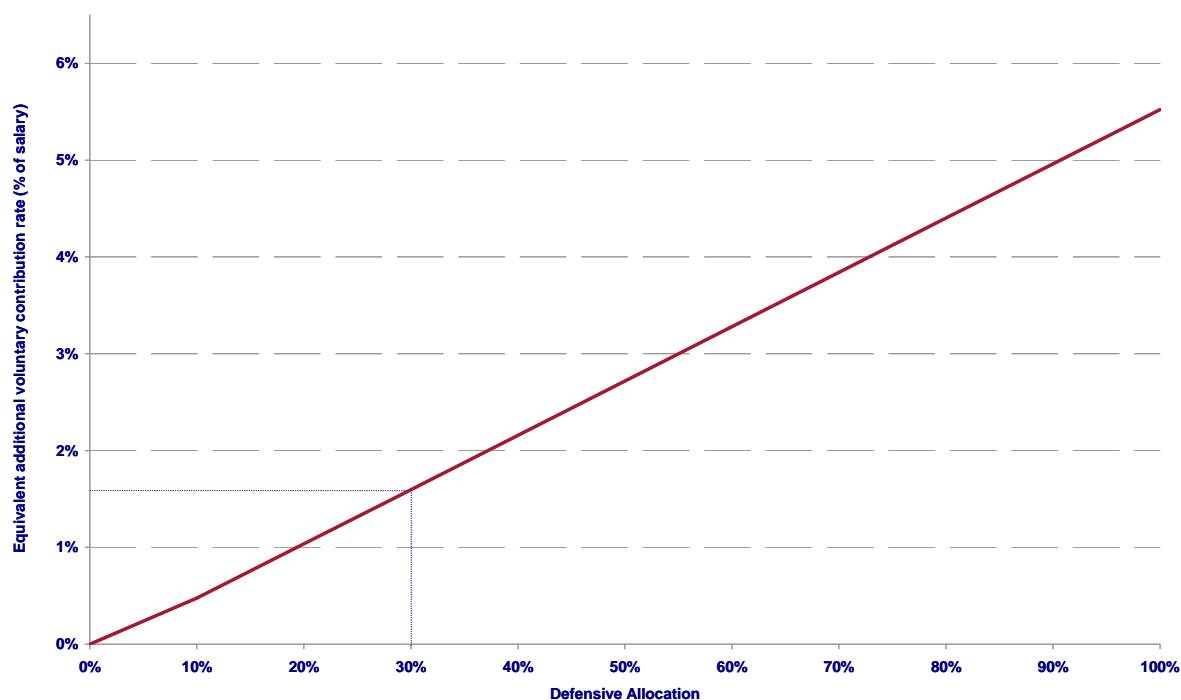
Assumptions: 9% pa Contribution Rate; \$30,000 Initial Account Balance; Asset Allocation: 70% Growth / 30% Defensive.

- 4.23 Table 4 shows the obvious result that lowering the superannuation fees results in an increase in the accumulated account balance at retirement under both the annuity and non-annuity strategies. The higher the fee level environment, the greater is the improvement in the accumulated account balance at retirement age arising under a shift to an annuity strategy.
- 4.24 The results for the higher earnings scenario set out in Table 4.1 in Appendix 3 show a similar pattern.

## Equivalent additional pre-tax contribution

- 4.25 As defined in 3.3 to 3.5, the equivalent additional pre-tax contribution rate is the additional annual pre-tax contribution (on top of the basic 9% level) that is required under the non-annuity strategies in order for the average account balance at retirement to be equal to that under the annuity strategies. This rate gives an indication of the magnitude of improved outcomes that can be obtained through investing in term annuities, based on the modelling assumptions.
- 4.26 Figure 1 below shows how this metric varies with the individual's asset allocation strategy.

Figure 1: Equivalent additional pre-tax contribution



- 4.27 As commented in 4.14 above, a 70/30 growth/defensive investor adopting an annuity strategy is obtaining the individual an average accumulated account balance at age 65 which is equivalent to a non-annuity strategy investor making an annual additional pre-tax contribution of around 1.6% of earnings for 35 years.
- 4.28 This additional contribution increases as the defensive asset allocation increases. For example, Figure 1 shows that a 50/50 growth/defensive investor is saving around 2.7% of earnings per annum by adopting an annuity strategy. A table of the contribution rates depicted in Figure 1 above can be found in Table 6 in Appendix 3.

## Driver of results - Annuity Pricing Basis vs Bond Portfolio Return

- 4.29 On the modelling assumptions used, the results indicate an increase in accumulated account balance at retirement arising from a re-allocation of the defensive portion of the individual's assets to an annuity strategy. The projection modelling has attempted to ensure that fair comparison is being made between annuity and non-annuity strategy under each scenario.
- 4.30 The defensive portfolio used in the non-annuity strategies assumes a mix of Australian and international government and corporate bonds, and cash. Term annuities are assumed to be priced at 100 basis points (1%) pa above swap rates, as requested by Challenger. Under these modelling assumptions, by substituting a term annuity strategy for the defensive assets, the individual enjoys an additional 2% pa gross return, on average, on defensive assets. It is this assumed incremental return, compounded over the accumulation period of 35 years, which drives the results presented.
- 4.31 However, there is no modelled increase in risk corresponding to this higher return. That is, the individual is effectively relying on the capital structure of the life office, and the safeguard provided by the surrounding regulatory environment, to "absorb" the additional credit risk inherent in the assets underlying the term annuities. By purchasing term annuities, the individual is assumed to enjoy the higher returns (relative to the non-annuity strategy defensive assets) while being shielded (via the structure described above) from any additional risk of poor returns or default.
- 4.32 We note also that the individual is not penalised under the model for the lower liquidity inherent in purchasing term annuities relative to a liquid portfolio. If the individual had to liquidate the term annuity portfolio before maturity, then generally penalties would apply. This aspect is not captured in the modelling.



This page is intentionally blank



# Section 5: Reliances and Limitations

## Reliances

- 5.1 In carrying out our analysis and producing this Report we have relied without independent verification upon the accuracy and completeness of the data and information provided to us, both in written and oral form, by Challenger which produced the sources of information discussed in the Report.
- 5.2 Reliance has been placed upon, but not limited to, the term annuity pricing structure provided by Challenger discussed in Appendix 1.

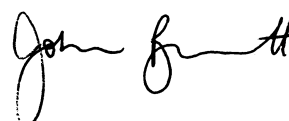
## Limitations

- 5.3 The Report has been prepared by Watson Wyatt Australia Pty Ltd on an agreed basis to meet the specific purposes of the Challenger Group Services Pty. Ltd. and must not be relied upon for any other purpose. The Report has been prepared for use by persons technically competent in the areas covered. Except with the written consent of Watson Wyatt Australia Pty Ltd, the Report and any written or oral information or advice provided by Watson Wyatt Australia Pty Ltd must not be reproduced, distributed or communicated in whole or in part to any other person, or be relied upon by any other person. Any reference to Watson Wyatt Australia Pty Ltd in any report, accounts or other published documents is not authorised without our prior written consent.
- 5.4 The Report must be considered in its entirety since individual sections, if considered in isolation, may be misleading. Draft versions of the Report must not be relied upon by any person for any purpose. No reliance should be placed on any advice not given in writing. If reliance is placed contrary to the guidelines set out above, Watson Wyatt Australia Pty Ltd disclaim any and all liability which may arise.
- 5.5 Assumptions are made about future experience, including mortality and morbidity. These assumptions have been made on the basis of reasonable estimates. However, actual future experience is likely to differ from these assumptions, due to random fluctuations, changes in the operating environment, and other factors. Such variations in experience could have a significant effect on the results and conclusions of this Report. No warranty is given by Watson Wyatt Australia Pty Ltd that the assumptions made in this Report will be reflected in actual future experience.
- 5.6 This Report was based on data available to Watson Wyatt Australia Pty Ltd at, or prior to, 14 December 2009, and takes no account of developments after that date.
- 5.7 This Report is subject to the terms and limitations, including limitation of liability, set out in our engagement letter of 21 July 2009.



Nick Callil  
Consulting Actuary

14 December 2009



Review: John Burnett  
Consulting Actuary



This page is intentionally blank



# Appendix 1: Modelling Assumptions

## 1.1 Investment Model

All results and analysis contained in this report are based on stochastic projections of a wide range of future market conditions, including investment returns for major asset classes and future levels of CPI and interest rates. Details of the methods and assumptions for the underlying Investment Model are set out separately in Appendix 2.

## 1.2 Model Individual

Our investigations have been based on the assumption that the model individual is a 30 year old assumed to retire at age 65.

## 1.3 Earnings

We have carried out projections assuming two different salaries in order to examine any variations in results. The earnings we have modelled are:

- \$45,000 pa – assumed to be 75% of Average Weekly Ordinary Time Earnings (AWOTE). This represents the median earnings of the full-time adult population; and
- \$120,000 pa – assumed to be 2 × Average Weekly Ordinary Time Earnings (AWOTE). This represents a high earning individual.

Both salaries are assumed to increase in line with Average Weekly Ordinary Time Earnings in the future.

## 1.4 Contribution Rate

For the purpose of this modelling work, we have assumed that the model individual accumulates 9% of earnings to their superannuation each year (before contribution tax of 15%). The contribution income is allocated between growth and defensive assets in accordance with the asset allocation strategy.

## 1.5 Initial Account Balance

We have assumed that the model individual has accumulated superannuation savings through employment prior to reaching the starting age of 30 years. The initial account balances modelled are:

- \$30,000 – for the individual earning \$45,000 pa; and
- \$80,000 – for the individual earning \$120,000 pa.





## 1.6 Asset Allocation

A significant objective of this project is to compare modelled outcomes for various growth/defensive asset allocations where the defensive element of the portfolio is invested either in a term annuity product or in the usual defensive asset classes.

We have modelled a number of different investment allocations with a varying exposure to defensive asset classes. In the strategy where term annuities are purchased as the defensive portion of the allocation, it is assumed that the remaining assets are fully invested in growth type asset classes.

The asset allocations we have investigated are:

- 100% Defensive;
- 30% Growth / 70% Defensive;
- 50% Growth / 50% Defensive;
- 70% Growth / 30% Defensive; and
- 90% Growth / 10% Defensive.

## 1.7 Rebalancing Strategy

Under the annuity strategy, a term annuity is purchased with the allocated portion of the portfolio, which provides a fixed level of income for the duration of the annuity term. As a result of this illiquid asset type, it is not possible to rebalance the overall portfolio on an annual basis to maintain the assumed asset allocation. The model therefore carries out a rebalancing calculation at the end of the term of each annuity to reset the asset allocation to the initial growth/defensive assumption.

Under the non-annuity strategy, there is no such constraint regarding rebalancing the portfolio (i.e. the portfolio could be rebalanced annually). However, rebalancing on an annual basis would result in a bias towards the annuity strategy since when equity returns are good the annuity strategy portfolio will have a greater exposure to growth assets until the end of the annuity term.

In order to ensure a more consistent exposure to growth assets over the projection, the rebalancing calculation under the non-annuity strategy has been carried out at discrete intervals to coincide with the annuity strategy rebalancing.

## 1.8 Investment Tax

In the accumulation phase, all returns used for the projections are net of investment tax. Where applicable, the Watson Wyatt Global Asset Model incorporates an allowance for the taxation of income and capital gains on the different asset classes. The model allows for different rates of taxation, both between income and capital gains, and also between different asset classes within the growth portfolios and the defensive portfolio under the non-annuity strategies. Under the annuity strategy, we have assumed a tax rate of 15% applied to the income from the term annuity.

## 1.9 Term Annuity

### *Term*

All of the annuities modelled have five year terms.

### *Residual Capital Value*

All of the term annuities modelled have a 100% residual capital value.

### *Guaranteed fixed income*

The guaranteed fixed income provided by each term annuity is determined based on the prevailing market conditions modelled at the date of purchase of the annuity. We have been advised by Challenger that the sustainable long-term guaranteed fixed income yield is 100 basis points above the swap rate with the appropriate duration to match the term of the annuity.

The Watson Wyatt Global Asset Model does not generate swap rates. We have therefore agreed with Challenger that swap rates used to determine the term annuities should be derived from the model in the year of purchase as follows:

- the yield on Commonwealth Government Bonds with appropriate term (5 years in this case); plus
- two thirds of the AA corporate bond spread.

The average 5 year swap rate generated is 6.5% pa. Allowing for the 100 basis points margin included in the pricing basis, this would imply an average guaranteed fixed income rate from a 5 year term annuity of 7.5% pa.

### *Commission rates*

All of the term annuities modelled have been calculated on a no commission basis. This is consistent with the managed portfolio where we have made no allowance for advisor fees.

## 1.10 Platform and Administration Fees

As part of the project objectives, Challenger has requested that the model incorporate projections both with and without the inclusion of platform and administration fees. No additional fees are to be incorporated into the term annuity element of the calculations as we understand that the annuity rates already include a margin for the life company expenses.

We have not included an explicit assumption for investment management fees. Returns from the Global Asset Model are assumed to be net of these fees.

As agreed with Challenger, we have assumed the fees to be those set out in the Superannuation Fees Report 2008 prepared for IFSA by Rice Warner Actuaries. The table below sets out an extract from that report detailing the average fees for Personal Super Open Products incorporated into our model.



We have also created a second set of fee assumptions which has been based on a survey of 16 industry super funds. These entities tend to charge lower fees than public offer retail funds and we have therefore identified this as our low fee assumption. Details of the fees assumed are set out below.

Table 7: Superannuation Fees

Account Balance	High Fee Assumption*		Low Fee Assumption#	
	Administration (%)	Platform (%)	Administration %	Platform %
>\$1 million	0.01	0.41	0.08	0
\$500,000 - \$1 million	0.01	0.47	0.09	0
\$250,000 - \$500,000	0.02	0.54	0.11	0
\$100,000 - \$250,000	0.05	0.62	0.13	0
\$50,000 - \$100,000	0.10	0.72	0.19	0
\$25,000 - \$50,000	0.20	0.82	0.29	0
<\$25,000	0.74	0.94	0.69	0

\* Personal Super Open Products Expense Rate (%) – Personal Superannuation Products, Superannuation Fees Report 2008, Rice Warner Actuaries.

# Based on research across 16 industry super funds.



## Appendix 2: A summary of the Watson Wyatt asset modelling assumptions as at 31 March 2009

The tables and charts in this Appendix show the summary statistics for the major asset classes included in the Watson Wyatt Global Asset Model as at 31 March 2009 from the perspective of an Australian investor who is valuing his or her investments in Australian dollars.

We believe that we are currently in an abnormal economic environment and in a number of areas our short-term expectations differ from our views of longer term central outcomes. However, this investigation is looking at the long-term impact of incorporating annuities into retirement incomes and we have therefore removed the short-term assumptions from our standard asset model in order to reflect a long-term view.

The tables below show the arithmetic average, median and standard deviation of return in the first year of projection. We also show the median and standard deviation of annualized returns over a 10-year period and in the long-term – median returns behave similarly to longer-term geometric average returns, and are therefore a more natural basis for comparison with past history. These assumptions are *before* allowing for the effects of tax and investment management expenses.

The return assumptions given for each mainstream asset class (i.e. equities, property, bonds, credit and cash) and certain alternatives (i.e. commodity futures, local currency emerging market debt) represent the expected market average (index) returns that an institutional investor could expect to achieve through a passive investment management approach. As such, they do not include expected premia for active investment management, or any offsets for the risks and costs of managing active strategies.

The return assumptions for private equity, infrastructure and fund of hedge funds are based on the return net of fees that could be expected from a low (active) risk, well diversified exposure such as through a fund of funds.



Table 9: Watson Wyatt Assumptions as at 31 March 2009  
Denominated in AUD, nominal, gross of tax

Asset class	Actual			10-year annualized	
	Arithmetic average	Median	Standard deviation	Median	Standard deviation
<b>Price Inflation (CPI)</b>	2.5	2.5	1.6	2.5	0.4
<b>Wage Inflation (AWE)</b>	4.1	4.0	2.6	4.1	0.8
<b>Cash &amp; Bonds</b>					
Cash	5.1	5.1	1.2	5.1	0.4
Australian 10yr Govt Bonds Return	5.9	5.4	7.9	5.6	0.5
Australian 10yr Govt Bonds Yield	5.6	5.5	1.3	5.6	0.5
Australian 5yr Govt Bond Yield	5.5	5.4	1.1	5.5	0.7
Australian Fixed Interest	5.9	5.7	4.0	5.9	0.5
Australian Inflation-Linked Bonds	4.9	4.8	4.2	4.8	0.4
Global Bonds (Govt, hedged)	5.5	5.3	3.8	5.4	0.5
Global Bonds (Aggregate, hedged)	6.1	5.9	4.0	6.0	0.5
Global Inflation-Linked Bonds (hedged)	5.5	5.3	4.4	5.4	0.4
Australian All Corp Bond Spread	1.5	1.5	0.6	1.5	0.1
<b>Equities</b>					
Australian Equities	9.7	8.3	18.4	8.2	2.5
Australian Small Cap Equities	10.6	8.2	23.3	8.3	3.2
Global Equities (ex Aus, unhedged)	9.8	8.7	15.6	8.8	2.1
Global Equities (ex Aus, hedged)	10.5	9.5	15.4	9.5	2.1
Emerging Market Equities (unhedged)	13.3	9.0	32.6	8.9	4.0
<b>Property</b>					
Australian Unlisted Property	7.6	7.1	10.0	7.1	1.4
Australian Listed Property	8.1	6.5	18.7	6.5	2.6
Global Listed Property (hedged)	8.2	7.1	15.2	7.1	2.1
<b>Credit</b>					
Emerging Market Debt (hedged)	7.6	7.6	15.9	6.4	2.3
High Yield Debt (hedged)	8.8	8.4	10.2	8.4	1.5
Australian Investment Grade Credit	6.6	6.4	4.7	6.5	0.5
Global Investment Grade Credit (hedged)	6.8	6.6	4.7	6.7	0.5
<b>Alternative assets</b>					
Fund of Hedge Funds (hedged)	7.7	7.5	6.7	7.5	1.0
Private Equity (global, unhedged)	9.8	7.5	23.4	7.4	3.0
Global Infrastructure (hedged)	9.6	9.1	13.7	8.8	1.8
Commodity Futures (hedged)	7.5	5.6	20.3	5.6	2.8
Timber (unhedged)	9.3	7.1	22.1	7.1	3.9
Emerging Market Cash (unhedged)	7.1	6.9	7.3	6.9	2.3
Local Currency EMD (unhedged)	8.2	6.8	17.2	6.9	5.3
<b>Equity Risk Premium</b>					
Aus equities – Aus govt bonds	3.8				
Aus equities – Aus ILBs	4.8				

Table 10: Assumptions underlying the superannuation fund at 31 March 2009  
Denominated in AUD, nominal, gross of tax

Portfolio	Actual			10-year annualized	
	Arithmetic average	Median	Standard deviation	Median	Standard deviation
0% Growth	5.8	5.6	2.7	5.7	0.4
50% Growth	7.6	7.2	6.5	7.4	0.9
70% Growth	8.4	7.8	8.7	8.0	1.2
90% Growth	9.1	8.4	11.1	8.5	1.6
100% Growth	9.5	8.7	12.3	8.8	1.7

Denominated in AUD, nominal, net of tax

Portfolio	Actual			10-year annualized	
	Arithmetic average	Median	Standard deviation	Median	Standard deviation
0% Growth	4.9	4.8	2.3	4.9	0.4
50% Growth	6.8	6.4	5.8	6.6	0.8
70% Growth	7.5	7.1	7.8	7.3	1.1
90% Growth	8.3	7.7	9.9	7.9	1.4
100% Growth	8.7	8.0	11.0	8.1	1.5

Please note that our assumptions are intended to be long-term assumptions, and as such they are intended to be used in setting long-term or strategic asset allocations. They are not intended to be representative of short-term experiences (for example over the next year), but rather they could be considered to represent the experience of an “average” year over the next ten years.

## Correlation assumptions

Correlation is a statistical measure that describes the extent to which the returns from two asset classes are linked. The correlations of returns between the different asset classes describe important characteristics of the Global Asset Model in addition to the expected annual return and the standard deviation of annual returns.

Table 11 shows the key correlations of nominal 1-year returns between assets used in the Global Asset Model. To help in interpreting these numbers, a figure below 0.3 (positive or negative) is indicative of low correlation, a figure between 0.3 and 0.5 indicates moderate correlation and a figure of above 0.5 indicates a high degree of correlation.



Table 11: Watson Wyatt Correlation matrix as at 31 March 2009

		<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>																														
--	--	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



## **Watson Wyatt global asset model: Confidentiality and Disclaimer**

*The assumptions shown in this Appendix and used for this report have been derived by Watson Wyatt through a blend of economic theory, historical analysis and the views of investment managers. They inevitably contain an element of subjective judgment.*

*These assumptions are intended to be used in conjunction with Watson Wyatt's global asset model, for the purpose of setting long-term or strategic asset allocations.*

*The key component of an asset allocation study is the way in which the assets are modelled. The structure of the Watson Wyatt global asset model is based on historical analysis of investment returns, although Watson Wyatt has incorporated its subjective judgement to complement the information provided by historical returns. The model is designed to illustrate the future range of returns stemming from different asset classes and their inter-relationship. It should be noted that no economic model could be expected to perfectly capture future uncertainty, particularly the risk of extreme events.*

*In particular it should be noted that our timeframe in establishing our asset model and the assumptions used in the model is long-term, and as such it is not meant to be precisely reflective of the likely course of the investment markets in the short-term. Furthermore, our opinions and return forecasts are not intended to imply, nor should be interpreted as conveying, any form of guarantee or assurance by Watson Wyatt, of the future performance of the asset classes in question, either favourable or unfavourable. Past performance should not be taken as representing any particular guide to future performance.*





This page is intentionally blank



# Appendix 3: Supporting Tables

Table 1: Core scenario results – impact of investing in a term annuity strategy

Strategy	Earnings (\$ pa)	Initial Balance (\$)	Contribution Rate	Accumulated account balance at retirement age 65 (\$)		
				Worst	Median	Best
Non-Annuity	45,000	30,000	9%	155,825	265,359	503,539
Annuity				176,512	302,965	570,094

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.

Table 2: Sensitivity to earnings

Strategy	Earnings (\$ pa)	Initial Balance (\$)	Contribution Rate	Accumulated account balance at retirement age 65 (\$)		
				Worst	Median	Best
Non-Annuity	45,000	30,000	9%	155,825	265,359	503,539
Annuity				176,512	302,965	570,094
Non-Annuity	120,000	80,000	9%	426,196	730,100	1,386,013
Annuity				479,930	826,787	1,555,428

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.



Table 3: Sensitivities to variation in asset allocation - Earnings of \$45,000 pa

Asset Allocation		Strategy	Earnings (\$ pa)	Accumulated account balance at retirement age 65 (\$)		
Growth	Defensive			Worst	Median	Best
0%	100%	Non-Annuity	45,000	113,224	156,780	221,794
		Annuity	45,000	166,341	239,228	353,544
30%	70%	Non-Annuity	45,000	137,049	198,778	298,264
		Annuity	45,000	182,246	267,456	407,507
50%	50%	Non-Annuity	45,000	147,912	229,944	383,950
		Annuity	45,000	182,406	284,429	475,965
70%	30%	Non-Annuity	45,000	155,825	265,359	503,539
		Annuity	45,000	176,512	302,965	570,094
90%	10%	Non-Annuity	45,000	159,203	303,903	660,344
		Annuity	45,000	166,499	317,654	687,625

Assumptions: 9% pa Contribution Rate; \$30,000 Initial Account Balance; High Fees.

Table 3.1: Sensitivities to variation in asset allocation - Earnings of \$120,000 pa

Asset Allocation				Accumulated account balance at retirement age 65 (\$)		
Growth	Defensive	Strategy	Earnings (\$ pa)	Worst	Median	Best
0%	100%	Non-Annuity	120,000	309,836	429,250	609,260
		Annuity	120,000	444,645	639,268	944,772
30%	70%	Non-Annuity	120,000	374,919	545,100	820,661
		Annuity	120,000	490,858	721,457	1,099,747
50%	50%	Non-Annuity	120,000	404,566	632,363	1,054,773
		Annuity	120,000	493,297	771,777	1,294,642
70%	30%	Non-Annuity	120,000	426,196	730,100	1,386,013
		Annuity	120,000	479,930	826,787	1,555,428
90%	10%	Non-Annuity	120,000	435,477	836,344	1,815,943
		Annuity	120,000	454,566	870,133	1,887,835

Assumptions: 9% Contribution Rate; \$80,000 Initial Account Balance; High Fees.

Table 4: Sensitivities to variation in superannuation fees - Earnings of \$45,000 pa

Fee Level	Strategy	Earnings (\$ pa)	Accumulated account balance at retirement age 65 (\$)		
			Worst	Median	Best
High	Non-Annuity	45,000	155,825	265,359	503,539
	Annuity	45,000	176,512	302,965	570,094
Low	Non-Annuity	45,000	173,445	297,956	568,293
	Annuity	45,000	191,110	330,333	624,728
None	Non-Annuity	45,000	178,847	307,309	586,646
	Annuity	45,000	195,243	338,108	638,965

Assumptions: 9% pa Contribution Rate; \$30,000 Initial Account Balance; Asset Allocation: 70% Growth / 30% Defensive.



Table 4.1: Sensitivities to variation in superannuation fees - Earnings of \$120,000 pa

Fee Level	Strategy	Earnings (\$ pa)	Accumulated account balance at retirement age 65 (\$)		
			Worst	Median	Best
High	Non-Annuity	120,000	426,196	730,100	1,386,013
	Annuity	120,000	479,930	826,787	1,555,428
Low	Non-Annuity	120,000	466,658	801,469	1,527,874
	Annuity	120,000	512,341	886,063	1,675,849
None	Non-Annuity	120,000	476,924	819,491	1,564,389
	Annuity	120,000	520,647	901,305	1,705,714

Assumptions: 9% pa Contribution Rate; \$80,000 Initial Account Balance; Asset Allocation: 70% Growth / 30% Defensive.

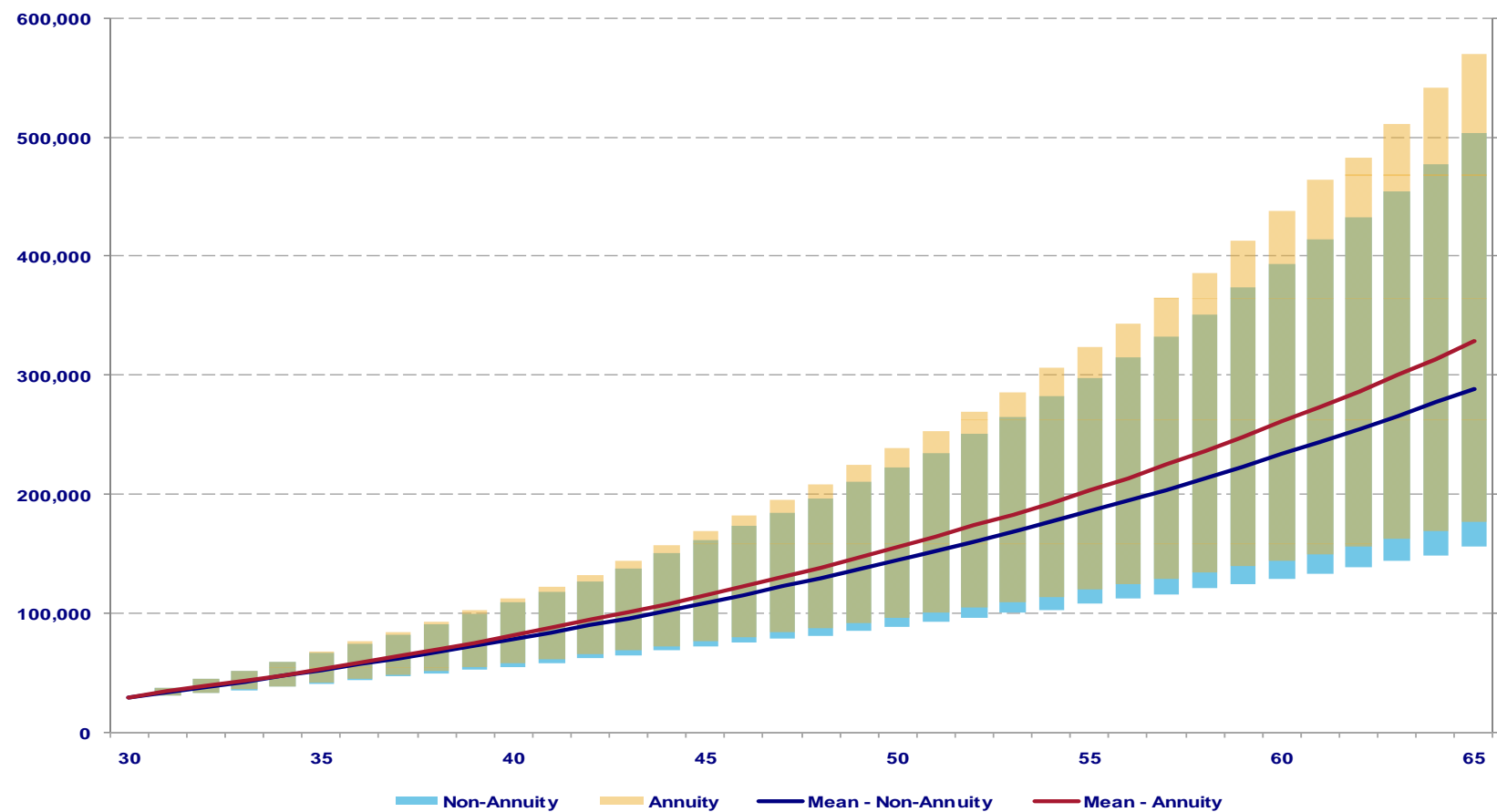
Table 6: Equivalent additional pre-tax contribution rate (% of salary)

Defensive Allocation	Contribution Rate
100%	5.5%
90%	5.0%
80%	4.4%
70%	3.8%
60%	3.3%
50%	2.7%
40%	2.2%
30%	1.6%
20%	1.0%
10%	0.5%
0%	0.0%

## Appendix 4: Supporting Charts



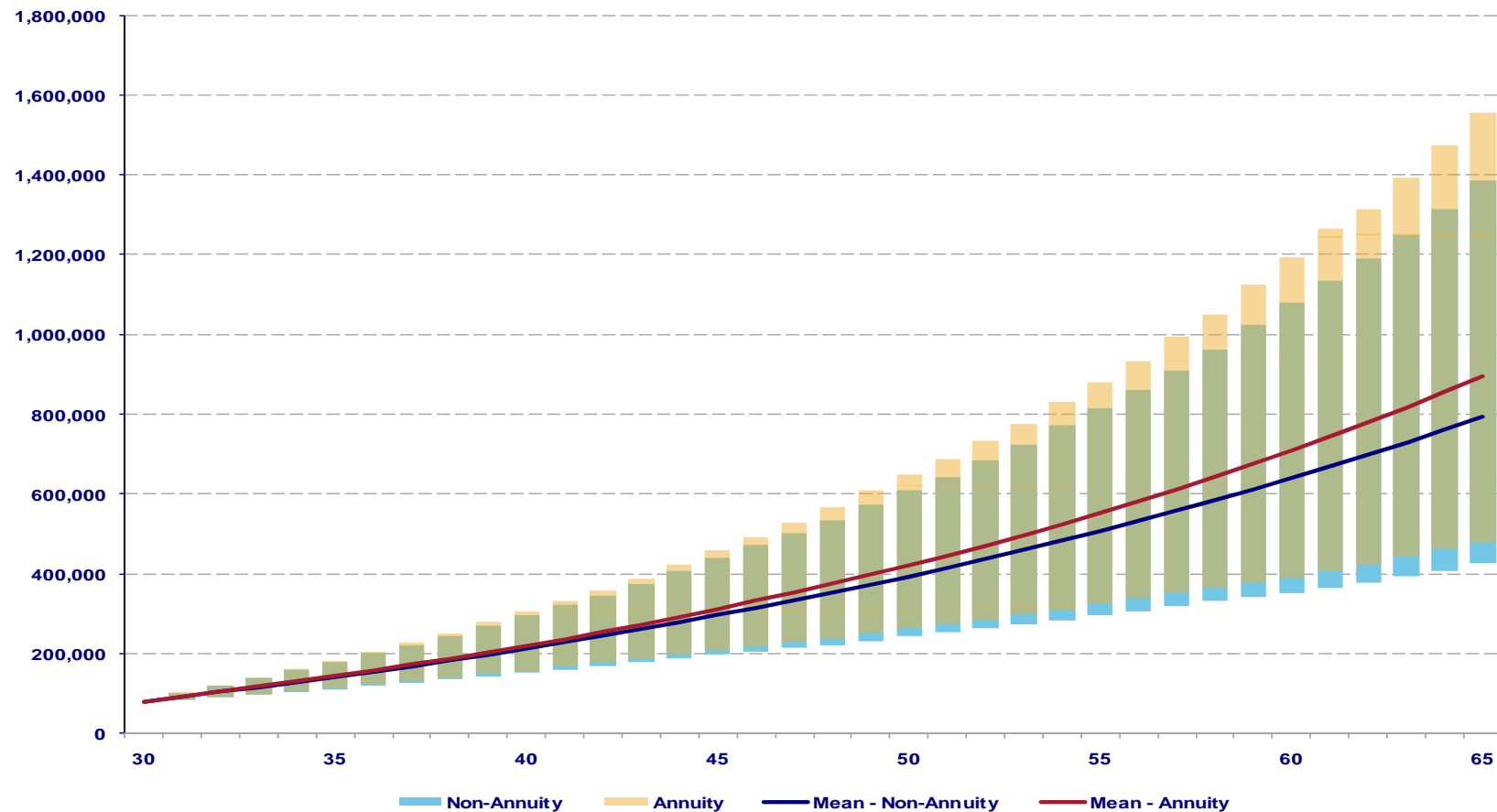
Figure 1.1: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 70% Growth, 30% Defensive; High Fees



Figure 1.2: Accumulated account balance  
- 90% Confidence interval



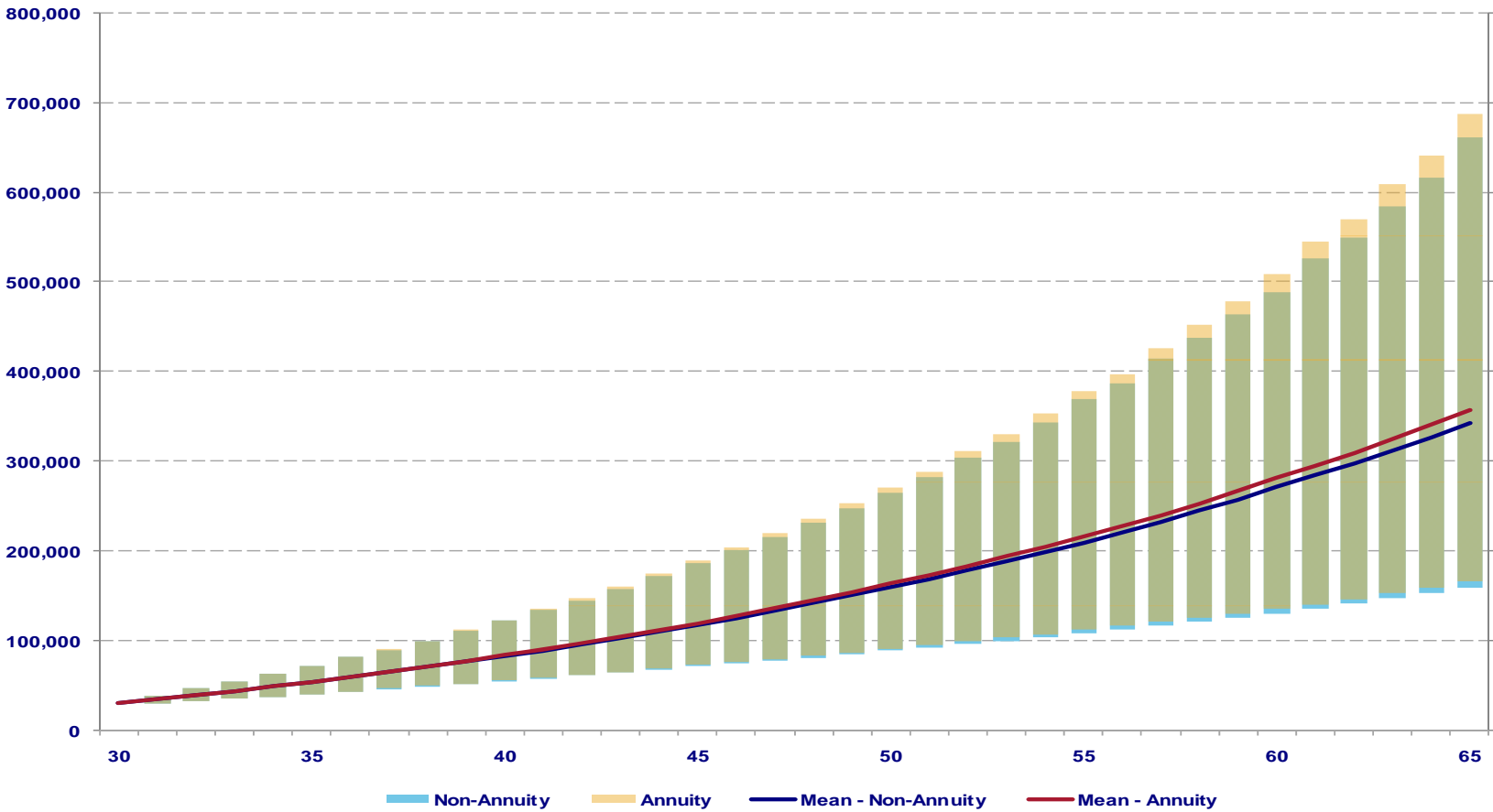
Assumptions: \$120,000 Earnings; 70% Growth, 30% Defensive; High Fees

Watson Wyatt Confidential





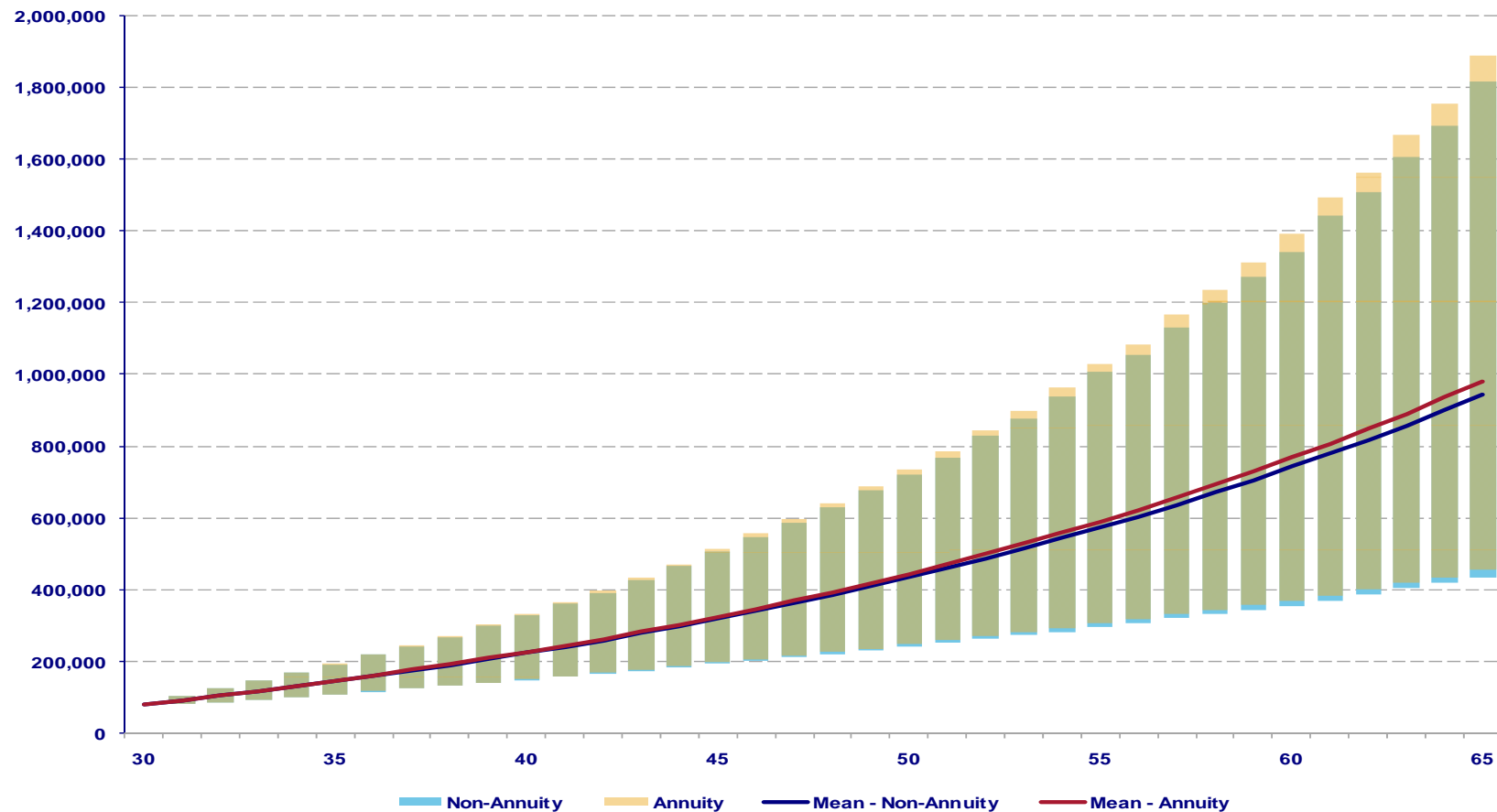
Figure 2.1: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 90% Growth, 10% Defensive; High Fees



