



Government Actuary's Department



Teachers' Pension Scheme (England and Wales)

Actuarial valuation as at 31 March 2016

Advice on assumptions

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1 Executive summary

This report contains our recommendations for the best estimate assumptions to be set by Secretary of State for Education for the 2016 valuation of the Teachers' Pension Scheme ('the Scheme').

- 1.1 An actuarial valuation of the Teachers' Pension Scheme¹, is carried out as at 31 March 2016. The Public Service Pension (Valuation and Employer Cost Cap) Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended) ("the Directions") require that, unless specified otherwise², the assumptions to be adopted for this valuation will be set by the Secretary of State for Education, having obtained advice from the scheme actuary. Direction 19(c) requires the assumptions to be Secretary of State's best estimates.
- 1.2 GAD is the appointed scheme actuary to the Scheme. This report sets out GAD's formal advice to the Secretary of State on the actuarial assumptions to be adopted where these are not otherwise specified in the Directions. The advice covers the assumptions to be set by the Secretary of State. The main advised assumptions are summarised in Table 1 with further detail in Appendix A. The advice contained in this report has been shared and discussed with the Teachers' Pension Scheme Advisory Board.
- 1.3 This report relates to demographic assumptions, i.e. assumptions about member behaviours. When considering appropriate assumptions past experience, both recent and longer term, generally provides the most reliable evidence when considering best estimates of future experience. Anticipated future events may also influence how assumptions are set. This advice sets out relevant analysis of recent experience and indicates which other factors have been considered in deriving recommendations of best estimate assumptions.
- 1.4 The previous actuarial valuation of the Teachers' Pension Scheme was carried out as at 31 March 2012. Many of the assumptions put forward in this report are the same as those adopted for that valuation. The most significant changes are:
 - > Reduced life expectancy for women retiring in normal health
 - > Higher assumed rates of withdrawal
- 1.5 The following chapters and the appendix provide more detail on the advice, supporting analysis and an indication of the magnitude of financial impact of each assumption on the valuation results. They also contain important background information about the context of this advice and its limitations.

¹ As provided by The Teachers' Pensions Regulations 2010 (SI 2010/990) and The Teachers' Pension Scheme Regulations 2014 (SI 2014/512).

² Certain assumptions are specified in the Directions.



- 1.6 This report was provided to the Secretary of State for Education in draft form, and was also circulated to the Scheme's member and employer representatives, in June 2017. A minor revision to the ill-health mortality assumption has been made to reflect subsequent discussions at a meeting of the Teachers' Pension Scheme SAB. This version of the report has been signed alongside the formal valuation report. No other substantive changes have been made to the draft version of the report. The Secretary of State for Education has already confirmed to GAD, having consulted with relevant stakeholders, that the actuarial assumptions to be adopted for the valuation should be those set out in this report.
- 1.7 This work has been carried out in accordance with the applicable Technical Actuarial Standards: TAS 100 and TAS 300 issued by the Financial Reporting Council (FRC). The FRC sets technical standards for actuarial work in the UK.

Table 1: Summary of recommended assumptions consistent with the 'best estimate' requirement

Assumption	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions	
			Past service	SCR (2019-23)
Pensioner baseline mortality³	Aligned to standard SAPS table ^{4,5}			
Normal health	Males: 106% of S2NMA_L Females: 75% of S1NFA_L up to age 79, 86% at ages 80-84, 100% at ages 85-89, 108% from age 90	In light of 2008-2016 experience*	(£½bn) ⁶	(0.1%) ⁶
Ill-health (current)	Males: 70% of S2IMA with an underpin of 119% of S2NMA up to age 75, 119% of S2NMA above age 75 Females: 85% of S2IFA with an underpin of 114% of S2NFA up to age 75, 114% of S2NFA above age 75	In light of 2008-2016 experience*		
Ill-health (future)	100% of S2IXA	In line with experience of UK self-administered pension schemes due to lack of Scheme experience on which to base this assumption.		
Dependants	Males: 120% of S2NMA Females: 95% of S2DFA	In light of 2008-2016 experience*		

³ HM Treasury has indicated that future improvements in mortality will be assumed to be in line with those underlying the most recent ONS population projections.

⁴ SAPS tables are published by the UK Actuarial Profession and are based on the experience of self-administered pension schemes from 2004 to 2011. The S2 series has separate standard tables based on experience of members retiring in normal health (S2NMA), in ill health (S2IXA) and for widows (S2DFA). The assumption for men retiring in normal health relates to the low mortality variant of the main table (S2NMA_L). The assumption for women retiring in normal health relates to the low mortality variant of the previous S1 series (S1NFA_L) because no corresponding tables have been produced in the S2 series.

⁵ Adjusted to take account of improvements in population mortality between the base year for the tables and the date the future improvements are applied from.

⁶ Change in baseline mortality only. Excludes any impact from the change in assumed future mortality improvements.

Assumption	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions	
			Past service	SCR (2019-23)
Age retirement				
NPA 60 protected	Retirements spread between ages 55 and 70	In light of 2008-2016 experience*	Immaterial	Immaterial
NPA 60 unprotected and tapered	Retirements spread between ages 55 and 70 (average retirement age later than protected members and dependent on SPA)	Unchanged from 2012 due to lack of scheme experience on which to amend this assumption	No change in assumption	
NPA 65 protected	Retirements spread between ages 60 and 65	Unchanged from 2012 due to lack of scheme experience on which to amend this assumption	No change in assumption	
NPA 65 unprotected and tapered	Retirements spread between age 60 and SPA (average retirement age later than protected members and dependent on SPA)	Unchanged from 2012 due to lack of scheme experience on which to amend this assumption	No change in assumption	
New entrants from 2015	Retirements spread between age 60 and SPA (average retirement age dependent on SPA and later than equivalent unprotected and tapered members)	Unchanged from 2012 due to lack of scheme experience on which to amend this assumption	No change in assumption	
Ill-health retirement				
Incidence	Increasing by age, around 0.4% per year for members in their late 50s	In light of 2008-2016 experience*	Immaterial	Immaterial
Upper/lower tier split	55% (M), 63% (F) on upper tier	Unchanged from 2012 as 2008-2016 experience close to assumption	No change in assumption	

Assumption	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions	
			Past service	SCR (2019-23)
Withdrawal	Withdrawals, net of re-entry within 5 years, of about 3% a year	12.5% higher than 2012 assumption, making partial allowance for observed increase in withdrawal in the Teacher Supply Model	(£½bn)	(0.2%)
Death before retirement	Increasing by age, around 0.1%(F)/0.2%(M) a year close to age 60	In light of 2008-2016 experience*	Immaterial	Immaterial
Promotional salary scale	Steeper at younger ages: about 4% a year at age 25, 1% at age 45 and 0.01% at age 65	As adopted for 2004, 2008 and 2012 valuations and no clear evidence that it is no longer appropriate	No change in assumption	
Commutation	5%(M)/4%(F) of NPA 60 pension commuted	2008-16 experience consistent with assumptions	No change in assumption	
Family statistics				
Proportion married/partnered	77%(M)/58%(F) at retirement (consistent assumptions for existing pensioners)	Comparative level of 2008-16 scheme experience against ONS statistics*	Immaterial	Immaterial
Age difference	Male member 3 years older than partner Female 2 years younger than partner	Experience consistent with assumption	No change in assumption	
Remarriage	No allowance	Simplification on grounds of materiality	No change in assumption	

* In general 50% of the observed difference in experience since the 2012 assumptions were set has been taken into account when resetting assumptions.



2 Introduction

This report contains our advice to the Secretary of State for Education but will be of interest to other parties who should note the limitations.

- 2.1 An actuarial valuation of the Teachers' Pension Scheme is being undertaken as at 31 March 2016. The Public Service Pensions (Valuations and Employer Cost Cap) Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended) ("the Directions") require that, unless specified otherwise⁷, the actuarial assumptions to be adopted for this valuation are the responsibility of the Secretary of State for Education, having taken advice from the scheme actuary. Direction 19(c) requires the assumptions to be the Secretary of State for Education's best estimates.
- 2.2 GAD is the appointed scheme actuary to the Scheme. This report is addressed to the Secretary of State for Education and contains our formal advice on the appropriate assumptions to be adopted for the 2016 valuation, as required by the Directions. The purpose of this advice is to enable the Secretary of State for Education to determine the required best estimate assumptions.
- 2.3 The advice covers the main assumptions to be set by the Secretary of State for Education. In particular, we consider the following sets of demographic assumptions in this report:
- > Pensioner mortality
 - > Age retirement from service
 - > Ill-health retirement from service
 - > Voluntary withdrawal from service
 - > Death before retirement
 - > Promotional pay progression
 - > Commutation of pension for cash at retirement
 - > Family statistics
- 2.4 Other assumptions are required to complete the valuation calculations, eg projection of the membership over the implementation period. We will provide separate advice on additional assumptions as required. Appendix B sets out assumptions made for data uncertainties.
- 2.5 This report was provided to the Secretary of State for Education in draft form, and circulated to the Scheme's member and employer representatives, in June 2017. It has been signed alongside the formal valuation report. A minor revision of the ill-health mortality assumption was made after June 2017, reflecting discussions with the TPS SAB. No other substantive changes have been made. The Secretary of State for Education has already confirmed to GAD, having consulted with relevant stakeholders, that the actuarial assumptions to be adopted for the valuation should be those set out in this report.

⁷ Certain assumptions are specified in the Directions.



- 2.6 Teachers' Pensions, the Scheme's administrator, supplied data on the experience of the scheme membership over the four-year period to 31 March 2016. We have used this data to analyse the Scheme's experience in order to develop our advice on the assumptions. Our report, *Teachers' Pension Scheme (England and Wales): Actuarial Valuation at 31 March 2016: Report on membership data* dated 5 March 2019, provides information about this data and should be read in conjunction with this advice. The report includes details of the checks carried out on the data, the amendments made to the data and our residual concerns about the quality of the data. In preparing our advice, we have relied upon the general completeness and accuracy of the data provided.
- 2.7 When considering appropriate assumptions past experience, both recent and longer term, generally provides the most reliable evidence when considering best estimates of future experience. Anticipated future events may also influence how assumptions are set. This advice sets out relevant analysis of recent experience and indicates which other factors have been considered in deriving recommendations of best estimate assumptions. The Secretary of State for Education should consider whether there is any reason why the conclusions reached would be inappropriate. We are happy to revisit our advice to take account of any evidence relevant to expected future experience of the Scheme membership. The Secretary of State should consider whether there is any reason why the approach taken to setting the assumptions would be inappropriate.
- 2.8 The report has also been made available to the Teachers' Pension Scheme Advisory Board.
- 2.9 We are content for the Secretary of State for Education to release this report to third parties, provided that:
- > it is released in full
 - > the advice is not quoted selectively or partially
 - > GAD is identified as the source of the report, and
 - > GAD is notified of such release.
- 2.10 Third parties whose interests may differ from those of the Secretary of State for Education should be encouraged to seek their own actuarial advice where appropriate. Other than to the Secretary of State for Education GAD has no liability to any person or third party for any act either taken or not taken, whether in whole or in part, on the basis of this report.



3 General considerations

This chapter sets out a number of general considerations common to the setting of the different assumptions considered in this report.

- 3.1 The key considerations taken into account in formulating the advice in this report are explained in this section.

Directions

- 3.2 The advice in this report reflects the requirements of the Directions issued by HM Treasury that assumptions should be set as the Secretary of State for Education's 'best estimates' of future experience and should contain no margin for prudence or optimism. They should be set having regard to:

- > assumptions set for previous valuations
- > analysis of demographic experience in the period up to the valuation date
- > historic long term trends and emerging evidence which may illustrate long-term trends in the future
- > relevant data from any other sources

Different populations

- 3.3 The Directions require this actuarial valuation to cover both the scheme established under the Public Service Pensions Act 2013⁸ ("2015 scheme") and the previous pension scheme ("pre-2015 scheme"). Assumptions appropriate to both the 2015 scheme and the pre-2015 scheme are required for the valuation. The Directions also require assessment of benefit accrual costs over the **implementation period**⁹. This requires assumptions about anticipated member behaviour and characteristics during 2019 - 2023 as well as assumptions about member behaviour and characteristics in the longer term.
- 3.4 There are currently three distinct groups of members.
- > Those with full protection and remaining in the pre-2015 scheme to retirement. The introduction of the 2015 scheme is not expected to have any impact on this group's behaviours
 - > New members to the 2015 scheme. These members' retirement behaviours are expected to be heavily influenced by the provisions of the 2015 scheme
 - > Members with service in both the 2015 scheme and pre-2015 scheme (including members with tapered protection). Over time, as the proportion of 2015 scheme service increases, the retirement behaviours of these members are expected to become increasingly influenced by the provisions of that scheme.

⁸ Public Service Pensions Act 2013 (2013 c 25)

⁹ 1 April 2019 to 31 March 2023.



- 3.5 Where relevant we indicate in each of the following chapters the relative importance of each set of assumptions to each of the three groups of members identified above.

Relative importance of assumptions

- 3.6 The Directions require the valuation results to be estimated to the nearest 0.1% of pensionable payroll. This is a required level of accuracy for a particular calculation and based on a particular set of assumptions. We show in Table 3 an indication of the sensitivity of the valuation results to the particular assumptions under consideration. This Table is taken from the report on the valuation of the Teachers' Pension Scheme as at 31 March 2016. Initial discussions with the TPS SAB were conducted using figures quoted in the equivalent 2012 report, and were with reference to the 2012 valuation results.

Table 3: Sensitivity of valuation results to Secretary of State set assumptions

	Combined addition to uncorrected employer contribution rate ¹⁰	Addition to employer contribution correction cost
(i) Membership profile* : 2 years older on average over implementation period	0.6%	0.6%
(ii) Mortality rates* : pensioners subject to mortality rates 5% heavier than assumed ¹¹	(0.9%)	(0.4%)
(iii) Age retirement rates* : members without full protection to retire (on average) one year later than currently assumed	0.1%	0.1%
(iv) Commutation* (other than as directed): all eligible members of the NPA 60 section commute 2% of pension more than assumed	(0.3%)	(0.3%)
(v) Ill health retirements* (a) Rate of ill health retirements: 5% higher numbers of members assumed to retire on ill health grounds than currently assumed	0.0%	0.0%
(b) Severity of ill health retirements: 5% more members assumed to receive upper tier benefits than currently assumed	0.0%	0.0%
(vi) Members' dependants* (a) proportions partnered: 5% more members assumed to have qualifying partners at death	0.2%	0.2%

¹⁰ Combined effect of additions for past service, underpayment of contributions over 2012-15 (not shown separately) and future accrual.

¹¹ Broadly speaking this is equivalent to assuming members spend 0.5 years less in retirement.



	Combined addition to uncorrected employer contribution rate ¹⁰	Addition to employer contribution correction cost
(vii) Withdrawal* : 5%* higher numbers assumed to leave voluntarily before retirement (net of rejoiners)	(0.2%)	(0.2%)
(viii) Promotional pay increases* : promotional pay increases 0.5% per annum higher on average than assumed	1.2%	1.1%

* Opposite changes in the assumptions will produce approximately equal and opposite changes in the valuation results.