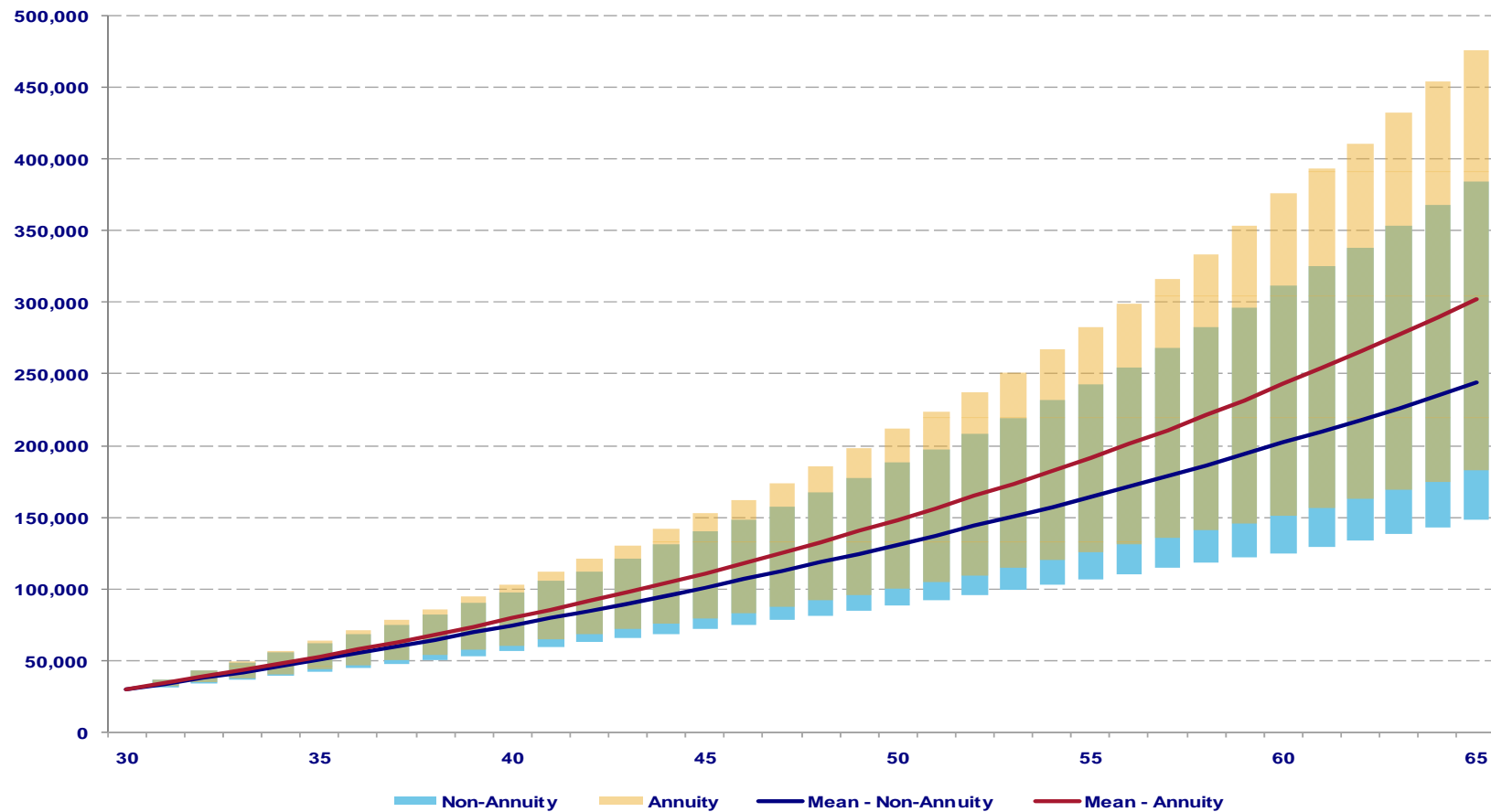
Figure 2.2: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$120,000 Earnings; 90% Growth, 10% Defensive; High Fees



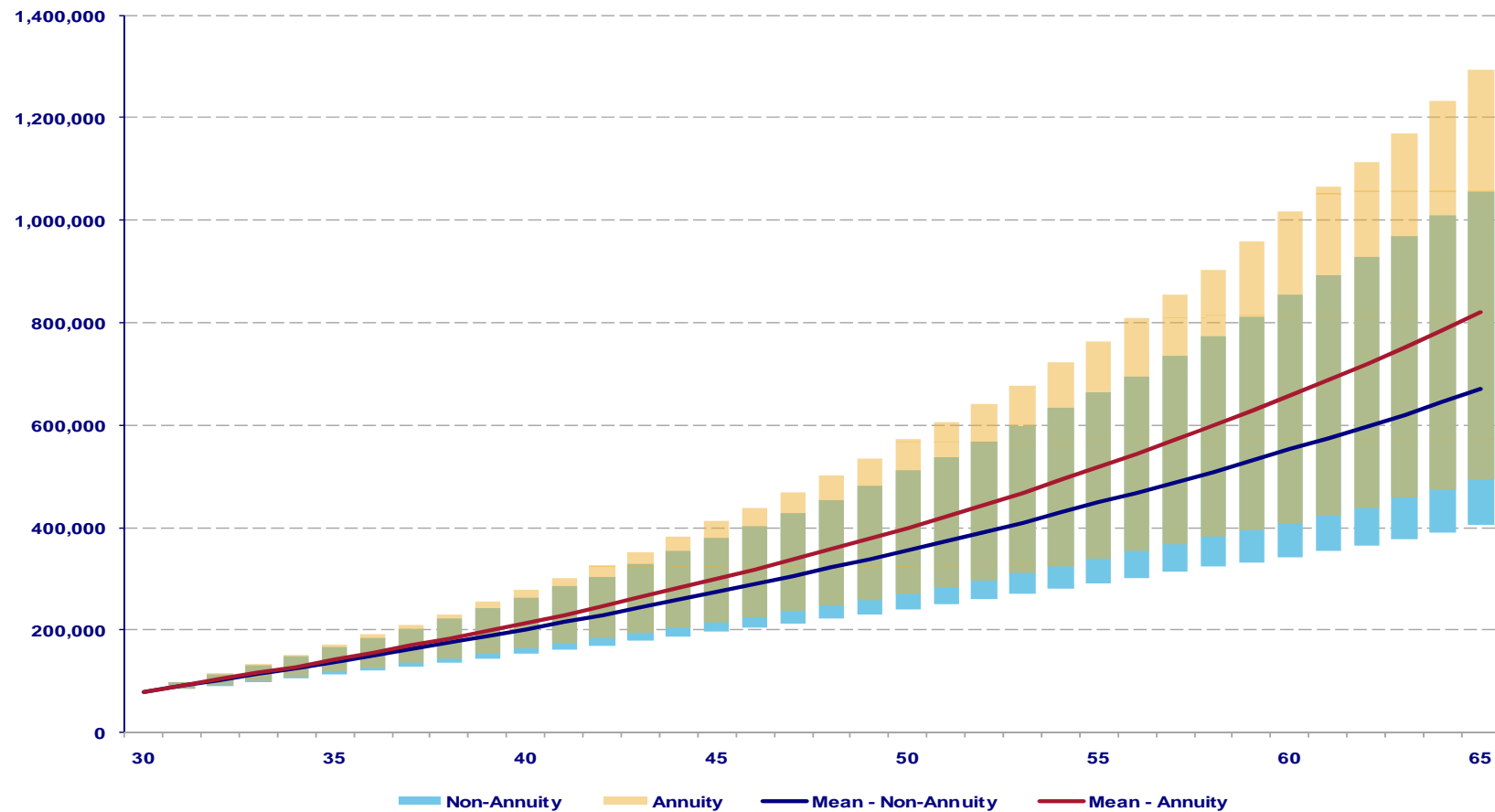
Figure 3.1: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 50% Growth, 50% Defensive; High Fees



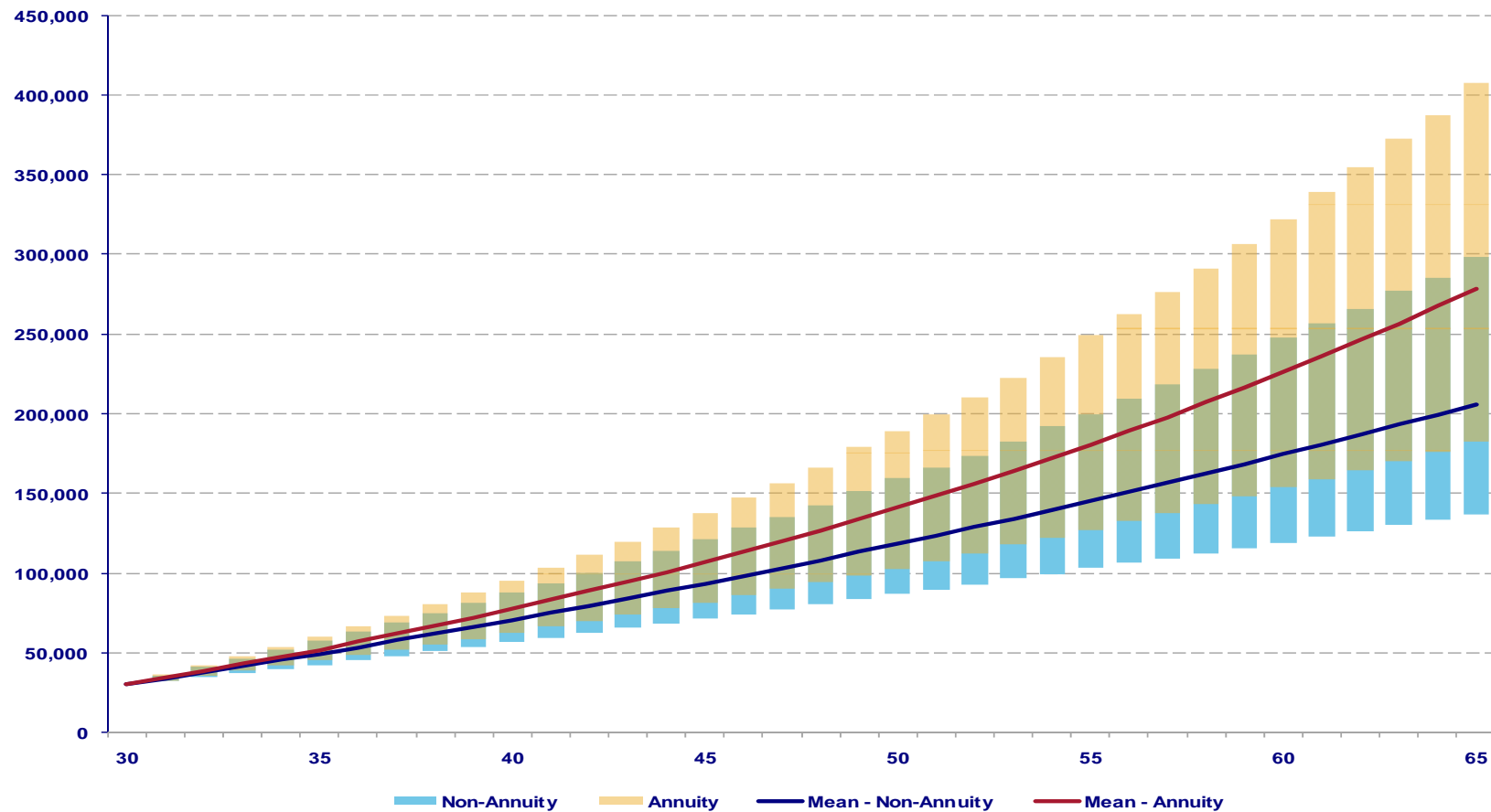
Figure 3.2: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$120,000 Earnings; 50% Growth, 50% Defensive; High Fees



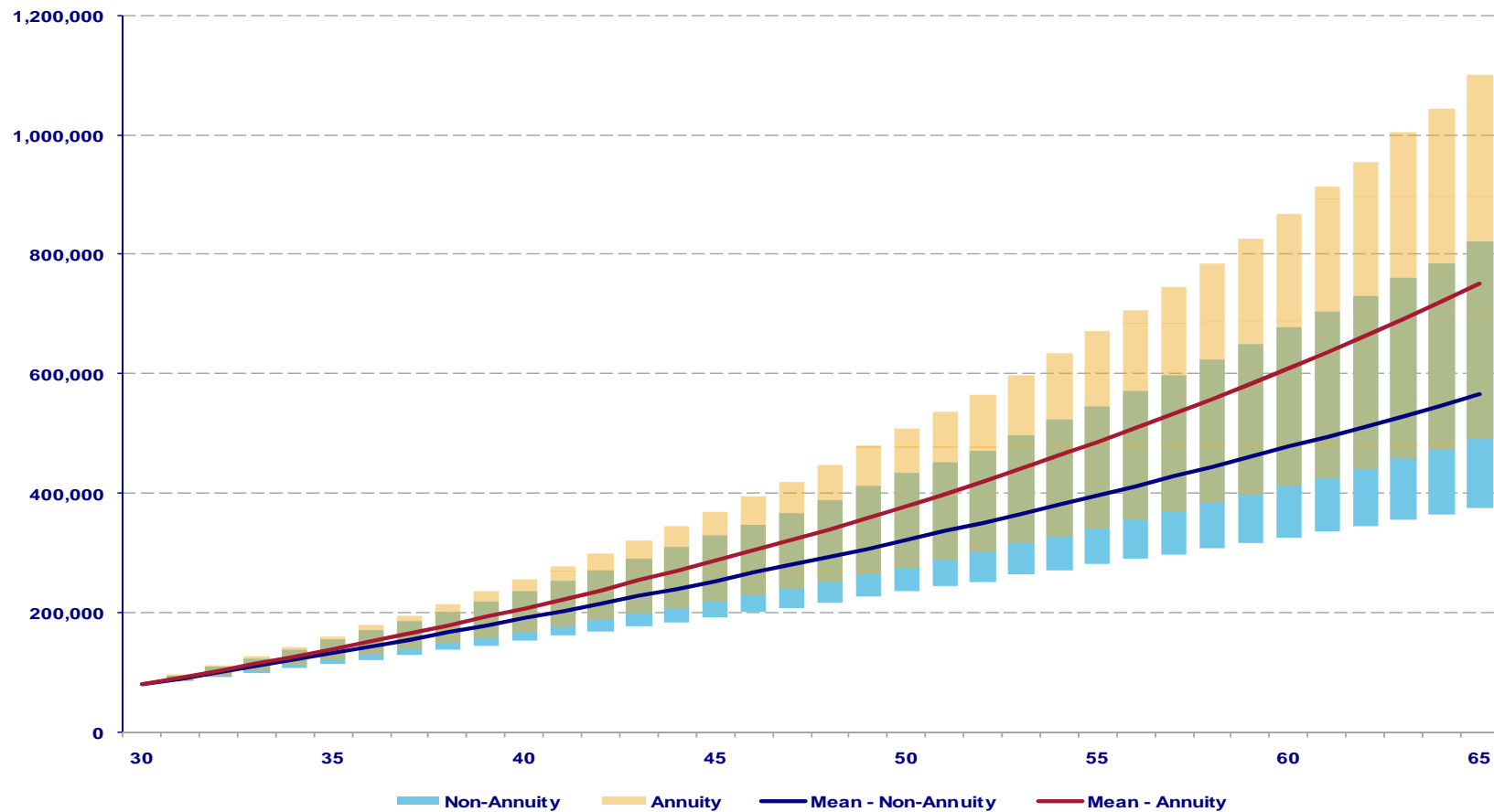
Figure 4.1: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 30% Growth, 70% Defensive; High Fees



Figure 4.2: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 30% Growth, 70% Defensive; High Fees



Figure 5.1: Accumulated account balance  
- 90% Confidence interval

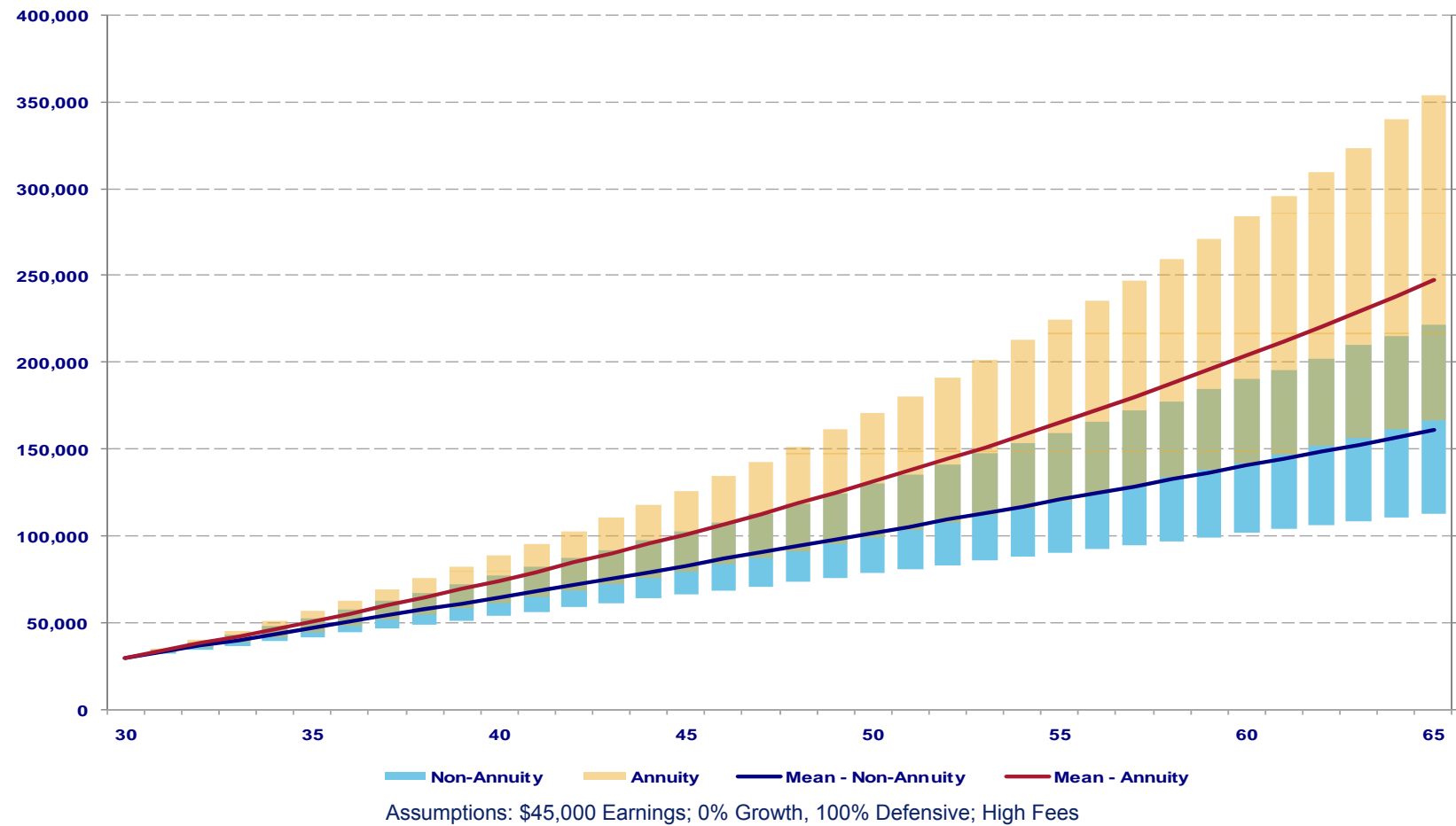
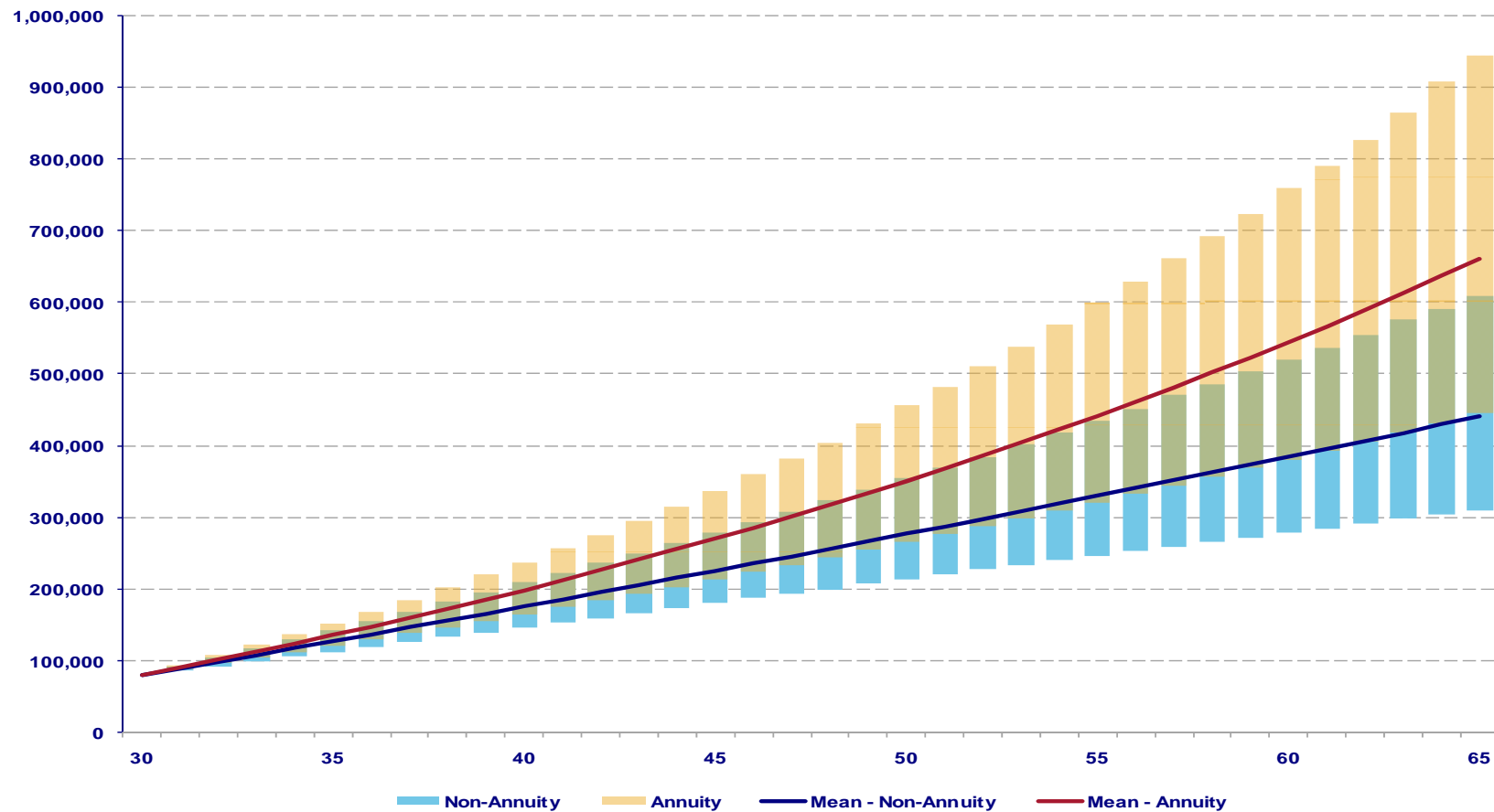


Figure 5.2: Accumulated account balance  
- 90% Confidence interval

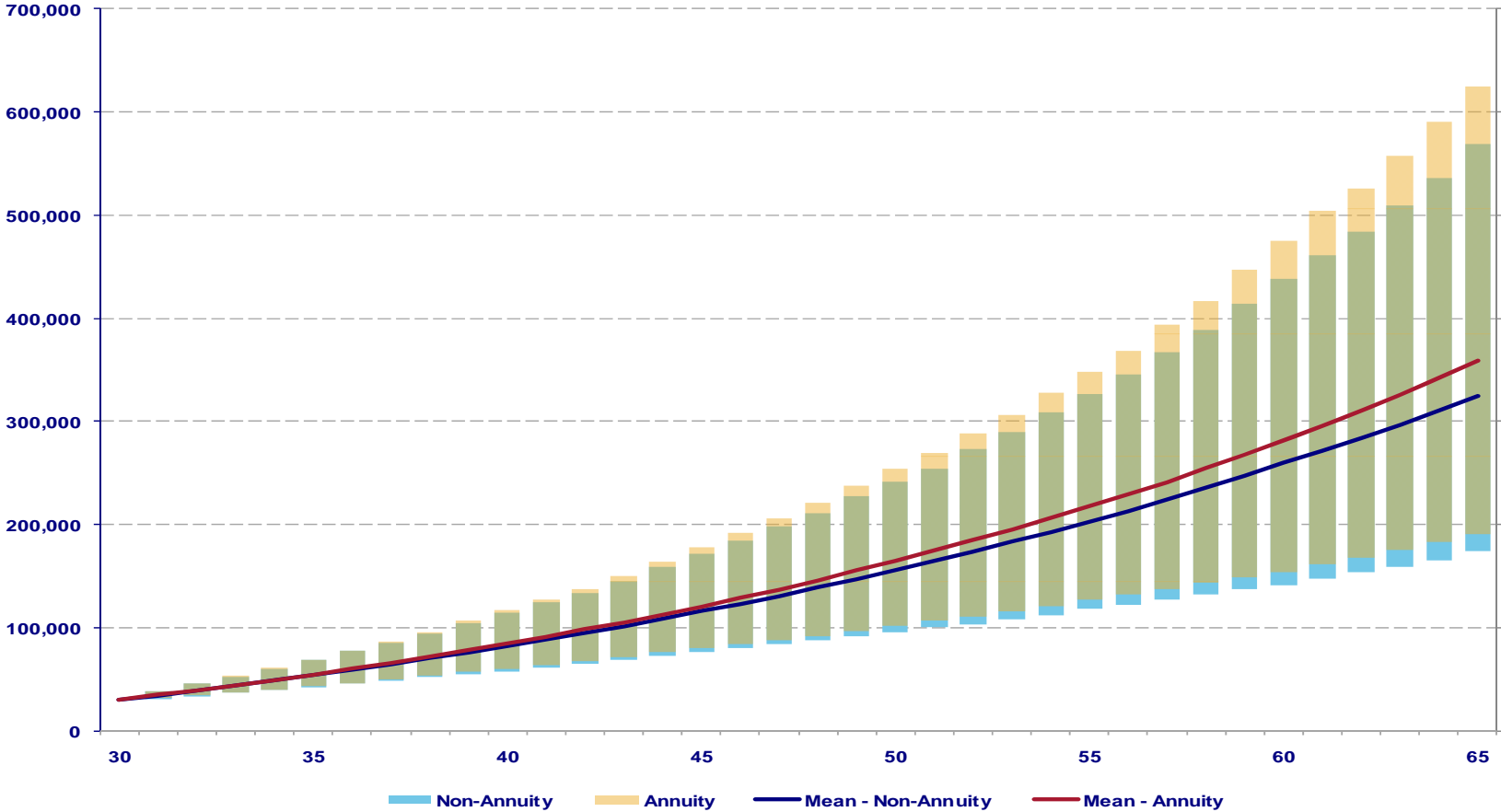


Assumptions: \$120,000 Earnings; 0% Growth, 100% Defensive; High Fees





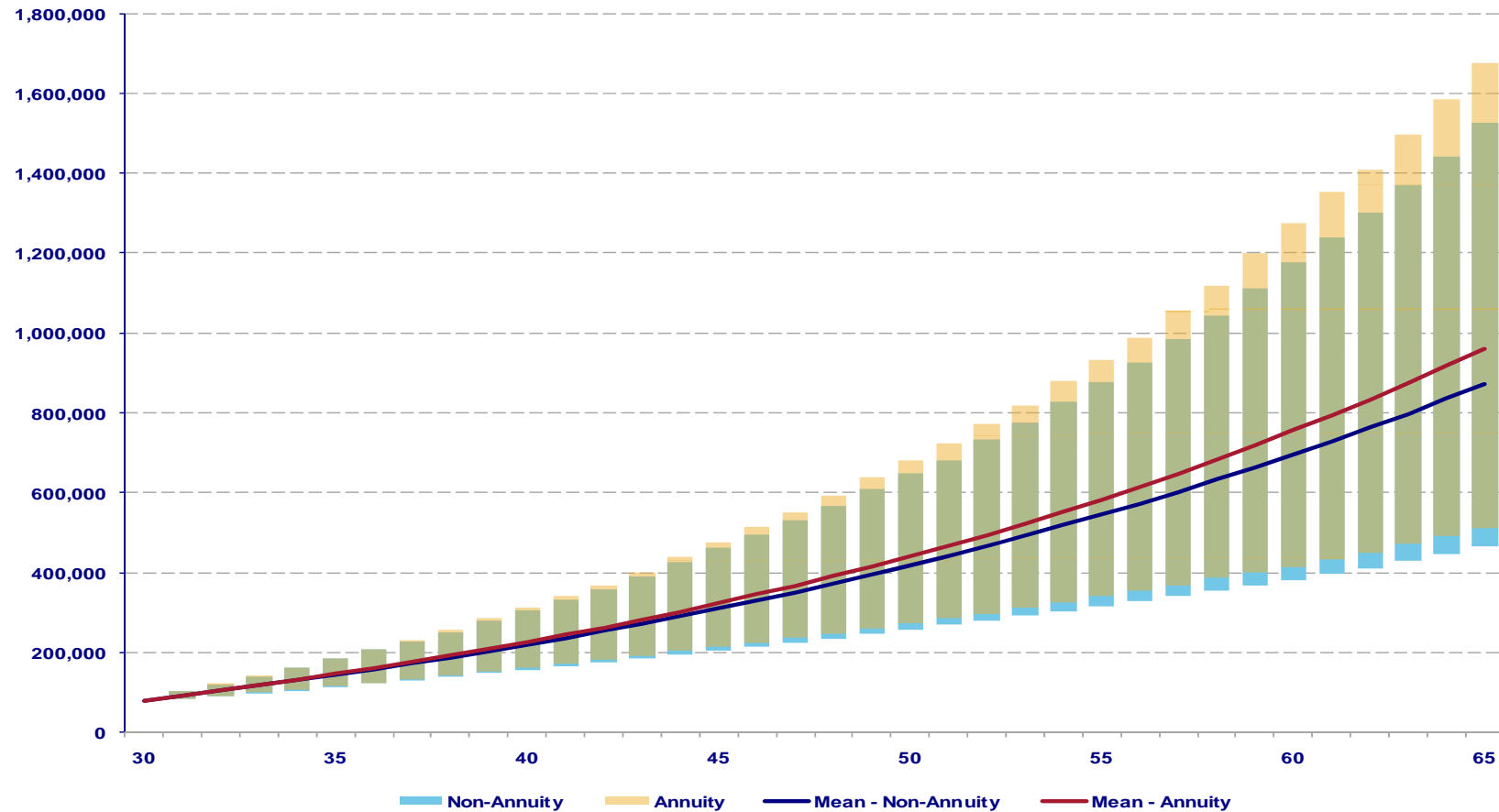
Figure 6.1: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 70% Growth, 30% Defensive; Low Fees



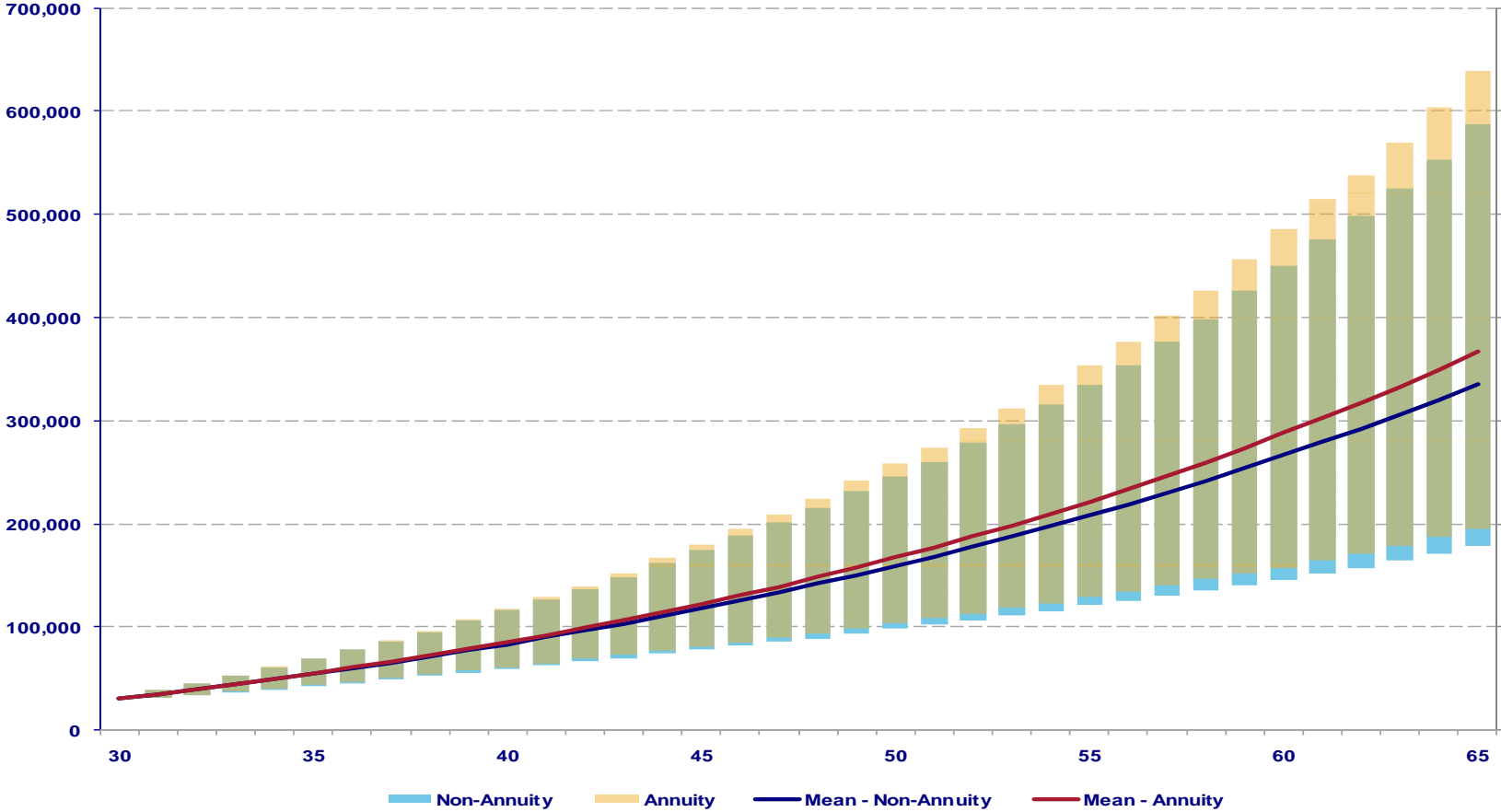
Figure 6.2: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$120,000 Earnings; 70% Growth, 30% Defensive; Low Fees



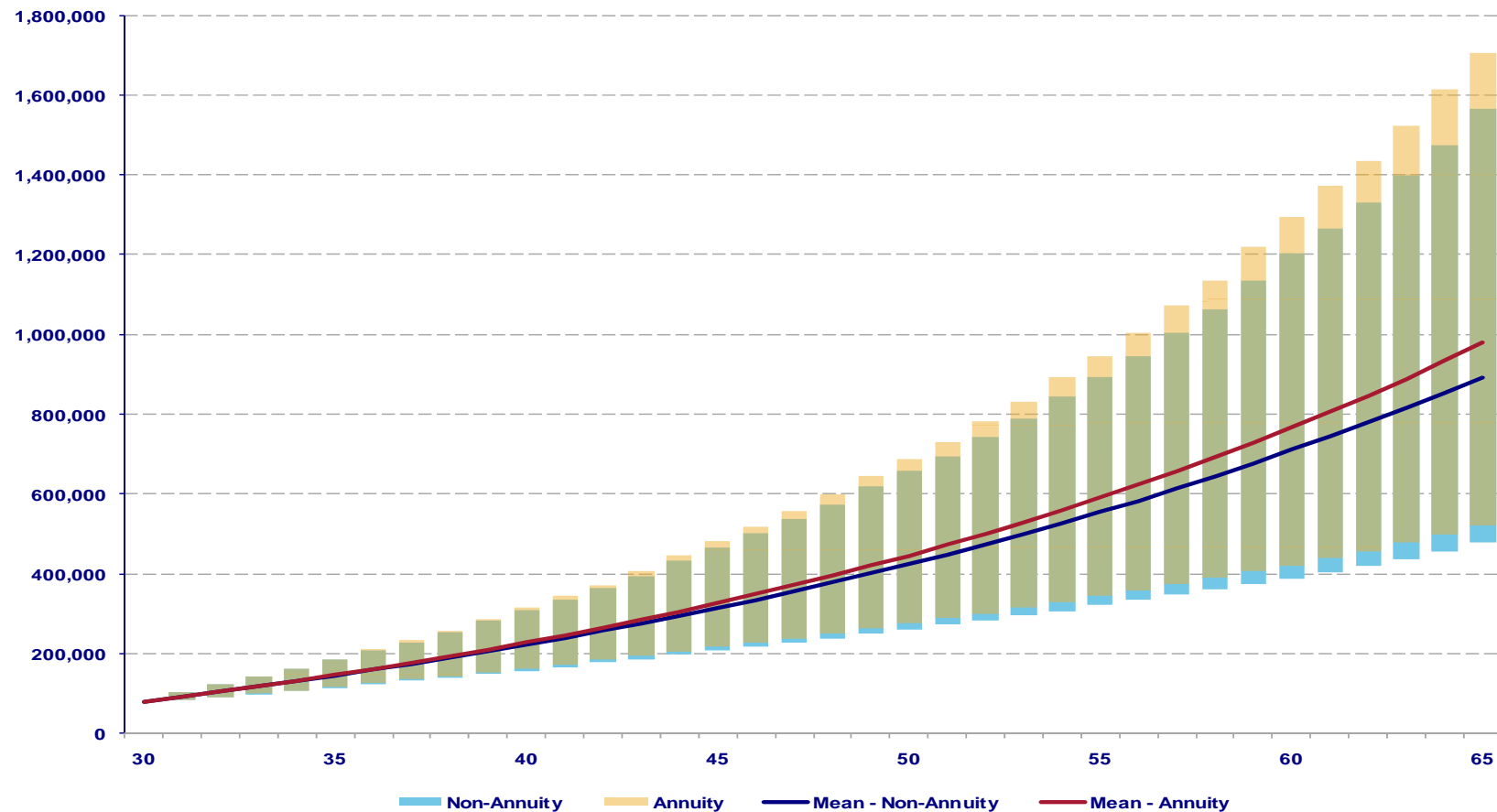
Figure 7.1: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$45,000 Earnings; 70% Growth, 30% Defensive; No Fees



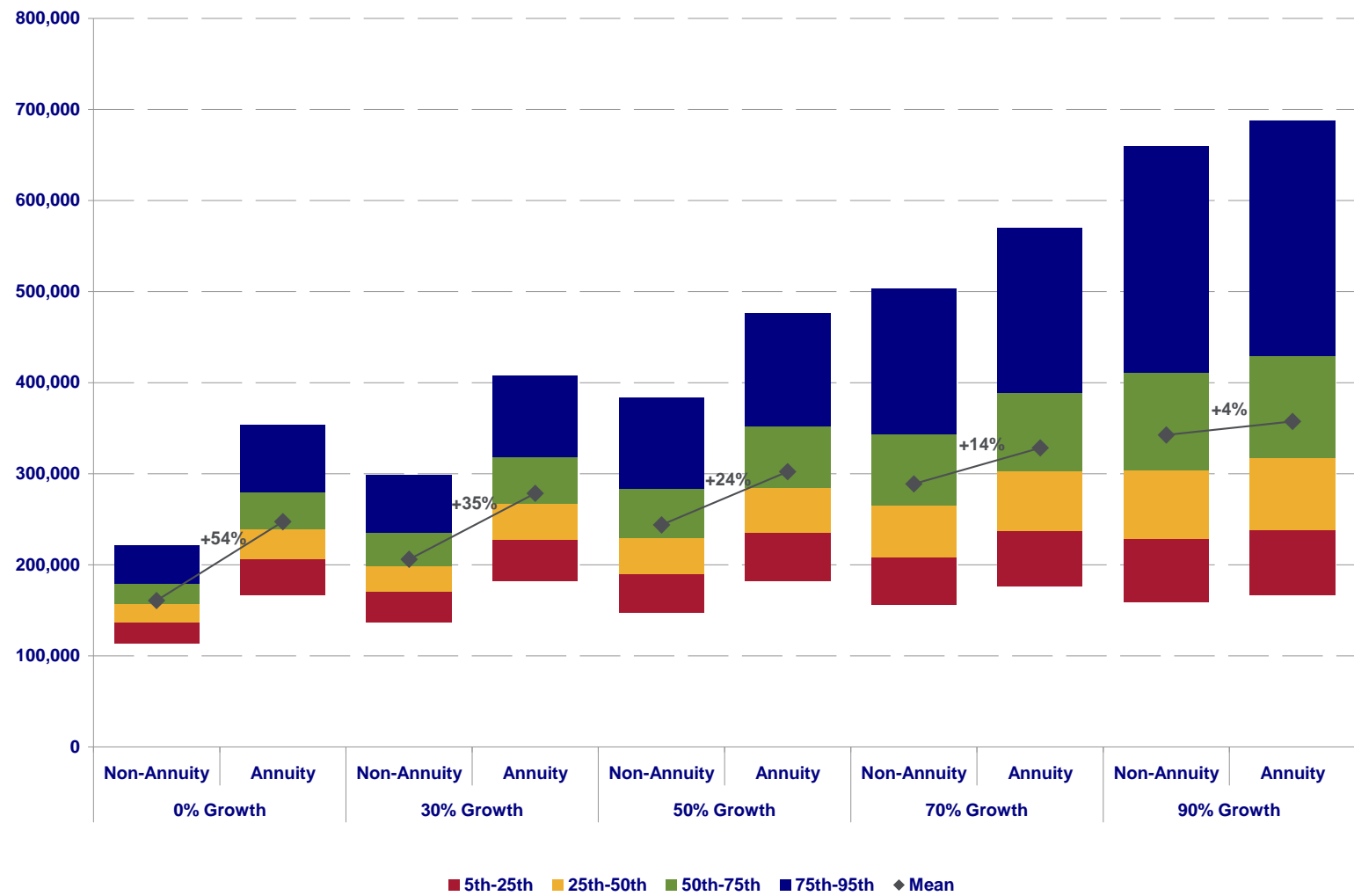
Figure 7.2: Accumulated account balance  
- 90% Confidence interval