- 3.7 To provide some context for the past service liabilities in this table and elsewhere in the report, note that a £0.3bn increase in past service liabilities corresponds to an increase of about 0.1% of salaries on the uncorrected employer contribution rate. Similarly, a £0.3bn decrease in past service liabilities would decrease the uncorrected employer contribution rate by about 0.1% of salaries.
- 3.8 In each variant of Table 3 the sensitivity shown is in relation only to the change in assumption described. The impact of a combination of assumption changes will not necessarily equate to the sum of the relevant rows above.



4 Pensioner Mortality

This chapter sets out our recommendation for the baseline pensioner mortality assumptions and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 4.1 The assumptions we recommend for baseline pensioner mortality for the 2016 valuation are summarised below, alongside the assumptions for the 2012 valuation.

Table 4.1: Recommended mortality assumptions

	2016 valuation	2012 valuation
Baseline mortality	Standard table ¹² and adjustments	
Males		
Retirements in normal health	106% of S2NMA_L	107% of S1NMA_L
Current ill-health pensioners	Age-dependent assumption ≤75: 70% of S2IMA with an underpin of 119% of S2NMA >75: 119% of S2NMA	Age-dependent assumption ≤71: 65% of S1IMA >71: 114% of S1NMA
Future ill-health pensioners	100% of S2IMA	100% of S1IMA
Dependants	120% of S2NMA	108% of S1NMA
Females		
Retirements in normal health	Age-dependent adjustments to S1NFA_L: ≤79: 75%, 80-84: 86% 85-89: 100%, ≥90: 108%	Age-dependent adjustments to S1NFA_L: ≤79: 74%, 80-84: 84% 85-89: 98%, ≥90: 106%
Current ill-health pensioners	Age-dependent assumption: ≤75: 85% of S2IFA with an underpin of 114% of S2NFA >75: 114% of S2NFA	Age-dependent assumption: ≤71: 89% of S1IFA >71: 109% of S1NFA
Future ill-health pensioners	100% of S2IFA	100% of S1IFA
Dependants	95% of S2DFA	88% of S1DFA

¹² SAPS (S2) tables are published by the Actuarial Profession and based on the experience of self-administered pension schemes over the period 2004 to 2011. The 'S2' series has separate standard tables based on experience of members retiring in normal health (S2NXA and a low mortality variant S2NXA_L) and in ill health (S2IXA) and for female dependants (S2DFA). There is no low mortality variant for female pensioners and so the previous S1 table is used for female normal health pensioners. The S3 series of tables were released by CMI in October 2018, these updated mortality tables cover experience between 2009 and 2016. GAD have concluded that moving to the S3 tables would have no material impact on either our analysis of mortality or the valuation results as a whole. It therefore remains appropriate to use the S2 tables for the current valuation although we would expect to transition to the S3 tables for future if this is appropriate.



- 4.2 HM Treasury has indicated that future improvements in mortality will be assumed to be in line with those underlying the most recent ONS population projections, ONS 2016.

Comparison of expected pensioner longevity

- 4.3 The table below gives a comparison of the resulting life expectancies¹³ (allowing for future improvements) assumed for the 2008 and 2012 valuations, and recommended for the 2016 valuation. The Directions specify that the future improvement basis for the 2016 valuation should be the ONS 2016 projections.

Table 4.2: Comparison of life expectancies (years) at the valuation date

	2008 valuation	2012 valuation	2016 valuation
Current pensioners			
Male aged 60	28.9	29.2	28.3
Male aged 65	23.9	24.2	23.3
Female aged 60	32.4	31.9	30.3
Female aged 65	27.3	26.8	25.3
Future pensioners – current age 45			
Male life expectancy from age 60	30.3	30.8	29.7
Male life expectancy from age 65	25.9	26.2	25.2
Female life expectancy from age 60	33.9	33.4	31.7
Female life expectancy from age 65	29.4	28.8	27.0

Impact of proposed change

- 4.4 The change in baseline mortality assumption will reduce the overall past service liability used for calculating the uncorrected employer contribution rate by about £1½bn and the cost of future accrual by about 0.1% of salaries.
- 4.5 The change in the assumption for future mortality improvements is more significant. Moving to the allowance incorporated in the 2016-based ONS population projections will reduce the overall past service liability used for calculating the uncorrected employer contribution rate by about £10bn and the cost of future accrual by about ¾% of salaries.

¹³ Cohort life expectancies based on the ages shown as at the valuation date, i.e. allowing for future mortality improvement. Mortality improvements as assumed for the relevant valuation, with 2016-based ONS projections used for the 2016 valuation figures.



Analysis and setting the assumption

- 4.6 We have analysed the actual pensioner mortality experience over the four-year period to 31 March 2016 on an 'amounts' basis. An amounts basis weights the experience by the size of each member's pension. To derive an assumption we have compared the actual amounts of pension ceasing on deaths with those expected had the members' experience been in line with the mortality rates in the relevant current SAPS tables ("S2 Tables"). The recommended assumption of baseline pensioner mortality is generally expressed by reference to suitable adjustments to the rates in the relevant S2 table ("the base table"). The analysis is carried out using ONS 2014 projections, being the set of projections available at the time that the analysis was carried out. Previous analysis carried out by GAD suggested that the impact of using ONS 2014 or 2016 projections for mortality analysis would be minimal.
- 4.7 The four year period ending on the valuation date showed significant volatility in mortality experience year on year. This is illustrated in Table 4.3 (for normal health only) below. The figures shown are the ratios of actual to expected death rates with expected rates based on the 2012 valuation assumptions (referred to as "A/E"), adjusted as appropriate for each period analysed. This analysis suggests that differing conclusions may have been drawn had the valuation date and inter-valuation period fallen differently. The volatility is believed to be largely a reflection of environmental factors such as weather. As assumptions are intended to reflect long term expectations it is reasonable to seek to smooth out the impact of these short term effects. Our recommendation is that the short term effects should be smoothed out by taking only 50% of the difference in experience since the 2012 valuation.

Table 4.3 – variation in rates of death by scheme year

Year	Normal health males (A/E based on 2012 assumption*)	Normal health females (A/E based on 2012 assumption*)
2012-13	104.0%	110.2%
2013-14	93.1%	99.1%
2014-15	101.7%	107.9%
2015-16	96.2%	99.8%
Overall	98.7%	104.1%

*2012 baseline with ONS-2014 improvements.

Results of analysis

- 4.8 Table 4.4 sets out the number of pensioner deaths and amount of pension ceasing due to deaths over the intervalation period. Figures are shown separately for males and females retiring in normal or ill health and for dependants. In each case these are compared with the expected figures from the 2012 valuation assumption (with ONS-2014 improvements) and from the unadjusted 2016 base table.



Table 4.4: Pensioner mortality experience 2012-16

Category	Number of Pensions ceasing due to death	Pension amount ceasing due to deaths £'000s (pa)	A/E relative to the 2012 valuation assumption ¹⁴	A/E relative to the S2 Base Tables ¹⁴
Normal Health:				
Males	18,362	244,932	99%	105%
Females	22,918	223,677	104%	N/A ¹⁵
Ill Health:				
Males age 75 and under	1,168	17,204	110%	74%
Males over age 75	1,634	20,481	99%	118%
Females age 75 and under	1,334	15,129	104%	87%
Females over age 75	2,684	27,407	102%	115%
Dependants:				
Males	1,574	4,086	111%	126%
Females	9,580	42,319	115%	102%

Results of Analysis: Normal Health Pensioner Mortality

- 4.9 For male normal-health pensioners there was a good fit to the S2NMA_L¹⁶ standard table with a single adjustment factor applying at all ages. For female normal-health pensioners we could not find a standard table which had the same shape as the Scheme's mortality experience (as was the case when setting the assumption for the 2012 valuation). The 2012 valuation assumption provided a good fit for female normal health pensioners, and so we have recommended adopting the 2012 valuation assumption with an appropriate adjustment factor applied at all ages.
- 4.10 The charts below show a comparison of the actual mortality experience (amount of pension ceasing) over the four year period with that expected based on the 2012 valuation assumption and the proposed 2016 valuation assumption.

¹⁴ Adjusted from the base year of the underlying table to allow for improvements in population mortality up to 2014 and in line with ONS 2014-based improvements thereafter.

¹⁵ Female normal health mortality has been set with reference to the 2012 assumption (see paragraph 4.9).

¹⁶ The S2NMA_L table is a low mortality variant of the S2NMA table (see paragraph 4.9).



Chart 4.1: Male normal health pensioner mortality experience 2012-16

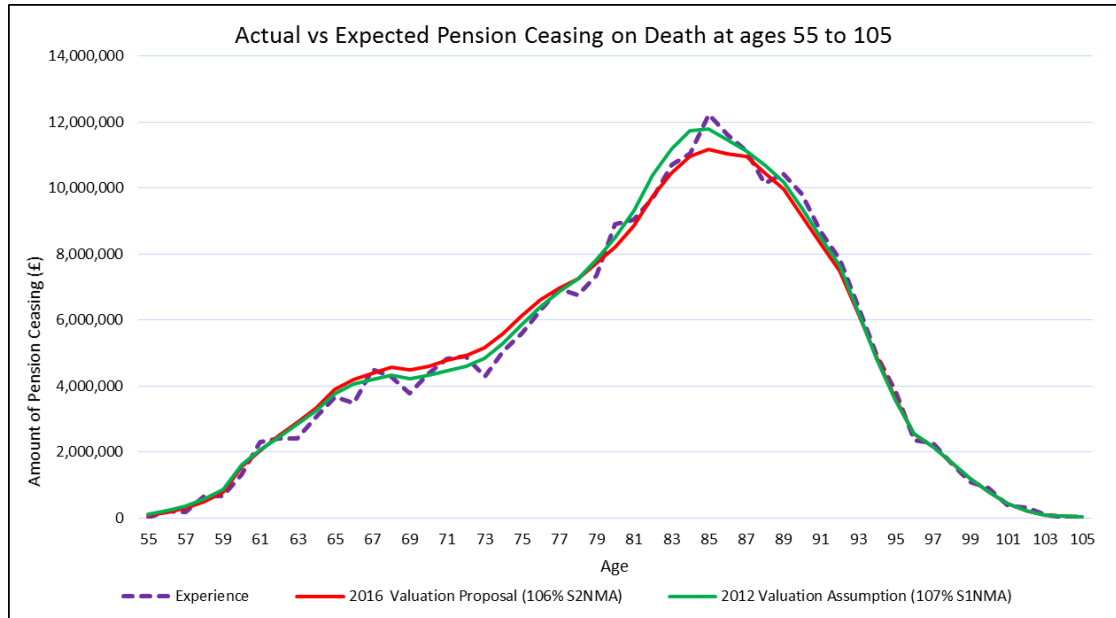
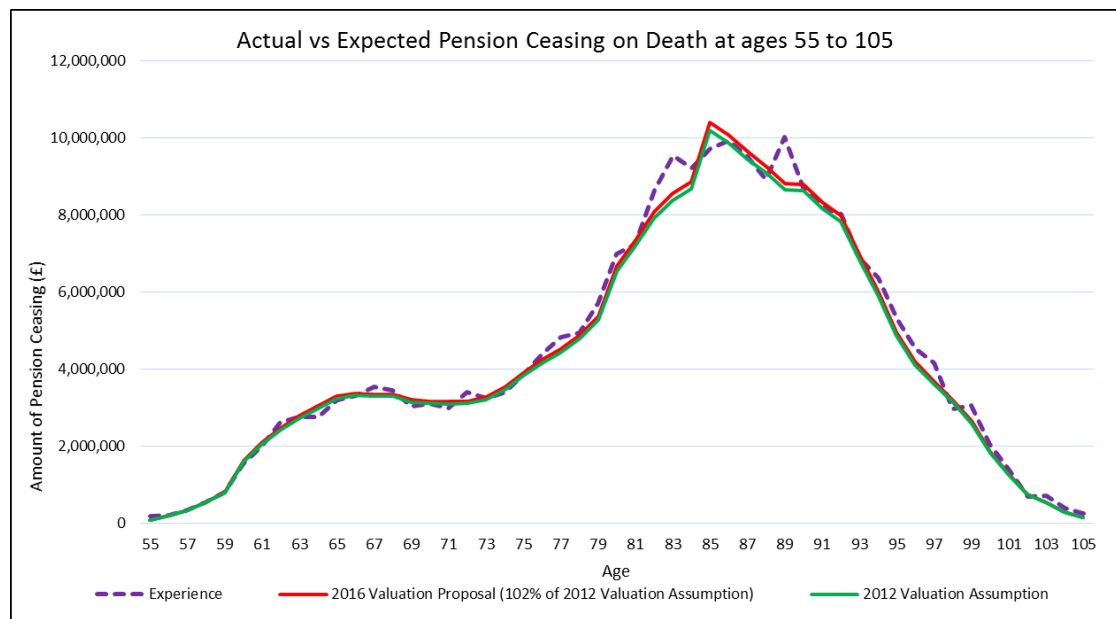


Chart 4.2: Female normal health pensioner mortality experience 2012-16





Comments on normal health analysis

- 4.11 Male normal health mortality experience has been broadly in line with the 2012 valuation assumption (overall there were around 1% fewer deaths than expected). Female normal health pensioners experienced heavier mortality (more deaths) than expected under the 2012 valuation assumption (overall there were around 4% more deaths than expected). As set out in 4.7 above, our proposed assumptions for the 2016 valuation takes account of broadly 50% of the difference in experience since the 2012 valuation.

Results of Analysis: Ill-Health Pensioner Mortality

- 4.12 Analysis of ill-health mortality is complicated by the fact that a significant change to the conditions for qualifying for ill-health benefits was made in 1997. This has led to a noticeable difference when analysing mortality experience for older ill-health pensioners (most of whom retired before 1997 and tend to experience relatively lighter mortality) and younger ill-health pensioners (most of whom retired after 1997 and tend to experience relatively heavier mortality). As a result, we have analysed the ill-health mortality experience separately, broadly for members who retired before and after 1 April 1997. We achieve this by assuming that pensioners aged 75 and below at 31 March 2016 are subject to the mortality of post-April 1997 retirees and that pensioners aged 76 and above are subject to the mortality of pre-April 1997 retirees.
- 4.13 The standard tables for normal-health pensioners provide a better fit for the relatively lighter mortality of the pensioners aged 76 and above. The standard tables for ill-health pensioners provide a better fit for the relatively heavier mortality of the pensioners aged 75 and below. Following discussions at the TPS SAB, and to ensure rates are heavier at all ages, it was agreed that the rates of mortality for members aged less than 75 should be underpinned by those which would be applicable under the table for members aged over 75 at the valuation.
- 4.14 The charts below show a comparison of the actual mortality experience (amount of pension ceasing) over the four year period with that expected based on the 2012 valuation assumptions and the proposed 2016 valuation assumptions for ill-health retirees (shown separately for members above and below age 75 at death).