Assumptions: \$120,000 Earnings; 70% Growth, 30% Defensive; No Fees



Figure 8.1: Distribution of Account Balance at retirement

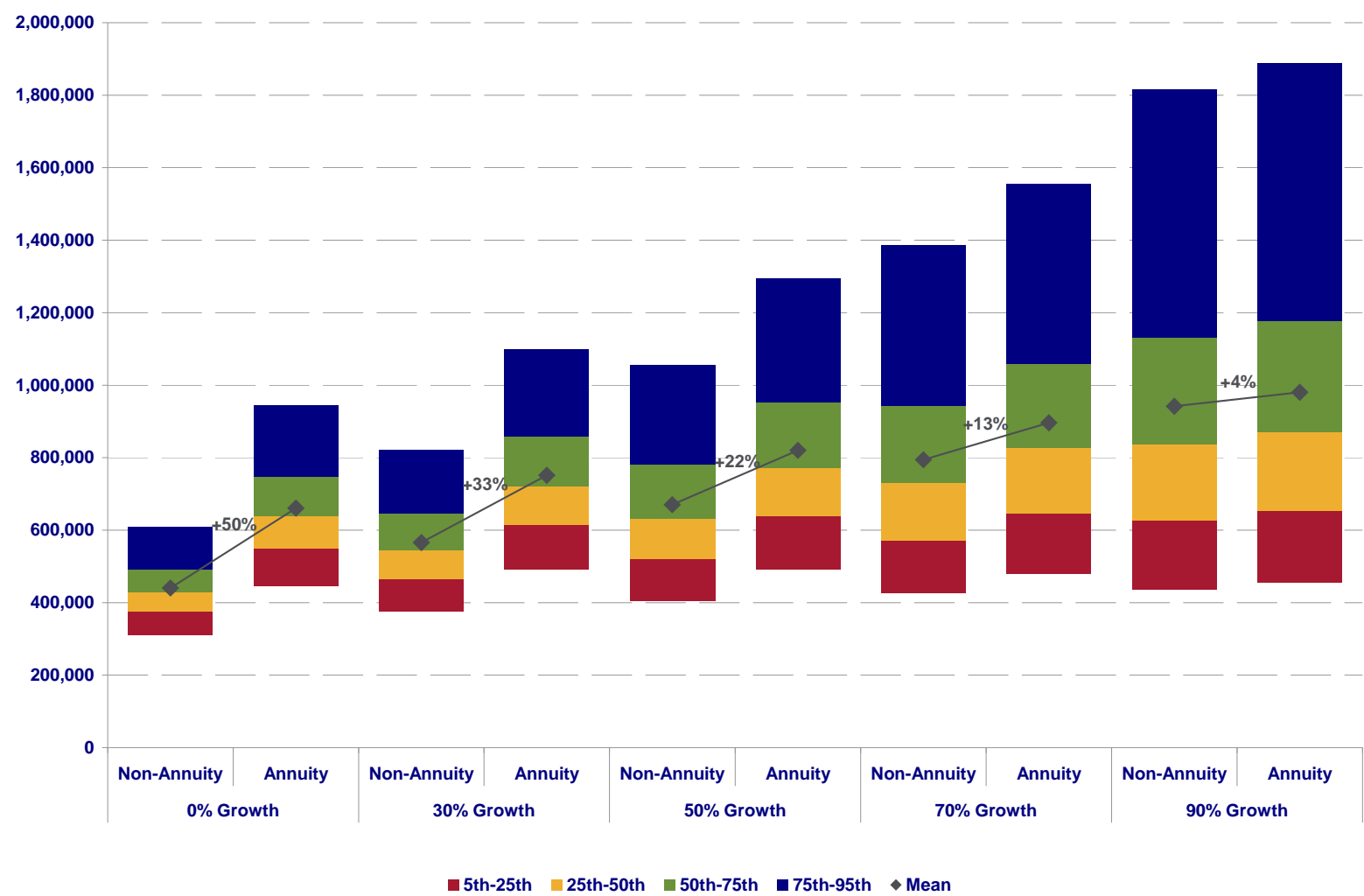


Assumptions: \$45,000 Earnings; High Fees

Challenger



Figure 8.2: Distribution of Account Balance at retirement

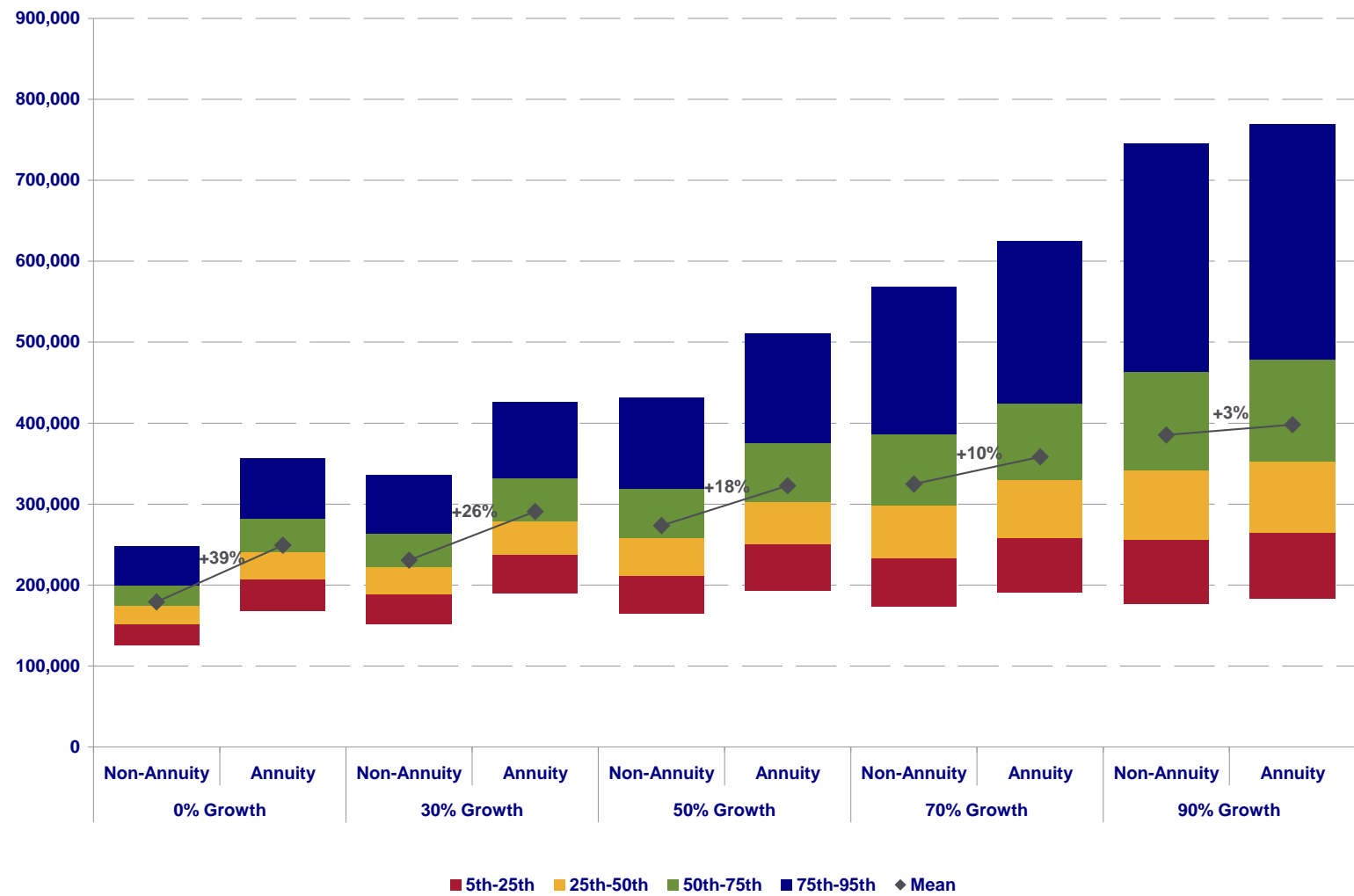


Assumptions: \$120,000 Earnings; High Fees

Watson Wyatt Confidential



Figure 8.3: Distribution of Account Balance at retirement



Assumptions: \$45,000 Earnings; Low Fees



# Figure 8.4: Distribution of Account Balance at retirement

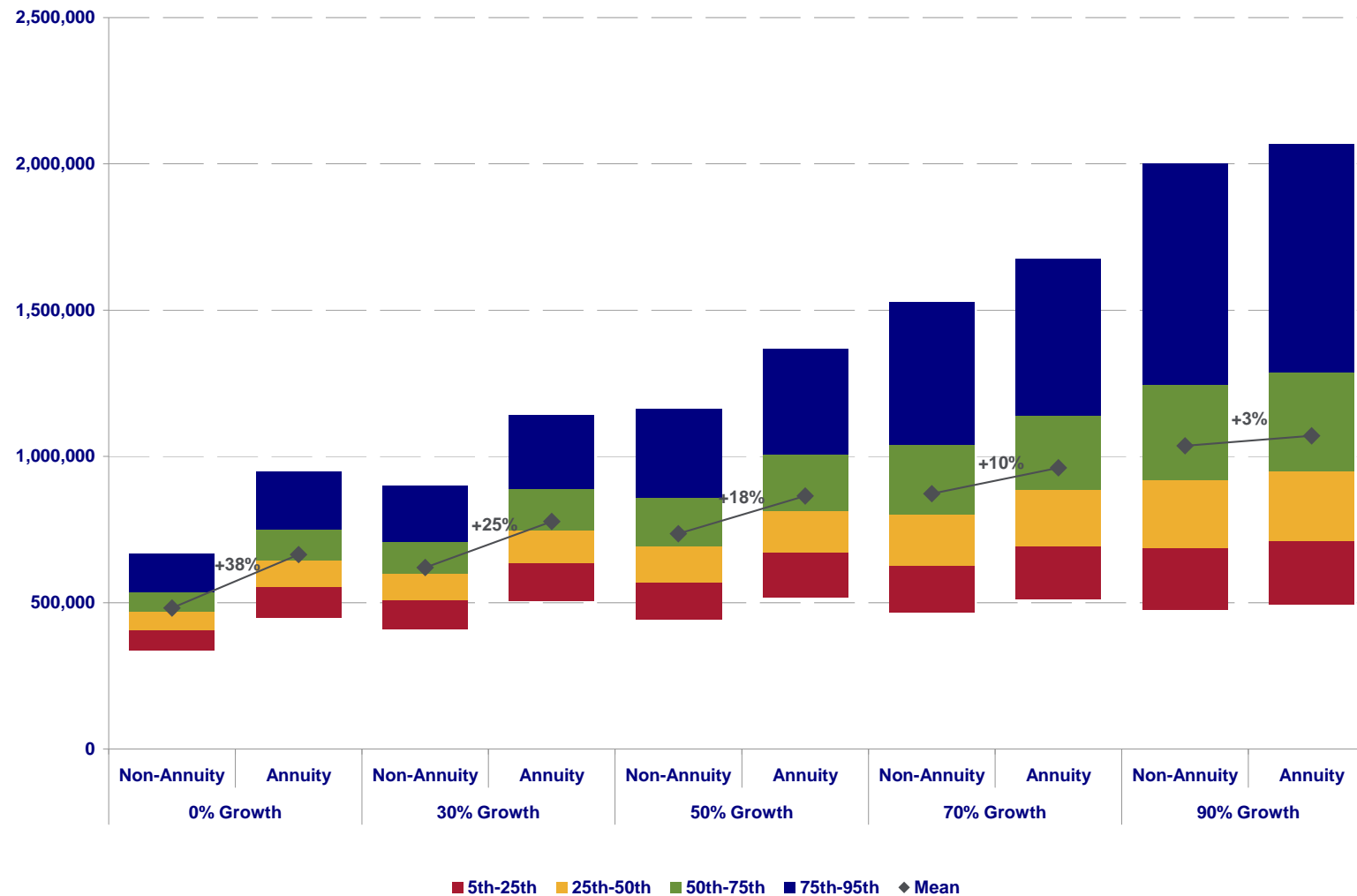




Figure 8.5: Distribution of Account Balance at retirement

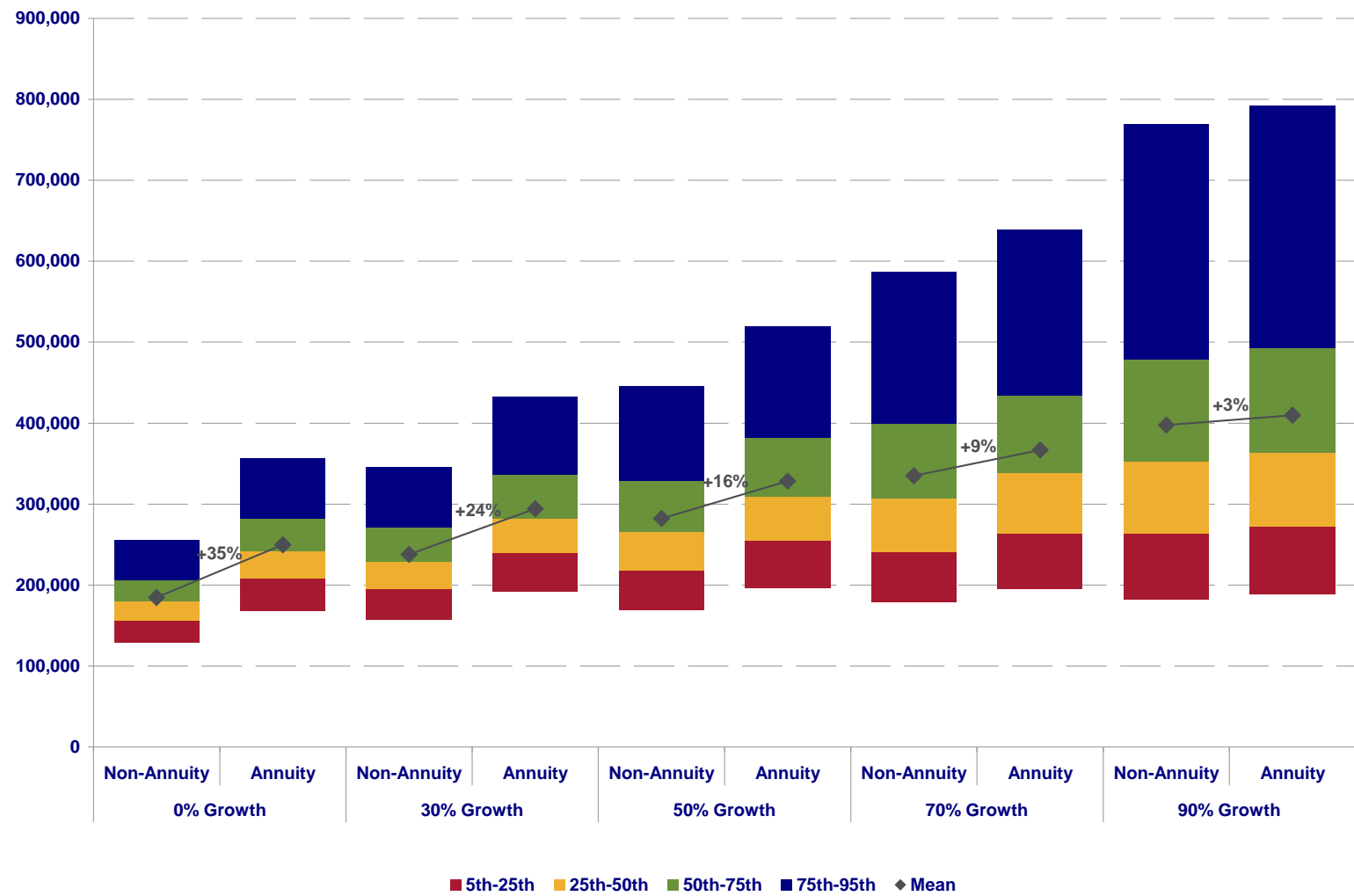
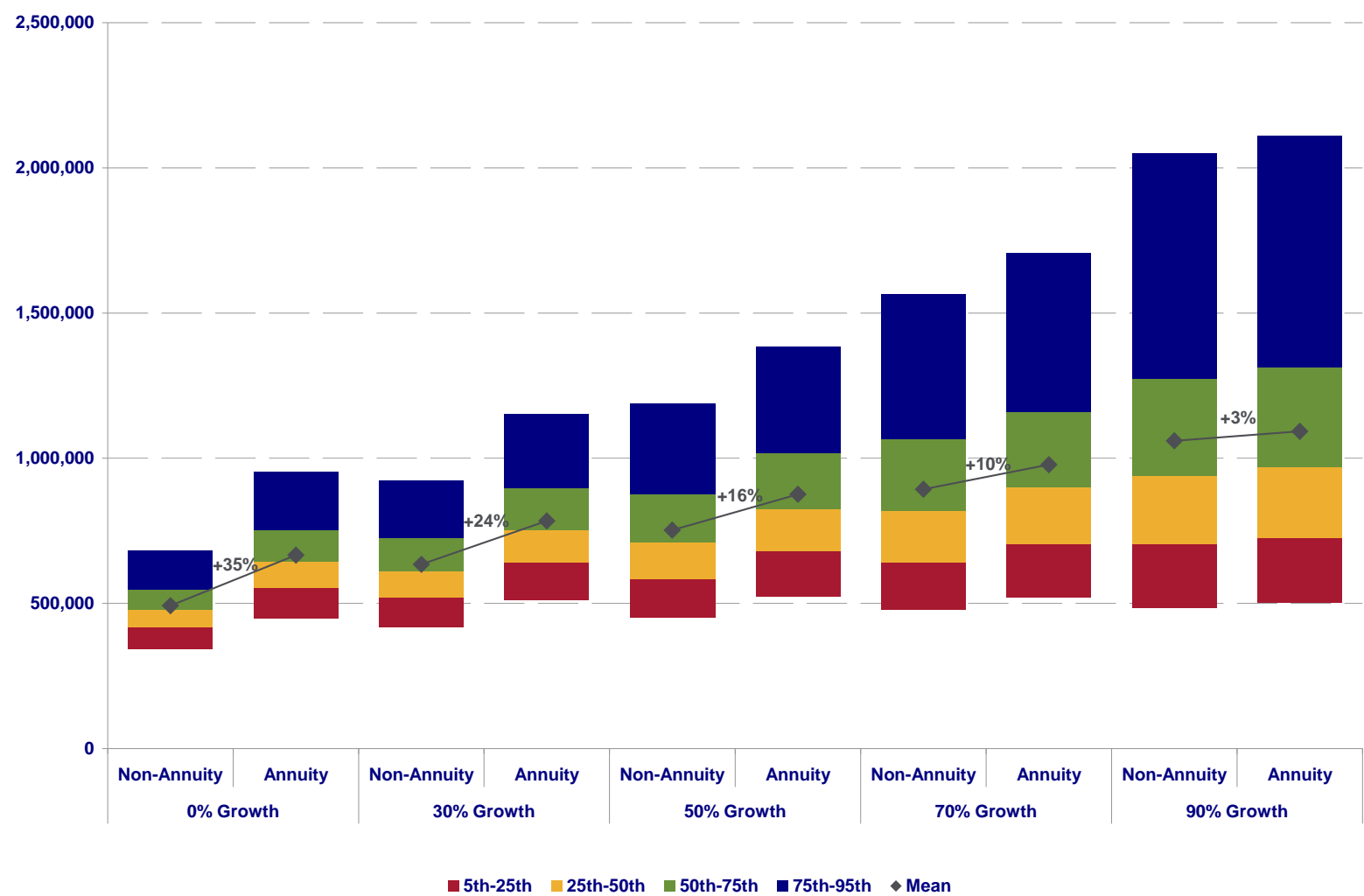


Figure 8.6: Distribution of Account Balance at retirement



Assumptions: \$120,000 Earnings; No Fees





## Retirement Income Modelling

### Challenger Group Services Pty. Ltd.

2 September 2009

This page is intentionally blank

# Table of contents

<b>Section 1 : Introduction .....</b>	<b>1</b>
<b>Section 2 : Methods and Assumptions .....</b>	<b>3</b>
<b>Section 3 : Key Concepts and Metrics .....</b>	<b>7</b>
<b>Section 4 : Analysis of Results .....</b>	<b>9</b>
<b>Section 5 : Reliances and Limitations.....</b>	<b>19</b>
<b>Appendix 1 : Modelling Assumptions .....</b>	<b>21</b>
<b>Appendix 2 : A summary of the Watson Wyatt asset modelling assumptions as at 31 March 2009 .....</b>	<b>27</b>
<b>Appendix 3 : Supporting Tables .....</b>	<b>33</b>
<b>Appendix 4 : Supporting Charts .....</b>	<b>39</b>



This page is intentionally blank



# Section 1: Introduction

- 1.1 Watson Wyatt has been commissioned by Challenger Group Services Pty. Ltd. (“Challenger”) to carry out a detailed investigation to assist in further understanding the impact of different asset allocations in the post-retirement phase of an individual’s life. This investigation focuses on the use of lifetime annuities as a replacement for bonds and cash as the defensive element of an individual’s asset allocation.
- 1.2 The scope of Watson Wyatt’s investigation is set out in this section.

## Previous work

- 1.3 In April 2009 Watson Wyatt issued a report entitled “Investment and Spending in Retirement – the Longevity Risk Impact”<sup>1</sup>. This report considered the risks associated with various investment and spending strategies in retirement. The investment strategies considered were portfolios of “growth” and “defensive” assets in varying proportions.

## Project objectives

- 1.4 Challenger has asked us to extend our existing research and modelling of retirement incomes in the following ways:
- to consider the use of lifetime annuities in place of the current defensive component of the retiree’s investment portfolio;
  - to allow for the impact of different levels of platform and administration fees in the model; and
  - to investigate the effects of a market downturn early in the retirement period.
- 1.5 This report sets out the results of certain scenarios obtained using our projection model. In the process of producing the figures for this report, we have modelled a number of other scenarios to help understand the driving factors behind the presented outcomes. We would be happy to discuss further aspects of this work with you in due course and provide any further results you may require.

---

<sup>1</sup> Available at [www.watsonwyatt.com](http://www.watsonwyatt.com)



This page is intentionally blank





# Section 2: Methods and Assumptions

## Methods

- 2.1 We have created a retirement income model which allows us to perform stochastic projections of a new retiree's income and wealth for a set of given starting assumptions. For each projected scenario, the initial starting conditions required to perform the projection modelling are:
- an initial amount of retirement savings (the "initial account balance");
  - a target income level to be drawn in aggregate from all sources; and
  - an asset allocation decision for the account (i.e. a growth and defensive percentage allocation).
- 2.2 Each scenario is then run through the projection model twice. Once with the defensive allocation invested in a diversified bonds and cash portfolio and then repeated with the defensive allocation used to purchase a lifetime annuity at retirement. These are referred to as the "non-annuity" strategy and "annuity" strategy respectively.
- 2.3 Underlying the retirement income model is the Watson Wyatt Global Asset Model. This is a projection tool which generates stochastic rates of investment returns and other market indicators such as the level of Consumer Price Indexation (CPI) and Average Weekly Ordinary Time Earnings (AWE). The model includes most of the major global asset classes and a correlation matrix has been developed as part of this model to ensure results are as consistent as possible with real world outcomes.
- 2.4 As agreed with Challenger, Watson Wyatt's standard asset model has been modified to remove some short term effects which have been recently incorporated to reflect the current state of financial markets. These adjustments were deemed appropriate as this research is intended to reflect a long-term view on the performance of annuities in providing for retirement and therefore should avoid any bias in outcomes as a result of the current financial crisis.
- 2.5 Under the annuity strategy, the retirement income model begins by calculating the annuity income which would be generated by purchasing an annuity with the assumed defensive allocation. The annuity purchase price is a function of the market swap rates which are determined from interest rates generated by the stochastic investment model. The result is that annuity price is allowed to vary for each stochastic outcome in a manner consistent with the other projected variables. Once the annuity income has been determined, it increases annually in line with projected CPI from the stochastic investment model.
- 2.6 After allowing for the annuity income (if any), the balance of the target income, under both annuity and non-annuity strategies, is drawn from a combination of the Age Pension and drawings from the account based pension. This is an iterative process due to the social security means tests. The model then calculates the remaining account based pension balance at the end of the projection year, allowing for investment returns, fees and any income drawn, and begins the calculations for the next projection year.
- 2.7 The stochastic nature of the underlying investment model means that our retirement income model results in a probabilistic range of retirement income results which we are then able to use to draw conclusions.



## Assumptions

- 2.8 All investment returns and other market indicators used in the modelling in this report are generated using the Watson Wyatt Global Asset Model. Further details of that model and the underlying assumptions are contained in Appendix 2.
- 2.9 A summary of the non-investment related assumptions which drive the core results is set out below.

### *Core Results*

- All modelled scenarios consider a single female who retires at age 65;
- The initial account balance (before annuity purchase) is \$500,000;
- The target retirement income drawn by the retiree from all sources (Age Pension, annuity income and account based pension) is assumed to be the December 2008 ASFA-Westpac Comfortable income of \$37,621 pa. We assume that the target income increases annually in line with Average Weekly Ordinary Time Earnings (AWE);
- The adequate retirement income used for calculating the probability of inadequacy metric (defined in 3.3) is assumed to be the December 2008 ASFA-Westpac Modest income of \$19,450. We assume that the adequate income increases annually in line with AWE;
- The Age Pension commences at age 65 and is assessed annually each year. The maximum Age Pension is assumed to increase annually in line with AWE;
- Account based pension platform and administration fees are in line with the Superannuation Fees Report 2008 published by Rice Warner Actuaries. These have been labelled as “High Fees” for the purpose of this report;
- The asset allocation assumption is 70% growth asset classes and 30% defensive asset classes. Under the non-annuity strategy the account based pension assets are annually rebalanced to maintain the asset allocation;
- The defensive allocation is assumed to be invested entirely in a lifetime annuity under the annuity strategy or in a diversified bonds and cash portfolio under the non-annuity strategy;
- Lifetime annuity rates have been provided by Challenger and are determined by reference to interest rates generated by the investment model. A summary of the annuity rates provided and a more detailed description of this process is set out in Appendix 1. The income from the annuities in our model increases annually in line with the Consumer Price index (CPI), with a minimum of 0%; and
- All dollar amounts have been discounted at AWE in order to present results in today's dollars.

### *Other Scenarios*

Apart from the core scenario outlined above, we have also considered other scenarios to determine the sensitivity of the core result to variations in certain assumptions. The assumptions varied are:

- Initial account balance;
- Target and adequate income levels;
- Asset allocation;
- Account based pension fee levels; and

Further details of assumptions used are contained in Appendix 1.



This page is intentionally blank



# Section 3: Key Concepts and Metrics

## Ruin vs Inadequacy

- 3.1 The fundamental metric which we examined in our April 2009 research paper was based on the concept of “Ruin”. Ruin is defined as the risk of running out of money before death (i.e. becoming reliant on the Age Pension as the only source of income). The “probability of ruin” metric allows for uncertain investment returns (via the stochastic investment model) and the uncertainty of the retiree’s lifespan (via a random lifespan based on the underlying retiree mortality assumptions).
- 3.2 When considering a strategy in which the retiree purchases a lifetime annuity at retirement, the concept of ruin falls away since under that strategy, while the retiree may still run out of money in their account based pension balance, the underlying annuity income means that they will never become reliant on the Age Pension as their only source of income.
- 3.3 We have therefore amended the concept of Ruin to become “Inadequacy”. This is defined as the event of the retirement income falling to (or below) a predetermined “adequate” income level at any time over the modelled lifetime. Using this concept, we can now use the “probability of inadequacy” metric to compare results under annuity and non-annuity strategies.
- 3.4 The metric is still not perfect since ultimately the income under the annuity strategy will stabilise at a level (Age Pension + annuity income), which is greater than a strategy with no annuity (Age Pension only). That is to say, while this metric captures the probability of income falling below an adequate level, it does not allow for the differing extent of that inadequacy under the annuity and non-annuity strategies.

## Remaining account balance

- 3.5 In order to provide a comparable measure of the downside (and upside) risks associated with each scenario, we have also determined the remaining account based pension balance at each future age. This amount represents the bequest that the retiree would leave to their estate if they were to die at that age. Thus a larger dollar value could be viewed as leaving a larger bequest. Alternatively, it could be viewed as reflecting that a larger income (i.e. in excess of target) could have been drawn by the retiree up to that age.
- 3.6 If the account based pension balance is exhausted, this metric then shows a negative amount which reflects the cumulative amount of income shortfall relative to the target income level. In principle, this reflects the amount of money the retiree would need to borrow in order to continue receiving their target income level.
- 3.7 The concept of a cumulative shortfall could be viewed in the context of reverse mortgage products available in the market to homeowner retirees. In principle our retiree could access additional capital from their home to maintain the target retirement income when other sources are exhausted. One could therefore argue that interest should be added to these shortfall amounts at a rate similar to that charged in the reverse mortgage market. As an approximation to this, where a negative account balance arises we have allowed for interest to be added at cash rates.



### *Allowance for income in excess of target*

- 3.8 The remaining account balance in a year (as described above) does not reflect the fact that income in any preceding year may have exceeded target. This “excess income” may occur due to the inflexibility of the annuity income (where applicable) in any year and/or the minimum drawdown rules applying to the account based pension.
- 3.9 Without making an appropriate allowance for these years of excess income, the remaining account balance measure is not directly comparable under annuity and non-annuity strategies as a different total income has been received in the past.
- 3.10 An adjusted remaining account balance has therefore been created which makes allowance for income in excess of target, as follows.
- Income in excess of target income in any year is identified and allocated to a new account (“savings account”), we assume the excess income is saved rather than spent. Interest at cash rates is added to this account.
  - The savings account is not used to supplement shortfalls in the income below target income where the account based pension balance has been depleted. Hence, the savings account would continue to roll up with interest even where the retiree’s account based pension assets are exhausted.
  - The savings account is added to the remaining account balance metric (described in 3.5 to 3.7 above), at each age.
  - The balance of the savings account is added to the individual's assets for the Age Pension means test calculation in each projection year.
- 3.11 The interpretation of the savings account is money set aside (outside the superannuation system) which adds to the individual's resources but is not used to supplement annual spending (and hence does not augment retirement income). While not a perfect representation of reality, within modelling constraints it is a reasonable means of allowing for years where income is in excess of the target level when calculating the remaining account balance metric. We have used this adjusted metric in the rest of this report.
- 3.12 We note also that the remaining account balance metric does not capture the fact that, under an annuity strategy, the retiree has the ongoing annuity income entitlement (as well as any positive remaining account balance) as support during any remaining years of life. Hence if the remaining account balance metric at a given retiree age has the same value under the annuity and non-annuity strategies, we would regard a retiree using an annuity strategy as being in a more secure financial position than one using a non-annuity strategy.

## Section 4: Analysis of Results

### Impact of purchasing an annuity (Core scenario results)

- 4.1 Our initial (core) results look at the impact of purchasing a lifetime annuity with the defensive allocation of the retiree's account balance. The results analysed here are based on the initial starting conditions and assumptions set out in 2.9.
- 4.2 The results for the core scenario are shown in Table 1 below and Figures 1.1 to 1.3 in Appendix 4.
- 4.3 Table 1 below shows the probability of inadequacy, and the "best" (95<sup>th</sup> percentile), median (50<sup>th</sup> percentile) and "worst" (5<sup>th</sup> percentile) outcomes of the remaining account balance (as discussed in sections 3.5 to 3.11) for our core scenario at age 90 (which is the assumed life expectancy for a 65 year old female).

Table 1: Core scenario results – impact of purchasing an annuity

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
500,000	37,621	19,450	Non-annuity	42%	-167,867	18,682	348,781
500,000	37,621	19,450	Annuity	4%	-121,776	98,179	563,188

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.

- 4.4 These core results indicate that incorporating a lifetime annuity on the terms modelled into the retirement portfolio to replace a diversified bonds and cash allocation results in:
- a smaller risk of inadequacy; and
  - a larger remaining account balance (or a smaller shortfall) at age 90.
- 4.5 The charts in Appendix 4 show the progression of incomes and remaining account balances for various scenarios over time. Figure 1.3 shows the progression of the remaining account balance for each strategy under the core scenario presented in Table 1. The bars represent the 90% confidence interval with the "worst"/"best" outcomes in Table 1 being the bottom/top of the bar at age 90. The average modelled outcome is identified by the solid line.
- 4.6 From Figure 1.3, we can see that, at earlier ages, a larger remaining account balance is expected under the non-annuity strategy. This is due to the purchase of the annuity costing the member 30% of their initial account balance at retirement which would be non-refundable on early death. However, as time progresses the average modelled outcomes cross over as a result of the smaller income being drawn from the account based pension balance under the annuity strategy. On death anytime prior to age 81, the average remaining account balance is larger if an annuity is not purchased.

- 4.7 When these observations are considered along side Figures 1.1 and 1.2, we see that under both the annuity and non-annuity strategies the target income is still being received at age 81. If a retiree does not expect to live beyond age 81 we can therefore deduce that the non-annuity strategy would provide a better outcome for the retiree.
- 4.8 However, beyond age 82, Figure 1.3 shows that the average remaining account balance is larger under the annuity strategy. Furthermore, Figures 1.1 and 1.2 show that, on average, purchasing an annuity results in:
- target income being received for 6 years longer, with a larger income than target in some years due to the application of minimum drawdown rules for account based pensions;
  - income not falling below the adequate level, whereas under the non-annuity strategy the income becomes inadequate from age 99 onwards;
  - a reduction in the amount of income sourced by the Age Pension (visible by inspection); and
  - the sum of the average annuity income and the age pension providing an income which is greater than the adequate level until after age 100.
- 4.9 Table 1 also shows the probability of inadequacy over the retiree's lifetime. Adding an annuity on the terms modelled reduces the probability materially for the core scenario. The probability of inadequacy under the annuity strategy remains slightly greater than zero due to the stochastic annuity rates (which allows a possibility for the retiree purchasing annuities at unfavourable rates), and also the assumption that adequate income level is indexed with AWE, whereas annuity income is indexed with (lower) CPI.
- 4.10 Extending our analysis to look at more extreme outcomes, we can observe from Figure 1.3 that under the "best" outcome (95<sup>th</sup> percentile) the cross over of the annuity and non-annuity strategy occurs at age 77 - 4 years earlier than under the average result. Conversely, under the "worst" outcome (5<sup>th</sup> percentile) the cross over of the two strategies occur at age 83 - 2 years later than under the average result.
- 4.11 The reason that the "best" outcomes favour the annuity strategy (when the converse might have been expected) is the effective increase in growth exposure over time under the annuity strategy, as explained in 4.45 – 4.49 below.

## **Sensitivity to the initial account balance**

- 4.12 We have considered the effect of varying the amount of the initial account balance at retirement. We have looked at scenarios with initial account balances of \$1 million, \$250,000 and \$100,000 in place of the "core" \$500,000. In each case we have retained the same target and adequate incomes as the core scenario.
- 4.13 We have also modelled two further scenarios for the \$1 million and \$100,000 initial account balances where the target and adequate income levels have been adjusted to reflect a more appropriate income given the size of the initial account balance.



- 4.14 Table 2 shows the same metrics as Table 1 but under these initial account balance sensitivity scenarios. The results for our Core assumptions are also included below for easy comparison.

Table 2: Sensitivities to variation in initial account balance

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
1,000,000	37,621	19,450	Non-Annuity	6%	179,815	721,061	1,982,340
			Annuity	1%	266,579	851,057	2,407,016
500,000	37,621	19,450	Non-Annuity	42%	-167,867	18,682	348,781
			Annuity	4%	-121,776	98,179	563,188
250,000	37,621	19,450	Non-Annuity	90%	-447,941	-344,376	-221,845
			Annuity	75%	-409,464	-314,140	-194,829
100,000	37,621	19,450	Non-Annuity	98%	-688,130	-546,661	-443,139
			Annuity	98%	-658,802	-525,762	-427,193
1,000,000	75,242	38,900	Non-Annuity	70%	-788,096	-422,117	417,291
			Annuity	66%	-712,485	-351,164	825,758
100,000	19,450	14,971	Non-Annuity	24%	-20,729	40,507	158,197
			Annuity	0%	-10,422	56,099	189,047

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.

- 4.15 In all cases considered, adding an annuity on the terms modelled to the portfolio continues to result in improved “best” outcomes and less poor “worst” outcomes at age 90 than the corresponding non-annuity strategy. Figures 2.3, 3.3, 4.3, 5.3 and 6.3 show similar results to Figure 1.3 in that, in the years following retirement, the remaining account balance on death is larger under the non-annuity strategy. However, there is a cross over age in each chart beyond which a larger remaining account balance at each future age is provided under the annuity strategy.
- 4.16 Figures 1.1 to 6.3 in Appendix 4 contain all the corresponding charts to the scenarios set out in Table 2.



## Sensitivity to asset allocation

4.17 We have considered the effect of varying the underlying asset allocation in our core scenario. The alternative allocations we have investigated are:

- 100% Defensive;
- 30% Growth / 70% Defensive;
- 50% Growth / 50% Defensive; and
- 90% Growth / 10% Defensive.

4.18 In each scenario the defensive allocation is either entirely used to purchase an annuity or entirely invested in a diversified bonds and cash portfolio. All other assumptions in the core scenario as set out in 2.9 have been retained.

4.19 The results to these sensitivities are set out in Table 3 which shows the usual metrics but under these asset allocation sensitivity scenarios. The results for our core assumptions are also included for easy comparison. Corresponding charts demonstrating these results are in Figures 7.1 to 10.3 of Appendix 4.

Table 3: Sensitivities to variation in asset allocation

Asset Allocation			Remaining account balance at age 90 (\$)			
Growth	Defensive	Strategy	Pr (Inadequacy)	Worst	Median	Best
0%	100%	Non-Annuity	67%	-180,359	-103,035	-2,698
		Annuity	0%	-115,676	28,296	254,911
30%	70%	Non-Annuity	57%	-157,853	-51,762	96,277
		Annuity	0%	-98,456	78,148	362,986
50%	50%	Non-Annuity	50%	-160,139	-18,006	204,226
		Annuity	0%	-102,315	96,905	462,624
70%	30%	Non-Annuity	42%	-167,867	18,682	348,781
		Annuity	4%	-121,776	98,179	563,188
90%	10%	Non-Annuity	36%	-183,093	55,496	594,990
		Annuity	32%	-163,898	84,891	691,012

Assumptions: Initial Balance \$500,000; Target income \$37,621 pa; Adequate income \$19,450 pa; High Fees.

- 4.20 The figures set out in Table 3 show that purchasing an annuity at retirement on the terms modelled provides a larger remaining account balance at age 90 over all asset allocation scenarios considered. This is consistent with our core scenario results and indicates that on the modelling assumptions used, purchasing an annuity improves this metric regardless of the asset allocation adopted. The improvement in this metric from purchasing an annuity is greater for high defensive asset allocations.
- 4.21 It is instructive also to examine the impact on this metric of varying asset allocation under an exclusively non-annuity (and alternatively, annuity) strategy. Under a non-annuity strategy, increasing the growth allocation in all cases improves the “best” and median outcomes. The “worst” outcome, conversely, deteriorates as the growth proportion is increased (with the exception of a shift from 0% to 30% growth assets), consistent with the greater downside risk of higher growth allocations. The results under an annuity strategy are broadly consistent, although the improvement in median outcomes is more marginal (and the metric actually worsens as the growth allocation is increased from 70% to 90%).
- 4.22 Figures 7.1 and 7.2 demonstrate an extreme scenario where the asset allocation is 100% defensive, and so the entire initial account balance is either invested in a bonds and cash portfolio or used to purchase an annuity. Under the annuity strategy, the income purchased, when combined with the Age Pension income, is sufficient to provide the target income until age 83. At that age, the impact of the annuity income being indexed with CPI rather than AWE means the income falls below the target level. However, the income never falls below the adequate level. Under the non-annuity strategy the target income is received until age 80 and then falls below the adequate level at around age 88.
- 4.23 Looking at the probability of inadequacy metric in Table 3, we see that an annuity strategy improves this metric relative to a non-annuity strategy under all asset allocations modelled. We note that the probabilities under the annuity strategy are zero when a proportion of greater than 30% of the initial account balance is used to purchase the annuity. This result is observed because the purchased level of annuity income proves to be larger than the benchmark adequate income used.
- 4.24 The probability of inadequacy metric demonstrates that, under a non-annuity strategy, the risk of achieving an inadequate income prior to death falls as the growth proportion in the account based pension is increased. This result is consistent with our previous results in our April 2009 report referred to in paragraph 1.3.
- 4.25 We have also modelled two further scenarios where we have assumed that the annuity allocation is capped at 30% of the initial account balance. In these scenarios the balance of the defensive portfolio remains in a diversified bonds and cash strategy. These scenarios are as follows:
- 30% Growth, 40% Bonds and Cash, 30% Annuities (Figure 11.1)
  - 50% Growth, 20% Bonds and Cash, 30% Annuities (Figure 12.1)

The corresponding tables for these scenarios are contained in Table 3.1 in Appendix 3.



## Sensitivity to level of account based pension fees

- 4.26 We have considered the effect of varying the level of fees associated with the account based pension. The core scenario allowed for administration and platform fees on invested assets in line with the Rice Warner Superannuation Fee Report 2008. We have also looked at the impact of using fees which are lower than those set out in the Rice Warner Report, and a no fee environment. Further details of the fees assumed are set out in Appendix 1. In each case we have retained all other assumptions as the core scenario as set out in 2.9.
- 4.27 The scenarios modelled to demonstrate the fee sensitivity are a repeat of our core scenario and the variations in initial account balance. This sensitivity has been modelled in order to capture the dependency of fees on the size of the account balance.
- 4.28 Table 4 shows the usual metrics for the fee sensitivity under our core scenario for easy comparison. The remaining fee sensitivity scenarios under the various initial account balances are contained in tables 4.1 to 4.3 in Appendix 3. We have only produced corresponding charts for the low fee scenario and these are contained in Figures 13.1 to 18.3.

Table 4: Sensitivities to variation in account based pension fees

Fee Level	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
			Worst	Median	Best
High	Non-Annuity	42%	-167,867	18,682	348,781
	Annuity	4%	-121,776	98,179	563,188
Low	Non-Annuity	38%	-155,860	44,091	397,819
	Annuity	4%	-114,612	118,879	614,206
None	Non-Annuity	35%	-145,790	64,068	437,111
	Annuity	4%	-105,871	138,170	662,611

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; Initial Balance \$500,000; Target income \$37,621 pa; Adequate income \$19,450 pa

- 4.29 The above figures demonstrate the obvious result that lowering the account based pension fees results in an increase in the remaining account balance at age 90. The improvement in remaining account balance at age 90 due to the purchase of an annuity is reasonably consistent across all fee scenarios.
- 4.30 Under the non-annuity strategy, Table 4 shows that the probability of inadequacy reduces as the fees on the account based pension are lowered. A similar result arises under the annuity strategy due to lower fees on the account based pension element. However, the probability of inadequacy is already small so the effect is not easily observed.

## Adverse Event Outcomes

- 4.31 A key driver of outcomes for retirees who hold an account based pension is the return on growth assets during the retirement period. In particular, early in the retirement period (where the dollar amount of the retiree's account balance is at its largest), the retiree is vulnerable to poor growth asset returns significantly eroding the size of their account balance and potentially reducing the likelihood of the retiree being able to draw enough to maintain target income throughout retirement.
- 4.32 The results presented in this report to this point capture the likelihood and impact of poor returns early in retirement in the stochastic scenarios modelled. That is, all of the outcomes generated include such poor return events, with the frequency and extent of such events in line with the underlying model assumptions.
- 4.33 Nonetheless it is instructive to explicitly identify the impact on retiree outcomes if poor returns occur early in the retirement period. This is equivalent to "stress testing" the chosen retirement strategy to see the effect of an adverse investment environment occurring shortly after a retiree's retirement date.

- 4.34 We have investigated this by defining the following as an "adverse event":

*"an average real (i.e. in excess of CPI) return on growth assets of –5% pa or less over any five year period during the first ten years following retirement".*

It should be noted that in any adverse event scenario, a recovery in growth asset returns after the first ten years is not precluded.

- 4.35 Using this definition, we have then isolated those stochastic outcomes where an adverse event occurs, generated the same metrics as previously (based on these outcomes), and compared results.
- 4.36 Table 5 below compares the core scenario results based on all outcomes, and alternatively adverse outcomes only.

Table 5: Core scenario results – Adverse event outcomes

Outcomes	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
			Worst	Median	Best
All	Non-Annuity	42%	-167,867	18,682	348,781
	Annuity	4%	-121,776	98,179	563,188
Adverse	Non-Annuity	71%	-252,260	-150,650	738
	Annuity	5%	-205,358	-98,312	91,900

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; Initial Balance \$500,000; Target income \$37,621 pa; Adequate income \$19,450 pa



- 4.37 The results show that an adverse event is expected to lead to significantly worse outcomes for retirees (as measured by remaining account balance at age 90) under both non-annuity and annuity strategies. In particular, under each strategy the median outcome moves from a positive to a significant negative position.
- 4.38 When the probability of inadequacy metric is considered, however, the impact of an adverse event is minimal under an annuity strategy but material under a non-annuity strategy. The minimal impact under an annuity strategy reflects that the (less onerous) “adequate” income level can generally be met over time by the annuity income plus age pension even where growth returns early in the retirement period are adverse.