Chart 4.3: Male ill-health under 75 pensioner mortality experience 2012-16

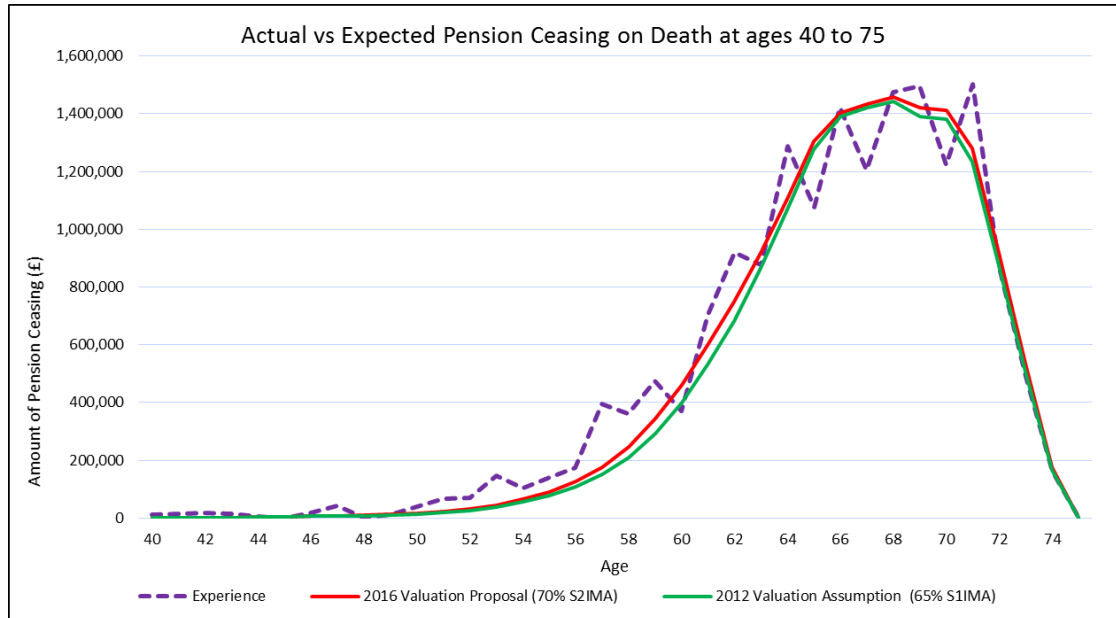


Chart 4.4: Female ill-health under 75 pensioner mortality experience 2012-16

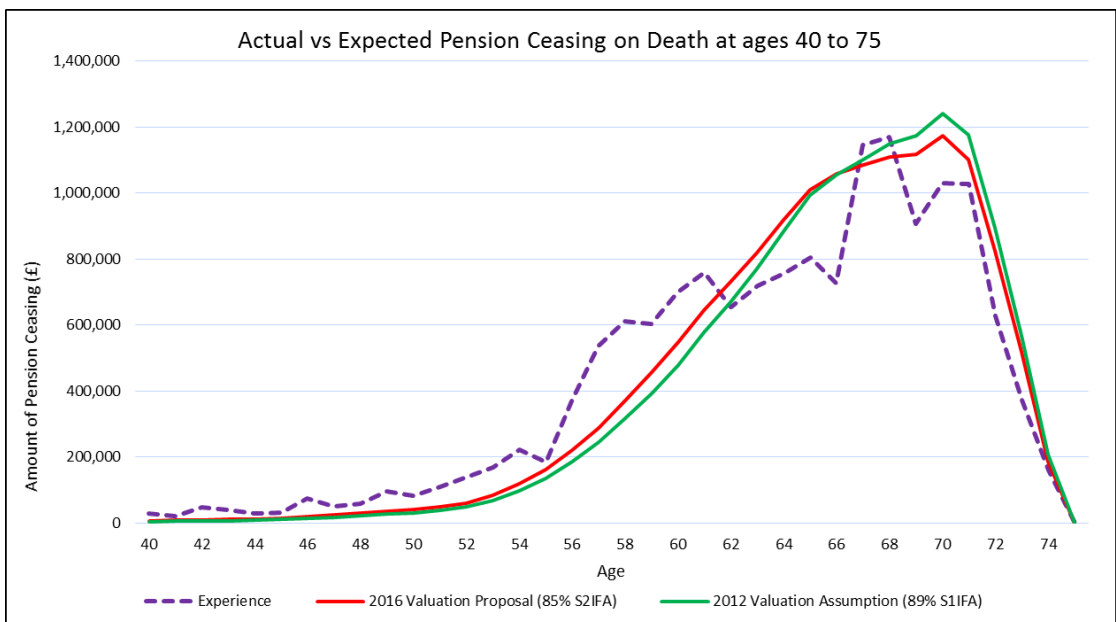




Chart 4.5: Male ill-health over 75 pensioner mortality experience 2012-16

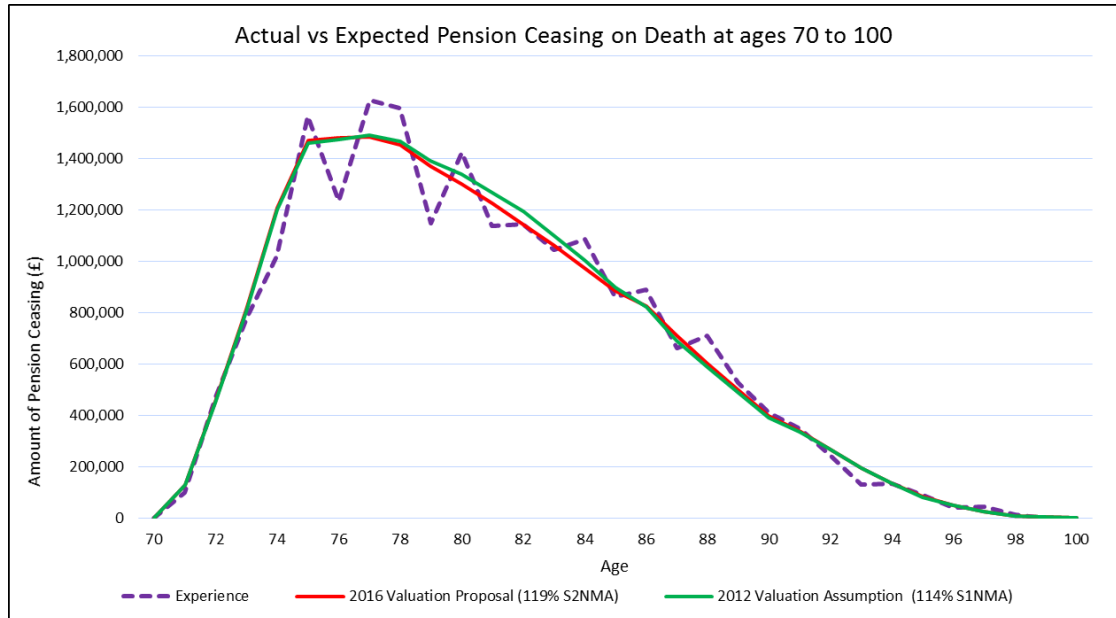
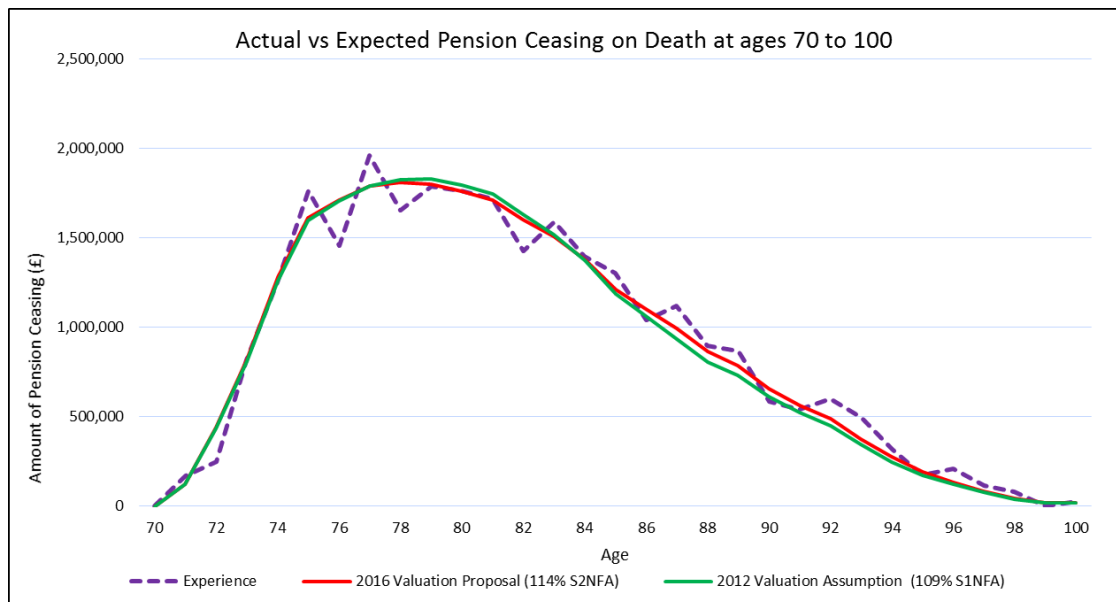


Chart 4.6: Female ill-health over 75 pensioner mortality experience 2012-16





Comments on ill-health analysis

Younger ill-health pensioners

- 4.15 Younger ill-health pensioners experienced heavier mortality (more deaths) than expected under the 2012 valuation assumption (overall there were around 10% more male and 4% more female deaths than expected). The recommended assumptions have been derived in the same way as for normal health pensioners by taking 50% of the change in experience since the previous valuation.
- 4.16 The 'shape' of the base table is slightly different to that of the scheme's experience (particularly for females) with overall the scheme's membership experiencing heavier mortality (more deaths) at younger ages and lighter mortality (fewer deaths) at older ages relative to the population underlying the base table. A better fit could be derived by applying differential adjustments to the rates for different ages. We have considered the materiality of the shape differential and have concluded the simpler approach of applying a single adjustment to all rates has materially the same financial effect as adopting a more complex approach. As noted above, an underpin has been applied to ensure mortality rates for this younger group are at all ages at least as heavy as they would be under the assumption applicable to the older group of ill-health pensioners.

Older ill-health pensioners

- 4.17 Ill health mortality experience has been broadly in line with the 2012 valuation assumption for older pensioners: overall there were around 1% fewer male deaths and 2% more female deaths than expected. The adjusted base tables provide a good fit to the experience for older ill-health pensioners.

Future ill-health pensioners

- 4.18 For future ill-health retirements we recommend a different assumption compared to that for current ill-health pensioners to reflect an expectation that the mortality experience of future ill-health pensioners will be different from that of existing ill-health pensioners due to the significant reduction in ill-health awards in recent years and in light of the introduction of the two-tier ill-health arrangements in 2007. We do not hold sufficient data on those retiring under the current ill-health arrangements to carry out a credible mortality analysis; therefore a pragmatic approach is needed to setting the assumption for the mortality of future ill-health pensioners.
- 4.19 The approach we recommend is to assume mortality is in line with the S2IA tables (which are based on the ill-health experience of certain private sector pension schemes). This may be justified on the grounds that the ill-health criteria in public and private sector pension schemes are now likely to be broadly similar, with ill-health mortality being driven primarily by the illness rather than the type of work undertaken. The relatively low level of ill-health retirement means that the choice of assumption is not particularly material.



Results of Analysis: Dependant Pensioner Mortality

- 4.20 The charts below show a comparison of the actual mortality experience (amount of pension ceasing) over the four year period with that expected based on the 2012 valuation assumption and the proposed 2016 valuation assumption.

Chart 4.7: Male Dependents mortality experience 2012-16

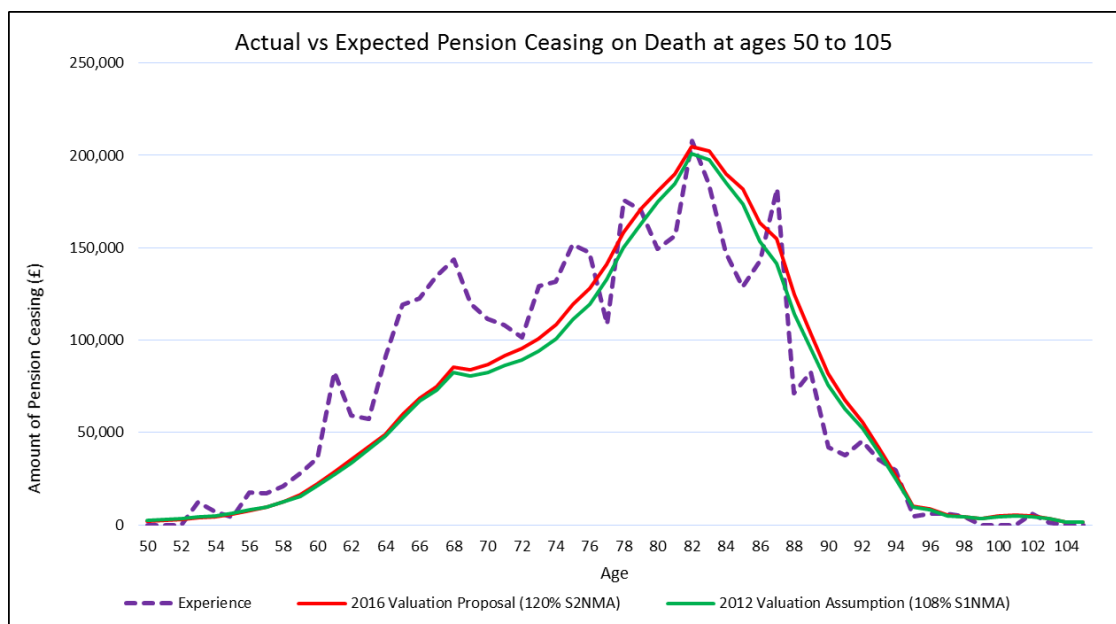
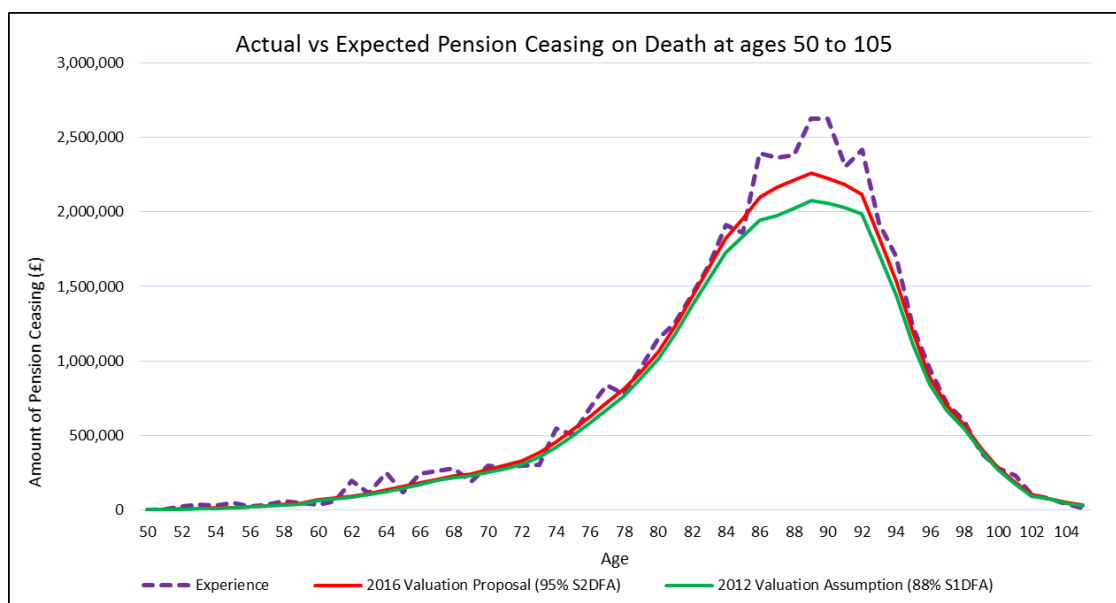


Chart 4.8: Female Dependants mortality experience 2012-16





Comments on Dependants analysis

- 4.21 There have generally been more deaths than expected over the period compared with expectations based on the 2012 valuation assumption. The recommended assumptions have been derived in the same way as for normal health pensioners by taking 50% of the change in experience since the previous valuation.
- 4.22 The proposed assumption provides a relatively good fit to female dependant experience. However, the experience of male dependants appears slightly different to that for the population underlying the base table, with more deaths than expected at younger ages and fewer deaths than expected at older ages. However, the assumption for male dependent mortality is not particularly material to the valuation results.