## Drivers of Results

- 4.39 On the metrics used, the results indicate a reduction in risk arising from a re-allocation of the defensive portion of the retiree’s assets to an annuity at the date of retirement. The risk reduction is not uniform; however the reduction is robust to a range of different initial balances, target incomes and portfolio asset allocations.
- 4.40 We have undertaken some analyses to understand the key underlying drivers of these results. In our view the results are dependent on the following two important drivers

### *Annuity Pricing Basis vs Bond Portfolio Return*

- 4.41 The defensive portfolio used in the non-annuity strategies assumes a mix of government and corporate bonds and cash, with an overall expected return similar to that of Australian government bonds. The annuity pricing basis we have used as provided by Challenger is based on swap rates, and we have used an expected margin of swap rates over government bonds of approximately 100 bps (1%) pa. Further details of the annuity rates can be found in Appendix 1.
- 4.42 Hence by substituting a lifetime annuity for defensive assets, in return terms the retiree is effectively generating an additional 1% pa on those assets. However, there is no accompanying increase in risk – indeed, as the annuity payments are certain (no probability of life office default is modelled), on the risk metrics used a reduction in risk occurs. Effectively the retiree is relying on the life office and/or the surrounding regulatory environment to “absorb” the additional credit risk inherent in the assets underlying the annuity.

### *Effective Increase in Growth Exposure over time under Annuity Strategy*

- 4.43 Under the non-annuity strategies, assets are assumed to be rebalanced annually to the starting growth and defensive allocations (e.g. 70% / 30% under the core scenario). The retiree’s proportional allocation to growth and defensive assets is therefore constant over time.
- 4.44 Given the higher assumed median return on growth assets compared to defensive assets, maintaining this constant growth/defensive proportion in fact requires (more often than not) a reallocation of assets from growth to defensive at the start of each year. (After a year where defensive assets outperformed growth, the reverse would be true). This process would be hidden from a retiree who invests via a managed portfolio which would maintain the proportion on the retiree’s behalf.
- 4.45 Under the annuity strategy, the defensive assets are used to purchase an annuity at the start date, the remaining account balance (after the annuity purchase) is held in growth assets, and thereafter no reallocation between asset classes occurs.

- 4.46 By analogy with the non-annuity strategy, it can be seen that the higher median return on growth assets results in the overall growth exposure of the retiree's portfolio under the annuity strategy increasing over time. To maintain a constant growth allocation, it would be necessary to rebalance growth assets portfolios annually (e.g. by "selling" growth assets in good return years, and allocate assets to a defensive portfolio – either by purchasing further annuities or allocation the assets to a cash/bonds portfolio). This approach would cause the investment returns underlying the annuity and non-annuity strategies to be comparable, meaning the results would be driven instead by the "repackaging" effect of the retiree selecting annuities instead of bonds.
- 4.47 This possible alternative approach is outside the scope of this report.



This page is intentionally blank





# Section 5: Reliances and Limitations

## Reliances

- 5.1 In carrying out our analysis and producing this Report we have relied without independent verification upon the accuracy and completeness of the data and information provided to us, both in written and oral form, by Challenger which produced the sources of information discussed in the Report.
- 5.2 Reliance has been placed upon, but not limited to, the lifetime annuity rates provided by Challenger found in Table 6 in Appendix 1.

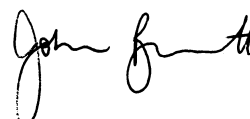
## Limitations

- 5.3 The Report has been prepared by Watson Wyatt Limited on an agreed basis to meet the specific purposes of the Challenger Group Services Pty. Ltd. and must not be relied upon for any other purpose. The Report has been prepared for use by persons technically competent in the areas covered. Except with the written consent of Watson Wyatt Limited, the Report and any written or oral information or advice provided by Watson Wyatt Limited must not be reproduced, distributed or communicated in whole or in part to any other person, or be relied upon by any other person. Any reference to Watson Wyatt Limited in any report, accounts or other published documents is not authorised without our prior written consent.
- 5.4 The Report must be considered in its entirety since individual sections, if considered in isolation, may be misleading. Draft versions of the Report must not be relied upon by any person for any purpose. No reliance should be placed on any advice not given in writing. If reliance is placed contrary to the guidelines set out above, Watson Wyatt Limited disclaim any and all liability which may arise.
- 5.5 Assumptions are made about future experience, including mortality and morbidity. These assumptions have been made on the basis of reasonable estimates. However, actual future experience is likely to differ from these assumptions, due to random fluctuations, changes in the operating environment, and other factors. Such variations in experience could have a significant effect on the results and conclusions of this Report. No warranty is given by Watson Wyatt that the assumptions made in this Report will be reflected in actual future experience.
- 5.6 This Report was based on data available to Watson Wyatt Limited at, or prior to, 2 September 2009, and takes no account of developments after that date.
- 5.7 This Report is subject to the terms and limitations, including limitation of liability, set out in our engagement letter of 21 July 2009.



Nick Callil  
Consulting Actuary

Review:



John Burnett  
Consulting Actuary

**Date: 2 September 2009**

T:\Clients\CHALL\N0002\_ChallengerReport FINAL.doc



This page is intentionally blank



# Appendix 1: Modelling Assumptions

## 1.1 Investment Model

All results and analysis contained in this report are based on stochastic projections of a wide range of future market conditions, including investment returns for major asset classes and future levels of CPI and interest rates. Details of the methods and assumptions for the underlying Investment Model are set out separately in Appendix 2.

## 1.2 Model Retiree

Our investigations have been based on the assumption that the model retiree is a single female who retires at age 65. The retiree is assumed to be a homeowner (for Age Pension means test purposes).

Previous research was based on a retired couple. However, incorporating a spouse into the research adds a significant degree of complexity into the modelling parameters and adds to the challenge of presenting and analysing results. We believe that the key insights into the project objectives can be obtained without incorporating a spouse.

## 1.3 Mortality

In order to make a direct comparison of the impact of incorporating an annuity into a retiree's asset allocation in isolation, much of the analysis has been performed without regard to underlying mortality rates. This is necessary since incorporating mortality would dilute the average outcomes through members dying before running out of account based pension either with or without an annuity.

Where a mortality assumption has been adopted, the base table adopted is the Australian Life Tables 2005-07.

We have adjusted these tables to reflect the general principle that socio-economic status is a key driver behind differences in health and therefore mortality. On this basis we have assumed that retirees with larger superannuation savings exhibit lighter mortality than the general population due to access to better healthcare and a better general standard of living.

In addition, we have also made a further adjustment to the mortality tables to make a specific allowance for mortality improvements in the future.

The actual adjustments made are:

- Socio-economic status (SES) allowance: 75% of base rates at age 60 rising to 95% of table at age 100 and over; and
- Mortality Improvement: 25-year improvement factors in Australian Life Tables 2000-02 (Australian Government Actuary).

Based on the adjusted mortality, the expected future lifetime of a female aged 65 is 25 years. An equivalent male future lifetime is 22 years.

The mortality tables which underpin the lifetime annuity rates used in the research may differ to those referenced here. The annuity rates used have been provided by Challenger.



## 1.4 Initial Retirement Account Balance

In order to examine the impact of the magnitude of a retiree's amount of savings at retirement, we have modelled four initial account balances:

- \$1,000,000;
- \$500,000;
- \$250,000; and
- \$100,000.

The retiree is assumed to have no assets other than the initial account balance.

## 1.5 Target Retirement Income

In each modelled scenario, we have made an assumption about the level of target retirement income which the individual will receive. This target income is the combination of income from three sources: Age Pension income, lifetime annuity income (if any) and account based pension income. The annual amount of income drawn from the account based pension is calculated as the balancing item required in order to achieve the target income in each year. This is an iterative process due to the social security means tests.

For the purpose of modelling, our core assumption is to assume that the initial target income is the December 2008 ASFA-Westpac Comfortable income level of \$37,621 pa ("Comfortable"). We have then extended our investigation to two additional scenarios set out below:

- \$1,000,000 with a target income of \$75,242 pa (2 × Comfortable)
- \$100,000 with a target income of \$19,450 pa (Modest)

These additional scenarios have been modelled to reflect a target income which is more sustainable given the level of initial account balance.

## 1.6 Adequate Retirement Income

In each modelled scenario, we have made an assumption about the level of "adequate" retirement income. We assume that falling below this income level is an unacceptable outcome for the retiree.

For the purpose of modelling, our core assumption is to assume that the initial adequate income is the December 2008 ASFA-Westpac Modest income level of \$19,450 pa ("Modest"). The assumed adequate income level for the two additional scenarios is set out below:

- \$1,000,000 with an adequate income of \$38,900 pa (2 × Modest)
- \$100,000 with an adequate income of \$14,971 pa (Maximum Age Pension)

As with the target income for these additional scenarios, the adequate income level adopted is designed to reflect an income which may be more appropriate to the level of initial account balance.

## 1.7 Indexation of Retirement Income

We have assumed that both the target income and the adequate income are indexed in line with Average Weekly Ordinary Time Earnings (AWE) in the future. The choice of index used is significant and materially affects the results. Using AWE rather than the Consumer Price Index (CPI) is justified by the following:

- Using AWE reflects an aspiration that living standards of retirees keep pace with those of the working community; and
- The Government Age Pension is indexed annually at AWE. With the Age Pension indexed at AWE, indexing the total target income at CPI (generally assumed to be 1-2% lower than AWE) results in a “crowding out” of the account based pension components of the retiree’s income at later ages, so that the longevity and investment risk for such a retiree is limited because the Age Pension quickly becomes a greater proportion of target income.

## 1.8 Lifetime Annuity Rates

Challenger has provided us with a table of Lifetime Annuity Rates for use in this research. We understand that the rates provided are appropriate for a female retiree and have been provided on a number of different interest rates to enable their use in the stochastic model. We have assumed that the rates provided by Challenger are appropriate for the purpose of this research and have not performed any reasonableness or consistency checks.

A summary of the annuity rates used in this investigation is set out below.

Table 6: Annuity Rates for a 65 year old female - CPI indexed Lifetime annuity

Swap Rate (Real)	Annuity Rate (\$ pa per \$100,000)
1%	4,266
2%	5,116
3%	6,017
4%	6,950
5%	7,893
6%	8,828
7%	9,737
8%	10,608
9%	11,429
10%	12,195

The Watson Wyatt Global Asset Model does not generate swap rates. We have therefore agreed with Challenger that real swap rates used to determine the CPI indexed annuities should be derived from the model at the start of the projection period as follows:

- the yield on 10 year Commonwealth Government Bonds; plus
- two thirds of the AA corporate bond spread; less
- expected long term price inflation.

The average real swap rate generated is 4.1% pa, which implies an average annuity rate of \$7,044 pa per \$100,000.

## **1.9 Asset Allocation**

The fundamental objective of this project is to compare modelled outcomes for various growth/defensive asset allocations where the defensive element of the portfolio is invested either in a lifetime annuity product or in the usual defensive asset classes.

We have modelled a number of different investment allocations with a varying exposure to defensive asset classes. In the scenarios where a lifetime annuity is purchased as the defensive portion of the allocation, it is assumed that the remaining assets are fully invested in growth type asset classes.

We note that this assumption takes no account of the risk appetite of retirees. For example, it is possible that, even with the safety net of a lifetime annuity, a retiree may still be cautious about investing their account based pension assets fully in growth type assets and so may choose to still hold a further portion of defensive assets to back their account based pension. We have considered this point further in the results set out in Table 3.1 of Appendix 3.

The account based pension account is rebalanced annually to maintain the desired asset allocations over time.

## **1.10 Account based Pension Fees**

As part of the project objectives, Challenger has requested that the model is extended to incorporate projections both with and without the inclusion of platform, administration and investment management fees. No additional fees are to be incorporated into the lifetime annuity element of the calculations as we understand that the annuity rates already include a margin for expenses.

We have not included an explicit assumption for investment management fees. Returns from the Global Asset Model are assumed to be net of these fees.

As agreed with Challenger, we have assumed the fees to be those set out in the Superannuation Fees Report 2008 prepared for IFSA by Rice Warner Actuaries. The table below sets out an extract from that report detailing the average fees for Retail Retirement Income Products which we have incorporated into our model.

We have also created a second set of fee assumptions which has been based on a survey of 12 industry fund super pension divisions. These entities tend to charge lower fees than public offer retail funds and we have therefore identified this as our low fee assumption. Details of the fees assumed are set out below.

Table 7: Account Based Pension Fees

Account Balance	High Fee Assumption*		Low Fee Assumption#	
	Administration (%)	Platform (%)	Administration %	Platform %
>\$1 million	0.01	0.33	0.16	0
\$500,000 - \$1 million	0.01	0.38	0.18	0
\$250,000 - \$500,000	0.02	0.44	0.23	0
\$100,000 - \$250,000	0.05	0.51	0.27	0
\$50,000 - \$100,000	0.10	0.58	0.32	0
\$25,000 - \$50,000	0.22	0.67	0.46	0
<\$25,000	0.99	0.77	0.75	0

\* - Allocated pension Open Products Expense Rate (%) – Retail Retirement Income Products, Superannuation Fees Report 2008, Rice Warner Actuaries

# - Based on research across 12 industry super pension divisions.

## 1.11 Age Pension

In all scenarios modelled, we have integrated the income provided by the Age Pension. When calculating the Age Pension income in each future projection year, the model allows appropriately for the remaining account based pension balance and any annuity purchased at retirement in the means test calculation for that projection year.



Table 8: Age Pension rules

Age Pension (effective from 20 March 2009) available from age 65	Singles	Couples	
Full Age Pension Rate (per fortnight)	\$569.80	\$475.90	(each)
Income Test			
Threshold (per fortnight)	\$138.00	\$240.00	(combined)
Rate of Reduction (per dollar over threshold)	\$0.40	\$0.20	(each)
Assets Test			
Threshold: Homeowners	\$171,750	\$243,500	(combined)
Threshold: Non-homeowners	\$296,250	\$368,000	(combined)
Rate of Reduction (per fortnight per \$1,000 over threshold)	\$1.50	\$1.50	(combined)
Pharmaceutical Allowance (per fortnight)	\$6.00	\$3.00	(each)



## Appendix 2: A summary of the Watson Wyatt asset modelling assumptions as at 31 March 2009

The tables and charts in this Appendix show the summary statistics for the major asset classes included in the Watson Wyatt Global Asset Model as at 31 March 2009 from the perspective of an Australian investor who is valuing his or her investments in Australian dollars.

We believe that we are currently in an abnormal economic environment and in a number of areas our short term expectations differ from our views of longer term central outcomes. However, this investigation is looking at the long term impact of incorporating annuities into retirement incomes and we have therefore removed the short term assumptions from our standard asset model in order to reflect a long term view.

The tables below show the arithmetic average, median and standard deviation of return in the first year of projection. We also show the median and standard deviation of annualized returns over a 10-year period and in the long-term – median returns behave similarly to longer-term geometric average returns, and are therefore a more natural basis for comparison with past history. These assumptions are *before* allowing for the effects of tax and investment management expenses.

The return assumptions given for each mainstream asset class (i.e. equities, property, bonds, credit and cash) and certain alternatives (i.e. commodity futures, local currency emerging market debt) represent the expected market average (index) returns that an institutional investor could expect to achieve through a passive investment management approach. As such, they do not include expected premia for active investment management, or any offsets for the risks and costs of managing active strategies.

The return assumptions for private equity, infrastructure and fund of hedge funds are based on the return net of fees that could be expected from a low (active) risk, well diversified exposure such as through a fund of funds.



Table 9: Watson Wyatt Assumptions as at 31 March 2009  
Denominated in AUD, nominal, gross of tax

Asset class	Actual			10-year annualized	
	Arithmetic average	Median	Standard deviation	Median	Standard deviation
<b>Price Inflation (CPI)</b>	2.5	2.5	1.6	2.5	0.4
<b>Wage Inflation (AWE)</b>	4.1	4.0	2.6	4.1	0.8
<b>Cash &amp; Bonds</b>					
Cash	5.1	5.1	1.2	5.1	0.4
Australian 10yr Govt Bonds Return	5.9	5.4	7.9	5.6	0.5
Australian 10yr Govt Bonds Yield	5.6	5.5	1.3	5.6	0.5
Australian Fixed Interest	5.9	5.7	4.0	5.9	0.5
Australian Inflation-Linked Bonds	4.9	4.8	4.2	4.8	0.4
Global Bonds (Govt, hedged)	5.5	5.3	3.8	5.4	0.5
Global Bonds (Aggregate, hedged)	6.1	5.9	4.0	6.0	0.5
Global Inflation-Linked Bonds (hedged)	5.5	5.3	4.4	5.4	0.4
Australian All Corp Bond Spread	1.5	1.5	0.6	1.5	0.1
<b>Equities</b>					
Australian Equities	9.7	8.3	18.4	8.2	2.5
Australian Small Cap Equities	10.6	8.2	23.3	8.3	3.2
Global Equities (ex Aus, unhedged)	9.8	8.7	15.6	8.8	2.1
Global Equities (ex Aus, hedged)	10.5	9.5	15.4	9.5	2.1
Emerging Market Equities (unhedged)	13.3	9.0	32.6	8.9	4.0
<b>Property</b>					
Australian Unlisted Property	7.6	7.1	10.0	7.1	1.4
Australian Listed Property	8.1	6.5	18.7	6.5	2.6
Global Listed Property (hedged)	8.2	7.1	15.2	7.1	2.1
<b>Credit</b>					
Emerging Market Debt (hedged)	7.6	7.6	15.9	6.4	2.3
High Yield Debt (hedged)	8.8	8.4	10.2	8.4	1.5
Australian Investment Grade Credit	6.6	6.4	4.7	6.5	0.5
Global Investment Grade Credit (hedged)	6.8	6.6	4.7	6.7	0.5
<b>Alternative assets</b>					
Fund of Hedge Funds (hedged)	7.7	7.5	6.7	7.5	1.0
Private Equity (global, unhedged)	9.8	7.5	23.4	7.4	3.0
Global Infrastructure (hedged)	9.6	9.1	13.7	8.8	1.8
Commodity Futures (hedged)	7.5	5.6	20.3	5.6	2.8
Timber (unhedged)	9.3	7.1	22.1	7.1	3.9
Emerging Market Cash (unhedged)	7.1	6.9	7.3	6.9	2.3
Local Currency EMD (unhedged)	8.2	6.8	17.2	6.9	5.3
<b>Equity Risk Premium</b>					
Aus equities – Aus govt bonds	3.8				
Aus equities – Aus ILBs	4.8				

Table 10: Assumptions underlying the Account based pension at 31 March 2009  
Denominated in AUD, nominal, gross of tax

Portfolio	Actual			10-year annualized	
	Arithmetic average	Median	Standard deviation	Median	Standard deviation
0% Growth	5.8	5.6	2.7	5.7	0.4
30% Growth	6.9	6.6	4.4	6.8	0.6
50% Growth	7.6	7.2	6.5	7.4	0.9
70% Growth	8.4	7.8	8.7	8.0	1.2
90% Growth	9.1	8.4	11.1	8.5	1.6
100% Growth	9.5	8.7	12.3	8.8	1.7

Please note that our assumptions are intended to be long-term assumptions, and as such they are intended to be used in setting long term or strategic asset allocations. They are not intended to be representative of short term experiences (for example over the next year), but rather they could be considered to represent the experience of an “average” year over the next ten years.

## Correlation assumptions

Correlation is a statistical measure that describes the extent to which the returns from two asset classes are linked. The correlations of returns between the different asset classes describe important characteristics of the Global Asset Model in addition to the expected annual return and the standard deviation of annual returns.

Table 11 shows the key correlations of nominal 1-year returns between assets used in the Global Asset Model. To help in interpreting these numbers, a figure below 0.3 (positive or negative) is indicative of low correlation, a figure between 0.3 and 0.5 indicates moderate correlation and a figure of above 0.5 indicates a high degree of correlation.



Table 11: Watson Wyatt Correlation matrix as at 31 March 2009

		<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>																														
--	--	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



## **Watson Wyatt global asset model: Confidentiality and Disclaimer**

*The assumptions shown in this Appendix and used for this report have been derived by Watson Wyatt through a blend of economic theory, historical analysis and the views of investment managers. They inevitably contain an element of subjective judgment.*

*These assumptions are intended to be used in conjunction with Watson Wyatt's global asset model, for the purpose of setting long term or strategic asset allocations.*

*The key component of an asset allocation study is the way in which the assets are modelled. The structure of the Watson Wyatt global asset model is based on historical analysis of investment returns, although Watson Wyatt has incorporated its subjective judgement to complement the information provided by historical returns. The model is designed to illustrate the future range of returns stemming from different asset classes and their inter-relationship. It should be noted that no economic model could be expected to perfectly capture future uncertainty, particularly the risk of extreme events.*

*In particular it should be noted that our timeframe in establishing our asset model and the assumptions used in the model is long-term, and as such it is not meant to be precisely reflective of the likely course of the investment markets in the short-term. Furthermore, our opinions and return forecasts are not intended to imply, nor should be interpreted as conveying, any form of guarantee or assurance by Watson Wyatt, of the future performance of the asset classes in question, either favourable or unfavourable. Past performance should not be taken as representing any particular guide to future performance.*



This page is intentionally blank



# Appendix 3: Supporting Tables

Table 1: Core scenario results – impact of purchasing an annuity

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
500,000	37,621	19,450	Non-Annuity	42%	-167,867	18,682	348,781
500,000	37,621	19,450	Annuity	4%	-121,776	98,179	563,188

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.

Table 2: Sensitivities to variation in initial account balance

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
1,000,000	37,621	19,450	Non-Annuity	6%	179,815	721,061	1,982,340
			Annuity	1%	266,579	851,057	2,407,016
500,000	37,621	19,450	Non-Annuity	42%	-167,867	18,682	348,781
			Annuity	4%	-121,776	98,179	563,188
250,000	37,621	19,450	Non-Annuity	90%	-447,941	-344,376	-221,845
			Annuity	75%	-409,464	-314,140	-194,829
100,000	37,621	19,450	Non-Annuity	98%	-688,130	-546,661	-443,139
			Annuity	98%	-658,802	-525,762	-427,193
1,000,000	75,242	38,900	Non-Annuity	70%	-788,096	-422,117	417,291
			Annuity	66%	-712,485	-351,164	825,758
100,000	19,450	14,971	Non-Annuity	24%	-20,729	40,507	158,197
			Annuity	0%	-10,422	56,099	189,047

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.



Table 3: Sensitivities to variation in asset allocation

Asset Allocation				Remaining account balance at age 90 (\$)		
Growth	Defensive	Strategy	Pr (Inadequacy)	Worst	Median	Best
0%	100%	Non-Annuity	67%	-180,359	-103,035	-2,698
		Annuity	0%	-115,676	28,296	254,911
30%	70%	Non-Annuity	57%	-157,853	-51,762	96,277
		Annuity	0%	-98,456	78,148	362,986
50%	50%	Non-Annuity	50%	-160,139	-18,006	204,226
		Annuity	0%	-102,315	96,905	462,624
70%	30%	Non-Annuity	42%	-167,867	18,682	348,781
		Annuity	4%	-121,776	98,179	563,188
90%	10%	Non-Annuity	36%	-183,093	55,496	594,990
		Annuity	32%	-163,898	84,891	691,012

Assumptions: Initial Balance \$500,000; Target income \$37,621 pa; Adequate income \$19,450 pa; High Fees.

Table 3.1: Sensitivities to variation in asset allocation - Annuity allocation capped at 30%

Asset Allocation				Remaining account balance at age 90 (\$)		
Growth	Bonds	Annuities	Pr (Inadequacy)	Worst	Median	Best
30%	70%	0%	57%	-157,853	-51,762	96,277
30%	40%	30%	5%	-113,598	9,926	193,737
50%	50%	0%	50%	-160,139	-18,006	204,226
50%	20%	30%	4%	-113,798	51,869	329,143
70%	30%	0%	42%	-167,867	18,682	348,781
70%	0%	30%	4%	-121,776	98,179	563,188

Assumptions: Initial Balance \$500,000; Target income \$37,621 pa; Adequate income \$19,450 pa; High Fees.





Table 4: Sensitivities to variation in account based pension fees

Fee Level	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
			Worst	Median	Best
High	Non-Annuity	42%	-167,867	18,682	348,781
	Annuity	4%	-121,776	98,179	563,188
Low	Non-Annuity	38%	-155,860	44,091	397,819
	Annuity	4%	-114,612	118,879	614,206
None	Non-Annuity	35%	-145,790	64,068	437,111
	Annuity	4%	-105,871	138,170	662,611

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; Initial Balance \$500,000; Target income \$37,621 pa; Adequate income \$19,450 pa

Table 4.1: Sensitivities to variation in initial account balance – High fees

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
1,000,000	37,621	19,450	Non-Annuity	6%	179,815	721,061	1,982,340
			Annuity	1%	266,579	851,057	2,407,016
500,000	37,621	19,450	Non-Annuity	42%	-167,867	18,682	348,781
			Annuity	4%	-121,776	98,179	563,188
250,000	37,621	19,450	Non-Annuity	90%	-447,941	-344,376	-221,845
			Annuity	75%	-409,464	-314,140	-194,829
100,000	37,621	19,450	Non-Annuity	98%	-688,130	-546,661	-443,139
			Annuity	98%	-658,802	-525,762	-427,193
1,000,000	75,242	38,900	Non-Annuity	70%	-788,096	-422,117	417,291
			Annuity	66%	-712,485	-351,164	825,758
100,000	19,450	14,971	Non-Annuity	24%	-20,729	40,507	158,197
			Annuity	0%	-10,422	56,099	189,047

Assumptions: Asset Allocation: 70% Growth / 30% Defensive; High Fees.



Table 4.2: Sensitivities to variation in initial account balance – Low fees

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
1,000,000	37,621	19,450	Non-Annuity	3%	206,911	794,661	2,118,643
			Annuity	1%	283,397	906,553	2,545,671
500,000	37,621	19,450	Non-Annuity	38%	-155,860	44,091	397,819
			Annuity	4%	-114,612	118,879	614,206
250,000	37,621	19,450	Non-Annuity	90%	-442,426	-338,200	-208,470
			Annuity	75%	-408,174	-312,075	-185,834
100,000	37,621	19,450	Non-Annuity	98%	-686,759	-545,685	-442,088
			Annuity	98%	-658,648	-525,652	-427,293
1,000,000	75,242	38,900	Non-Annuity	67%	-768,171	-383,603	534,918
			Annuity	64%	-705,188	-331,173	961,981
100,000	19,450	14,971	Non-Annuity	19%	-15,896	51,808	174,242
			Annuity	0%	-6,997	64,555	204,877

Assumptions: Asset Allocation: 70% Growth / 30% Defensive.



Table 4.3: Sensitivities to variation in initial account balance – No fees

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
1,000,000	37,621	19,450	Non-Annuity	2%	228,428	846,431	2,203,154
			Annuity	1%	297,834	950,612	2,638,033
500,000	37,621	19,450	Non-Annuity	35%	-145,790	64,068	437,111
			Annuity	4%	-105,871	138,170	662,611
250,000	37,621	19,450	Non-Annuity	89%	-437,650	-332,807	-197,612
			Annuity	75%	-405,178	-308,984	-178,350
100,000	37,621	19,450	Non-Annuity	98%	-685,838	-545,080	-441,641
			Annuity	98%	-658,169	-525,221	-426,975
1,000,000	75,242	38,900	Non-Annuity	65%	-753,776	-358,709	618,126
			Annuity	65%	-693,358	-310,026	1,044,261
100,000	19,450	14,971	Non-Annuity	15%	-9,978	62,227	186,762
			Annuity	0%	-2,138	73,949	217,088

Assumptions: Asset Allocation: 70% Growth / 30% Defensive.



Table 5: Core scenario results – Adverse event outcomes

Outcomes	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
			Worst	Median	Best
All	Non-Annuity	42%	-167,867	18,682	348,781
	Annuity	4%	-121,776	98,179	563,188
Adverse	Non-Annuity	71%	-252,260	-150,650	738
	Annuity	5%	-205,358	-98,312	91,900

Assumptions: Asset Allocation: 70% Growth / 30% Defensive.

Table 5.1: Sensitivities to variation in initial account balance - adverse event outcomes

Initial Balance (\$)	Target Income (\$)	Adequate Income (\$)	Strategy	Pr (Inadequacy)	Remaining account balance at age 90 (\$)		
					Worst	Median	Best
1,000,000	37,621	19,450	Non-Annuity	20%	18,529	262,233	812,071
			Annuity	0%	122,311	371,321	906,020
500,000	37,621	19,450	Non-Annuity	71%	-252,260	-150,650	738
			Annuity	5%	-205,358	-98,312	91,900
250,000	37,621	19,450	Non-Annuity	92%	-496,282	-396,106	-311,852
			Annuity	70%	-433,260	-355,697	-282,576
100,000	37,621	19,450	Non-Annuity	97%	-690,929	-542,715	-439,022
			Annuity	98%	-654,162	-523,215	-417,923
1,000,000	75,242	38,900	Non-Annuity	87%	-987,575	-741,400	-456,069
			Annuity	86%	-848,383	-649,263	-394,823
100,000	19,450	14,971	Non-Annuity	61%	-42,158	-14,650	41,190
			Annuity	0%	-31,603	-3,344	54,570

Assumptions: Asset Allocation: 70% Growth / 30% Defensive.

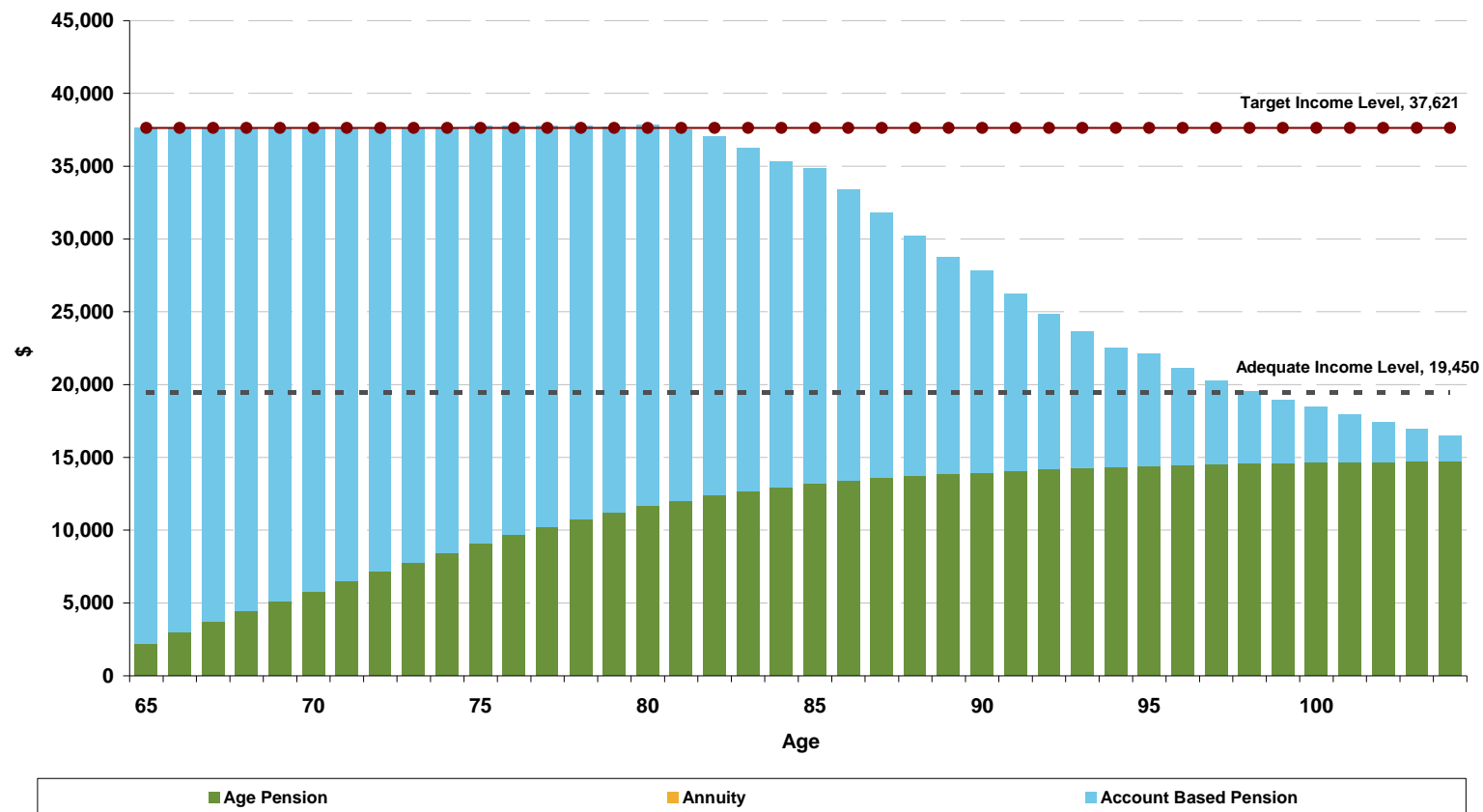


## Appendix 4: Supporting Charts



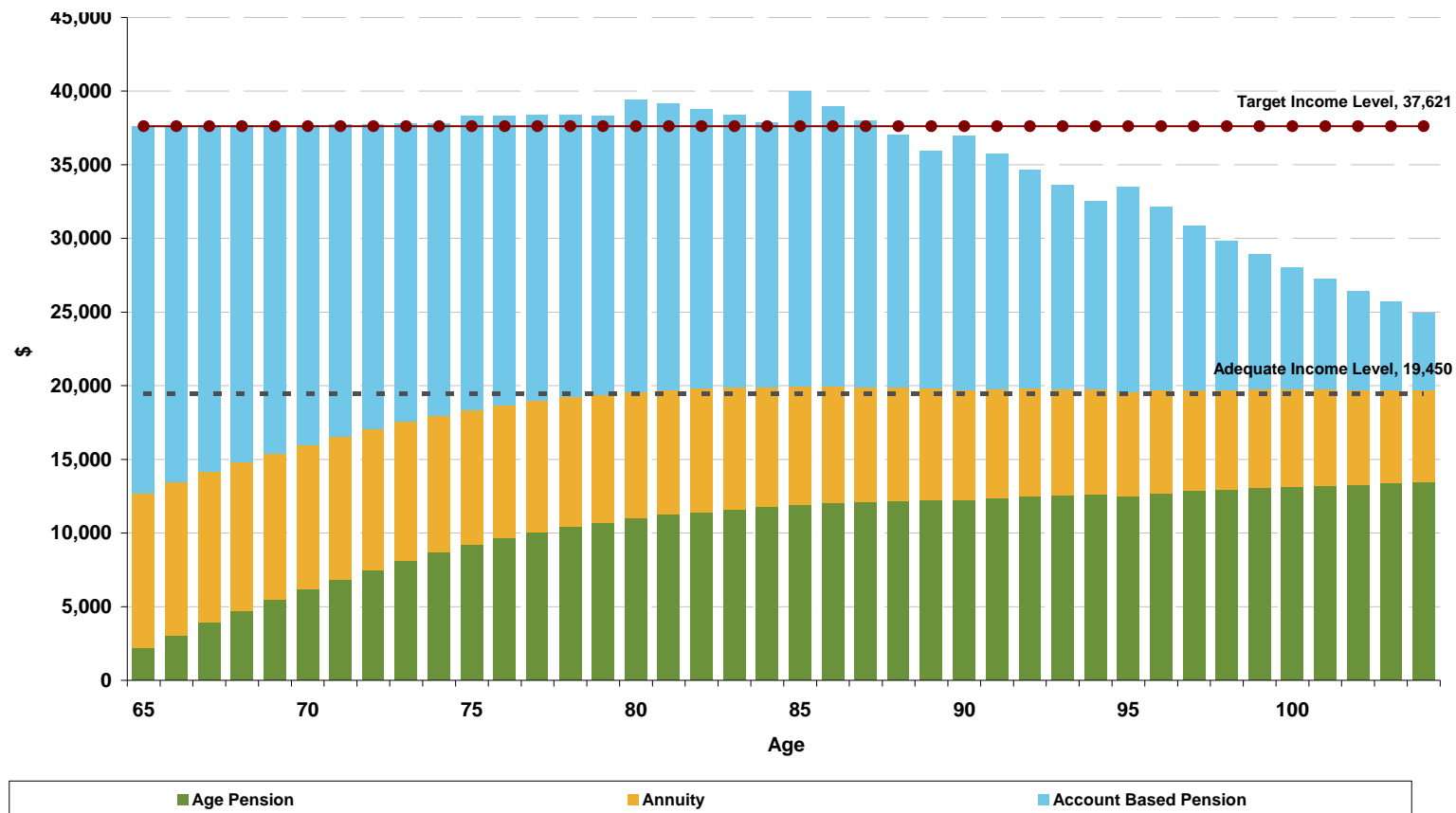
# Figure 1.1: Average retirement income

## - No lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; High Fees

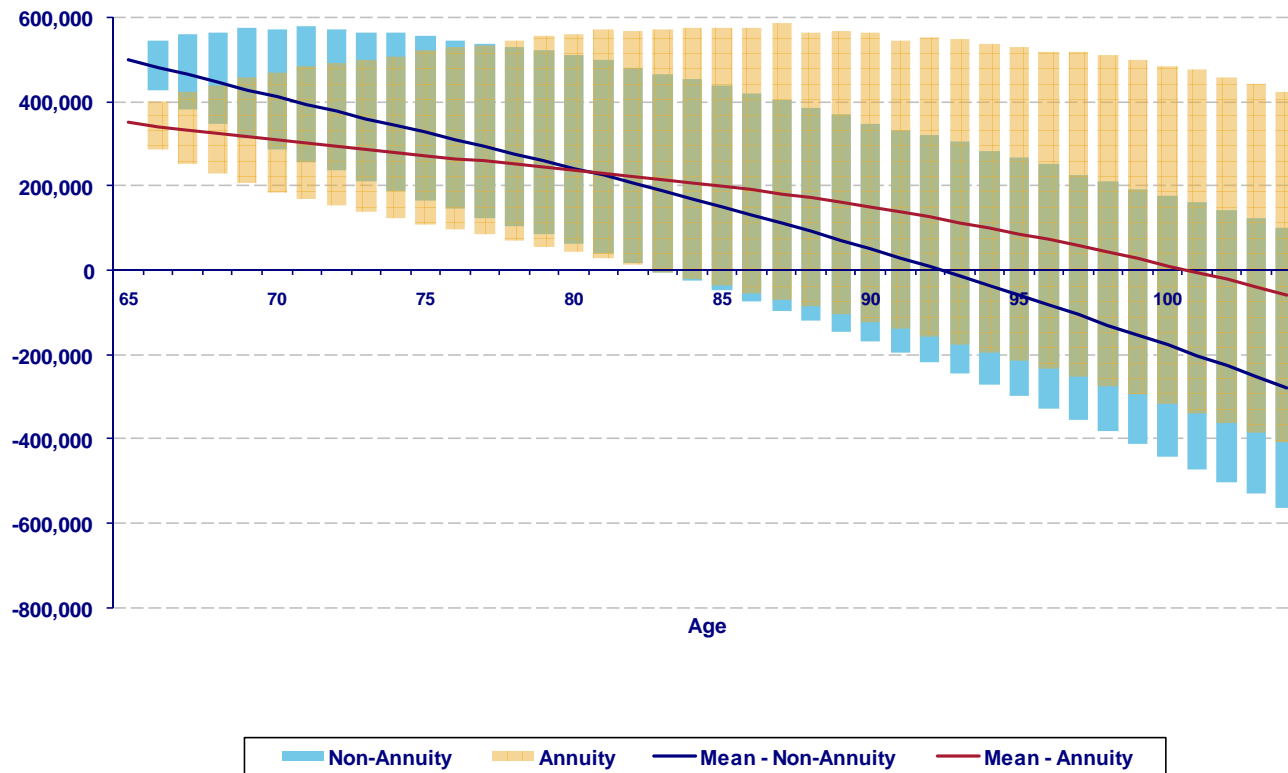
# Figure 1.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; High Fees