5 Age retirement from service

This chapter sets out our recommendation for the assumed patterns of retirement on grounds other than ill-health, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 5.4 For the NPA 60 protected group, we recommend a slight increase in assumed rates of early retirement, especially for women. We also recommend lower retirement rates after NPA, meaning that those who serve past NPA are assumed to retire slightly later.
- 5.5 We do not recommend changes to the assumptions for other groups of members.
- 5.6 We do not expect a material impact on the valuation results from the changes made.

Analysis and setting the assumption

- 5.7 There were around 68,000 age retirements in the NPA 60 section of the scheme over the four-year period to 31 March 2016. There were only about 1,600 retirements in the NPA 65 section, including mixed service members.
- 5.8 We have compared the actual rate of normal-health retirements (by gender and age at retirement) to the expected rate from the 2012 actuarial valuation and the recommended assumption has been based on this comparison.

Results of analysis

- 5.9 The charts below show a comparison of the actual age retirement experience over the four year period with that expected based on the 2012 valuation assumptions and the proposed 2016 valuation assumptions.



Chart 5.1: NPA 60 male age retirement experience

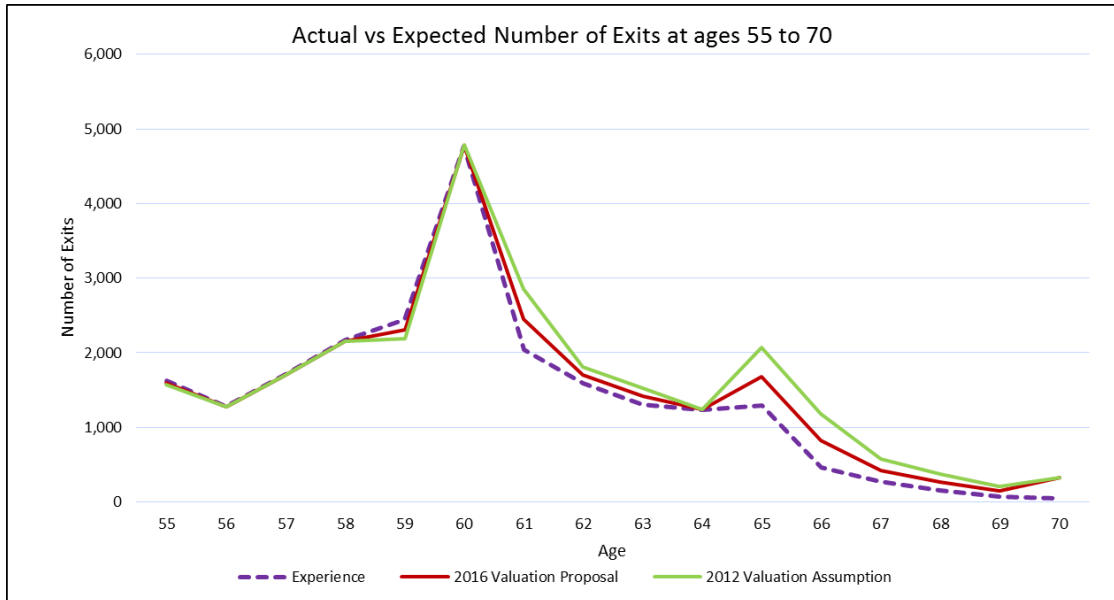


Chart 5.2: NPA 60 female age retirement experience

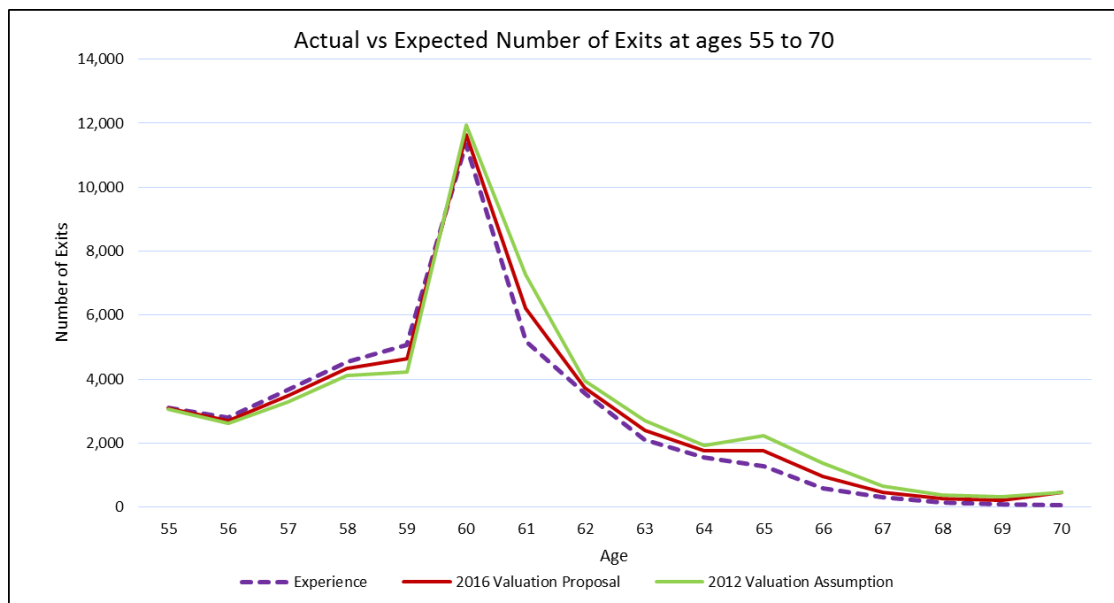




Chart 5.3: NPA 65 male age retirement experience

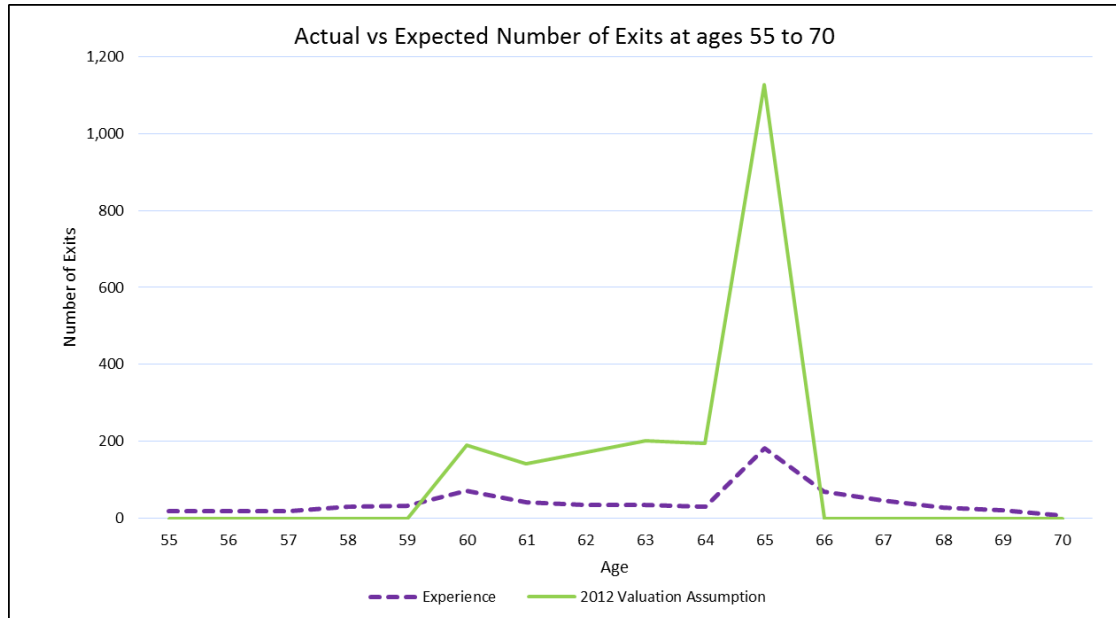
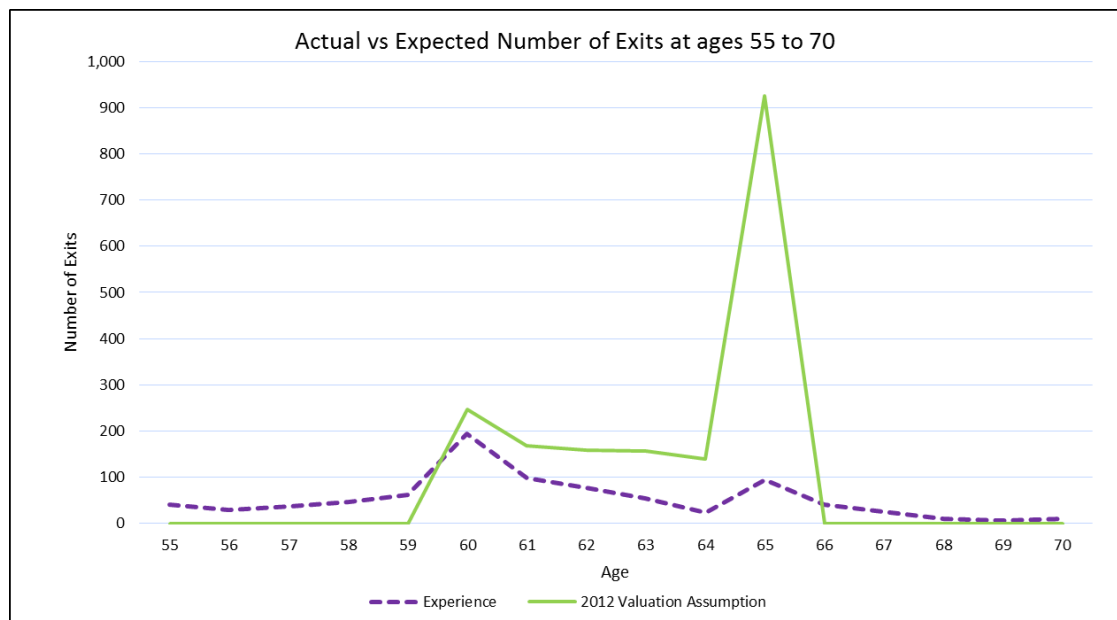


Chart 5.4: NPA 65 female age retirement experience





Comments on analysis

Protected NPA 60 members

- 5.10 The charts above show reasonably good alignment of experience against the 2012 valuation assumptions for both men and women. There were more retirements before age 60 than expected (most notably for women), and fewer retirements than expected after age 60. Allowing for some expected fluctuation in experience over periods of time we recommend 50% of the difference in experience is reflected in the revised assumptions for both men and women.
- 5.11 All remaining members are assumed to retire at age 70. This is a pragmatic simplification as the experience of active members above this age does not have a material impact on valuation results.

Protected NPA 65 members

- 5.12 The 2012 valuation assumption was derived based on the experience in the NPA 60 section, with early retirement patterns assumed to be the same in both sections relative to NPA, eg the same proportion of members are assumed to retire at age 59 in the NPA 60 section as at age 64 in the NPA 65 section. This was a pragmatic approach in the absence of other evidence.
- 5.13 All remaining members are assumed to retire at age 65 in the NPA 65 section. Again this is a pragmatic approach because the use of late retirement factors means that later retirements should be cost neutral to a retirement at age 65.
- 5.14 Actual experience has not been in line with these assumptions. Not unexpectedly, we see some retirement before age 55 and after age 65. Levels of early retirement are overall significantly lower than assumed.
- 5.15 Although this might suggest reducing the assumption, we do not intend to do so for a number of reasons. Firstly, the members retiring over 2012-16 entered service, or re-entered in the case of mixed service members, at high ages compared to more typical teachers. Although this is true to a degree for protected NPA 65 members retiring in the future, those members will have significantly more service in the scheme at retirement and may behave quite differently. Secondly, the recent experience implies a typical retirement age of over 70, which may be seen as rather implausible as a longer term assumption, especially since the average retirement age in the NPA 60 section is just over 60. Finally, it is reasonable not to change the assumption on the grounds of materiality. The protected NPA 65 and mixed groups make up less than 1% of the active membership numbers, and significantly less than this by liability. The use of early and late retirement factors mean that the costs for this group are not particularly sensitive to the timing of retirements and so any change of assumption would not have a material impact on valuation results.



Other membership groups

- 5.16 The recent experience of NPA 60 and NPA 65 members is not directly relevant to other groups of members. The assumptions for these other groups of members at the 2012 valuation were set by reference to NPA 60 experience but this was a pragmatic approach in the absence of other information. We consider that it would be inappropriate to amend these assumptions based on the experience of NPA 60 members. To do so would add volatility to the valuation results without strong evidence to suggest that the revised assumptions are better. As noted above, the experience of NPA 65 members is likely to be atypical of future behaviour.



6 Ill-health retirement from service

This chapter sets out our recommendation for the assumed rates of retirement on grounds of ill-health, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 6.1 We recommend reducing the assumed incidence of ill-health at all ages, by 17% for men and 8% for women. We recommend no change to the split between tiers: 55% of men and 63% of women should be assumed to receive upper-tier benefits.
- 6.2 We do not expect a material impact on the valuation results from the changes made.

Analysis and setting the assumption

- 6.3 There were around 2,000 ill-health retirements in the scheme over the four-year period to 31 March 2016. We have compared the actual rate of ill-health retirements (by gender and age of retirement) to the expected rate from the 2012 actuarial valuation and the recommended assumption has been based on this comparison.

Results of analysis

- 6.4 The charts below show a comparison of the actual ill-health retirement experience over the four year period with that expected based on the 2012 valuation assumptions and the proposed 2016 valuation assumptions.