Figure 1.3: Remaining account balance  
- 90% Confidence interval

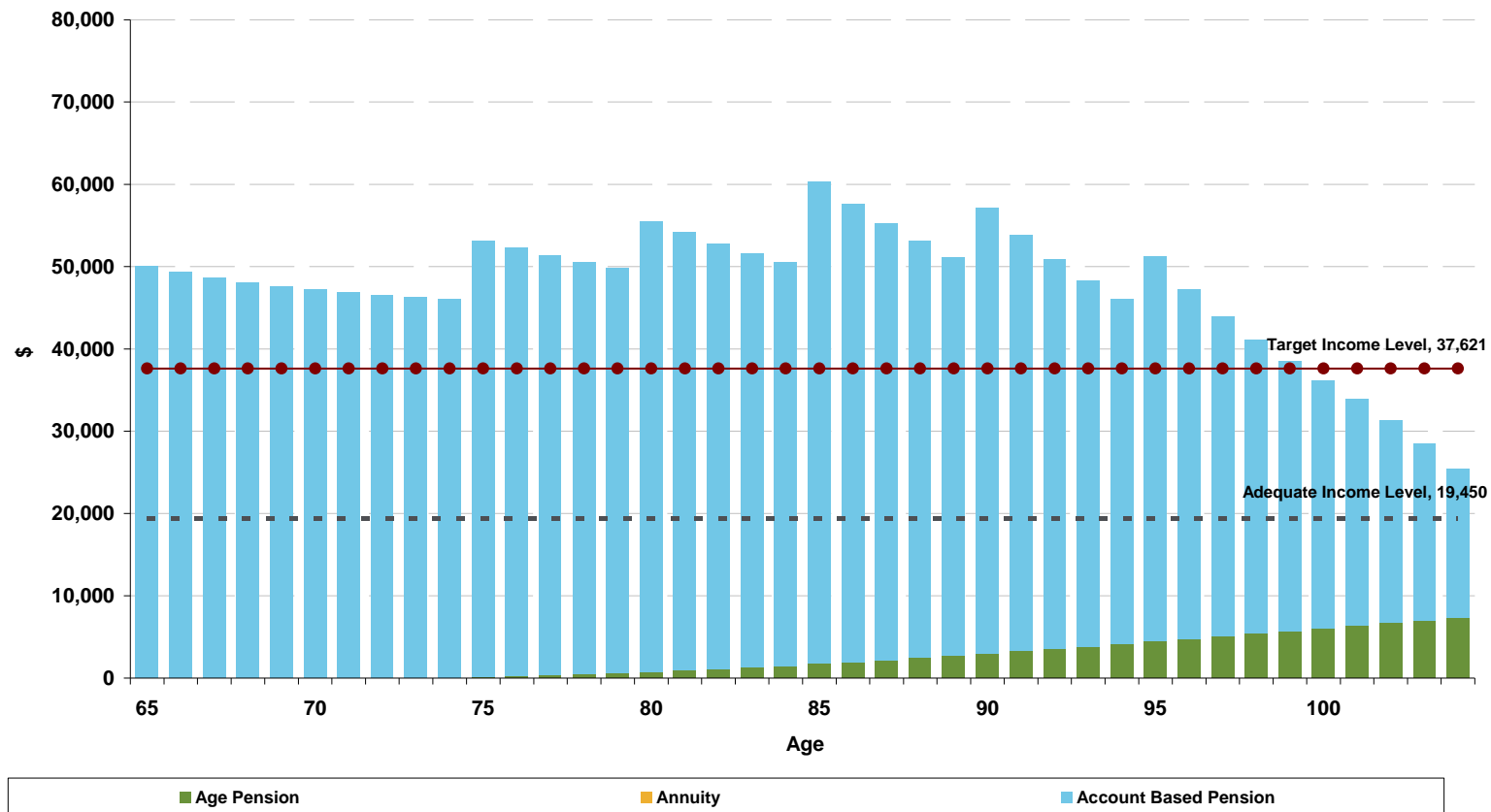


Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; High Fees





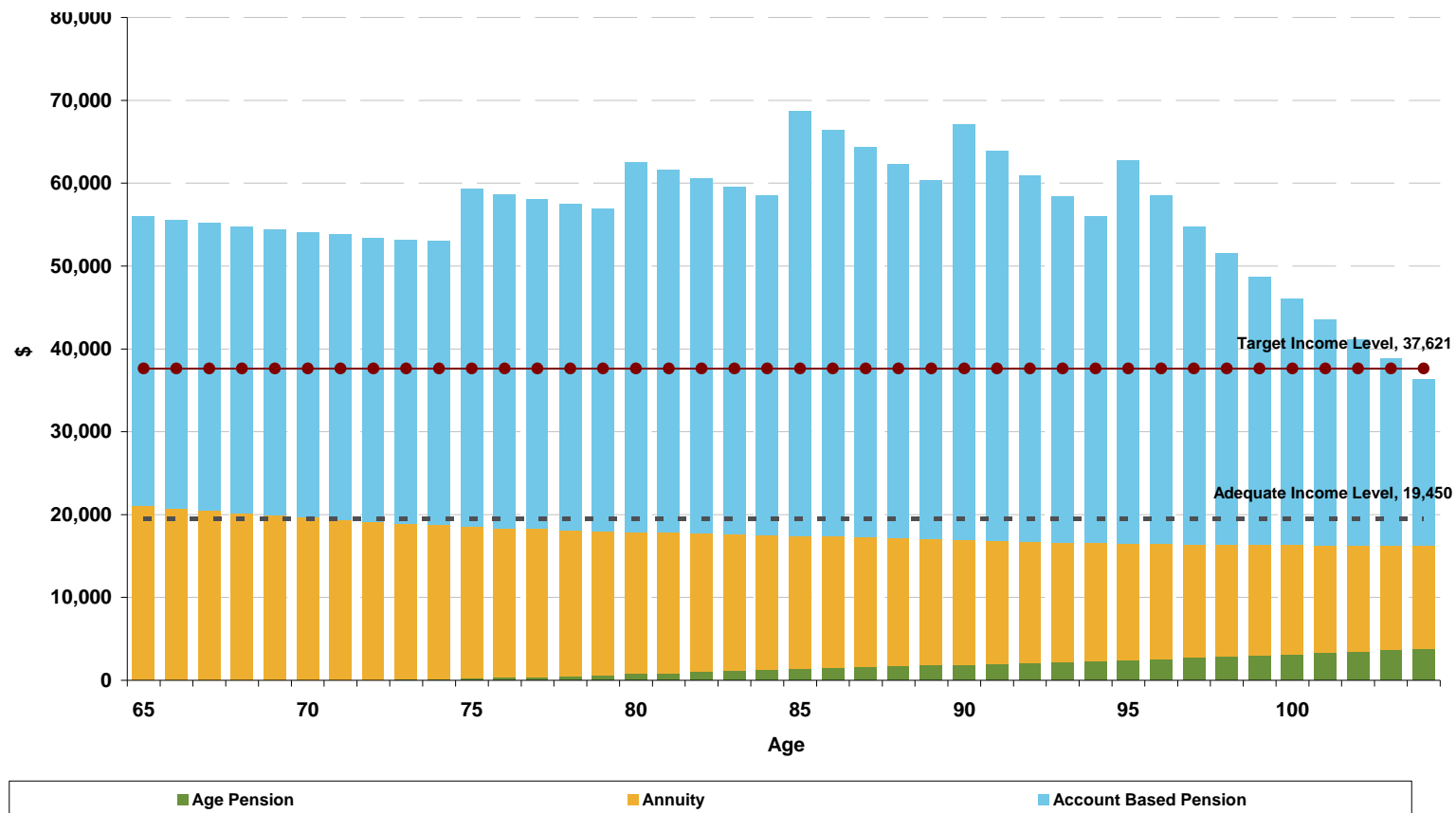
Figure 2.1: Average retirement income  
- No lifetime annuity purchased at retirement



Assumptions: \$1,000,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; High Fees

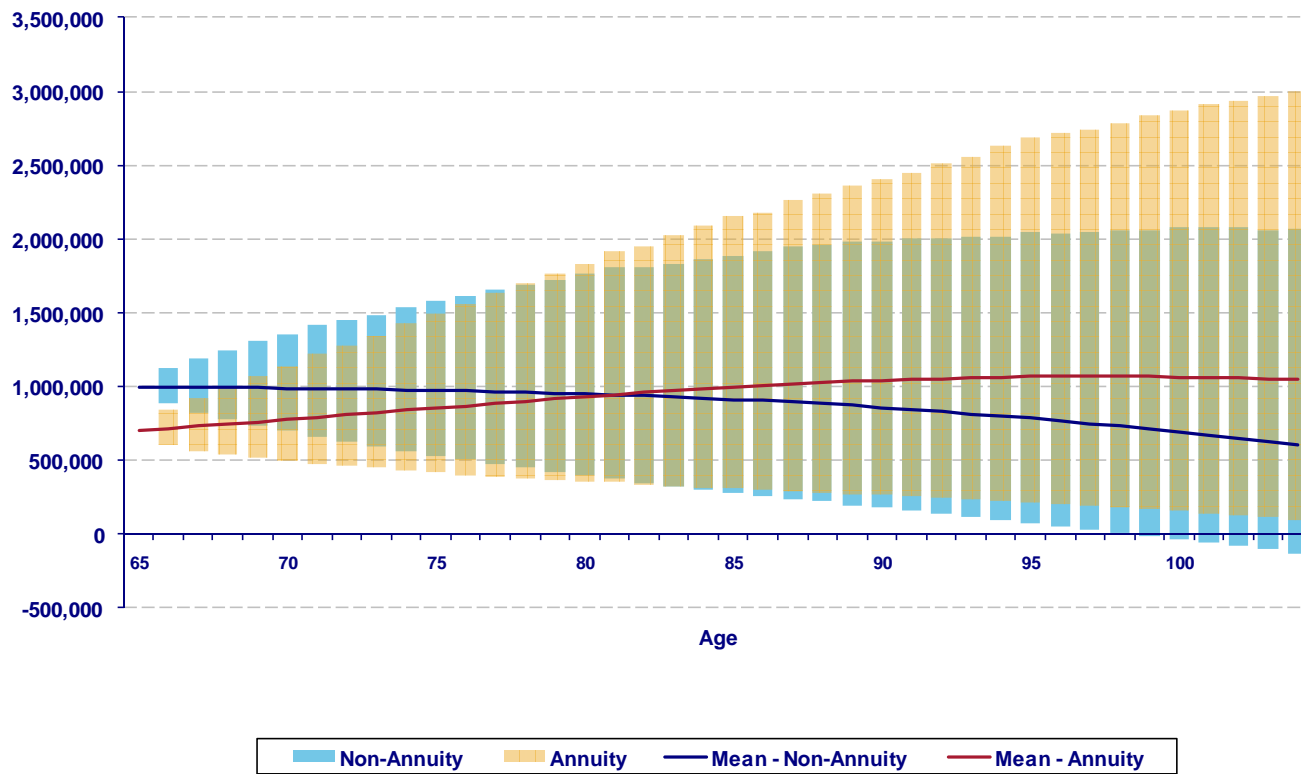


Figure 2.2: Average retirement income  
- Lifetime annuity purchased at retirement



Assumptions: \$1,000,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; High Fees

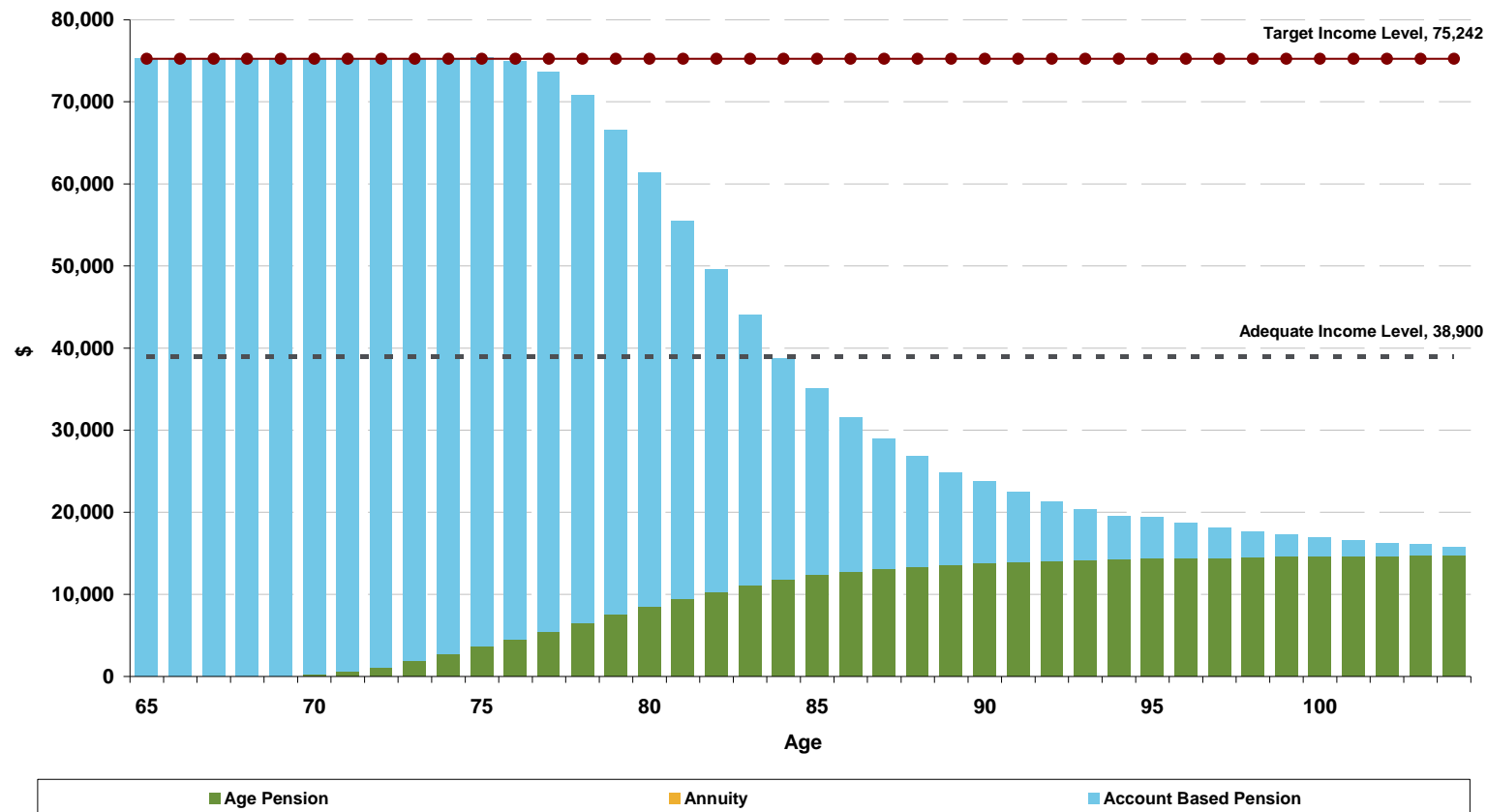
Figure 2.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$1,000,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; High Fees

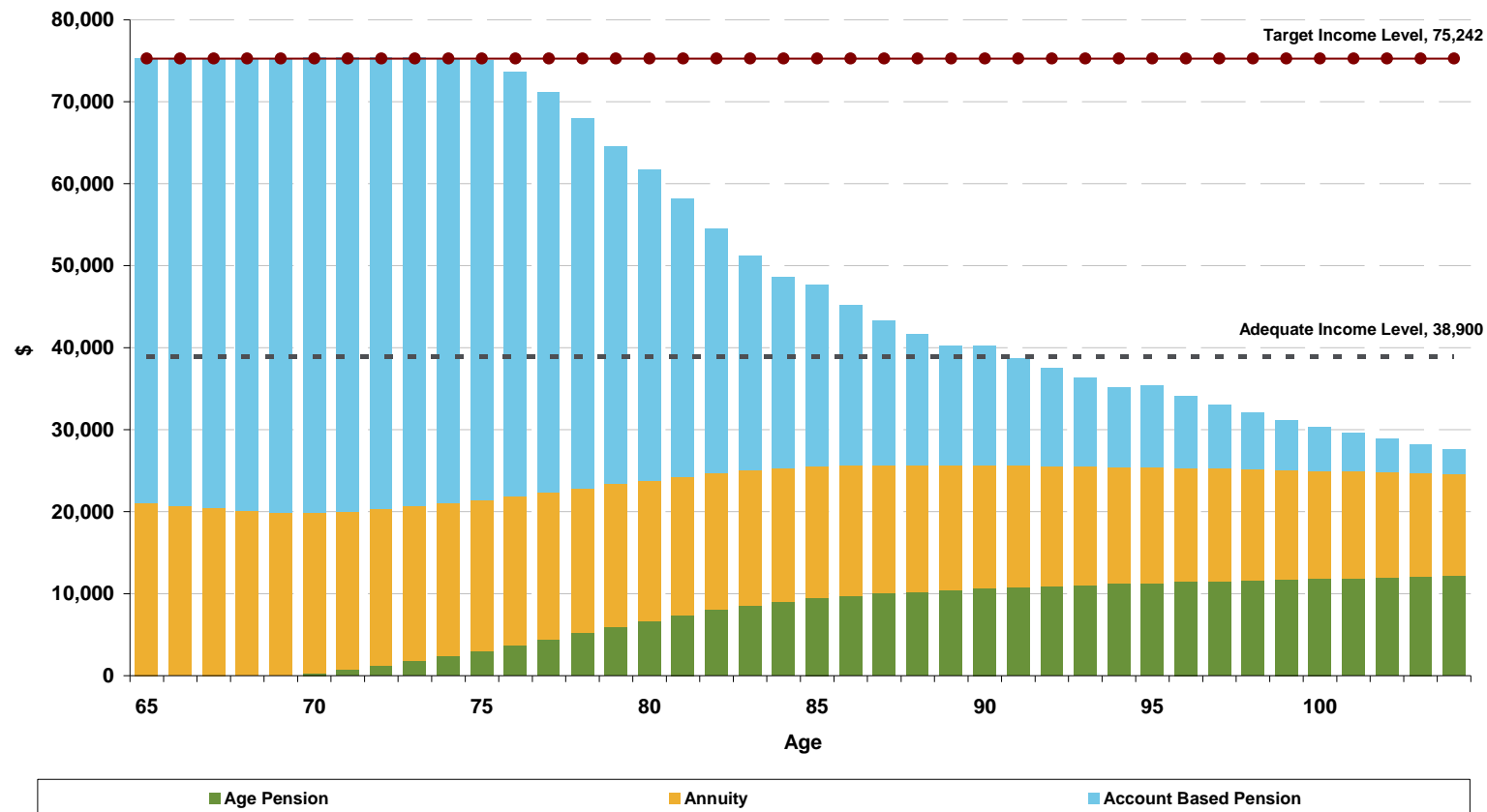


Figure 3.1: Average retirement income  
- No lifetime annuity purchased at retirement



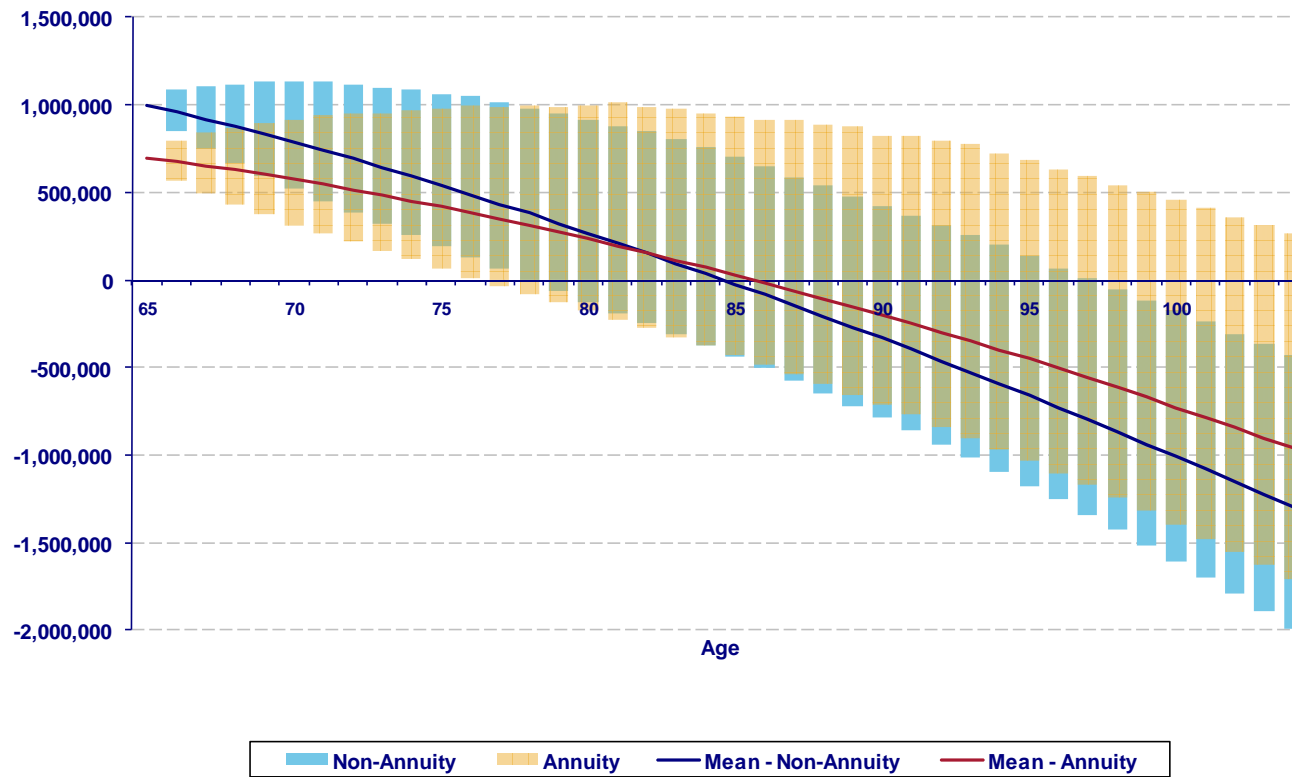
Assumptions: \$1,000,000 Initial account balance; \$75,242 pa Target income; \$38,900 pa Adequate income; 70% Growth, 30% Defensive; High Fees

# Figure 3.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$1,000,000 Initial account balance; \$75,242 pa Target income; \$38,900 pa Adequate income; 70% Growth, 30% Annuity; High Fees

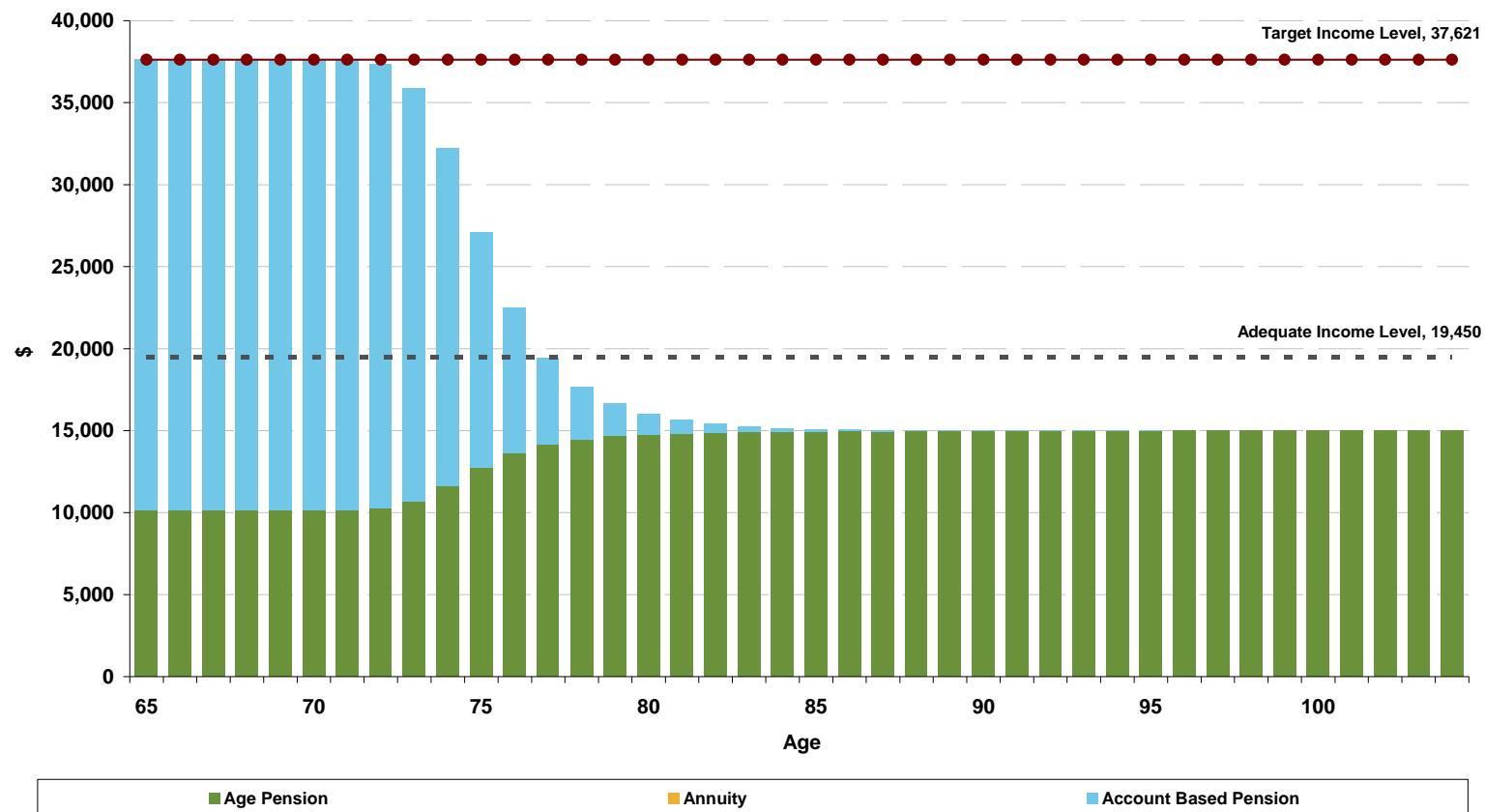
Figure 3.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$1,000,000 Initial account balance; \$75,242 pa Target income; \$38,900 pa Adequate income; 70% Growth; High Fees

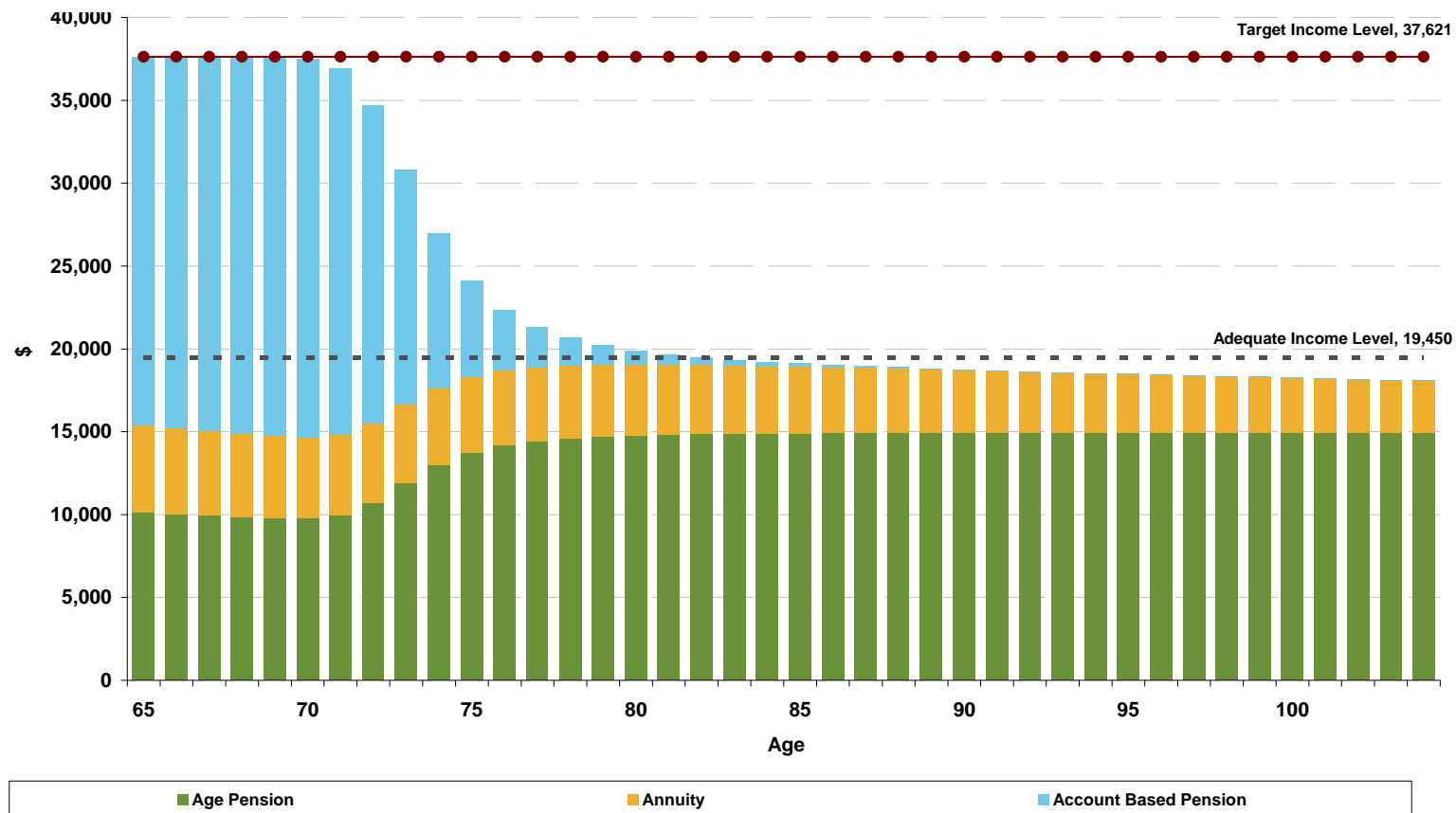


Figure 4.1: Average retirement income  
- No lifetime annuity purchased at retirement



Assumptions: \$250,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; High Fees

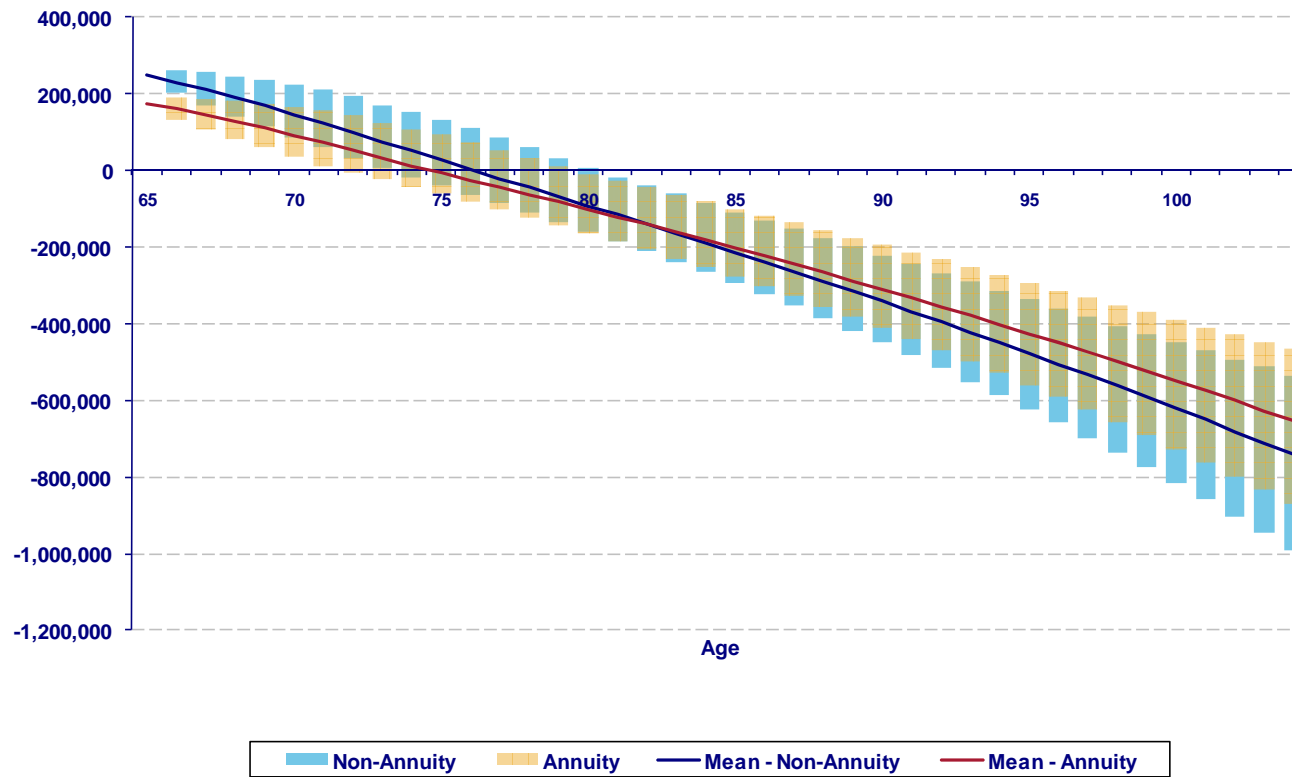
# Figure 4.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$250,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; High Fees



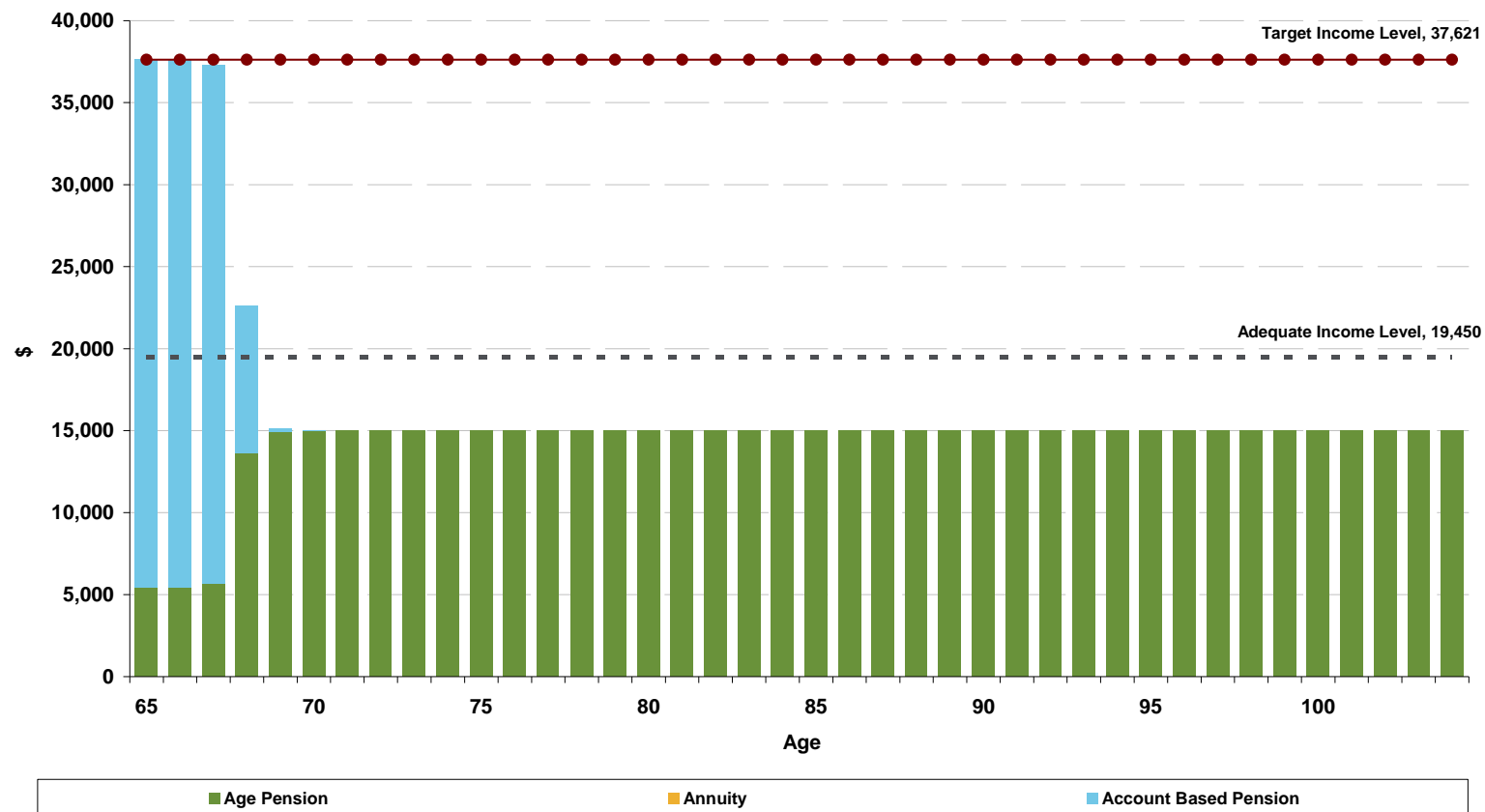
Figure 4.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$250,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; High Fees



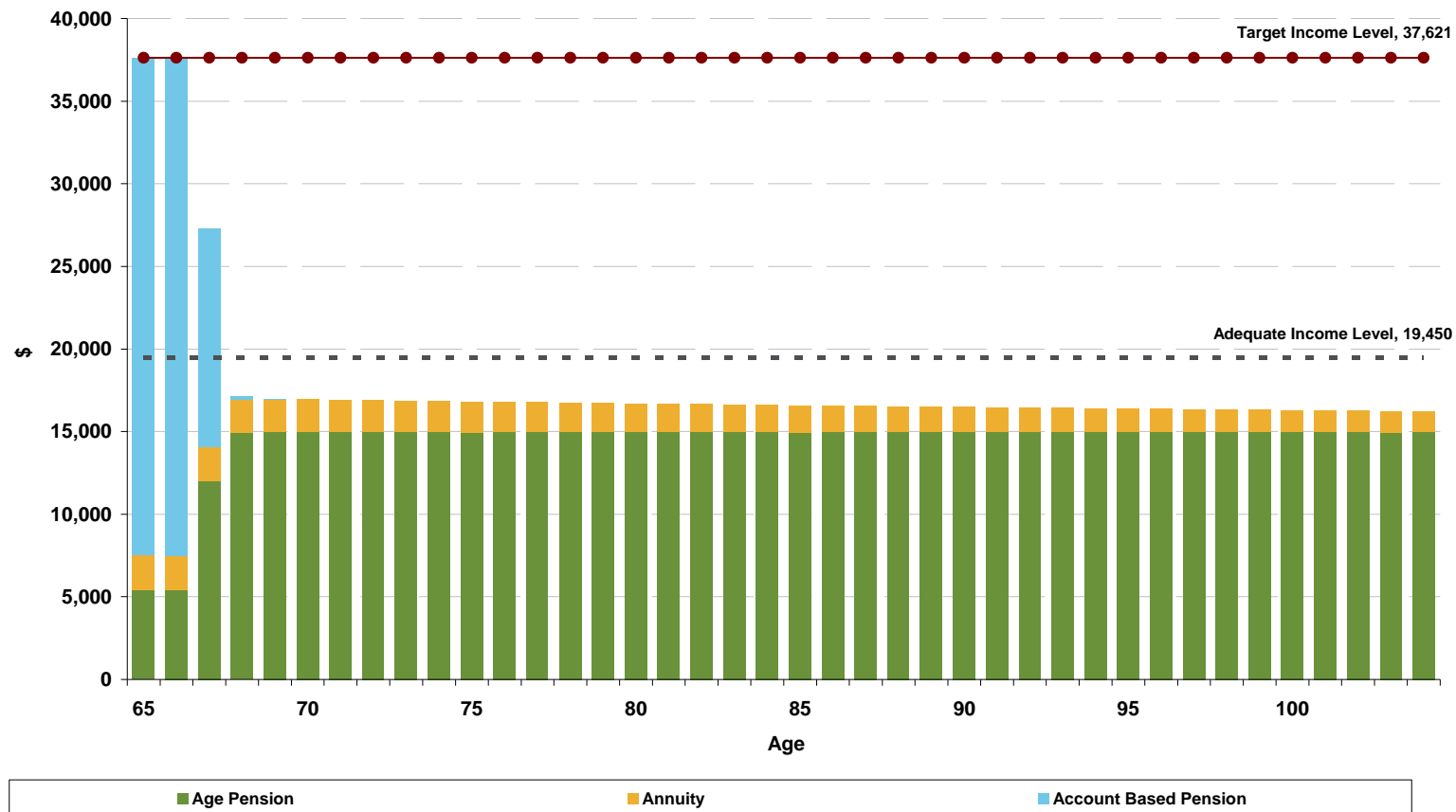
Figure 5.1: Average retirement income  
- No lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; High Fees

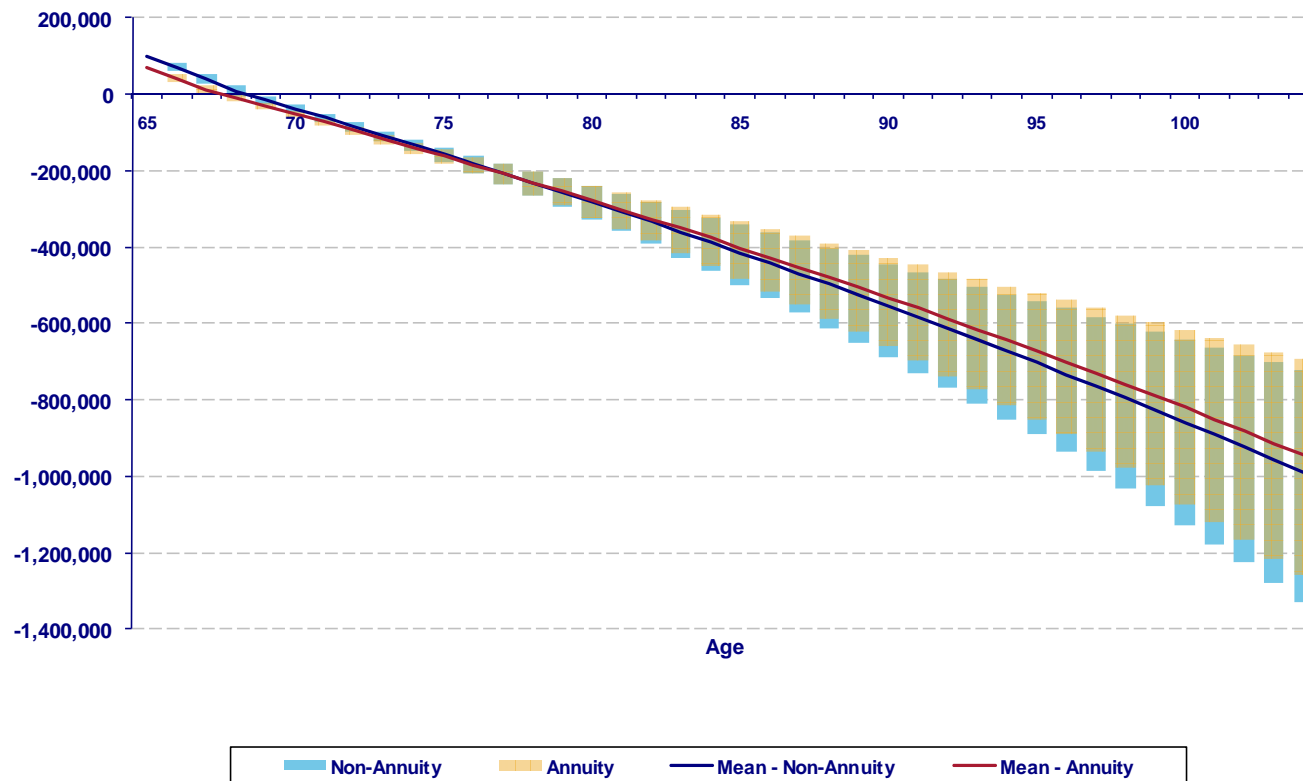
# Figure 5.2: Average retirement income

## - Lifetime annuity purchased at retirement



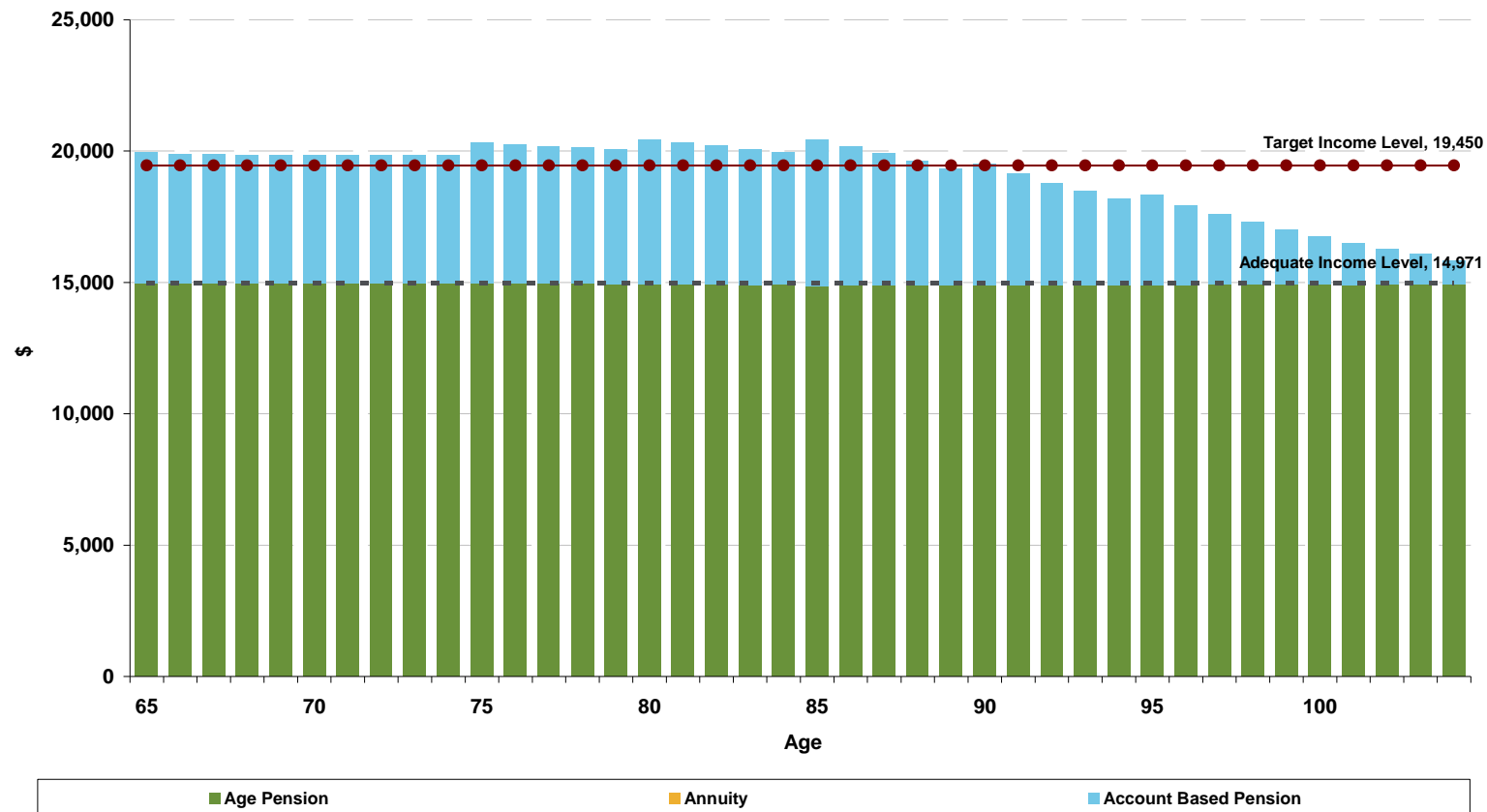
Assumptions: \$100,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; High Fees