Chart 6.1: Proposed male ill-health retirement rate assumption

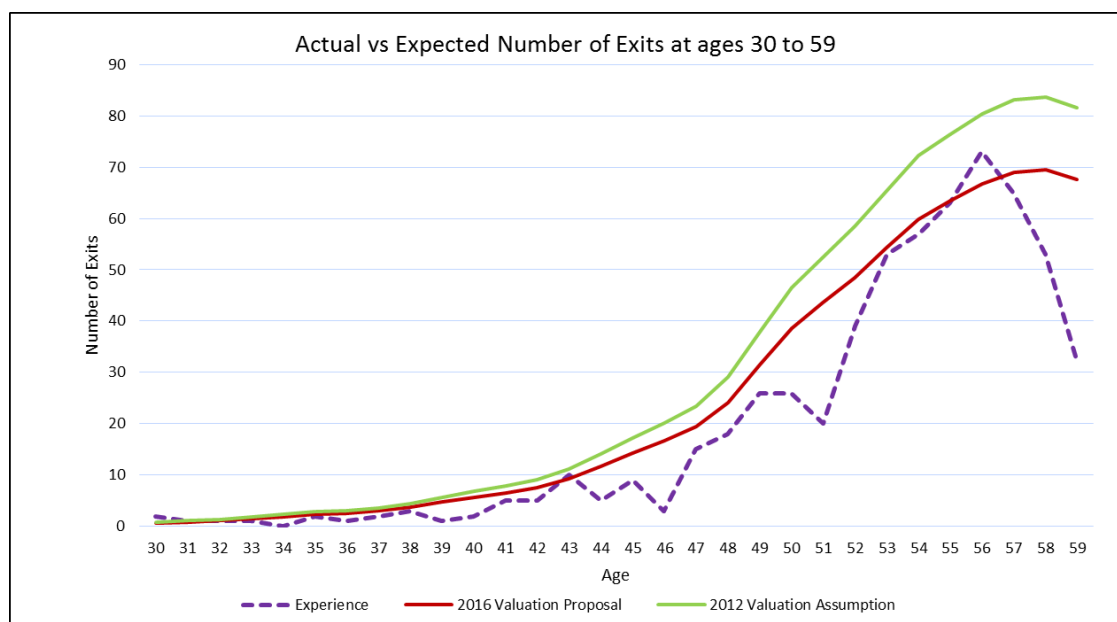
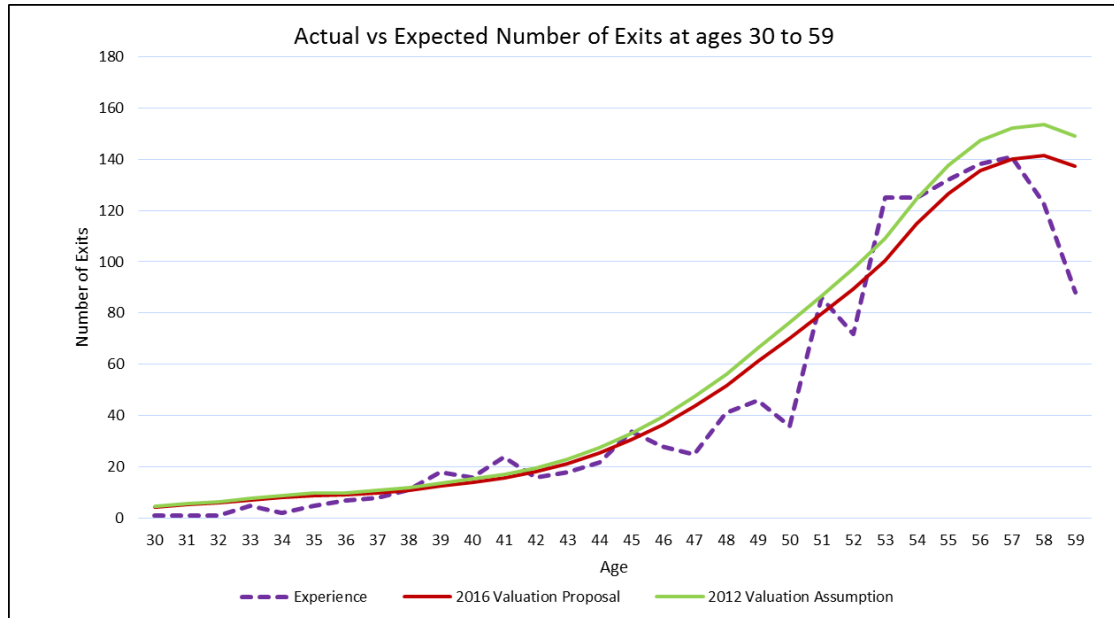




Chart 6.2: Proposed female ill-health retirement rate assumption



Comments on analysis

- 6.5 Overall around 34% fewer men and 16% fewer women retired on ill-health grounds over the 4-year period than expected, although there was significant variation year on year. For this reason we recommend that the assumed rates of ill-health retirement are decreased for the purposes of the 2016 valuation. Allowing for some expected fluctuation in experience over periods of time we recommend 50% of the difference in experience is reflected in the revised assumptions for both men and women, ie the rates are set equal to 83% and 92% of those adopted for the 2012 valuation for men and women respectively.

Split between tiers

- 6.6 Overall 55% of male members and 64% of female members retired on upper-tier ill-health benefits over the 4-year period, compared to the 2012 valuation assumption of 55% and 63% for men and women respectively. We recommend no change to these assumptions.



7 Voluntary withdrawal from service and rejoining service

This chapter sets out our recommendation for the assumed rates of withdrawal from active service, which are considered in conjunction with rates of rejoining service, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 7.1 We recommend increasing the assumed net withdrawal rates at all ages by 12.5%.
- 7.2 The change in assumption will reduce the overall past service liability by about £½bn and the cost of future accrual by about 0.2% of salaries.

Analysis and setting the assumption

- 7.3 Using the valuation data alone, it has not been possible to carry out a robust withdrawal or rejoiner analysis. A new data specification has been used for the 2016 valuation. The new specification is recording far more withdrawals than were seen under the old specification for 2008-12 (>150k a year on the new specification over 2012-16 compared to around 50k a year on the old specification over 2008-12). There are a number of reasons for this. The new specification is picking up members who change job and leave an employer rather than leave the scheme, eg members are recorded as a withdrawal on one day and re-entering the next day. Excluding these 'one-day leavers' brings the number of withdrawals down to c100k pa. There are also problems caused by missing or incomplete returns from employers. It is difficult to identify the affected members to exclude them from analysis.
- 7.4 In the absence of a robust analysis direct from the valuation data, we have considered the following sources of information:
- > The assumption used for the 2012 valuation and the experience analysis underlying this data. The net withdrawal rate was assumed to be about 3% a year (typically slightly more for men and slightly less for women).
 - > Wastage data from the Teacher Supply Model (TSM). This covers the maintained school workforce in England, which makes up about two thirds of the overall TPS membership.
 - > 2008-2015 experience data on the new valuation data specification.

TSM data

- 7.5 The TSM data show an increasing level of withdrawals over time from the maintained school workforce. This covers about 70% of the TPS membership. Some of these withdrawals may not be leaving the scheme (they could for example have moved to a private school that is also eligible for TPS) and some may not be scheme members (though TPS membership is thought to be very high). However, it should still give a good impression of trends amongst TPS membership. The data show a clear increase in withdrawal rates, as shown in the charts below.



Chart 7.1: Withdrawal rates by year and age band (TSM data)

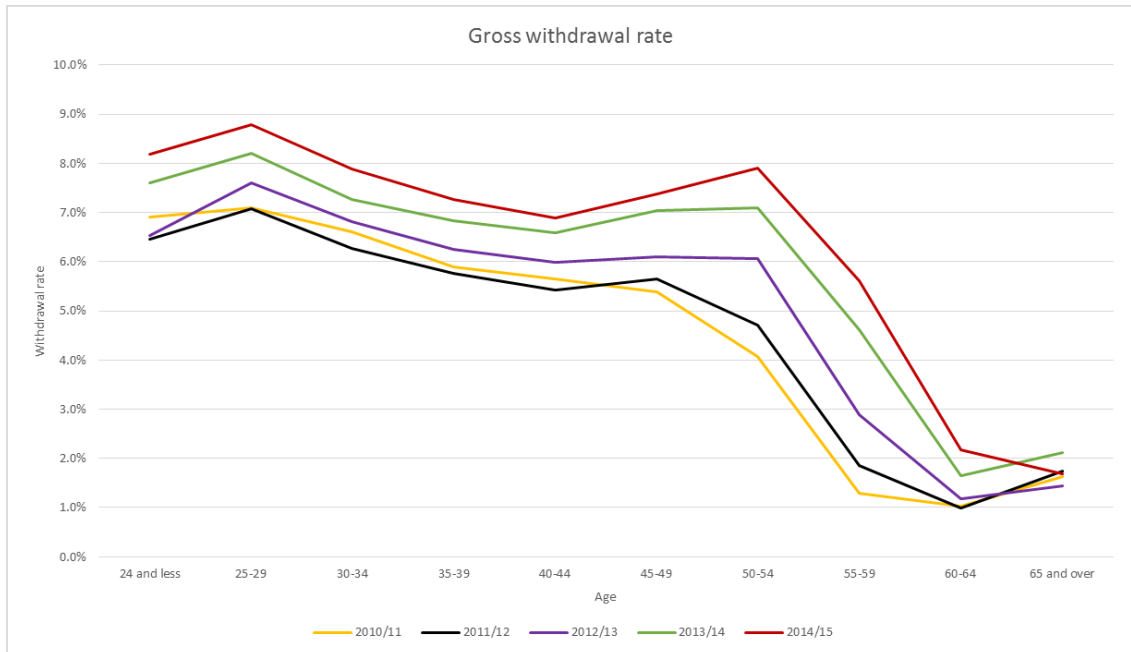
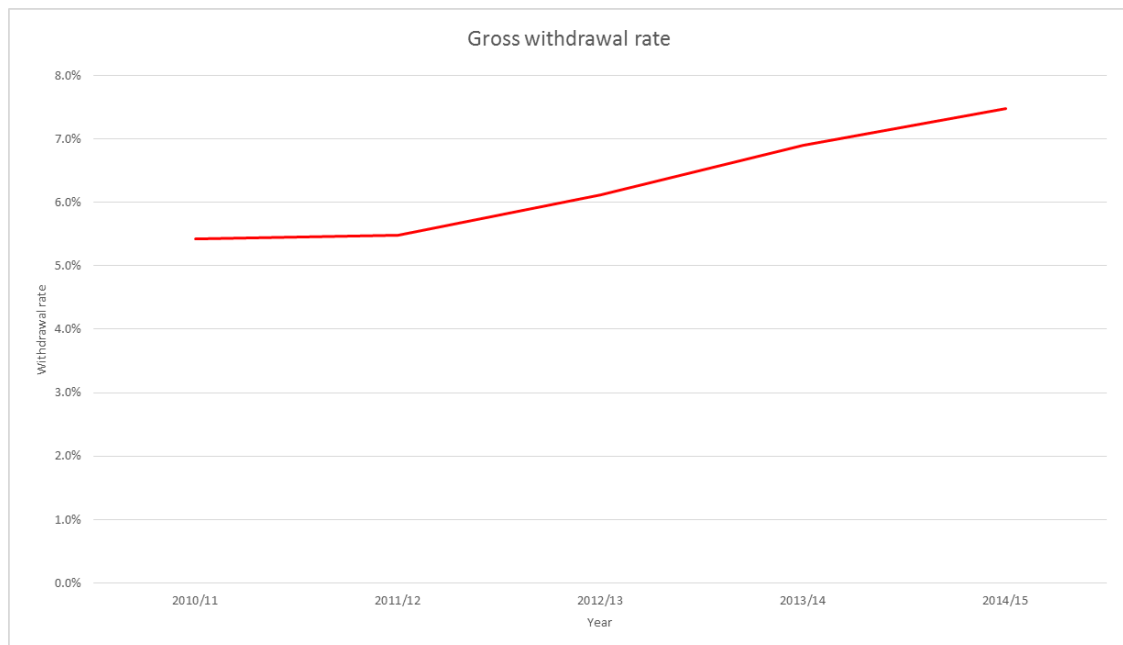


Chart 7.2: Withdrawal rate by year (TSM data)



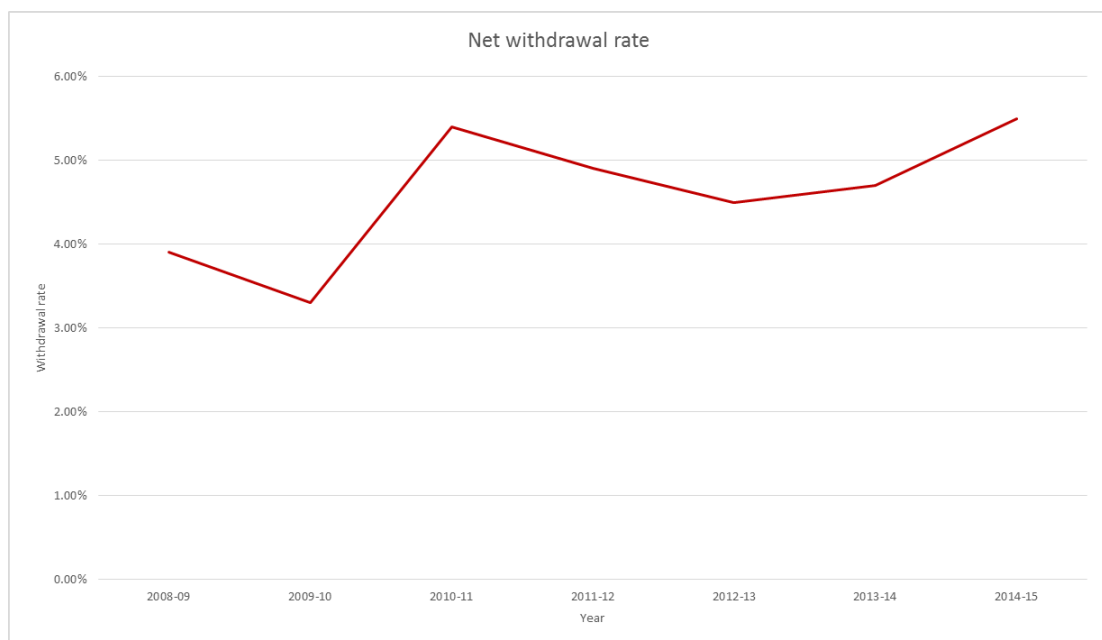


- 7.6 The withdrawal rate is about a quarter higher over 2012-15 than over 2010-12. There appears to be an upward trend in withdrawals, both in this data and in the 2008-12 data provided for the 2012 valuation. The withdrawal assumption in 2012 was based on the average withdrawal experience over 2008-12. As the TSM only covers the second half of the 2008-12 period, it is arguable that the increase in withdrawal rate between 2008-12 and 2012-16 would actually be somewhat higher than the quarter above.
- 7.7 The overall withdrawal rate in 2010-12 in the TSM data is actually lower than in the original valuation data for that period. This is not necessarily unexpected as the maintained school sector is understood to be more stable than other sectors. It does, however, show that this sector is not necessarily representative of the overall scheme.

Valuation experience data

- 7.8 The scheme experience data on the new spec appear to overstate the number of withdrawals. Some of the issues causing this overstatement are likely to be matched by an overstatement of re-entrants. Looking at the net withdrawal rate also suggests withdrawals have been increasing over time, as shown in the chart below.

Chart 7.3: Net withdrawal rate (data on new valuation specification)



- 7.9 The net withdrawal rate implied by the valuation data is about 11% higher over 2012-15 than over 2008-12.



Considerations

- 7.10 Both data sources imply an increase in withdrawals but neither is ideal as the basis for setting an assumption. The TSM data does not cover the entire scheme membership. It is possible that experience elsewhere in the scheme has been different.
- 7.11 The valuation data clearly overstates the gross level of withdrawals. We cannot amend the data to isolate genuine withdrawals (see paragraph 7.3). Looking at net withdrawals may be more reliable but the net withdrawal rate for 2008-12 is still significantly higher than implied by the data on the old spec for this period. It is also difficult to explain pattern of annual rates, including the apparent peak in 2010-11. It is, therefore, difficult to draw firm conclusions from this data.
- 7.12 On balance, the TSM seems the more reliable data source. We could reflect the full apparent increase in withdrawal rates. However, that risks causing volatility in the valuation results that would be hard to justify given: (i) the TSM data does not cover the full TPS membership; (ii) an alternative data source suggests a lower increase; and (iii) withdrawal rates tend to vary over time so an increase over a short period may not reflect longer-term expectations.
- 7.13 To avoid excessive volatility, we propose to allow for only half the increase implied by the TSM data.



8 Death before retirement

This chapter sets out our recommendation for the assumed rates of death before retirement, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 8.1 We recommend increasing the assumed rates of death in service by 2% for men and reducing them by 4% for women. The changes apply at all ages.
- 8.2 We do not expect a material impact on the valuation results from the changes made.

Analysis and setting the assumption

- 8.3 To formulate a recommended assumption we compared the scheme experience to the expected rates from the 2012 actuarial valuation. In total there were 1,385 deaths of active members, compared to an expected number of 1,436 based on the adjusted 2012 valuation assumption.

Results of analysis

- 8.4 The charts below compare the rates of actual and expected deaths by age for men and women respectively. In each case expected deaths are shown by reference to the 2012 valuation assumptions.

Chart 8.1: Male death before retirement experience 2012-16

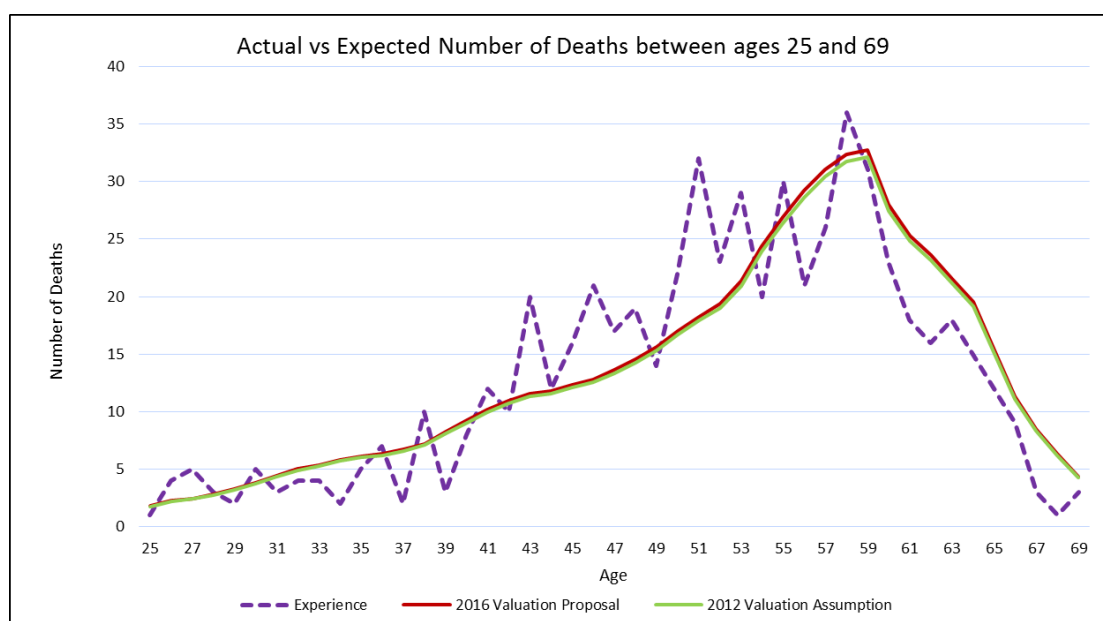
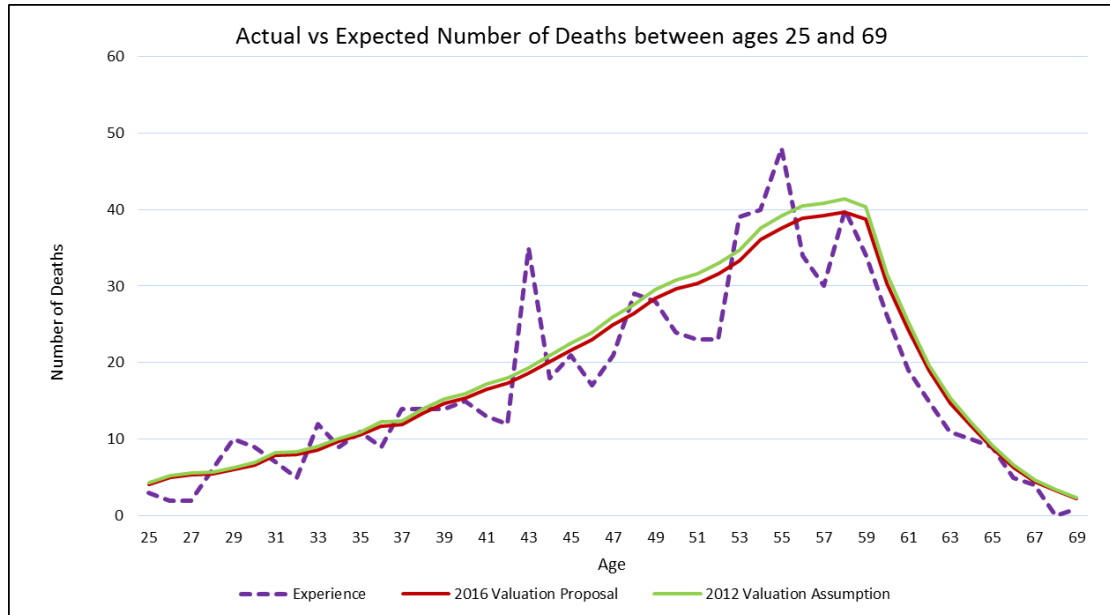




Chart 8.2: Female death before retirement experience 2012-16



Comments on analysis

- 8.5 For men, recent experience has been around 4% heavier than the rates assumed for the 2012 valuation, whilst for women experience has been around 8.5% lighter than rates assumed for the 2012 valuation. Allowing for some fluctuation in experience over periods of time we recommend 50% of the difference in experience is reflected in the assumption to be adopted for the 2016 valuation, ie the rates are set equal to 102% and 96% of those adopted for the 2016 valuation for men and women respectively.



9 Promotional pay increases

This chapter sets out our recommendation for the assumed promotional pay increases of active members, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 9.1 We recommend no changes to the promotional pay increase assumptions.

Analysis and setting the assumption

- 9.2 To formulate a recommended assumption we compared the scheme experience to the assumption adopted for the 2012 valuation. This analysis has been carried out in two separate ways:

- > Looking at the profile of the active membership as at 31 March 2016 in terms of average pensionable pay at each year of age and how this compares with the next year of age (the 'profile analysis'); and
- > Tracking the pensionable pay progression of individual members who were in active service at both 31 March 2015 and 31 March 2016 (the 'annual increase analysis'). Under this analysis, we have stripped out the effect of a general pay increase over the year of 1%.

- 9.3 Both types of analysis should be treated with some caution.

- 9.4 For the profile analysis:

- > The analysis is affected by the mixture of members at each age. For example, the group of members at, say, age 30 might better correspond to the members at age 31 with at least a year's service (ie those who were in service at age 30) than the full group at age 31
- > There will be effects from members leaving and re-joining. For example, early retirement may lead the average salary of active members aged 55 and above to be lower than the average salary of younger members, as members with higher salaries are thought more likely to take early retirement.

- 9.5 For the annual increase analysis:

- > Not all members will benefit from the same headline pay award. In particular, the 1% general pay increase only applies directly to the maintained sector and even there not all members will receive exactly the 1% general increase. The analysis will be distorted by differences between the maintained and other sectors.



- > It is often the case that average pay increases by more than the headline general pay award (usually referred to as 'pay drift'). We have only allowed for the headline general pay award. HMT have included an allowance for drift in their directed general earnings increase assumption. If the promotional salary assumption also includes drift then this will be double counted.
- > Much of the increase is driven by members with shorter service where pay scales are relatively steep. Applying the average increase to all members is likely to understate the liability for members with less service and overstate for those with more service. As the overall liability is dominated by those with more service this is likely to be overstated if the average increase is applied to all members.

Results of the analysis

- 9.6 The charts below show the implied age related promotional pay scales for men and women respectively based on the pay profile of all members at the valuation date (profile analysis) and the pay increases for those in service throughout the year 2015/16. These are compared with the assumed age related promotional scales adopted for the 2012 valuation.

Chart 9.1: Male profile analysis

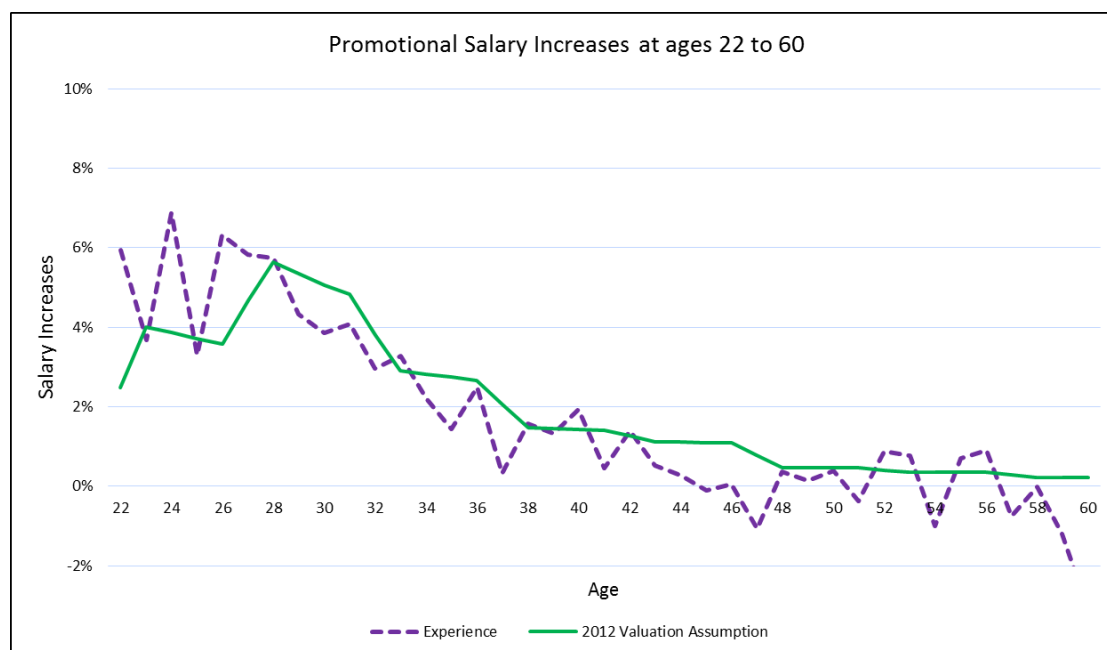




Chart 9.2: Male annual increase analysis

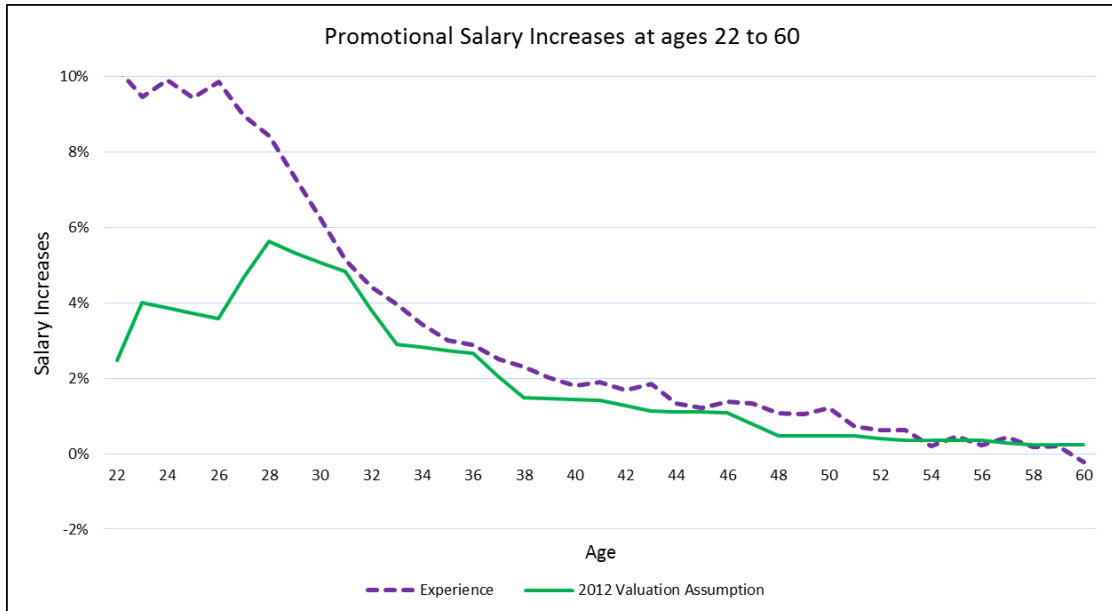


Chart 9.3: Female profile analysis

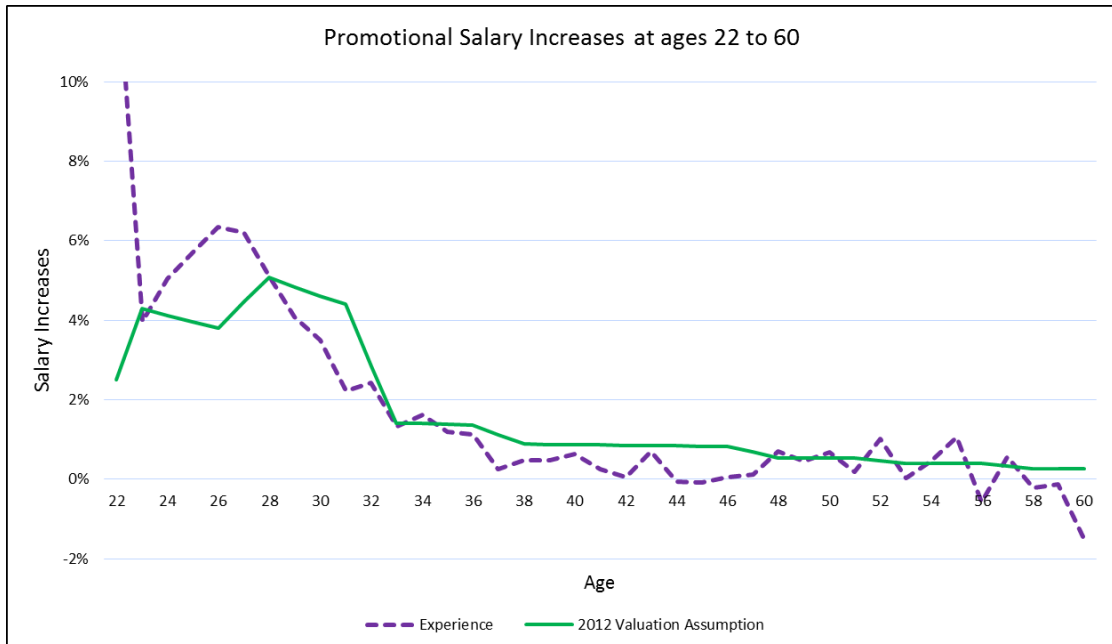
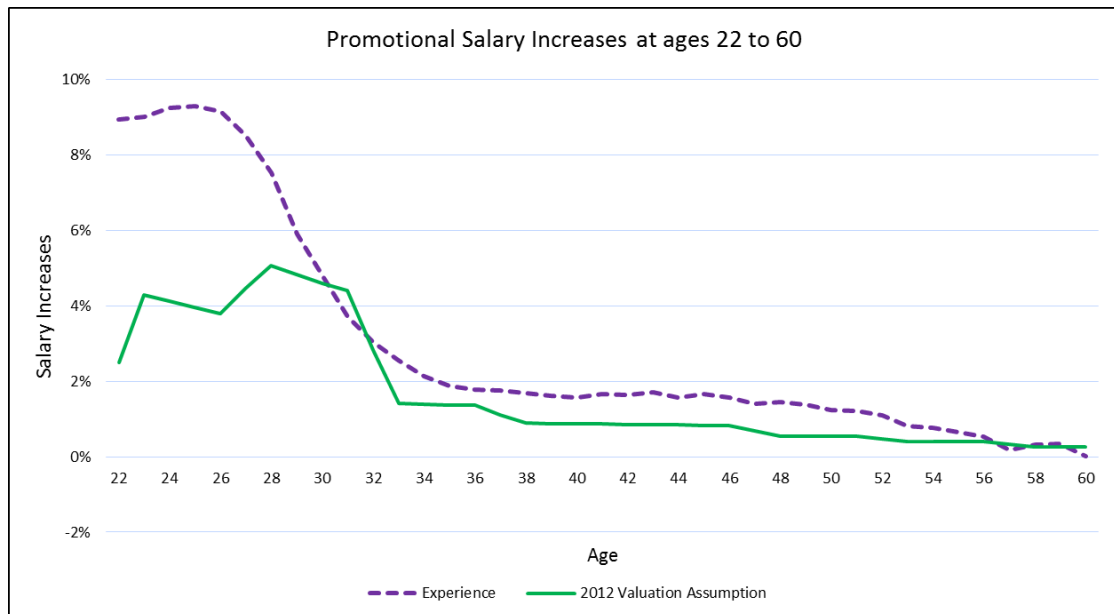