Figure 5.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$100,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; High Fees

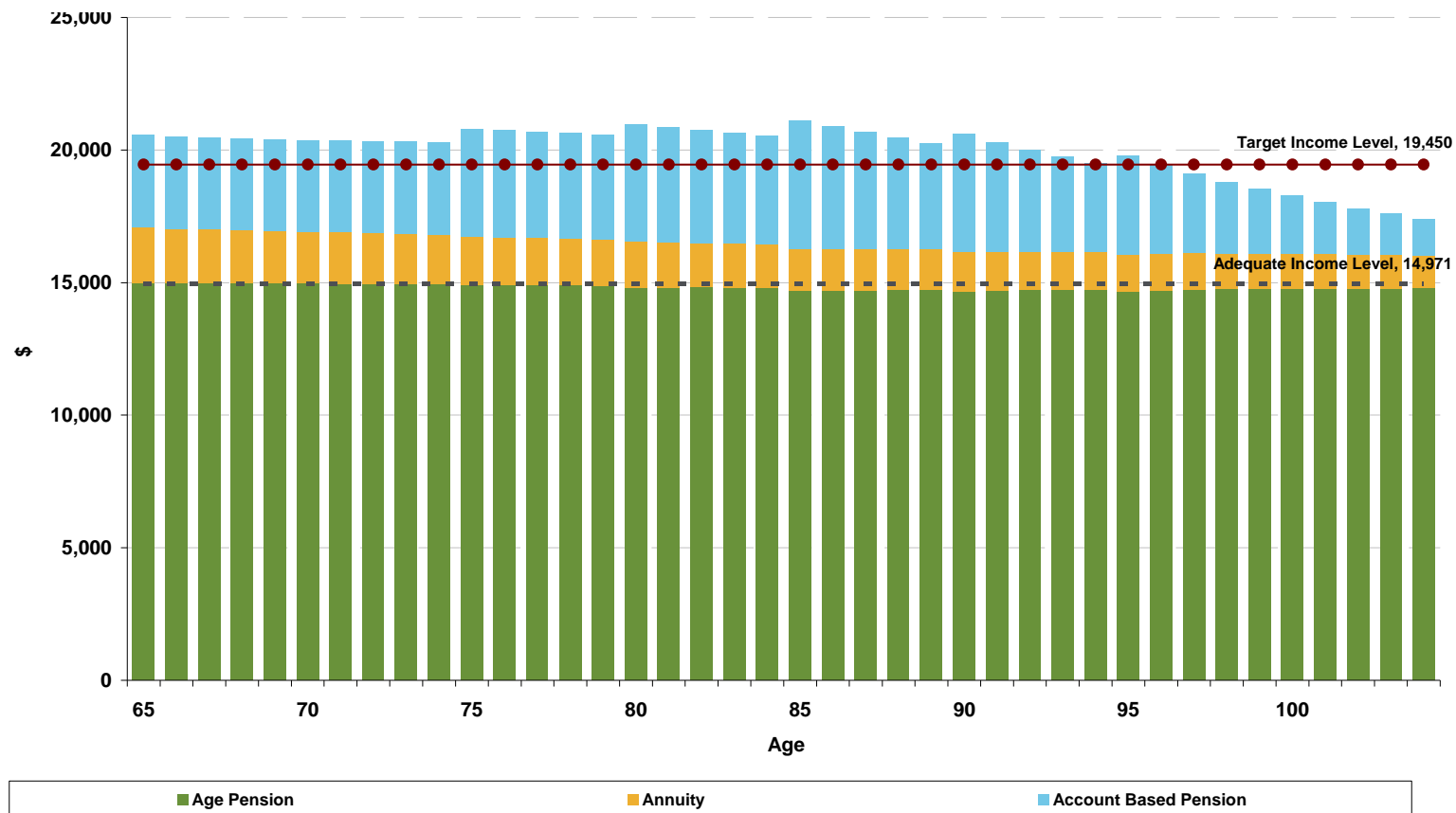
Figure 6.1: Average retirement income  
- No lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$19,450 pa Target income; \$14,971 pa Adequate income; 70% Growth, 30% Defensive; High Fees

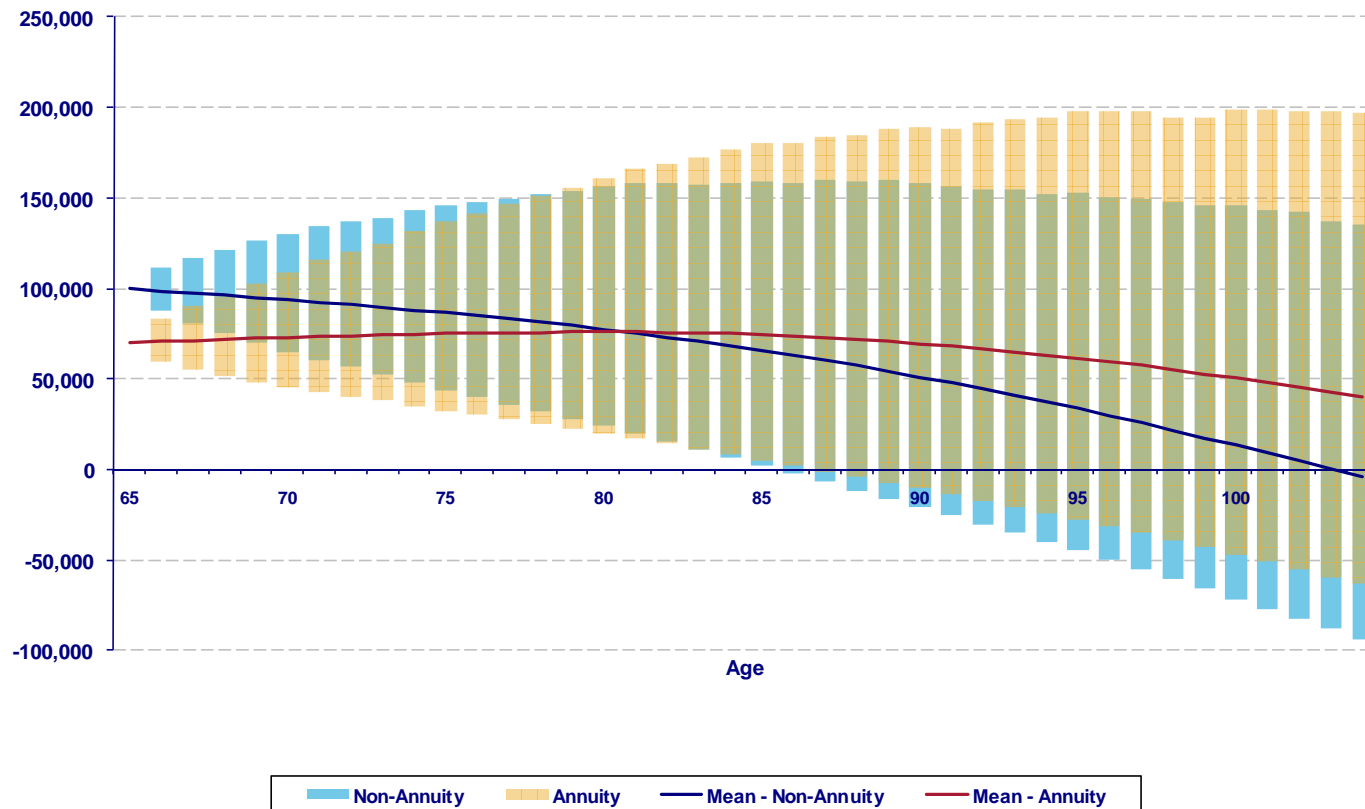


Figure 6.2: Average retirement income  
- Lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$19,450 pa Target income; \$14,971 pa Adequate income; 70% Growth, 30% Annuity; High Fees

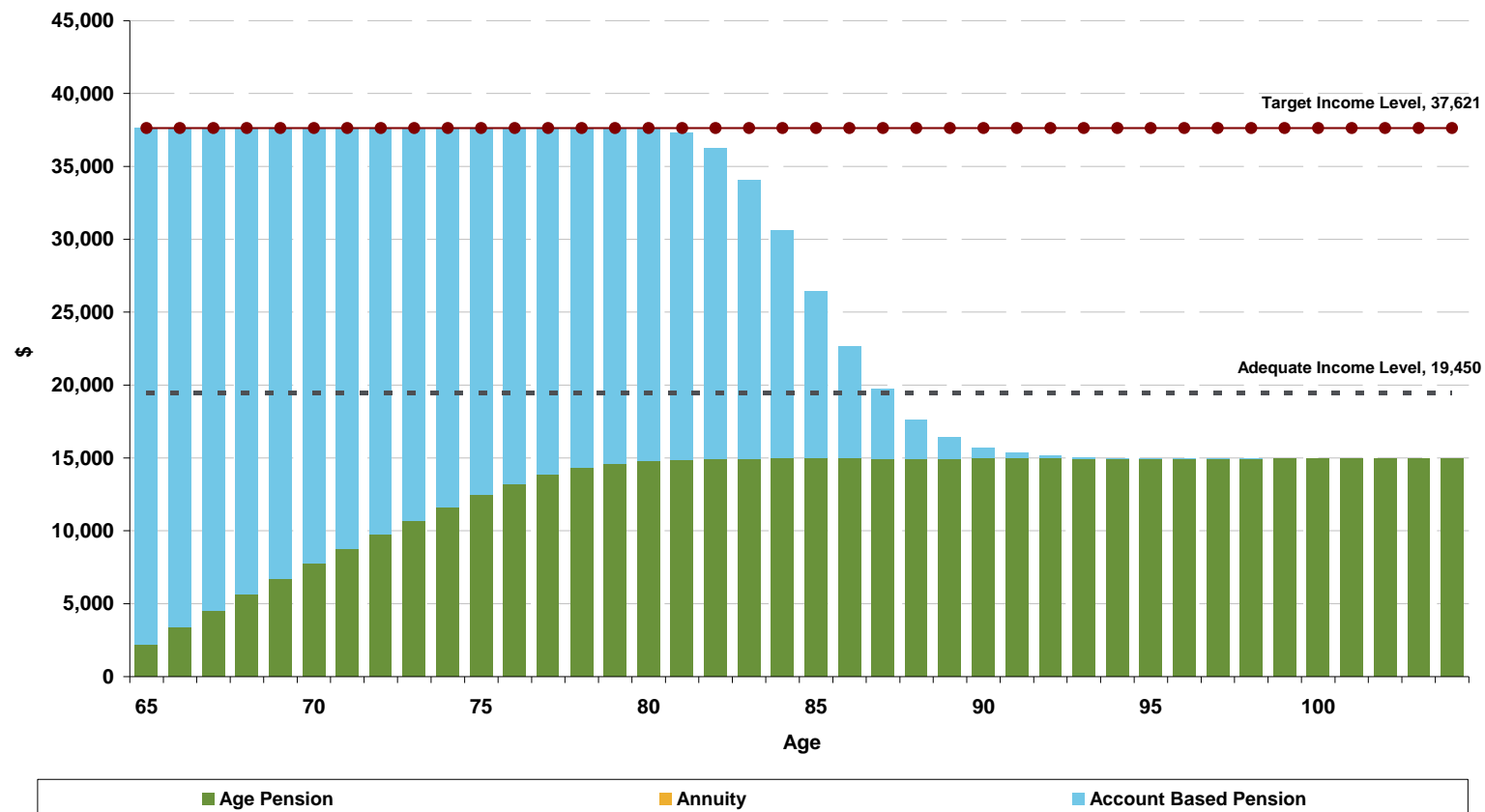
Figure 6.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$100,000 Initial account balance; \$19,450 pa Target income; \$14,971 pa Adequate income; 70% Growth; High Fees



Figure 7.1: Average retirement income  
- No lifetime annuity purchased at retirement

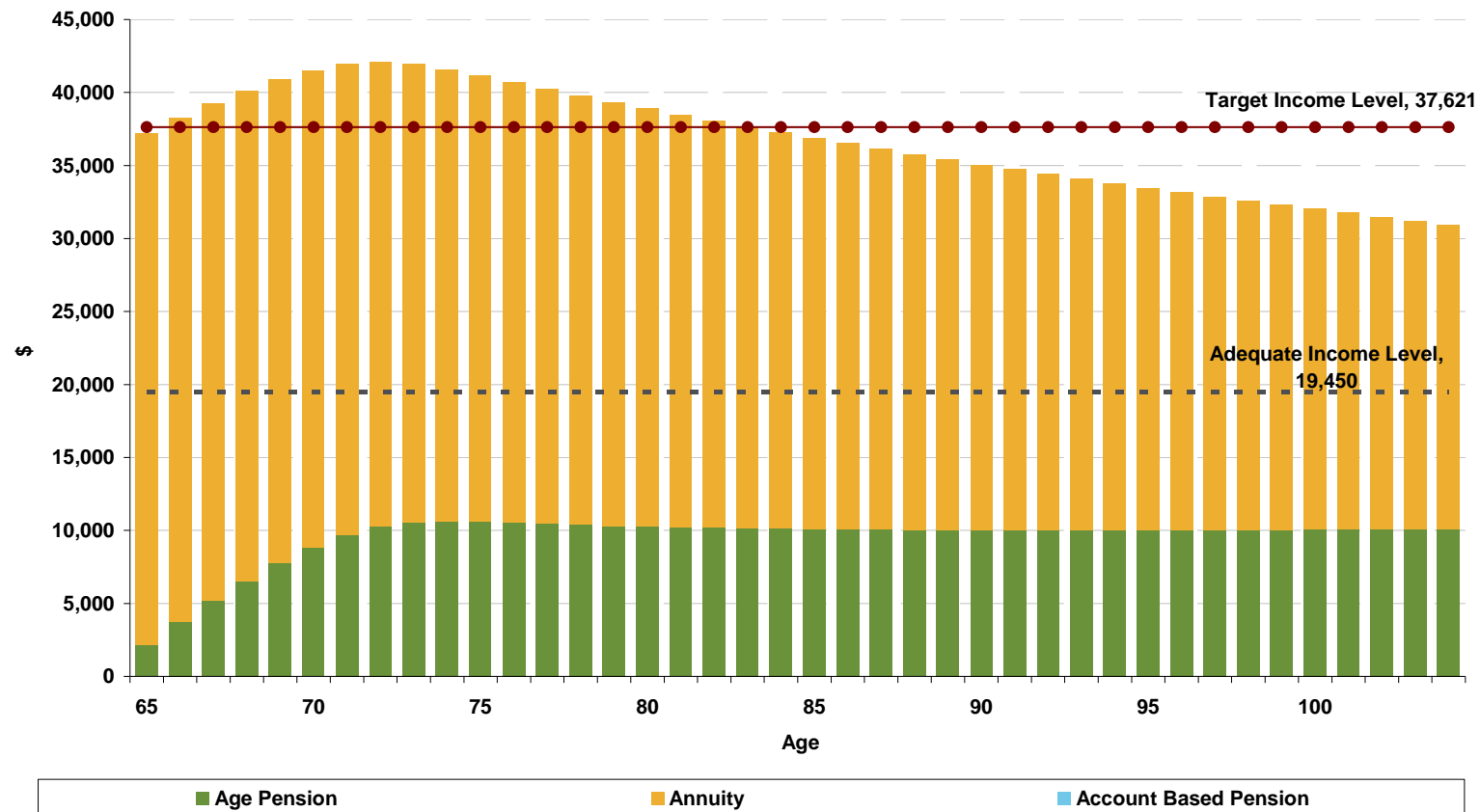


Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 0% Growth, 100% Defensive; High Fees



# Figure 7.2: Average retirement income

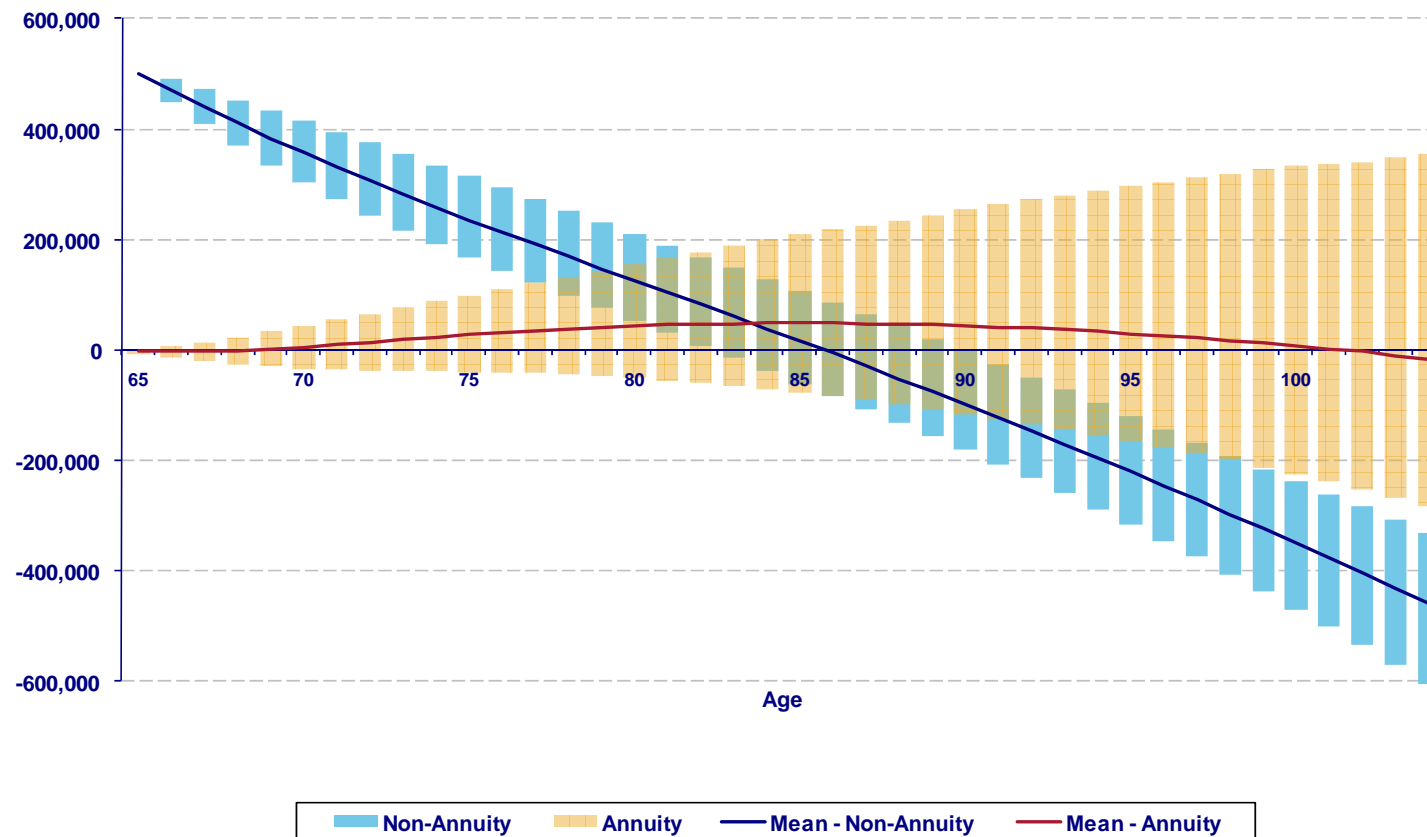
## - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 0% Growth, 100% Annuity; High Fees



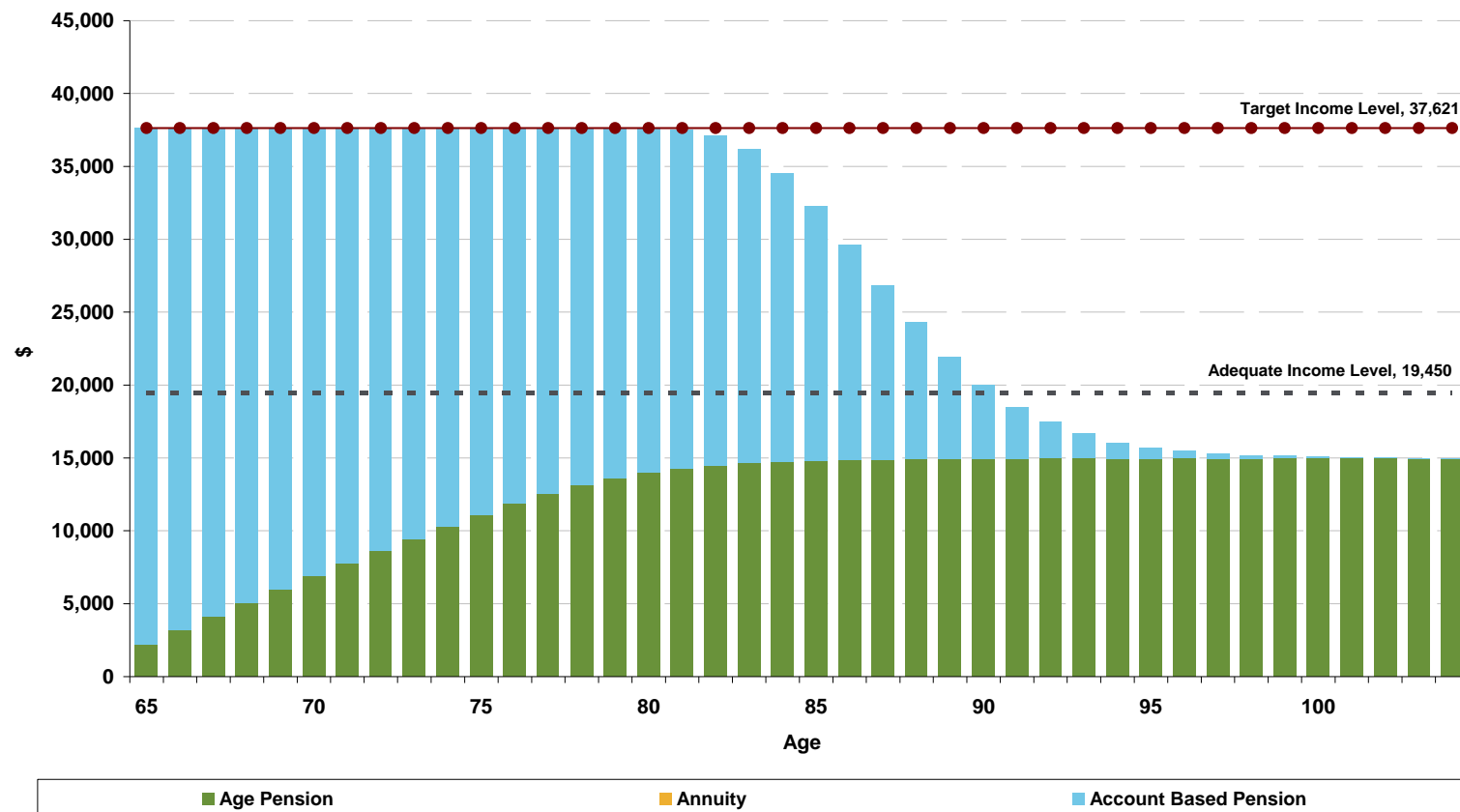
Figure 7.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 0% Growth; High Fees



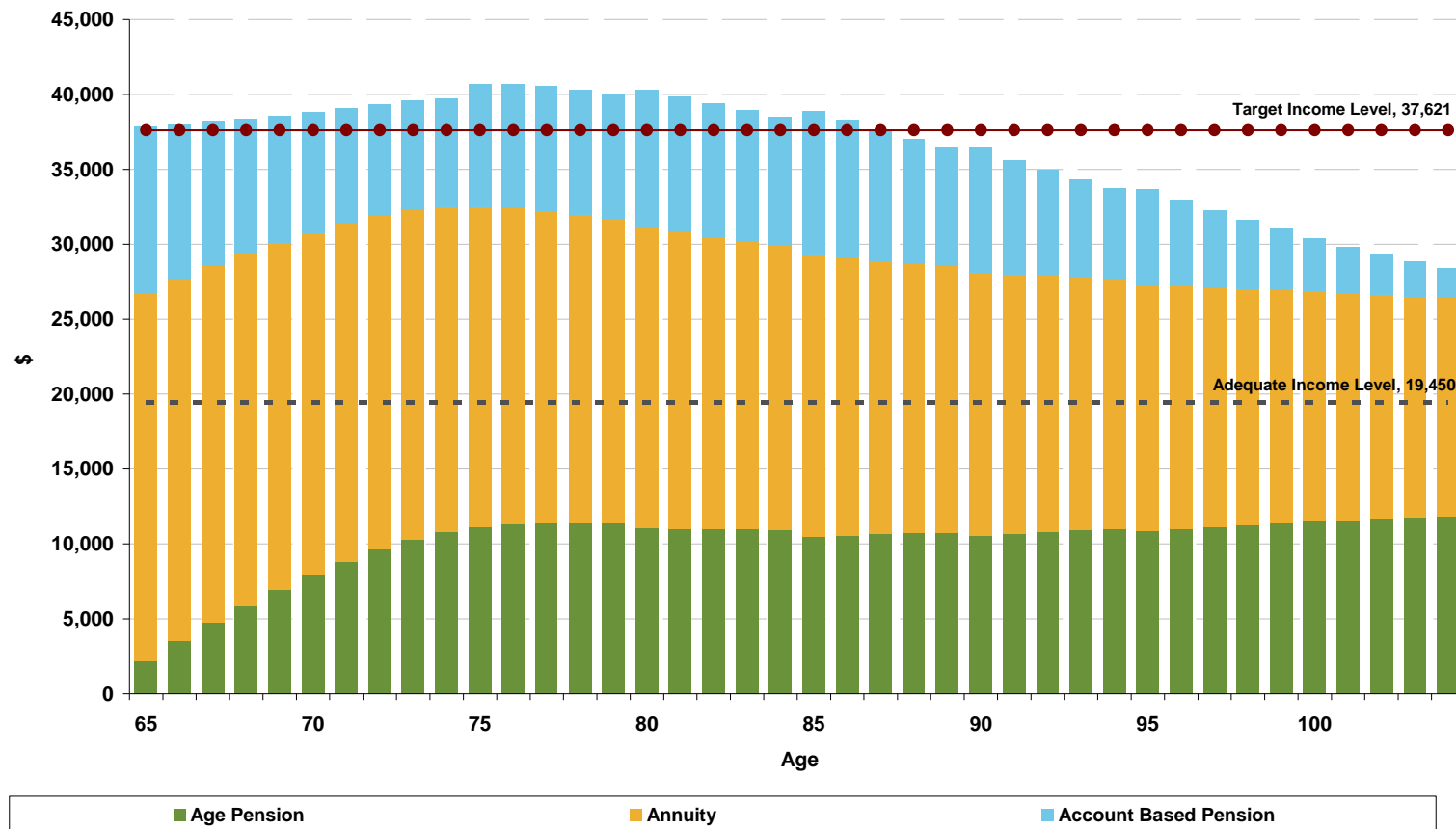
Figure 8.1: Average retirement income  
- No lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 30% Growth, 70% Defensive; High Fees

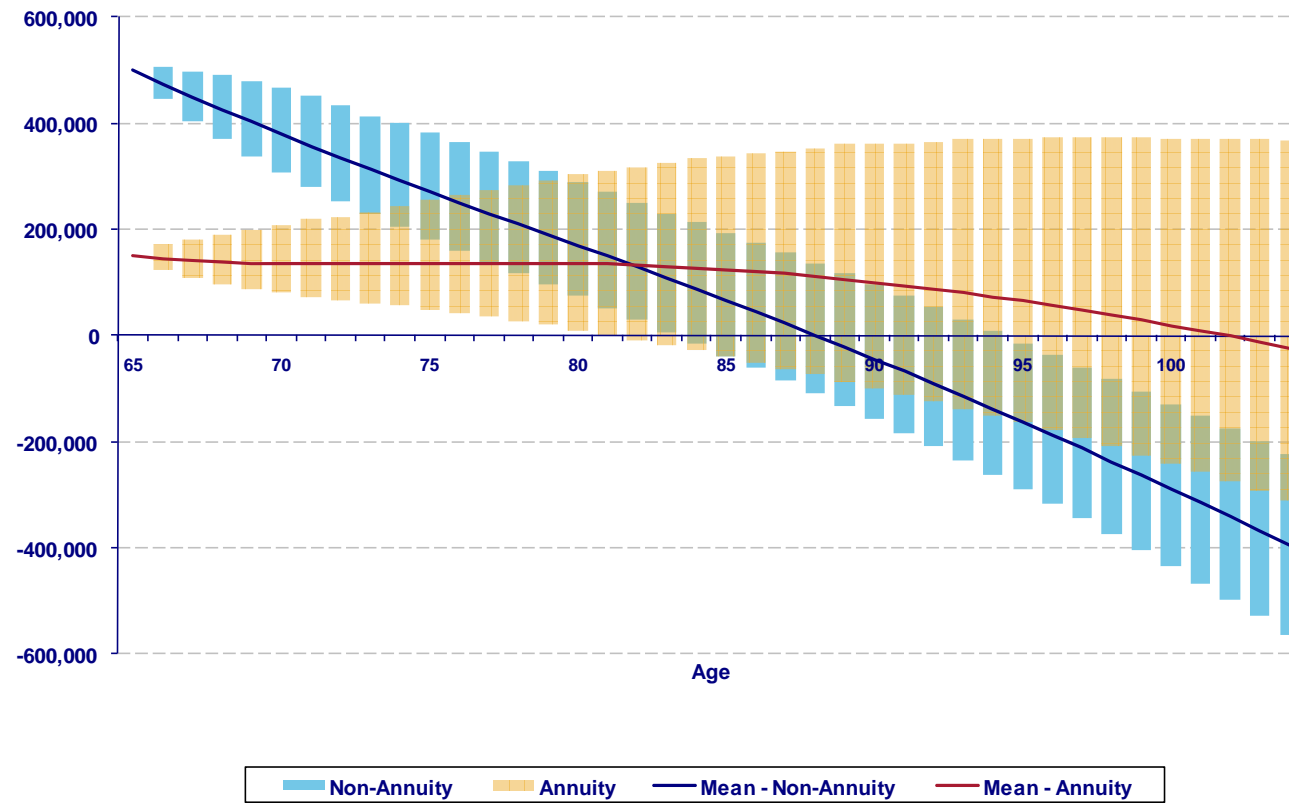


Figure 8.2: Average retirement income  
- Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 30% Growth, 70% Annuity; High Fees

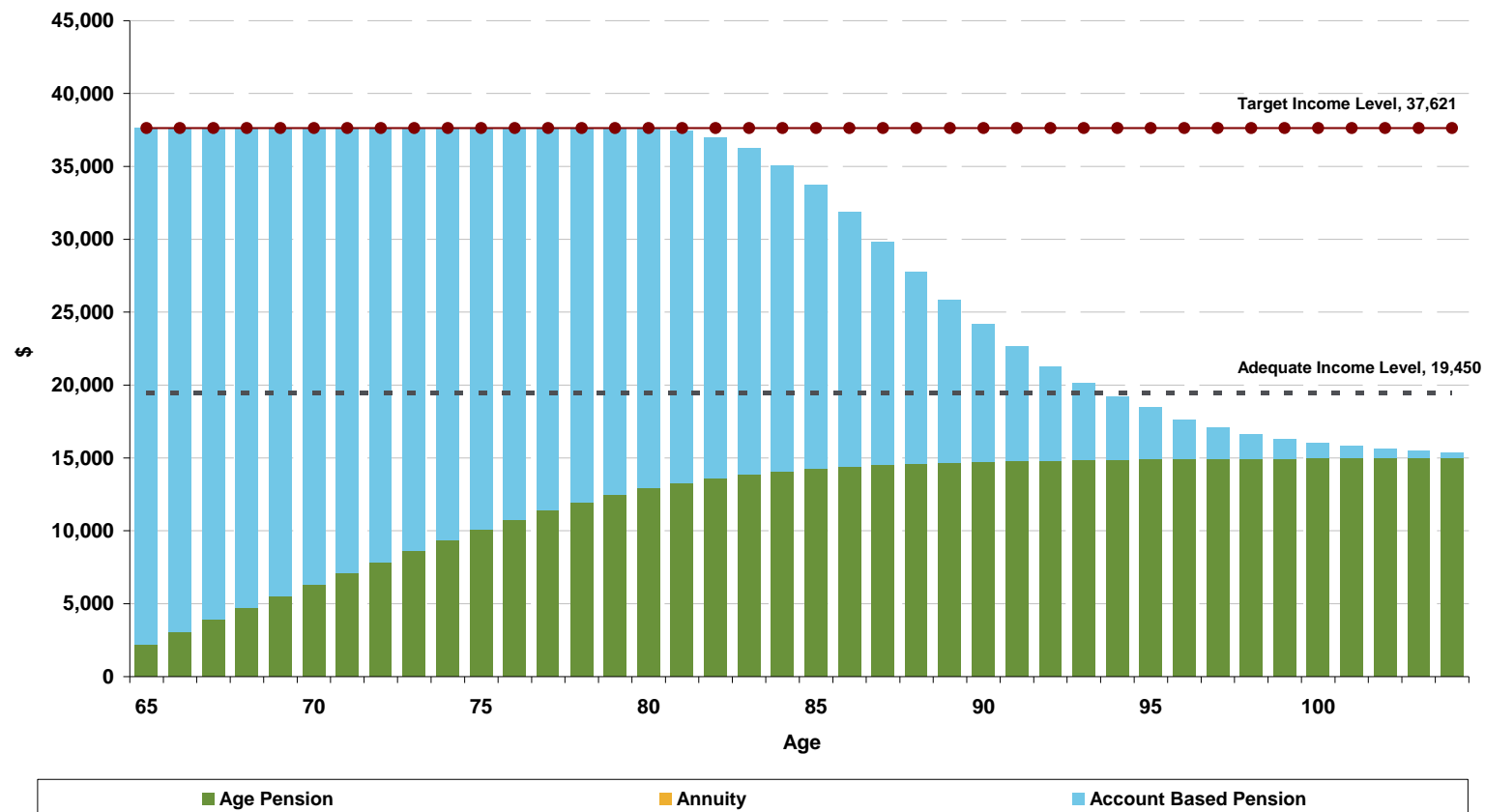
Figure 8.3: Remaining account balance  
- 90% Confidence interval



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 30% Growth; High Fees

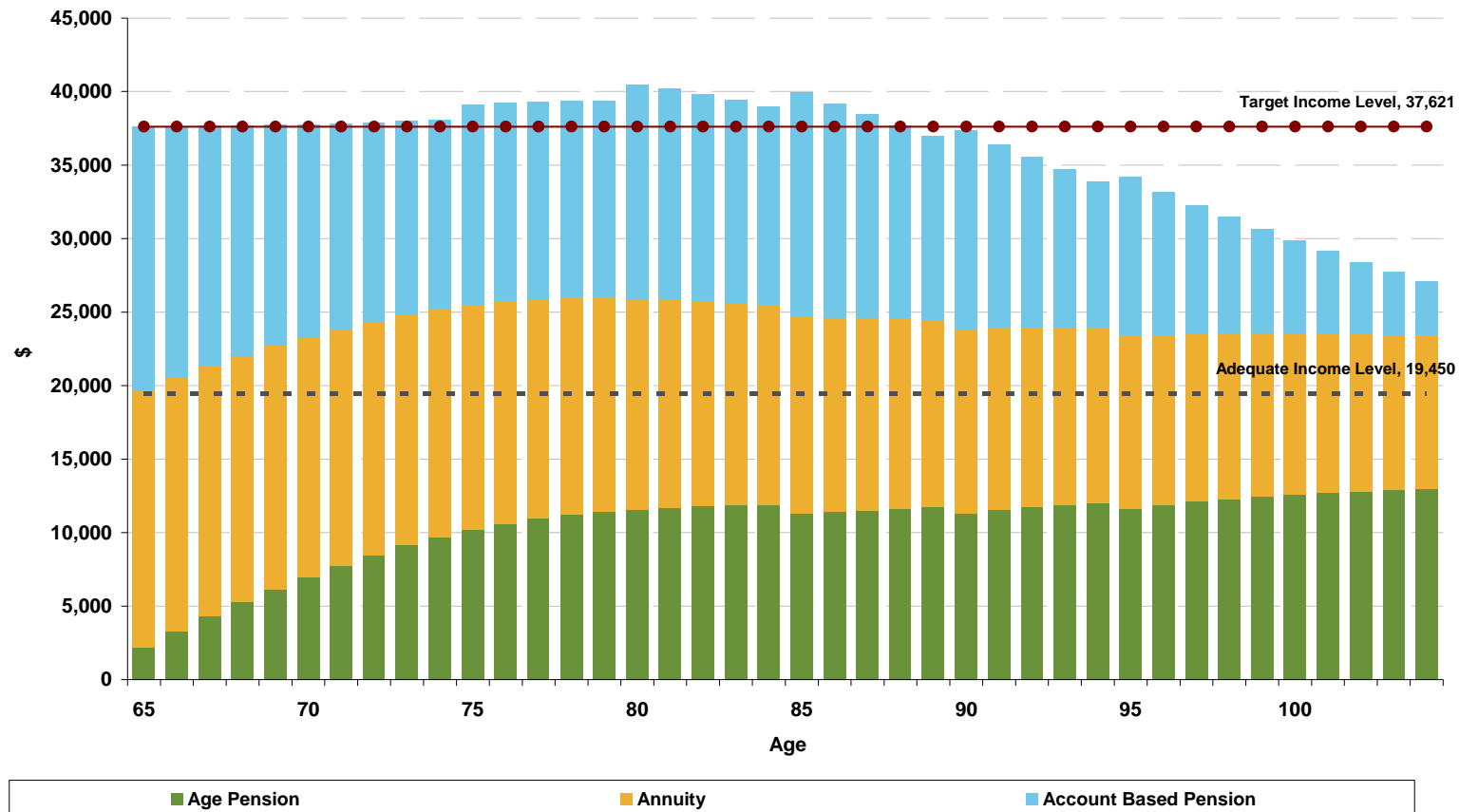


Figure 9.1: Average retirement income  
- No lifetime annuity purchased at retirement



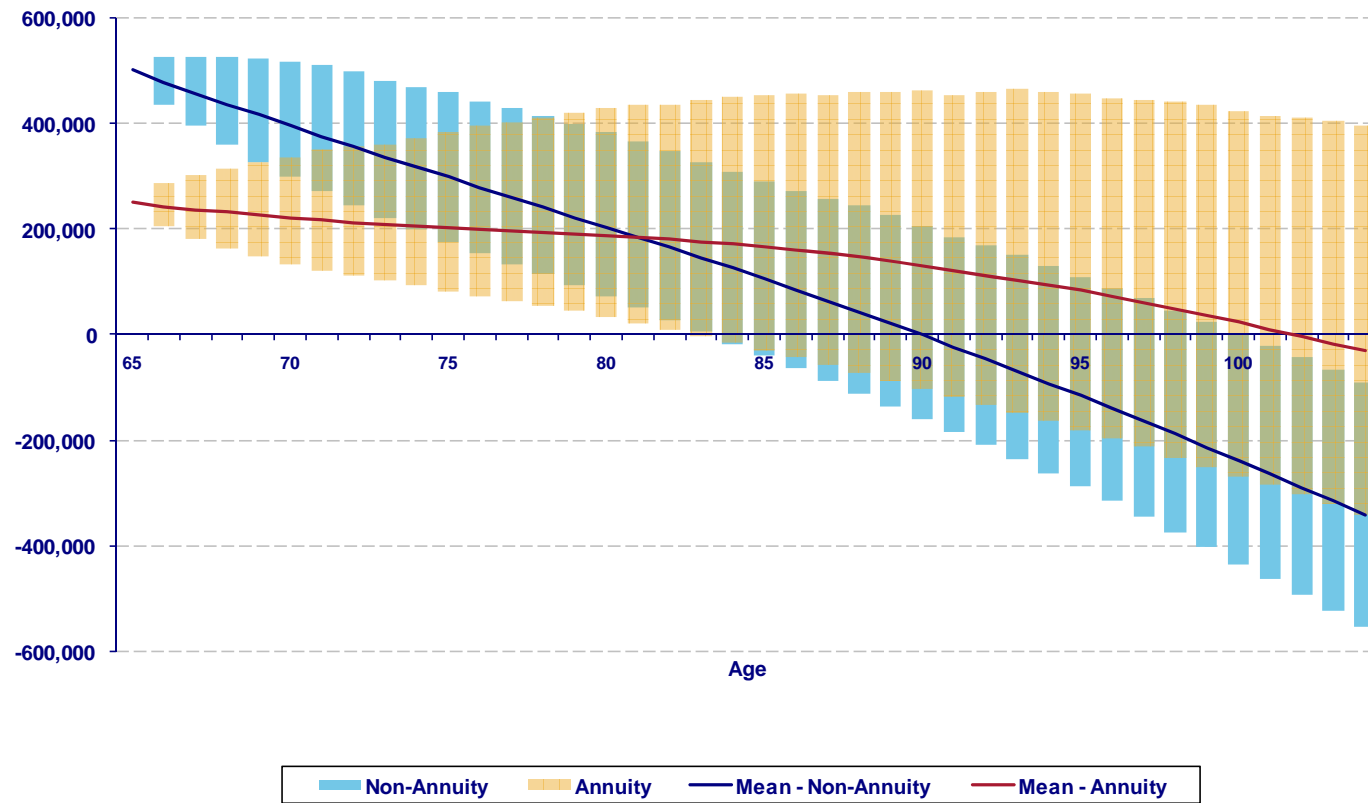
Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 50% Growth, 50% Defensive; High Fees

# Figure 9.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 50% Growth, 50% Annuity; High Fees

Figure 9.3: Remaining account balance  
- 90% Confidence interval



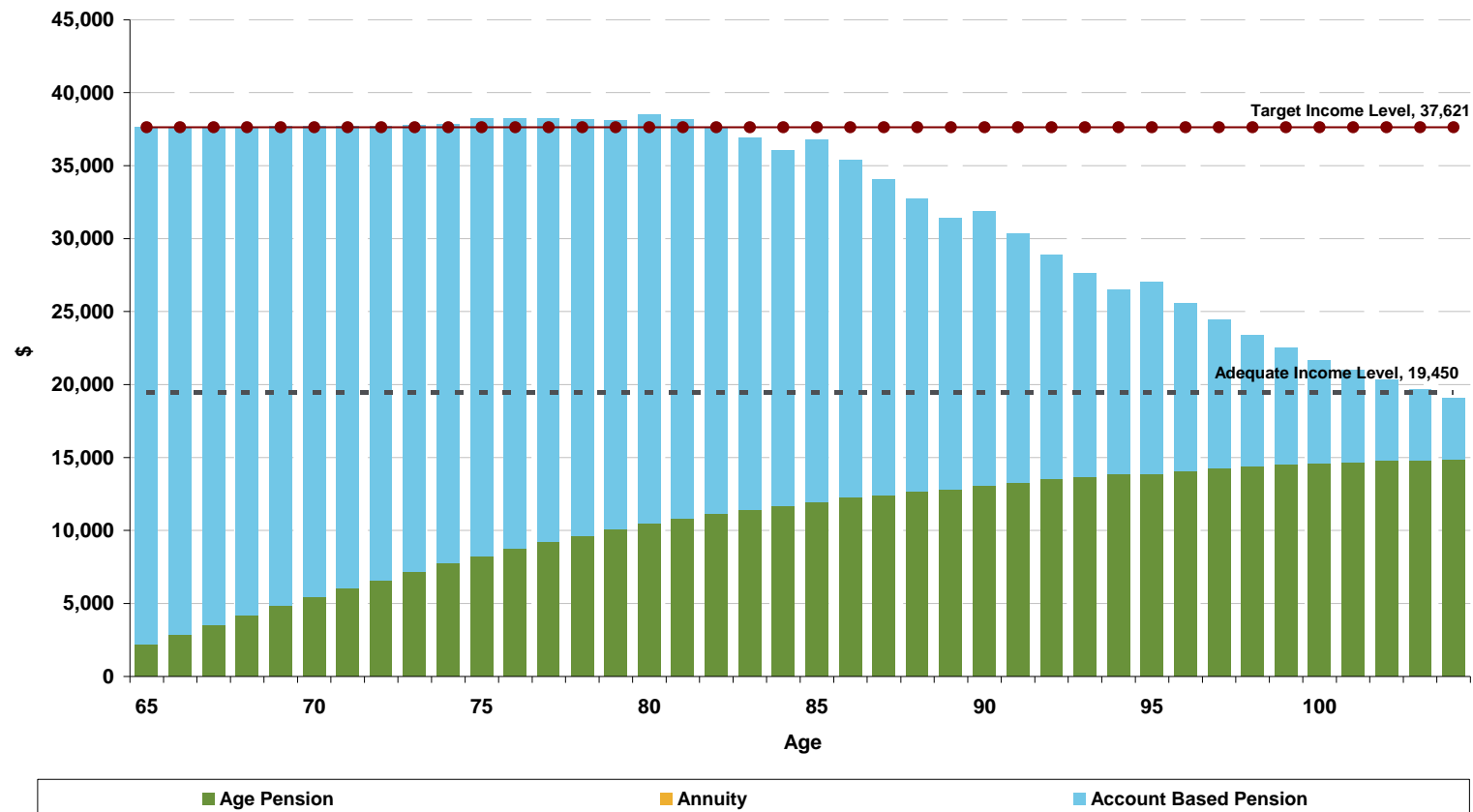
Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 50% Growth; High Fees





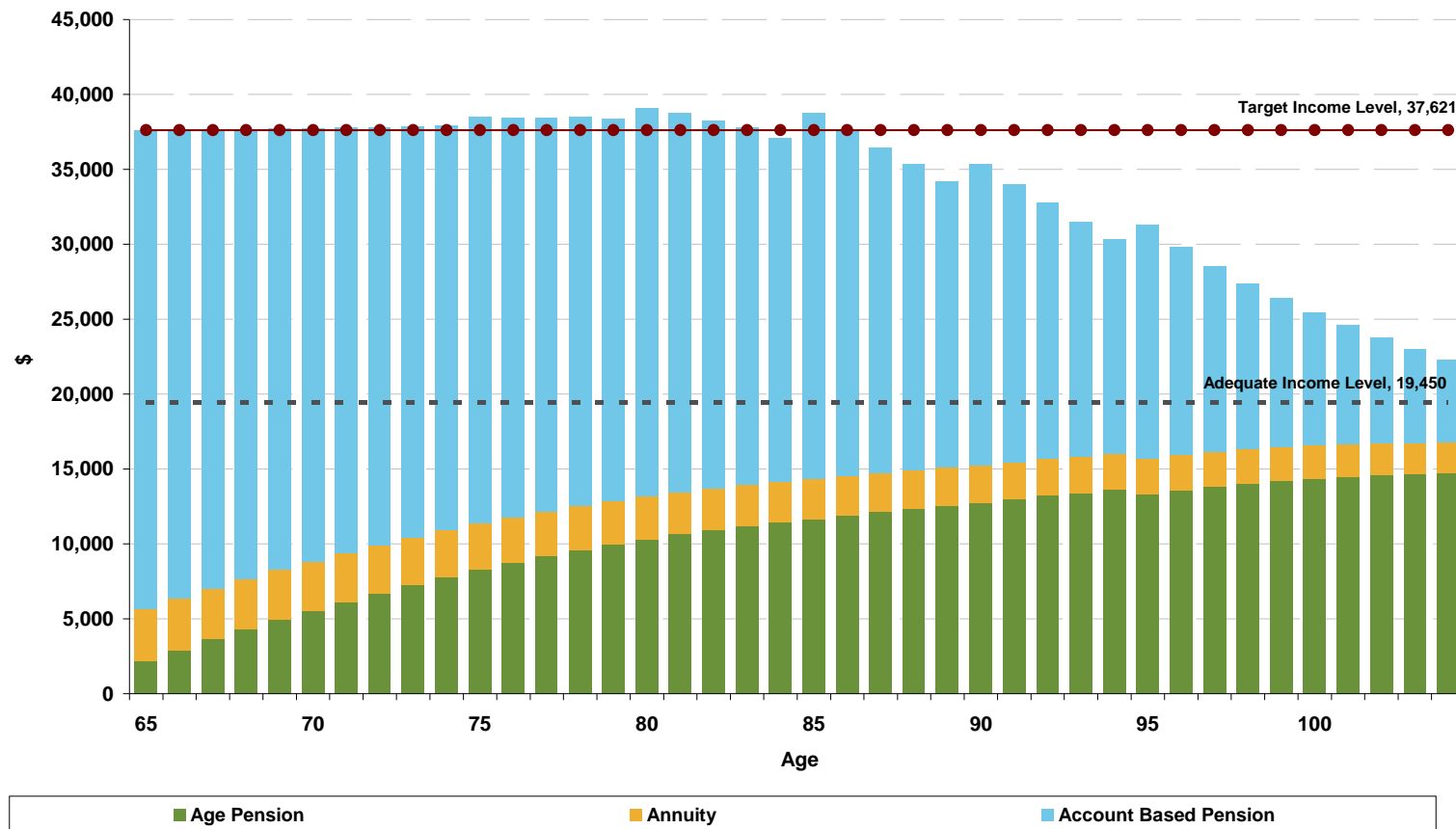
# Figure 10.1: Average retirement income

## - No lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 90% Growth, 10% Defensive; High Fees

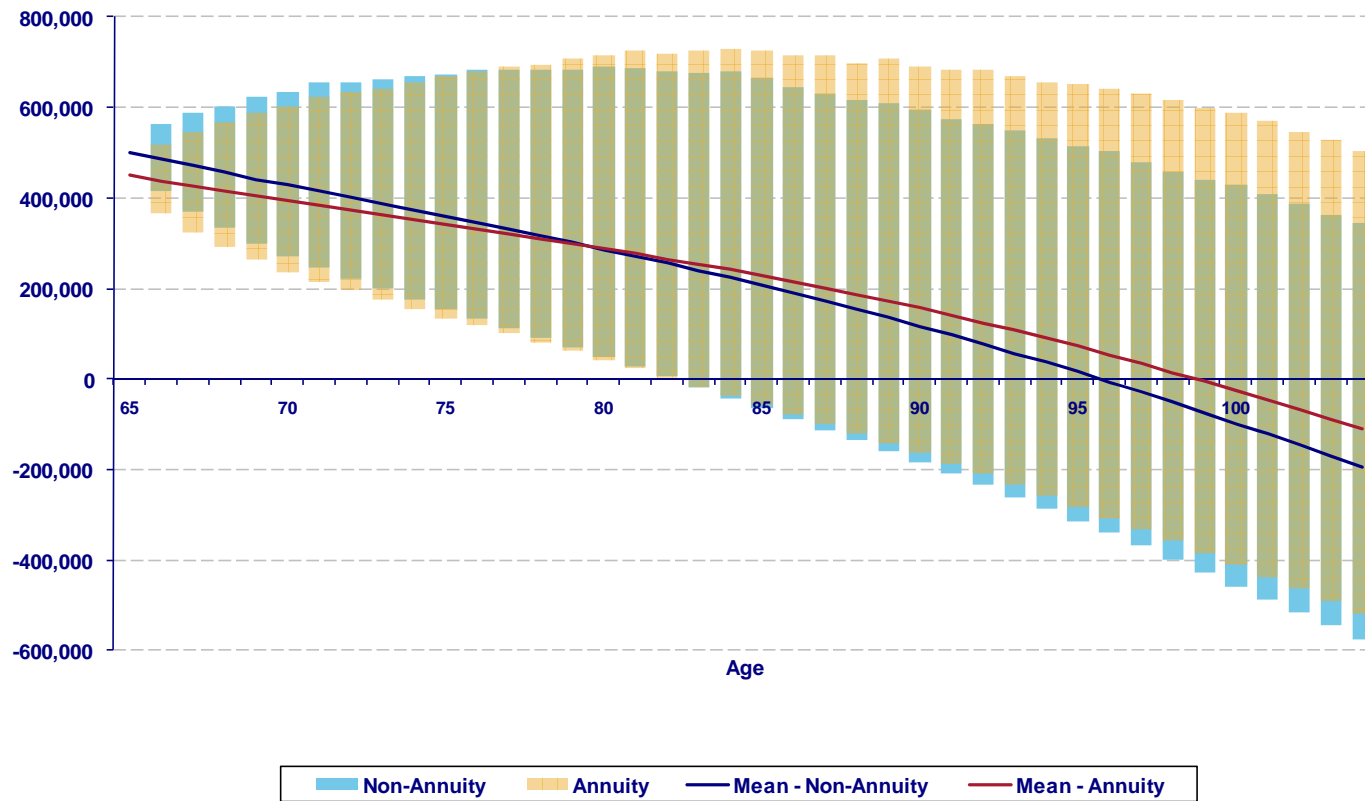
# Figure 10.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 90% Growth, 10% Annuity; High Fees



# Figure 10.3: Remaining account balance - 90% Confidence interval

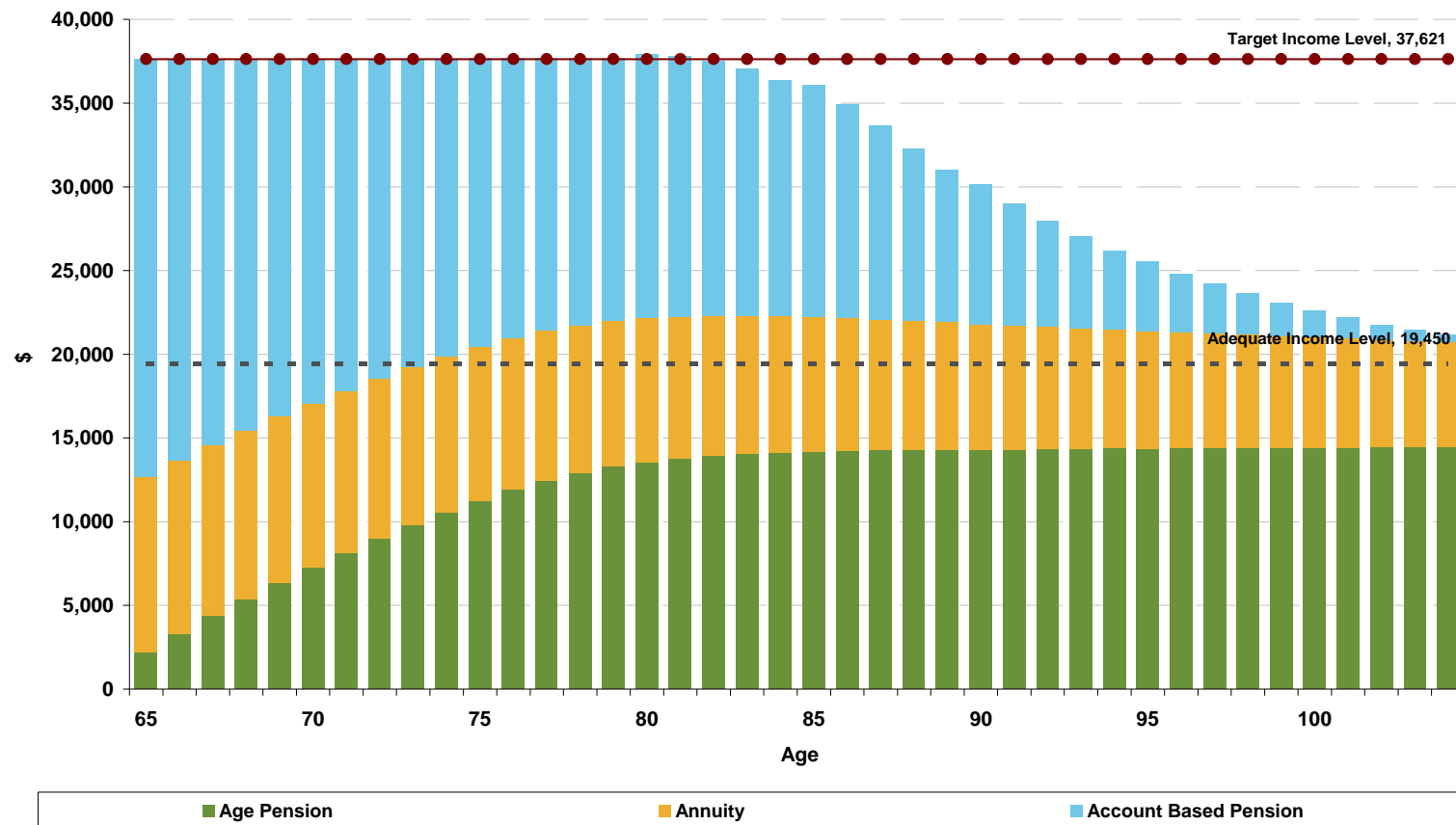


Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 90% Growth; High Fees



# Figure 11.1: Average retirement income

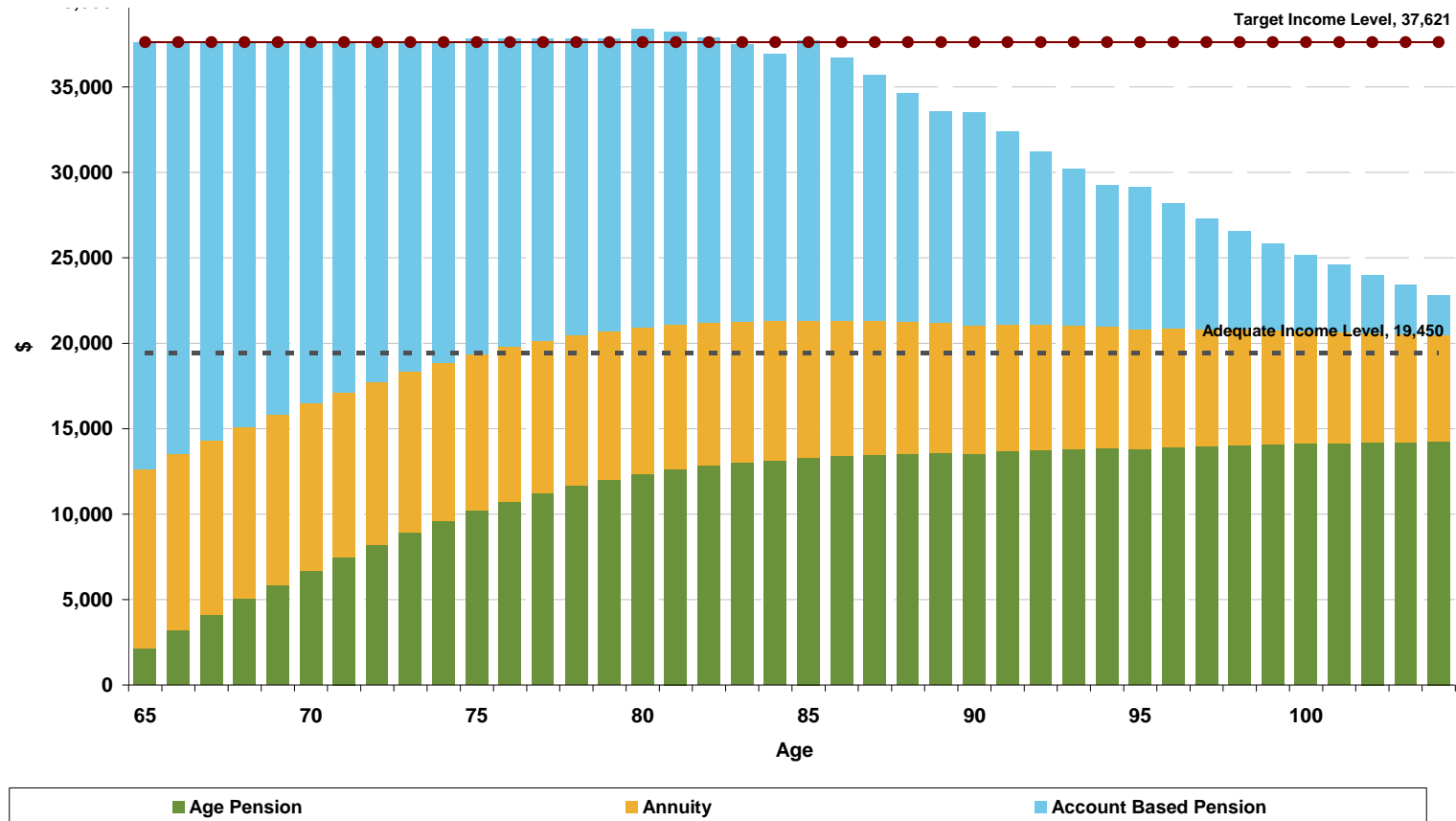
## - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 30% Growth, 40% Bonds, 30% Annuity; High Fees



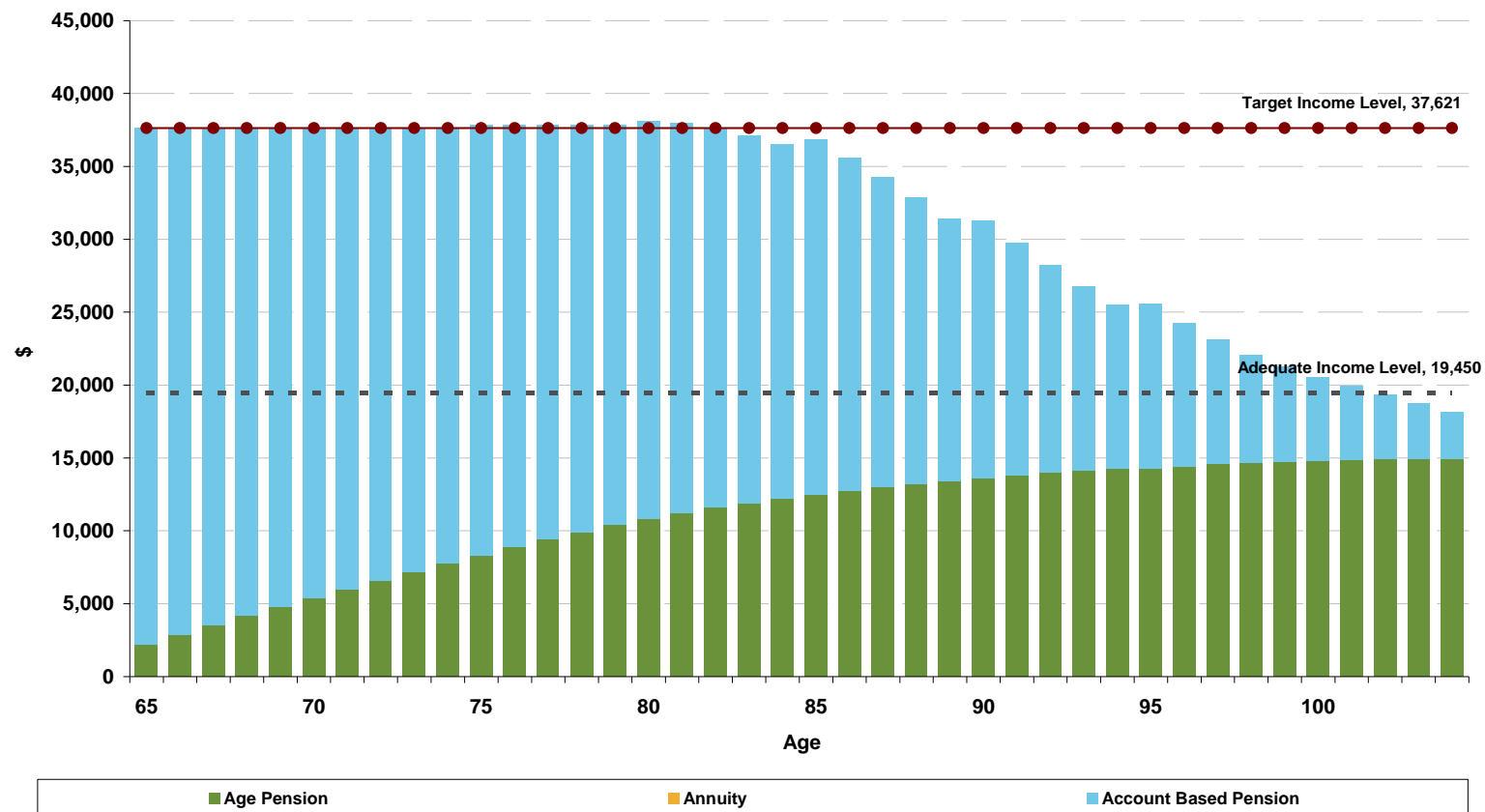
# Figure 12.1: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 50% Growth, 20% Bonds, 30% Annuity; High Fees

# Figure 13.1: Average retirement income

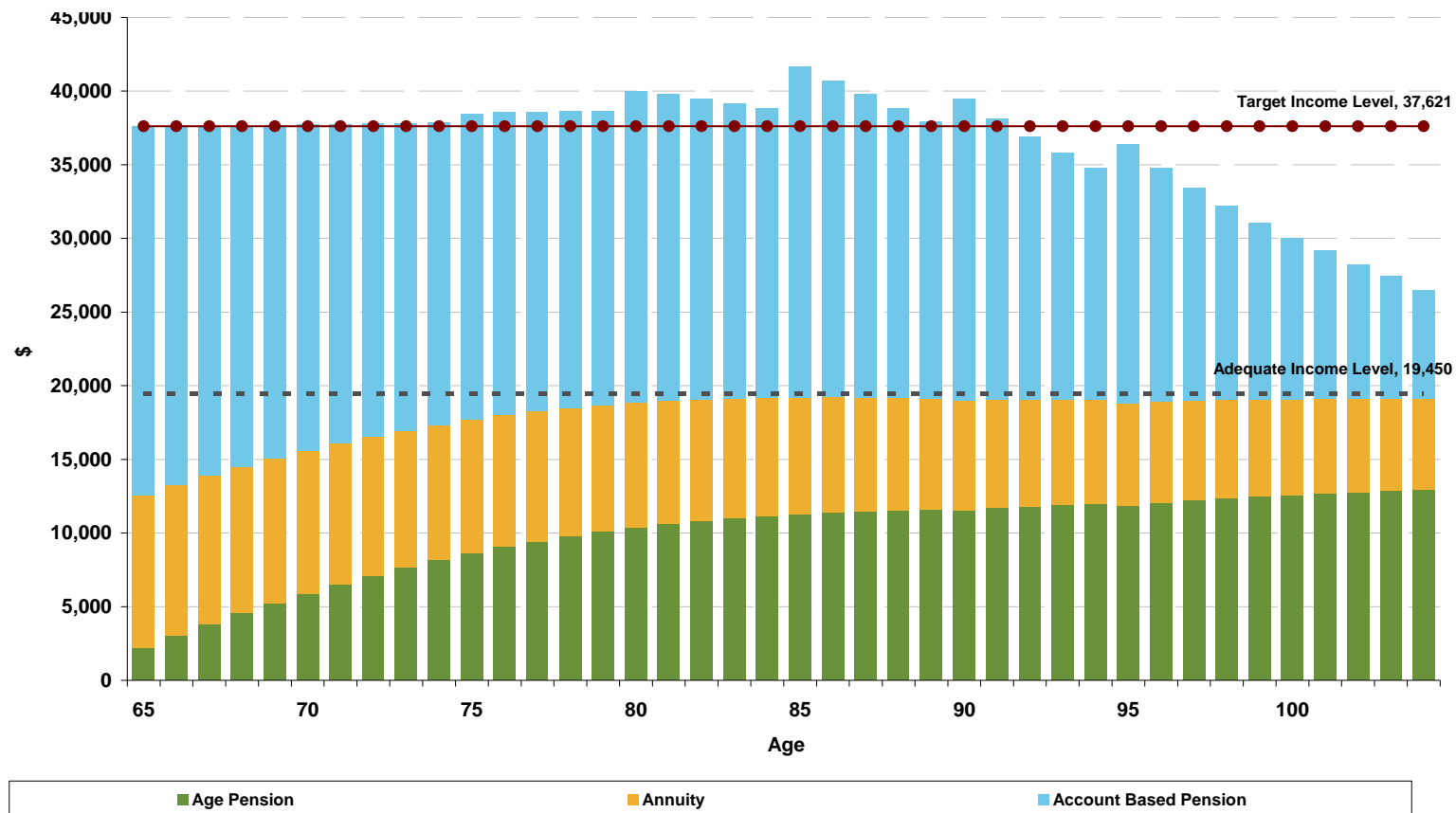
## - No lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; Low Fees

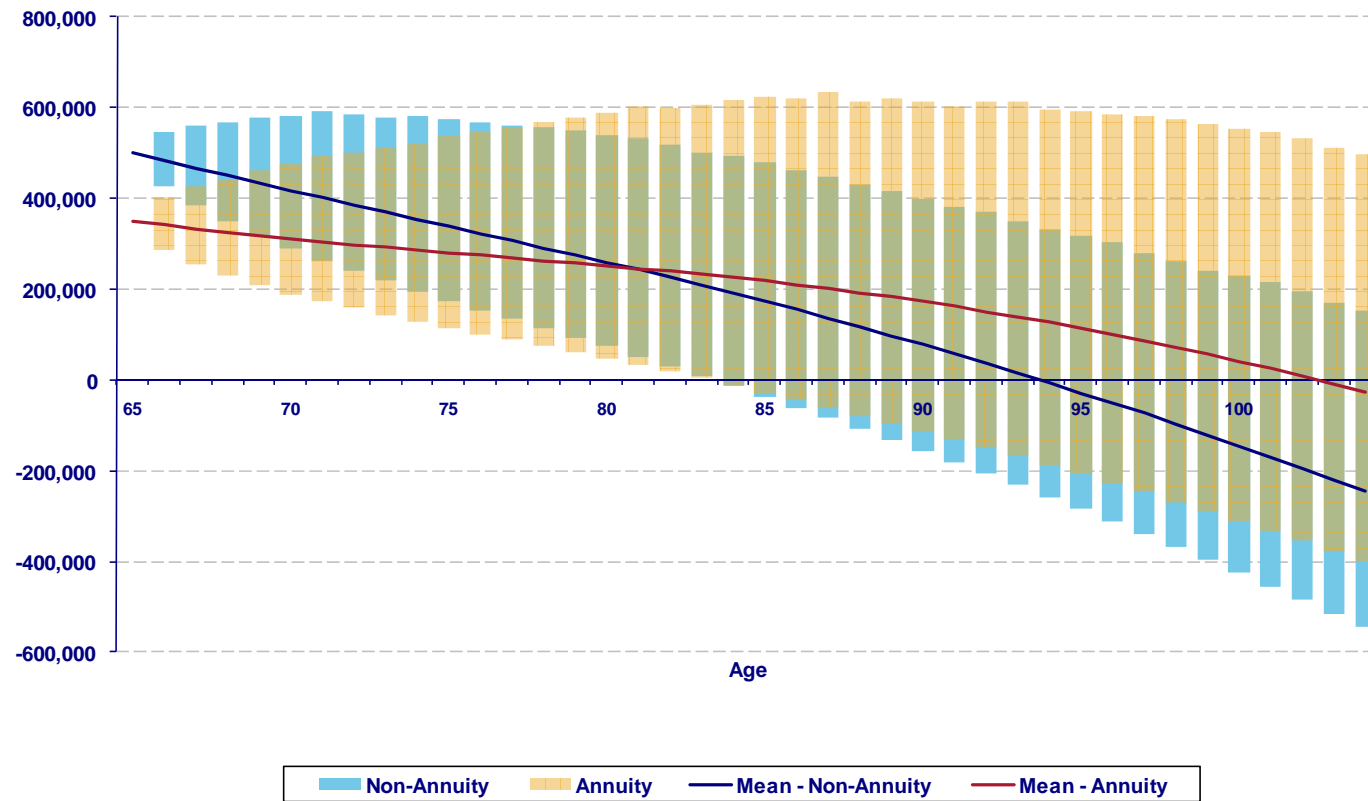


# Figure 13.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; Low Fees

# Figure 13.3: Remaining account balance - 90% Confidence interval



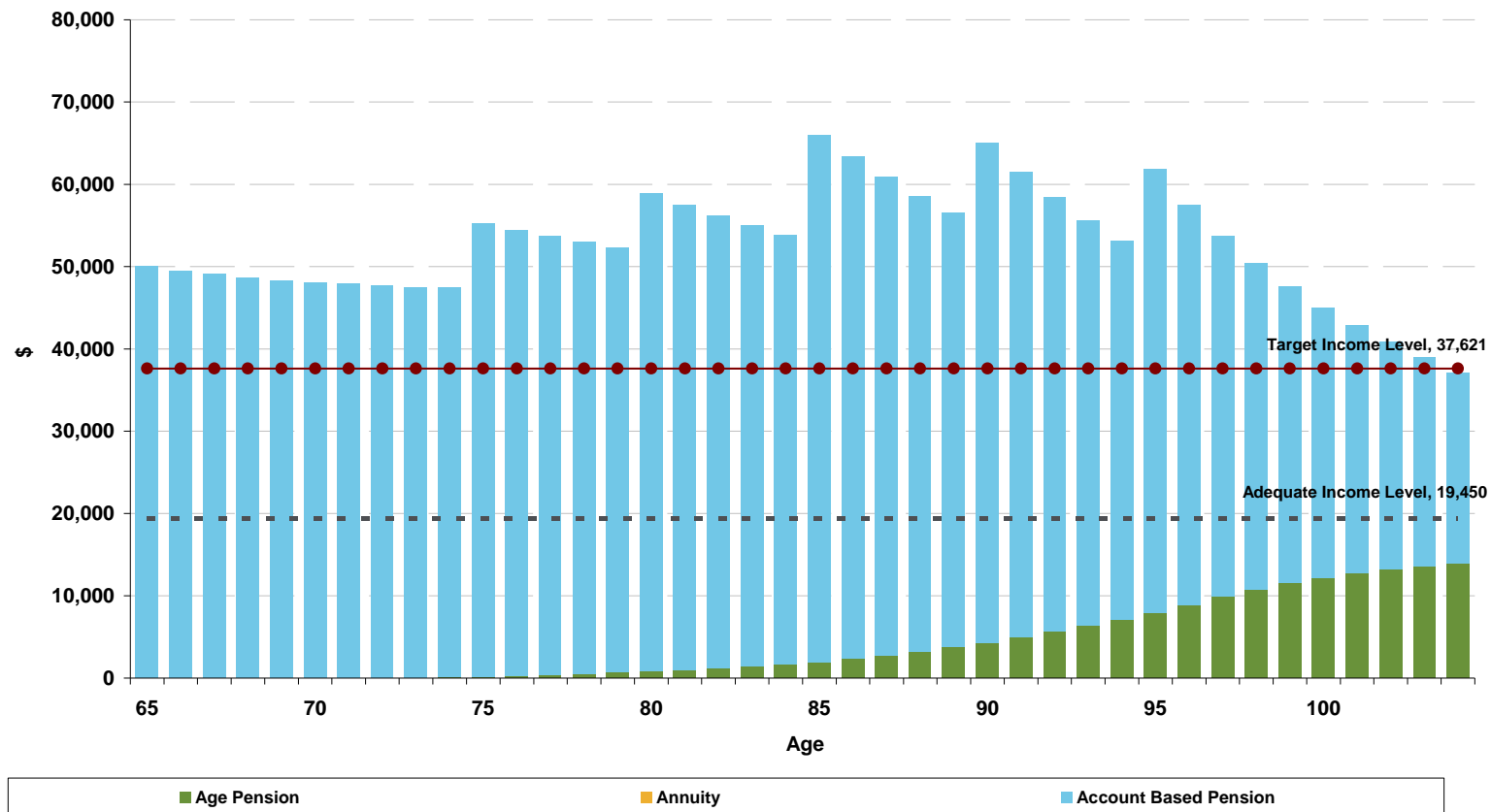
Assumptions: \$500,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; Low Fees





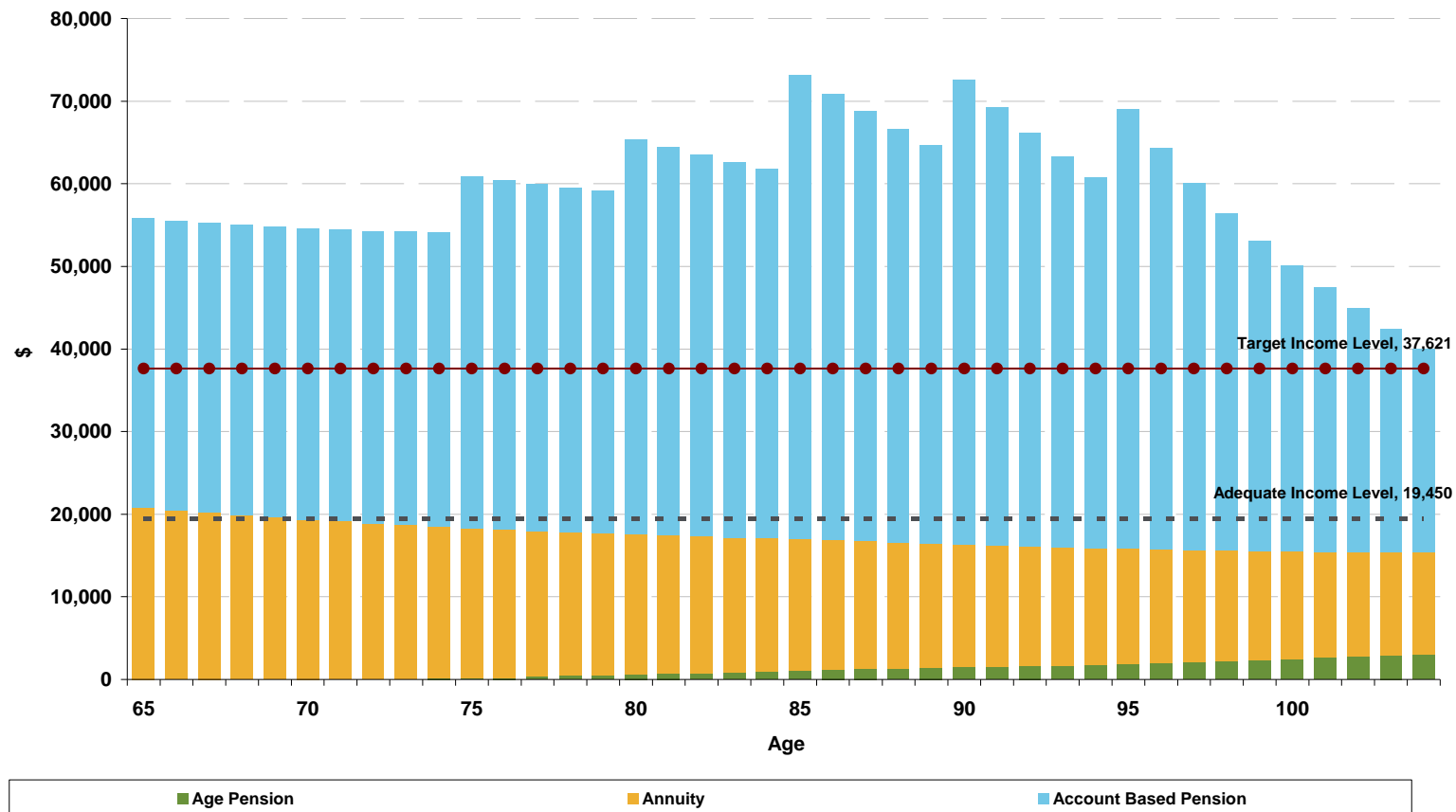
# Figure 14.1: Average retirement income

## - No lifetime annuity purchased at retirement



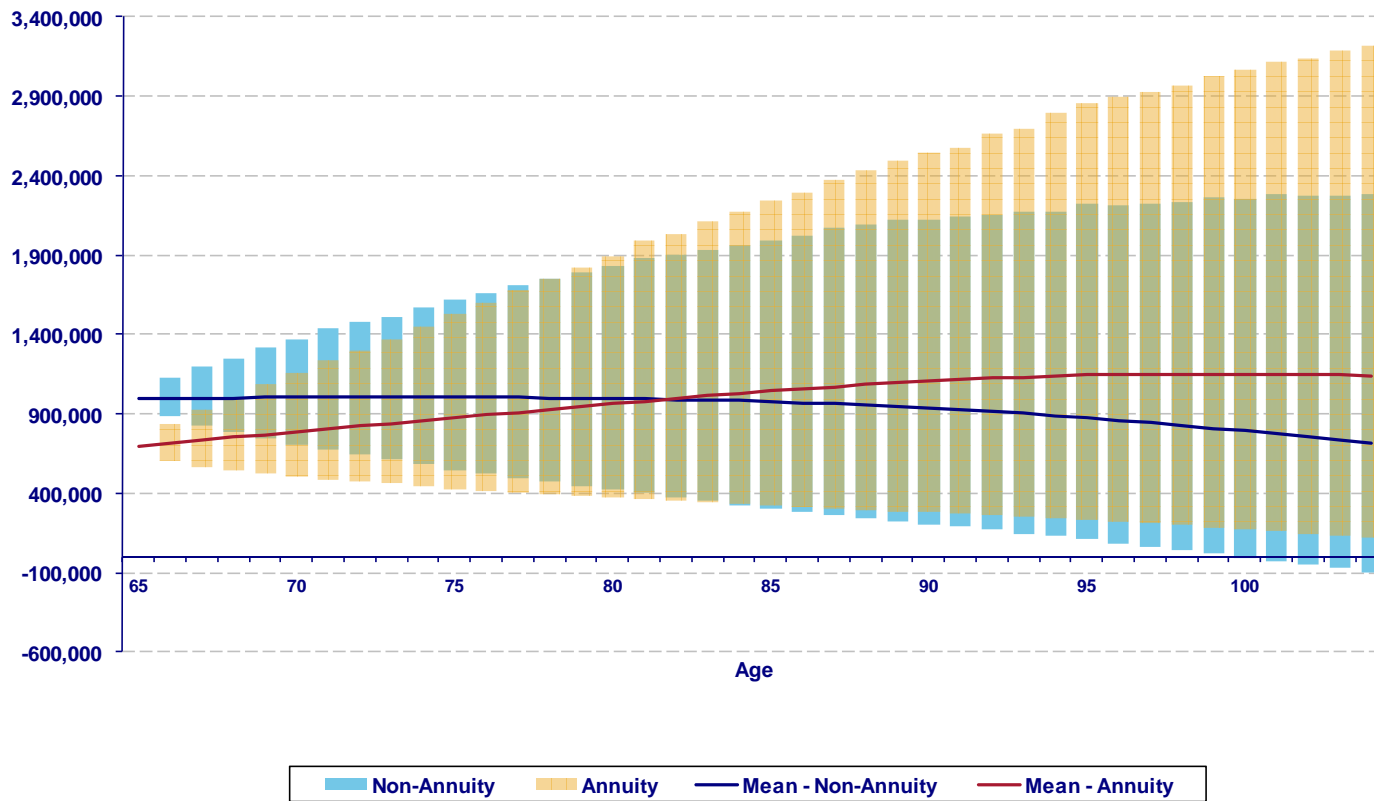
Assumptions: \$1,000,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; Low Fees

# Figure 14.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$1,000,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; Low Fees

# Figure 14.3: Remaining account balance - 90% Confidence interval

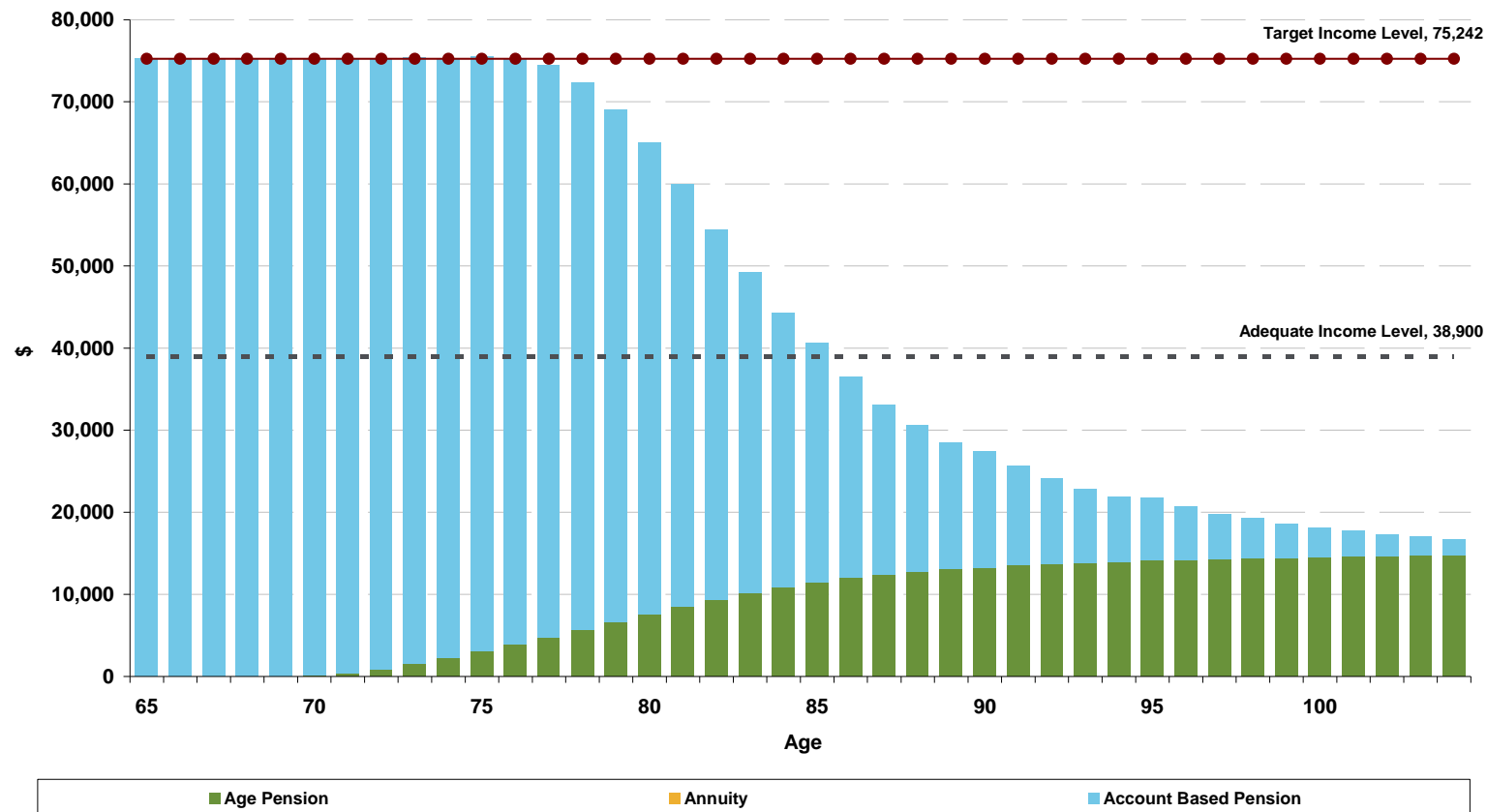


Assumptions: \$1,000,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; Low Fees