Chart 9.4: Female annual increase analysis



Comments on the analysis

- 9.7 For males, the profile analysis broadly supports the existing salary scale, though pay increases seem in general slightly lower than assumed from about age 30. In contrast, the annual increase analysis suggests that promotional pay increases have exceeded the assumption.
- 9.8 For females, the profile analysis suggests that pay increases are generally less than assumed, especially in the mid-30s to mid-40s. In contrast, the annual increase analysis suggests that promotional pay increases have exceeded the assumption at almost all ages.
- 9.9 All analyses suggest that the assumptions for members in their mid-20s and below are too low. This suggests that the assumption should be increased. The 'correct' assumption, however, is unclear as the analyses are inconsistent and heavily influenced by those at the start of their careers who have high initial pay growth. We have made the pragmatic suggestion to retain the current assumption on the grounds of materiality. The amount of final salary benefit accrued at these ages is low and the assumption does not impact the cost of career average benefits that these members are now accruing. We estimate that increasing the promotional salary assumption to 10% a year throughout the 20s, which is a significantly stronger assumption than any of the analyses suggest, would increase past service liabilities used to calculate the uncorrected employer contribution rate by around £0.3bn and an increase to the uncorrected employer contribution rate of about 0.1%.
- 9.10 At other ages there is no clear evidence that the existing assumptions are inappropriate. Given the financial significance of this assumption on the valuation results (see Table 3), it would be inappropriate to make a change to the assumption without robust evidence.



10 Commutation of pension for cash at retirement

This chapter sets out our recommendation for the assumed level of pension commutation at retirement (where this is not specified in the HM Treasury valuation directions), and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 10.1 We recommend retaining the 2012 valuation assumptions for NPA 60 commutation: men are assumed to commute 5% of their pension and women 4%. The assumption for the NPA 65 section and 2015 scheme is specified in the HM Treasury directions (currently 17.5% of pension).

Results of analysis

- 10.2 We analysed the amounts of pension exchanged for cash at retirement separately for male and female NPA 60 members.

Table 10.1: NPA 60 commutation experience

	Number of retirements	Pension before commutation £ 000s	Pension post commutation £000s	Implied Commutation proportion
Males	40,536	583,381	552,124	5.4%
Females	81,685	937,690	893,682	4.7%

Comments on commutation analysis

- 10.3 The above analysis shows that the amount of pension commuted has been slightly higher than under the 2012 valuation assumption, which was 5% for men and 4% for women. However, considering the experience over 2008 to 2016 (and rounding to the nearest percentage point) supports retaining the existing assumption.



11 Family statistics

This chapter sets out our recommendation for the assumptions around dependants' pensions, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

11.1 We recommend the following assumptions.

- > 77% of men and 58% of women are assumed to be married or have a qualifying partner at retirement with consistent assumptions for current pensioners.
- > Men are assumed to be three years older than their partners and women are assumed to be two years younger than their partners.
- > On the grounds of materiality, no allowance is made for remarriage.

11.2 The proportion married/partnered assumption is a change from the 2012 assumption (75% for men and 60% for women). The age difference assumption and the approach for remarriage are unchanged.

11.3 We do not expect a material impact on the valuation results from the changes made.

Analysis and approach to setting the assumptions

Proportions married/partnered

11.4 To formulate a recommended assumption we compared the scheme experience with the corresponding 2012 assumption.

11.5 We analysed the proportion of deaths giving rise to the payment of a surviving spouse's or partner's pension. The majority of deaths observed relate to members with service before 1 January 2007 only and so would qualify for a pension to a legal spouse (or civil partner) and the analysis compared the aggregate experience with the assumption for proportions married (rather than partnered).

11.6 As there is no robust scheme specific experience of proportion partnered we recommend the same approach as adopted for the 2012 valuation is retained for this assumption. That approach relies on the differential between proportions married and proportions partnered in population statistics¹⁷.

¹⁷ published by the Office for National Statistics (ONS).



Results of analysis

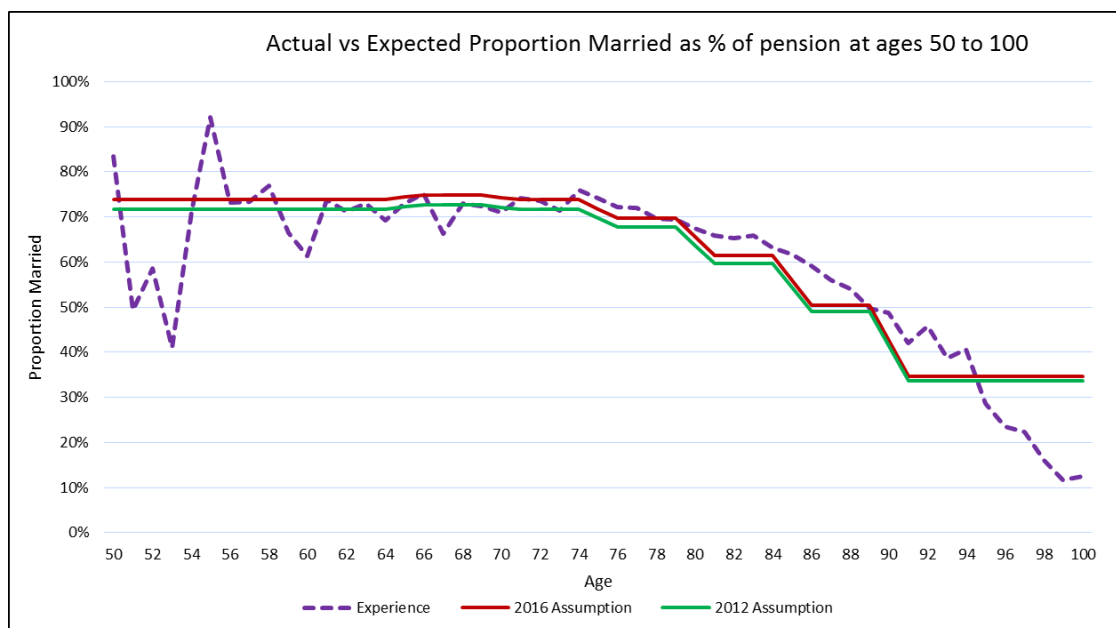
- 11.7 The overall ratio of actual to expected numbers of members dying over the four-year period to 31 March 2016 and leaving a dependant eligible for a contingent pension are shown in the table below. In the below expected numbers are based on the proportions married assumptions adopted for the 2012 valuation for the reasons outlined above.

Table 11.1: Comparison of actual to expected proportions married at death

	A/E
Men	106%
Women ¹⁸	95%

- 11.8 The charts below show a similar comparison but split by age at death.

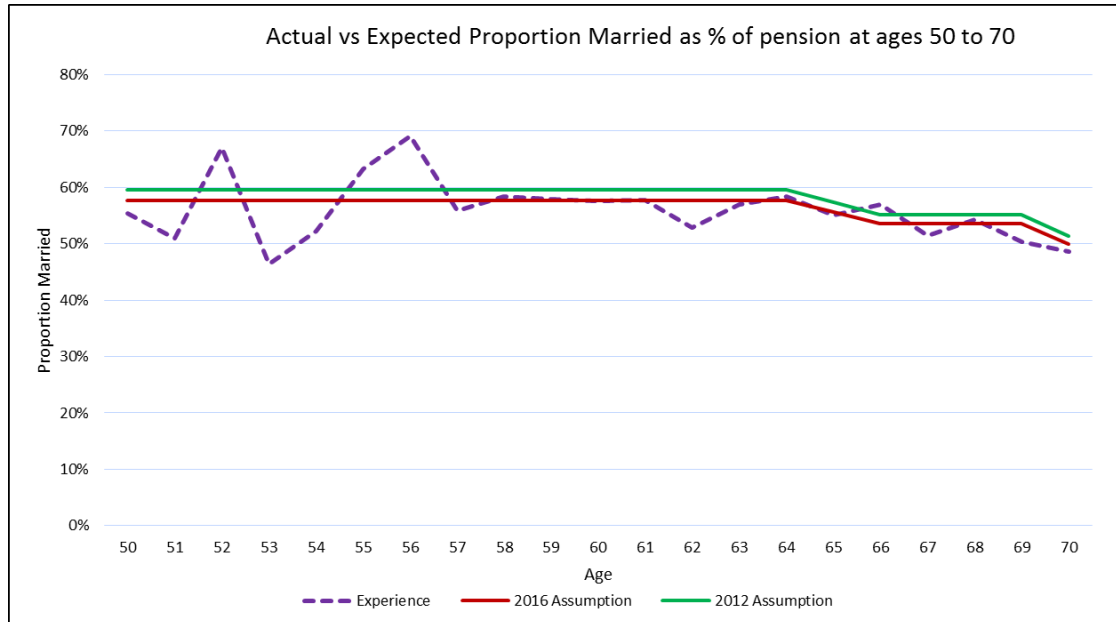
Chart 11.1: Male pensioners: proportions married at death



¹⁸ The analysis only covers deaths of members up to age 70. Above this age, there will be significant numbers of members with no service that counts for a spouse's pension. As a result, no dependant's pension will be payable for some members even if the member is married and so the experience does not provide a reliable measure of whether the member was married at death.



Chart 11.2: Female pensioners: proportions married at death



Comments on analysis

- 11.9 The scheme's experience by age over the four-year period to 31 March 2016 is reasonably consistent to the assumption made for the 2012 valuation. The overall proportion dying with a dependant entitled to a pension is slightly higher than expected for male members (female dependants) and slightly lower than expected for female members. Allowing for some fluctuation in experience over periods of time we recommend 50% of the difference in experience is reflected in the assumption to be adopted for the 2016 valuation.



Age difference between member and spouse

11.10 The charts below show the age differences between members and the dependent receiving a pension after the members' deaths.

Chart 11.3: Male pensioners: Spouse Age Difference

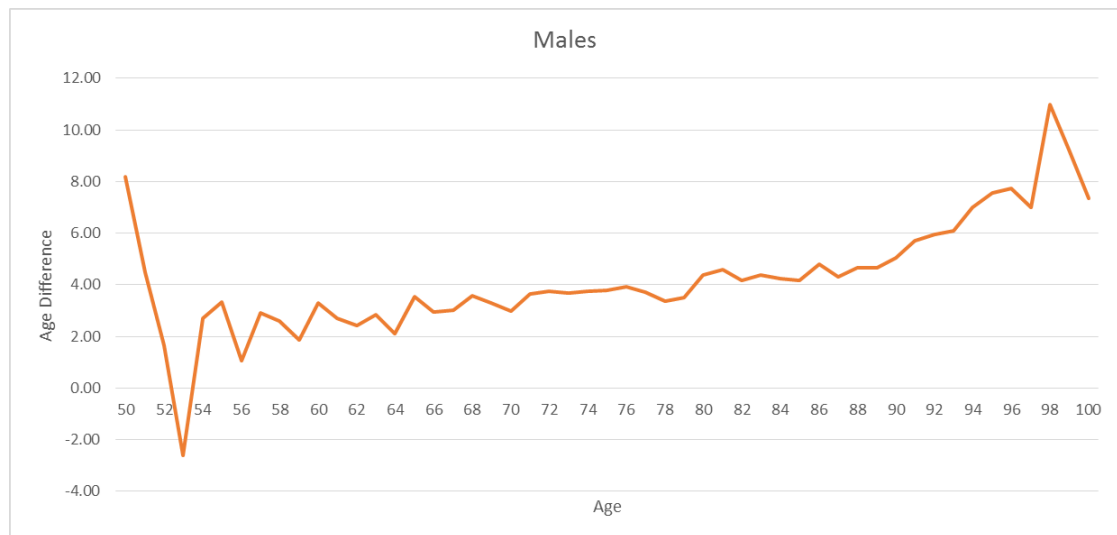
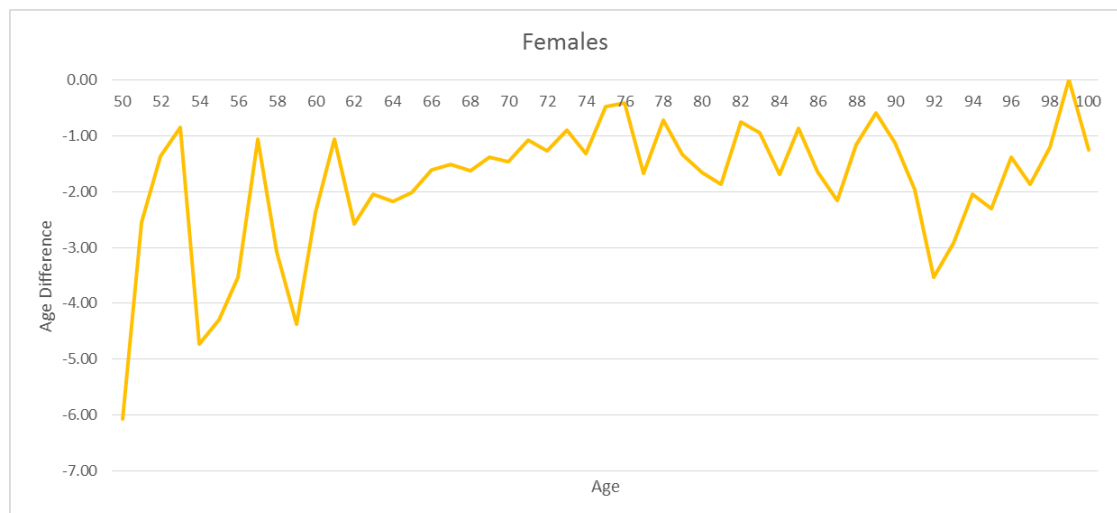


Chart 11.4: Female pensioners: Spouse Age Difference



11.11 The use of a single age difference between a member and spouse, rather than an assumption that varies by the member's age at death, is a simplification, which is justified because the assumption is not particularly material. The analysis shows that the existing assumption remains reasonable, especially when considering the ages of deaths that will result in dependants' pensions being paid for longer periods.