# Figure 15.1: Average retirement income

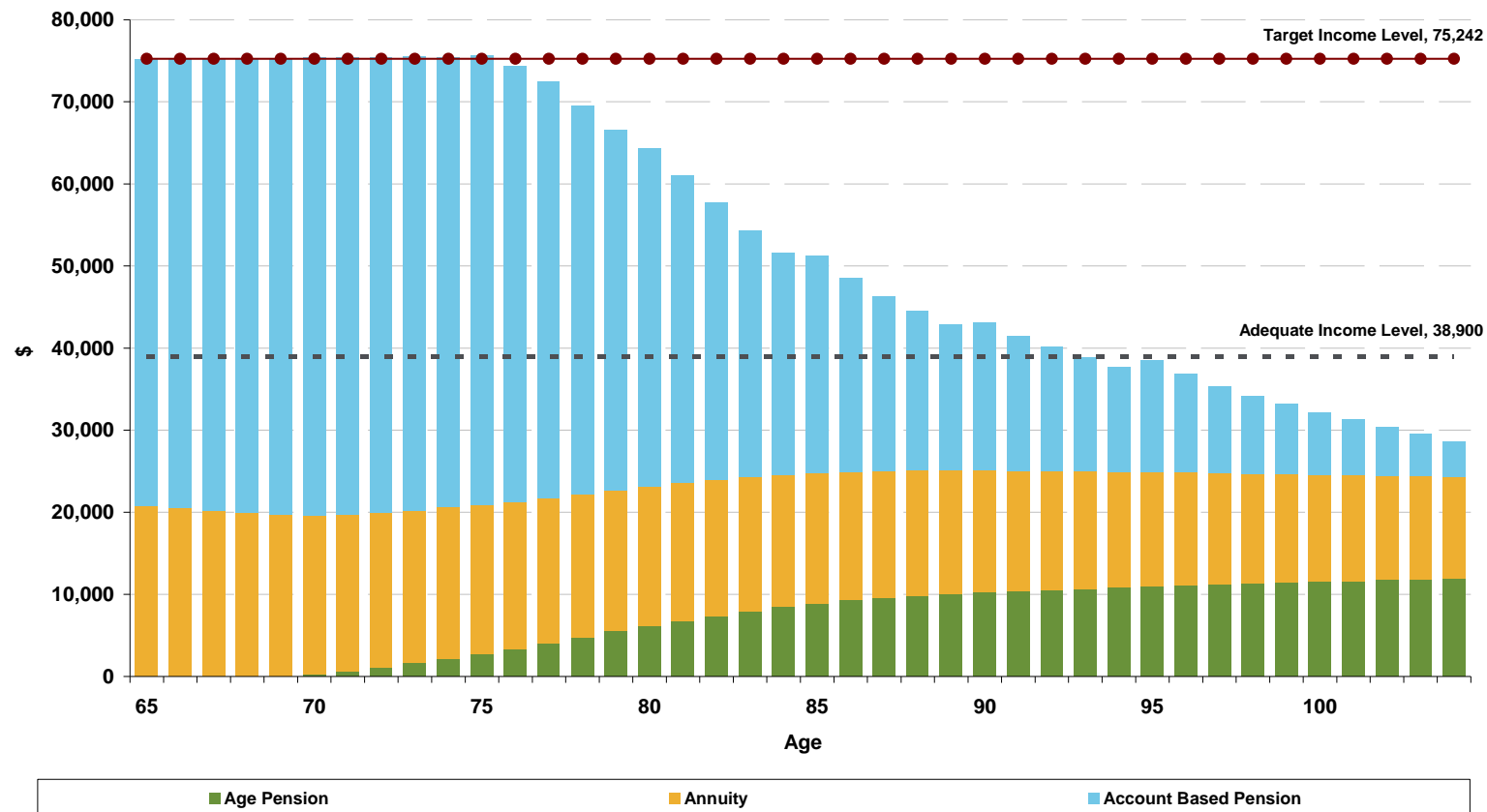
## - No lifetime annuity purchased at retirement



Assumptions: \$1,000,000 Initial account balance; \$75,242 pa Target income; \$38,900 pa Adequate income; 70% Growth, 30% Defensive; Low Fees

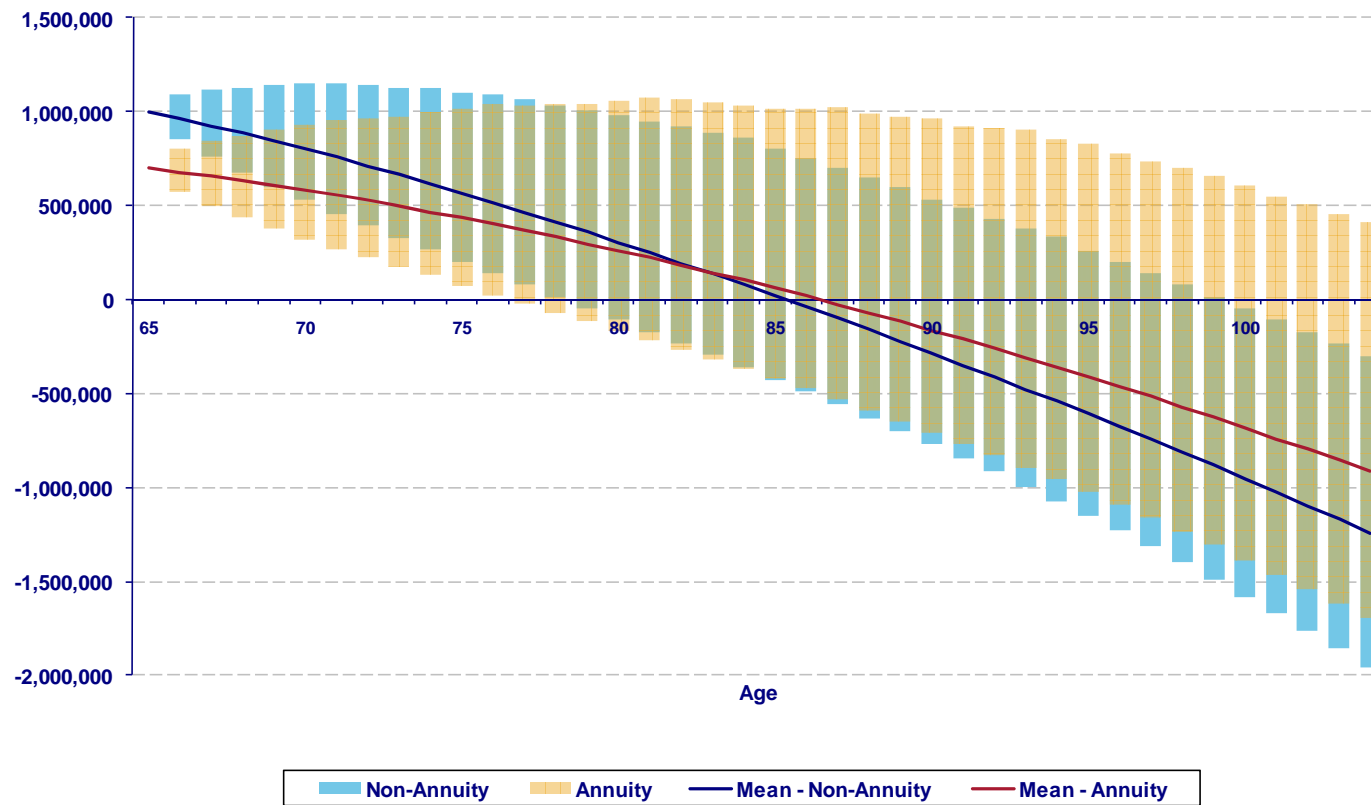


# Figure 15.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$1,000,000 Initial account balance; \$75,242 pa Target income; \$38,900 pa Adequate income; 70% Growth, 30% Annuity; Low Fees

Figure 15.3: Remaining account balance  
- 90% Confidence interval

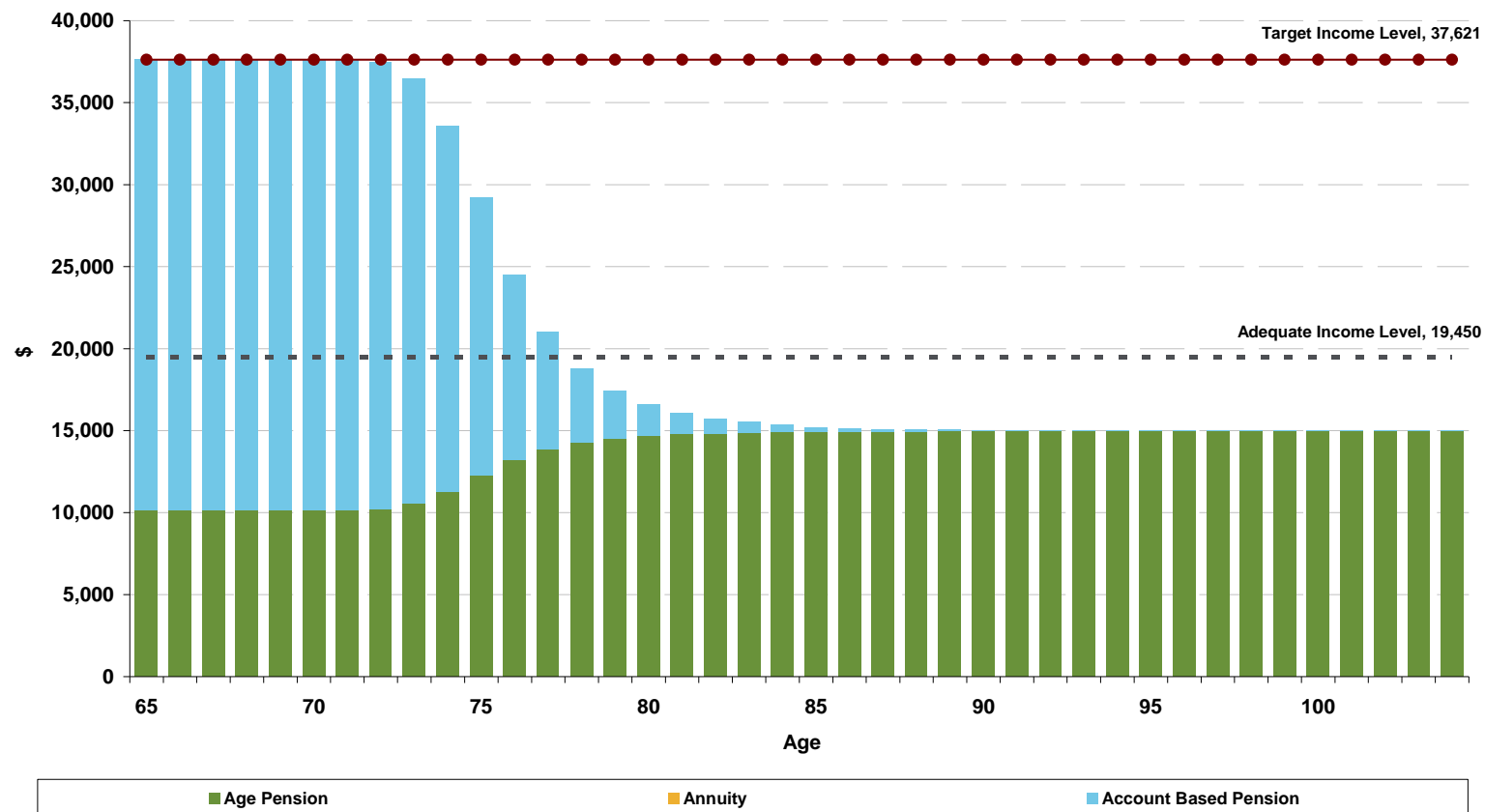


Assumptions: \$1,000,000 Initial account balance; \$75,242 pa Target income; \$38,900 pa Adequate income; 70% Growth; Low Fees



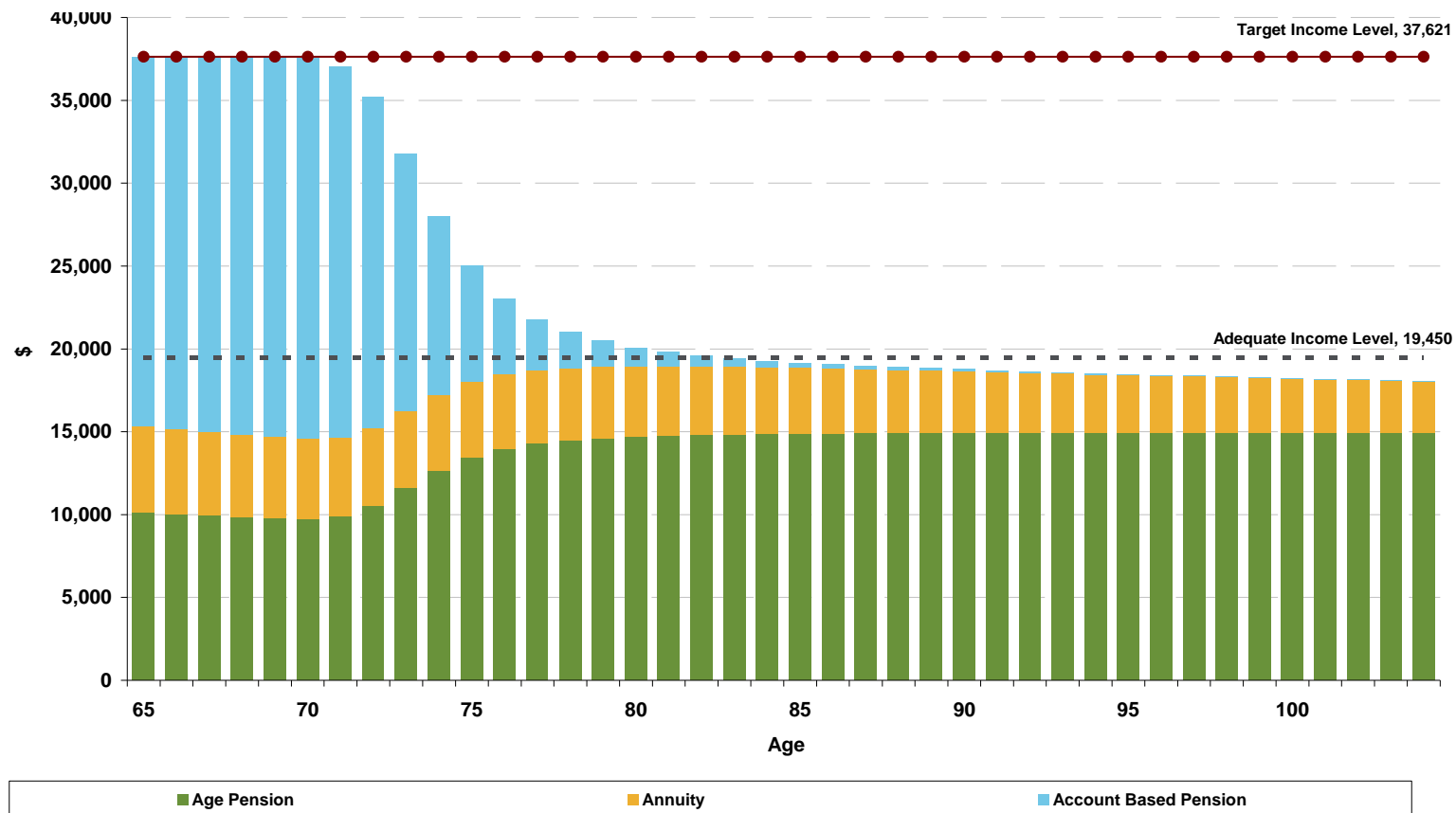
# Figure 16.1: Average retirement income

## - No lifetime annuity purchased at retirement



Assumptions: \$250,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; Low Fees

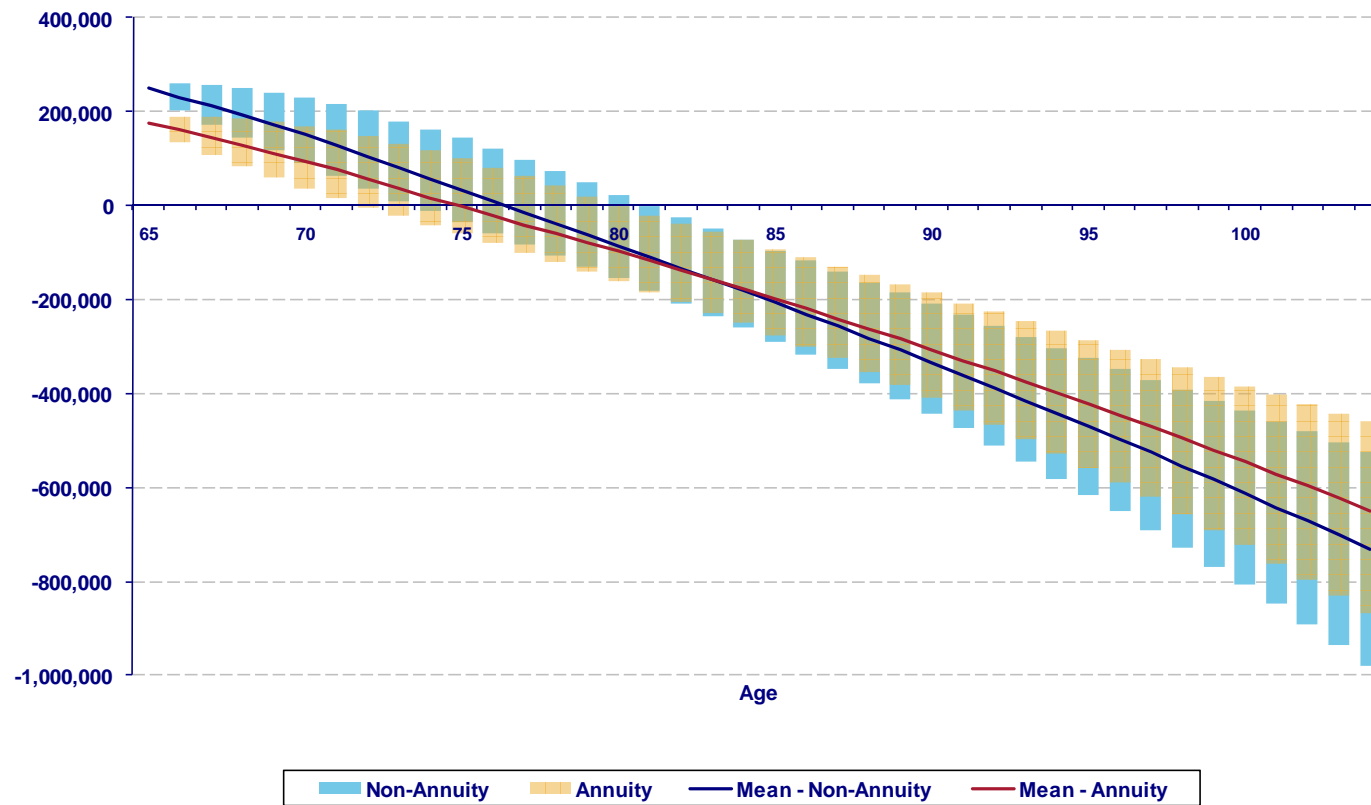
# Figure 16.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$250,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; Low Fees



# Figure 16.3: Remaining account balance - 90% Confidence interval

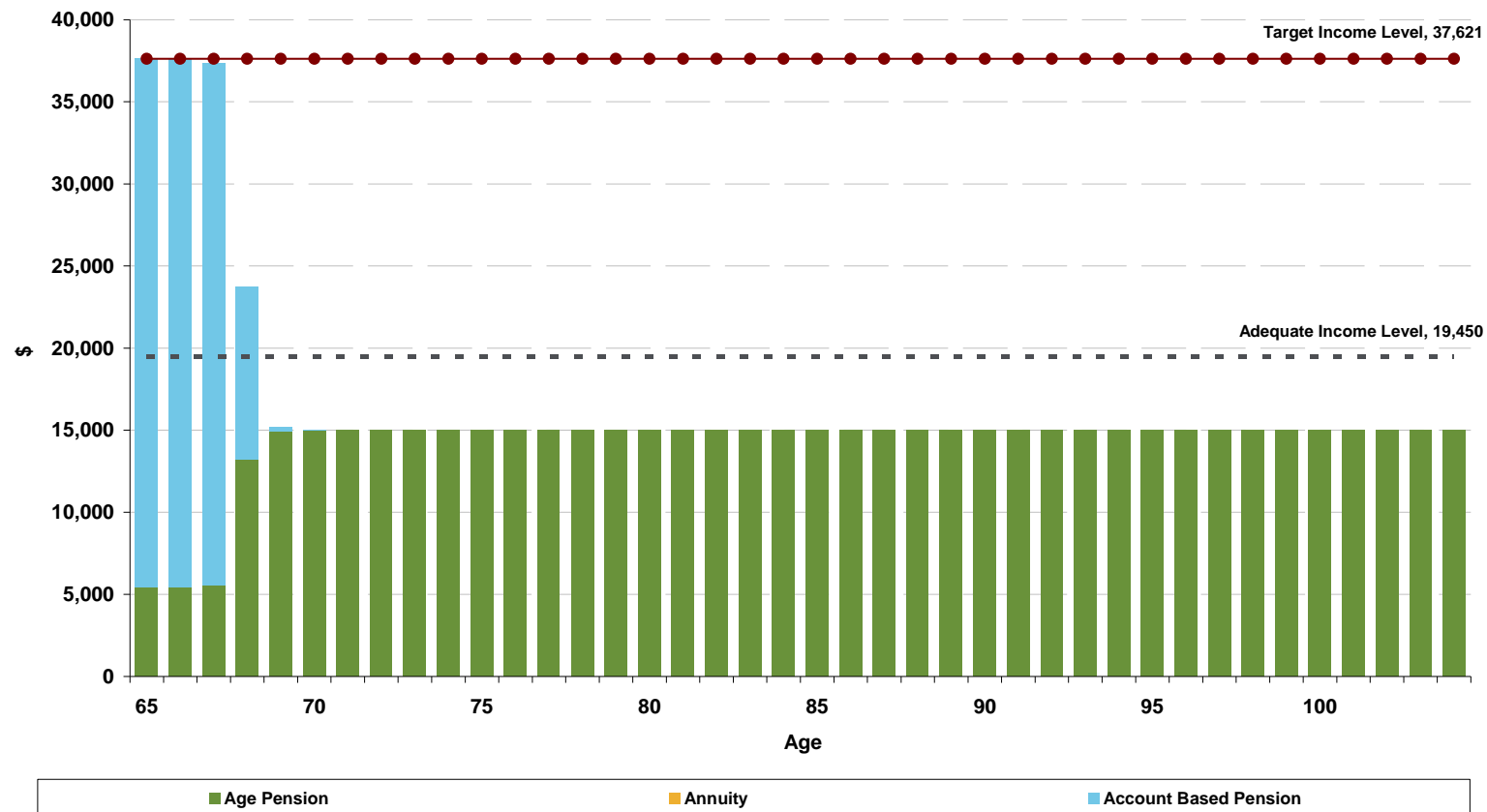


Assumptions: \$250,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; Low Fees



# Figure 17.1: Average retirement income

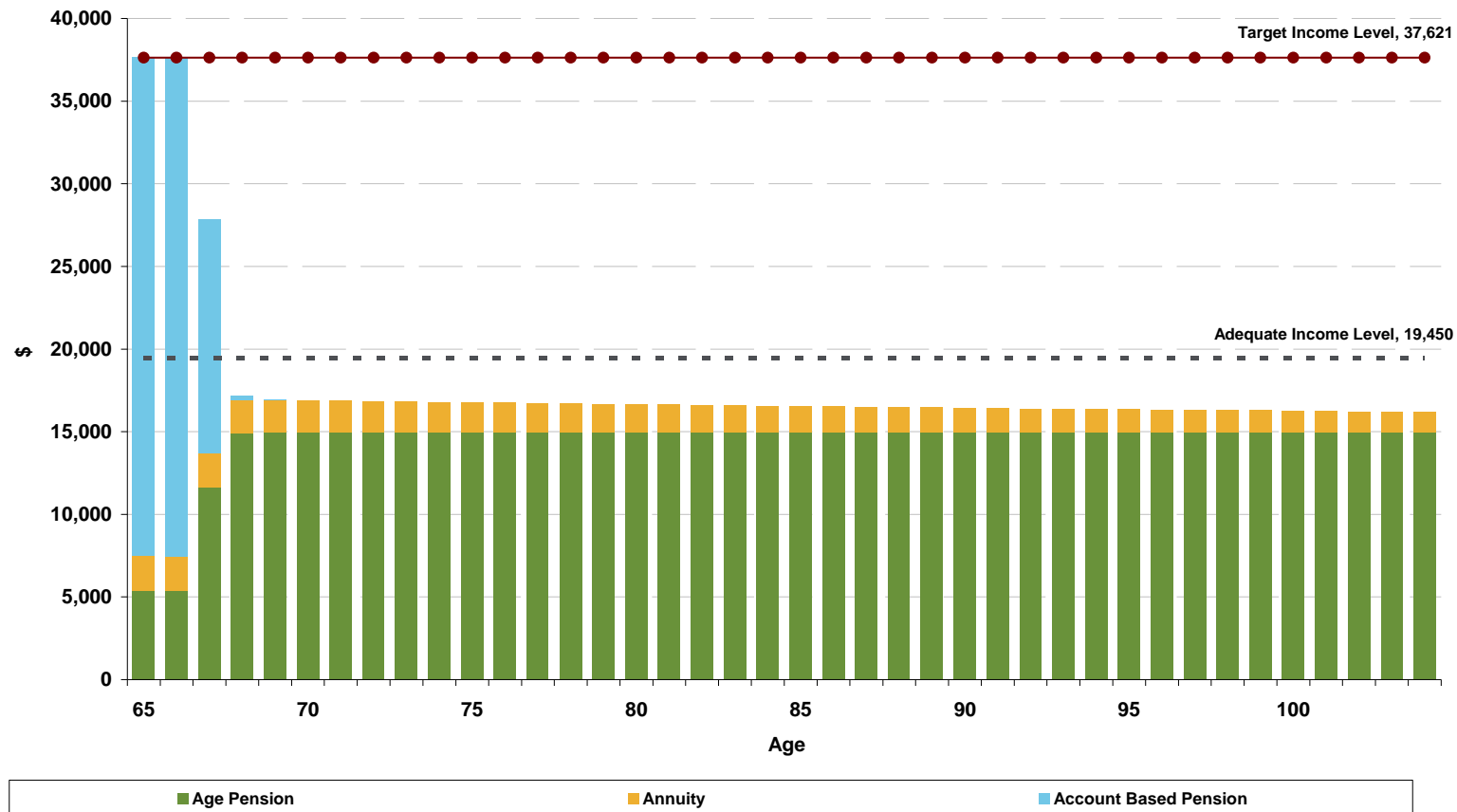
## - No lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Defensive; Low Fees

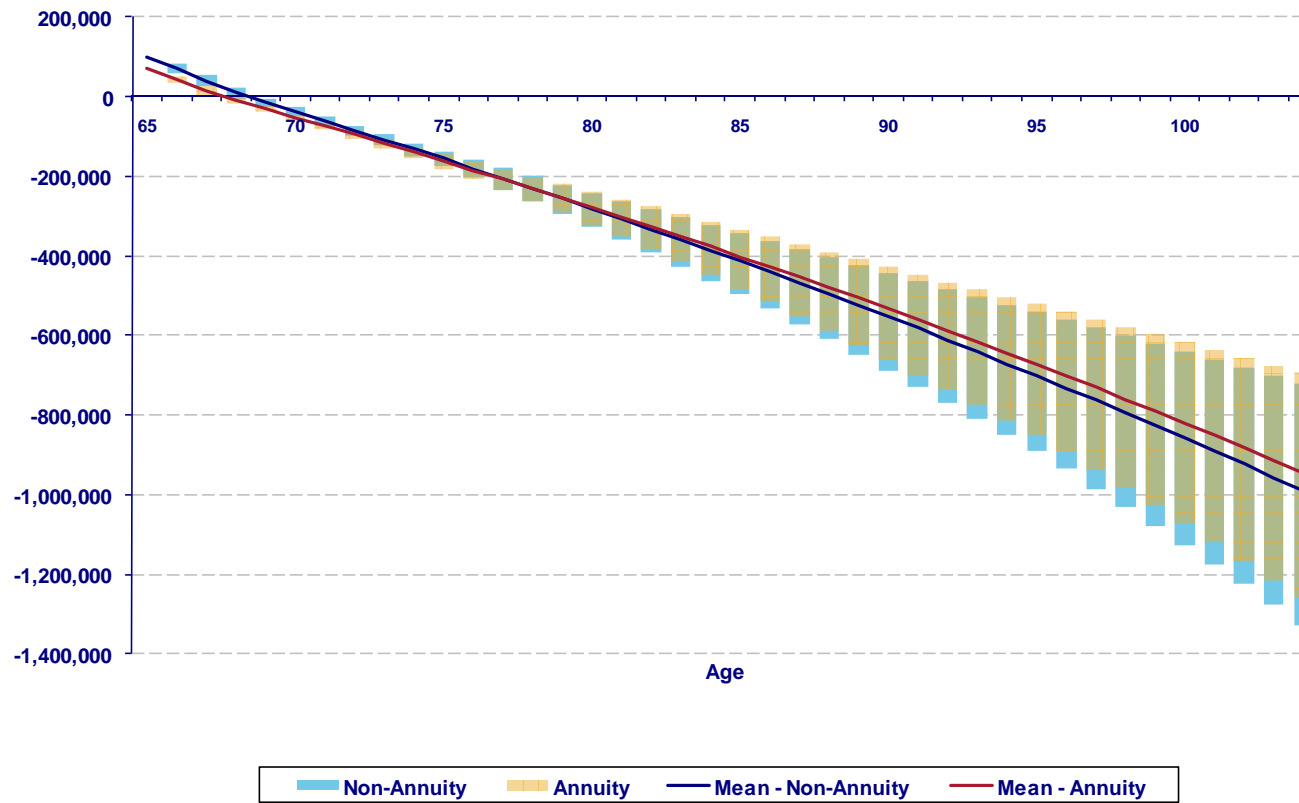
# Figure 17.2: Average retirement income

## - Lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth, 30% Annuity; Low Fees

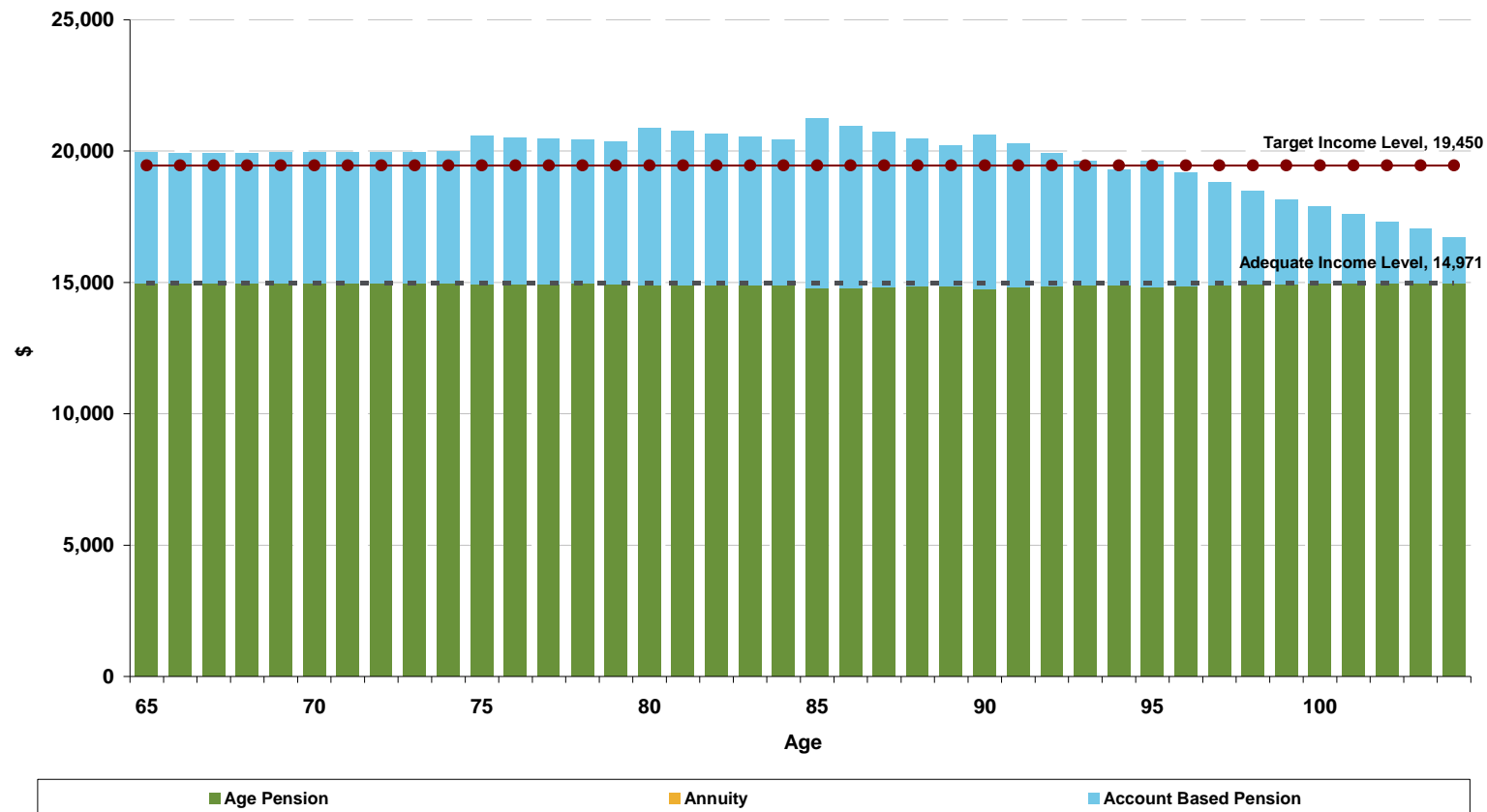
# Figure 17.3: Remaining account balance - 90% Confidence interval



Assumptions: \$100,000 Initial account balance; \$37,621 pa Target income; \$19,450 pa Adequate income; 70% Growth; Low Fees

# Figure 18.1: Average retirement income

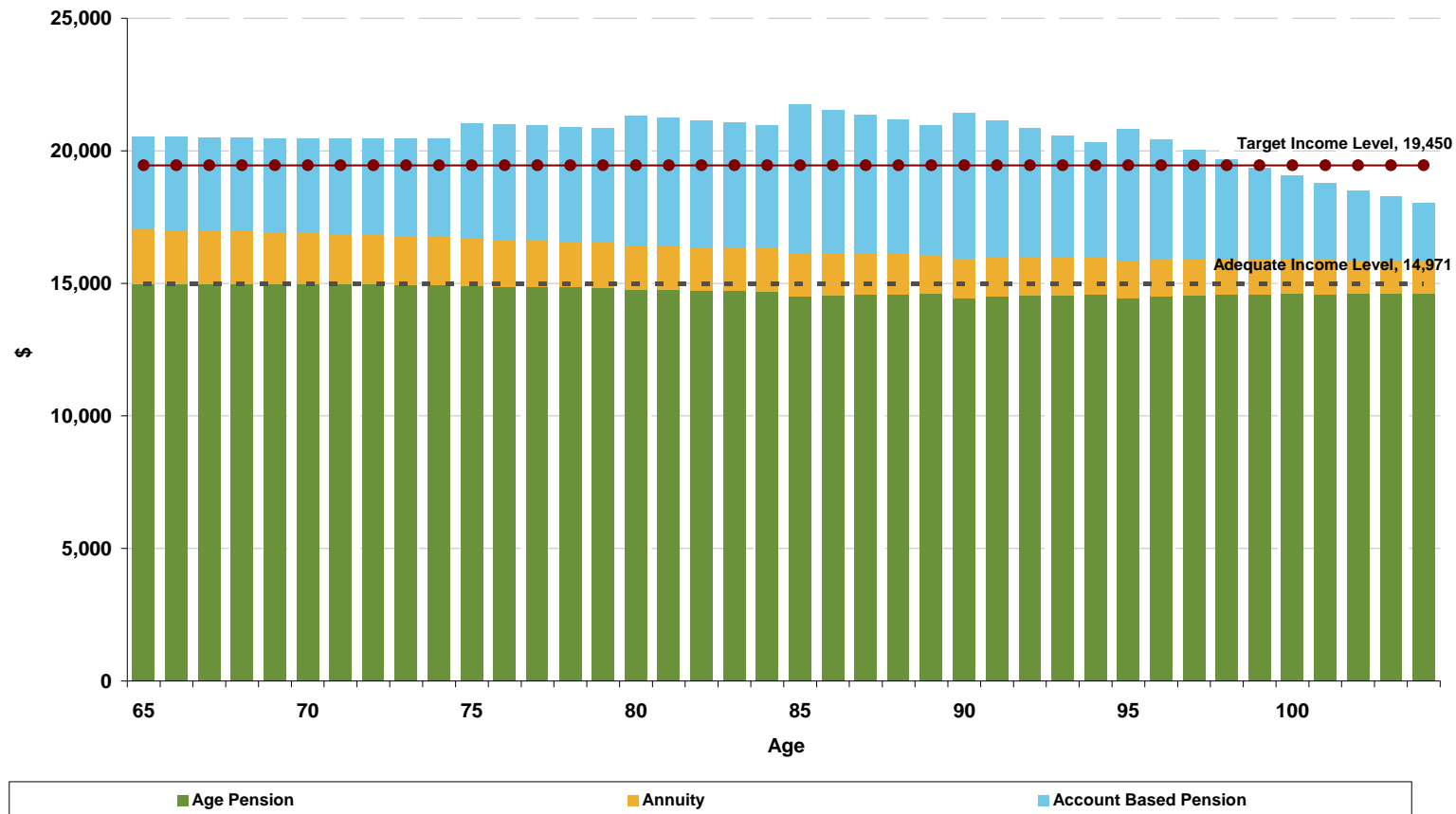
## - No lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$19,450 pa Target income; \$14,971 pa Adequate income; 70% Growth, 30% Defensive; Low Fees

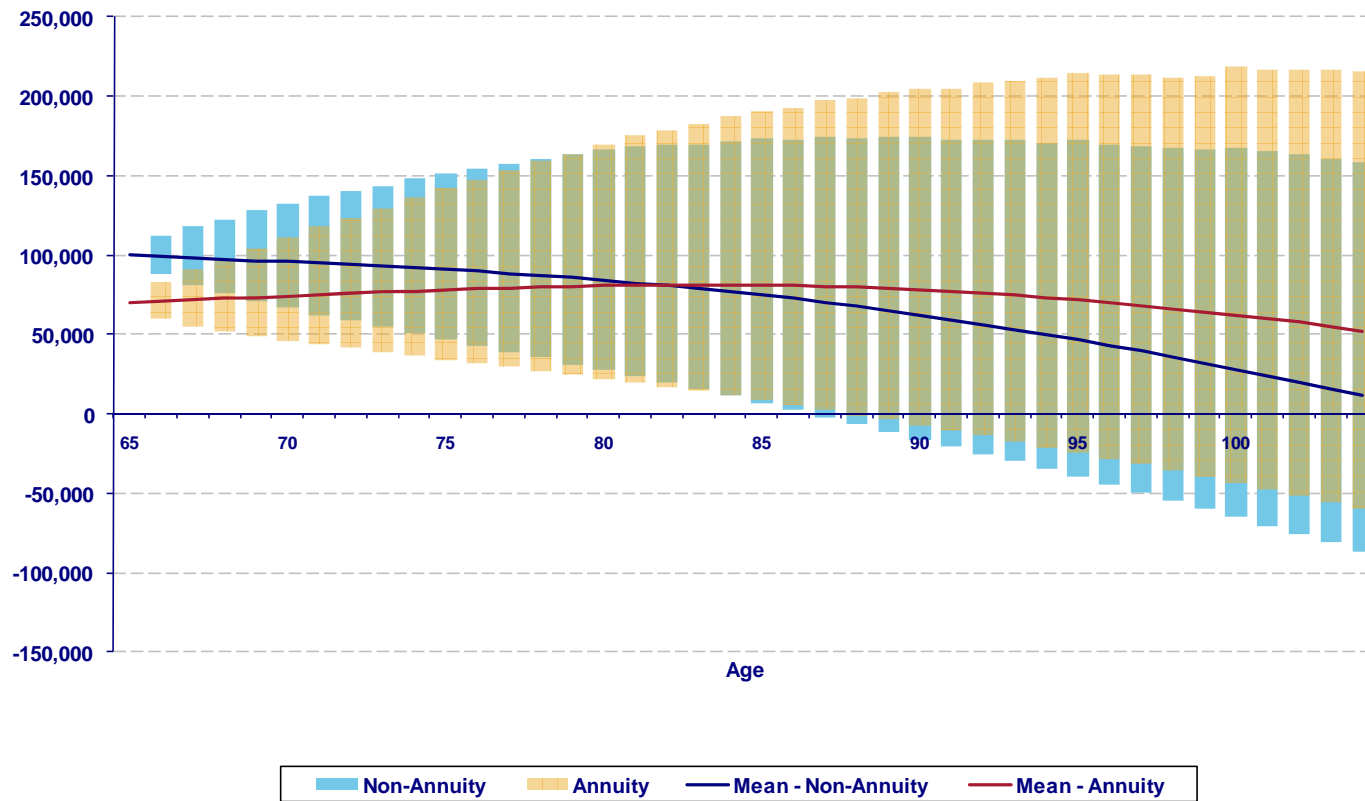


# Figure 18.2: Average retirement income - Lifetime annuity purchased at retirement



Assumptions: \$100,000 Initial account balance; \$19,450 pa Target income; \$14,971 pa Adequate income; 70% Growth, 30% Annuity; Low Fees

# Figure 18.3: Remaining account balance - 90% Confidence interval



Assumptions: \$100,000 Initial account balance; \$19,450 pa Target income; \$14,971 pa Adequate income; 70% Growth; Low Fees