Appendix A: Details of assumptions

This appendix contains details of the recommended assumptions including sample rates and values.

Pensioner mortality

Table A1: Baseline mortality assumptions

Standard table and adjustments	
Males	
Retirements in normal health	106% of S2NMA_L
Current ill-health pensioners	Age-dependent assumption ¹⁹ : ≤75: 70% of S2IMA with an underpin of 119% of S2NMA >75: 119% of S2NMA
Future ill-health pensioners	100% of S2IMA
Dependants	120% of S2NMA
Females	
Retirements in normal health	Age-dependent adjustments to S1NFA_L ²⁰ : ≤79: 75% 80-84: 86% 85-89: 100% ≥90: 108%
Current ill-health pensioners	Age-dependent assumption ¹⁹ : ≤75: 85% of S2IFA with an underpin of 114% of S2NFA >75: 114% of S2NFA
Future ill-health pensioners	100% of S2IFA
Dependants	95% of S2DFA

HM Treasury has indicated that future improvements in mortality will be assumed to be in line with those underlying ONS-2016 population projections.

¹⁹ Age at valuation date.

²⁰ Age at time assumption is applied.



Age retirement from service

Table A2: Age retirement rates (members with full protection)

Age	NPA 60		NPA 65	
	Males	Females	Males	Females
55	0.09	0.08	-	-
56	0.08	0.07	-	-
57	0.11	0.09	-	-
58	0.14	0.12	-	-
59	0.16	0.14	-	-
60	0.37	0.40	0.09	0.08
61	0.27	0.32	0.08	0.07
62	0.22	0.27	0.11	0.09
63	0.22	0.25	0.14	0.11
64	0.24	0.25	0.15	0.13
65	0.42	0.35	1.00	1.00
66	0.35	0.31	1.00	1.00
67	0.28	0.24	1.00	1.00
68	0.28	0.21	1.00	1.00
69	0.27	0.27	1.00	1.00
70	1.00	1.00	1.00	1.00

Table A3: Age retirement rates (new entrants to the 2015 scheme)

Age	SPA 65		SPA 66		SPA 67		SPA 68	
	Males	Females	Males	Females	Males	Females	Males	Females
55	-	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-	-
57	-	-	-	-	-	-	-	-
58	-	-	-	-	-	-	-	-
59	-	-	-	-	-	-	-	-
60	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.08
61	0.08	0.07	0.08	0.07	0.08	0.07	0.08	0.07
62	0.11	0.09	0.11	0.09	0.11	0.09	0.11	0.09
63	0.14	0.11	0.14	0.11	0.14	0.11	0.14	0.11
64	0.15	0.13	0.15	0.13	0.15	0.13	0.15	0.13
65	1.00	1.00	0.50	0.50	0.33	0.33	0.25	0.25
66	1.00	1.00	1.00	1.00	0.50	0.50	0.33	0.33
67	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.50
68	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00



Table A4: Age retirement rates (members with service in NPA 60 and 2015 schemes)

Age	SPA 67		SPA 68	
	Males	Females	Males	Females
55	0.07	0.06	0.02	0.02
56	0.06	0.05	0.02	0.02
57	0.08	0.07	0.03	0.02
58	0.11	0.09	0.04	0.03
59	0.12	0.10	0.04	0.03
60	0.31	0.34	0.16	0.16
61	0.26	0.31	0.14	0.15
62	0.21	0.24	0.14	0.14
63	0.22	0.24	0.16	0.16
64	0.22	0.24	0.17	0.17
65	0.46	0.40	0.32	0.30
66	0.46	0.41	0.38	0.36
67	0.40	0.37	0.47	0.46
68	0.51	0.47	0.84	0.83
69	0.53	0.38	0.85	0.80
70	1.00	1.00	1.00	1.00

Table A5: Age retirement rates (members with service in NPA 65 and 2015 schemes)

Age	SPA 65		SPA 66		SPA 67		SPA 68	
	Males	Females	Males	Females	Males	Females	Males	Females
55	-	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-	-
57	-	-	-	-	-	-	-	-
58	-	-	-	-	-	-	-	-
59	-	-	-	-	-	-	-	-
60	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.08
61	0.08	0.07	0.08	0.07	0.08	0.07	0.08	0.07
62	0.11	0.09	0.11	0.09	0.11	0.09	0.11	0.09
63	0.14	0.11	0.14	0.11	0.14	0.11	0.14	0.11
64	0.15	0.13	0.15	0.13	0.15	0.13	0.15	0.13
65	1.00	1.00	1.00	1.00	0.76	0.76	0.41	0.41
66	1.00	1.00	1.00	1.00	0.78	0.78	0.48	0.48
67	1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.61
68	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Although there has been no change to the assumptions, rates in Tables A3 to A5 differ from the equivalent tables in the 2012 report because they have been presented using a different age definition (exact age at start of year is used in this report).



III-health retirement from service

Table A6: III-health retirement rates for all members

Age	Males	Females
20	-	-
25	0.0000	0.0000
30	0.0000	0.0001
35	0.0001	0.0002
40	0.0002	0.0003
45	0.0006	0.0006
50	0.0018	0.0015
55	0.0032	0.0029
60	0.0047	0.0043
65*	0.0057	0.0058

*rates are zero if above the NPA of the relevant section.

In all scheme sections, 55% of men and 63% of women are assumed to qualify for upper tier ill-health retirement awards.

Voluntary withdrawal from service

Table A7: Withdrawal rates (net of re-entry within 5 years) for all members

Age	Males	Females
20	0.063	0.043
25	0.051	0.038
30	0.039	0.034
35	0.034	0.030
40	0.034	0.027
45	0.034	0.027
50	0.036	0.031
55	0.036	0.035
60	0.036	0.037
65*	0.036	0.038

*rates are zero if above the NPA of the relevant section.



Death before retirement

Table A8: Death before retirement rates for all members

Age	Males	Females
20	0.0001	0.0000
25	0.0001	0.0001
30	0.0002	0.0001
35	0.0003	0.0002
40	0.0004	0.0003
45	0.0006	0.0004
50	0.0008	0.0006
55	0.0014	0.0009
60	0.0023	0.0012
65	0.0036	0.0017

Promotional pay increases

Table A9: Promotional salary scales for all members

Age	Males	Females
20	89	89
25	100	100
30	125	124
35	151	143
40	168	152
45	179	158
50	186	164
55	190	168
60	192	170
65	194	172

Commutation of pension for cash at retirement

Table A10: Commutation assumptions

	NPA 60 service	NPA 65 service ²¹	2015 scheme service ²¹
Males	5%	17.5%	17.5%
Females	4%	17.5%	17.5%

²¹ Specified by HMT Directions.



Family statistics

Table A11: Recommended proportion married or partnered at retirement for future pensioners

	Accrual before 1/1/2007	Accrual on or after 1/1/2007
	Proportion married	Proportion married or partnered
Males	77%	77%
Females	58%	58%

Table A12: Recommended proportion married or partnered for current pensioners (at the valuation date)

Age	Accrual before 1/1/2007		Accrual on or after 1/1/2007	
	Males	Females	Males	Females
50	74%	58%	78%	60%
60	74%	58%	78%	60%
70	74%	46%	76%	47%
80	61%	23%	62%	23%
90	35%	7%	35%	7%

Men are assumed to be three years older than their partners and women are assumed to be two years younger than their partners.

No allowance is made for pensions to cease on remarriage.



Appendix B: Assumptions made for data uncertainties

Summary

- B.1 Whilst comprehensive data was received from Teachers' Pensions for the 2016 valuation, some aspects of the data were incomplete and/or unreliable for certain elements of our valuation calculations.
- B.2 It has not been possible to fully resolve these data issues in the timescale required for the valuation. Therefore to calculate results for the 2016 valuation of the Scheme requires assumptions in respect of incomplete and/or unreliable individual member records and movements data, the latter is used for setting assumptions and in the calculation of the Net Leavers Liability.
- B.3 Scheme specific assumptions are determined by the "responsible authority", which is the Secretary of State for Education in the case of the Scheme, and must be set as best estimate assumptions and not include margins for prudence or optimism.

Individual member records

- B.4 Membership data is provided by Teachers' Pensions for the purpose of the 2016 valuation and we apply checks to these membership records to ensure all key data items are provided and reliable for valuation purposes. Following these checks, it was identified that individual member records at the relevant dates as required for valuation purposes were not fully complete and reliable. We worked with Teachers' Pensions to address a number of these issues, however where critical data items were missing from member records the general approach taken was to exclude that record for calculation purposes with calculations based on the remaining dataset being rated up incorporate an allowance for the excluded records.
- B.5 Uprating factors were determined for each membership category equal to the ratio of known valid records and the number of records with adequate data. Implicitly this uprating approach assumes that the records with omissions or errors have the same average profile (age, sex, pay, service) as fully complete records. As very few records were ultimately excluded as a result of our data checks, this is not expected to be a material source of uncertainty on the results of the TPS valuation.
- B.6 Our report on the membership data provided for this valuation also includes a section on data uncertainty. The key issues highlighted in that section are the uncertainties around the status of non-pensioner members (ie. whether members are classified as active or deferred at the valuation date) and potential underreporting of active members' service. These uncertainties arise as a consequence of the rating up of the active member data, and rating down of deferred member data and missing employer returns. This adjustment process assumes that it is appropriate to benchmark the active membership against the active payroll implied by the scheme accounts, and that misclassified members of broadly typical of other active members of the scheme.



- B.7 Full details on the adjustment made, and our assessment of the associated risks can be found in our membership data report. However, as an overall guide, we estimate that the total potential impact on this uncertainty on the valuation results may be of the order of 0.2% of pensionable pay.
- B.8 The figures above illustrate the potential impact if known data omissions are subsequently found to have been handled incorrectly. Since it is not possible to undertake independent checks for all categories of members and a full reconciliation has not been achieved against all prior datasets there is the potential for currently unidentified problems with the data to emerge in future. For example, a group of deferred members could be identified where no liability has previously been determined. The impact of such unknowns emerging at subsequent valuations could be considerably more than the sensitivity indicated above.

Movements data

Setting assumptions

- B.9 Teachers' Pensions supplied data on the experience of the scheme membership over the four-year period to 31 March 2016. Fully complete and comprehensive data about members moving between certain statuses (e.g. leaving and rejoining active status) was not able to be provided. Analysis of member movements is needed to inform scheme specific demographic assumptions as scheme-specific experience, both recent and longer term, generally provides the most reliable evidence when considering best estimates of future experience.
- B.10 Assumption setting relies on analysis of movements data in consideration with such other relevant information which is available. The setting of demographic assumptions is to some extent subjective and a matter of interpretation. Changes in assumptions may be expected at successive valuations as circumstances change even with full data. Thus, the absence of fully complete movements data does not necessarily introduce uncertainty into the valuation results provided there is other relevant information available to inform those assumptions. It is to be expected that there is some volatility in the experience arising from an analysis of movements data. As assumptions are intended to reflect long term expectations it is reasonable to seek to smooth out the impact of these short term effects. A number of the recommendations we make for scheme-specific valuation assumptions smooth out the short term effects by taking only 50% of the difference in experience since the 2012 valuation, for example in recommending the assumption for baseline pensioner mortality.



- B.11 It should however be recognised that should movements data become available for future valuations it could result in recommendations regarding appropriate assumptions which lead to greater changes in valuation results than otherwise. It is difficult to quantify the potential scale of this discontinuity but it could be over +/-1% of pensionable pay on the uncorrected employer contribution rate and the employer contribution correction cost. For example, if the number of pensioner deaths was overstated or understated in the data available for setting assumptions for the 2016 valuation but correctly stated at a subsequent valuation, this would have an impact on the mortality assumptions adopted and potentially lead to a large change in the assumption at future valuations and hence a corresponding change in liability and employer cost.

Net Leavers Liability (NLL)

- B.12 The initial cost cap fund is set equal to the liability for actives members at 31 March 2015. The cost cap mechanism is intended to manage the costs of the reformed scheme and recognise any unexpected experience relating to pre-reformed entitlements of members in service at 1 April 2015, but only to the point at which they leave active service. NLL is a quantification of the amount of pre-reformed liabilities which fall out of the cost cap fund at a valuation owing to members which have left service since the previous valuation (or since the initial cost cap fund was set in the case of the 2016 valuation), net of the additional liabilities in respect of members with pre-reformed service who rejoined active membership during 2015-16.
- B.13 To accurately calculate NLL in accordance with the directions requires full movement data for all members who were active in 2015 and are no longer active at the 2016 valuation. The data available was not suitable for calculating NLL, primarily due to the large number of members movements recorded during the inter valuation period, which showed significant numbers of members withdrawing, and then subsequently rejoining, active service. Cashflow data taken from the scheme accounts was therefore used to supplement and adjust the data available to provide for a reasonable estimate of NLL to be calculated.
- B.14 An alternative would be to adopt an approach which implicitly makes an assumption that there is no unidentified experience gain or loss arising over the period 2015 to 2016. A risk of this approach is that any upward or downward cost pressure that has occurred over the period, but has not been explicitly identified will not be reflected in the 2016 valuation results.
- B.15 If we had adopted the alternative approach to setting the NLL, then the results of the assessment of the employer contribution correction cost would have been 0.1% of pensionable pay different from under the recommended approach. This level of uncertainty relating to the NLL is in addition to the uncertainty associated with the scheme's individual membership data, as set out in Appendix F of our membership data report.



- B.16 We would not expect significant unidentified experience gains or losses to arise over the one year period 2015 to 2016, although some uncertainty remains. In addition we have reconciled the surplus or deficit arising over the period 2012-16 with an unexplained item of £0.2 bn, which is equivalent to less than 0.1% of pay on the uncorrected employer contribution rate. There could only be an unidentified experience gain or loss to arise over the period one year 2015 to 2016 greater than 0.1% of pay if it was offset by another unidentified experience gain or loss arising in the period 2012-15 (or in 2015-16 in respect of non-active members of the pre-reform schemes).
- B.17 For the 2016 valuation, the NLL calculation period is only one year, rather than a full four-year valuation. Given the short period over which any gain or loss may have arisen it might reasonably be concluded that the lack of data for the NLL calculation is not critical for this valuation although it would become so in future valuations when a longer period is considered.



Appendix C: Modelling approach and minor assumptions

Active membership projections

- C.1 Direction 11²² requires the actuary to use the 'projected unit methodology' to calculate the valuation results. The valuation results require the calculation of the cost of benefit accrual over periods after the effective date (31 March 2016). The expected cost of benefits provided to members remaining in the pre-2015 scheme under the provisions of transitional protection differs from the expected cost of providing members with benefits in the 2015 scheme. Further the expected cost of providing benefits varies for members with differing benefit provisions within the pre-2015 scheme (notably for members with differing normal pension ages). This implicitly requires the actuary to estimate the membership to future dates in order to determine the valuation results.
- C.2 Since the majority of members (around 90%) were accruing benefits in the 2015 scheme at the effective date, and further given that the remaining members continuing to accrue benefits in the pre-2015 scheme are expected to rapidly decline to close to nil over the future periods being considered in this valuation, a pragmatic approach to estimating the future membership of each section/scheme over the relevant future periods is suitable.
- C.3 The approach taken has 3 component assumptions:
- > Members of the pre-2015 sections at the valuation date are assumed to retire in line with recent experience. This provides for some protected members to remain in the scheme beyond 2022 due to late retirement
 - > The overall profile of the membership in terms of average age and pay distribution is assumed to remain constant over the period

These assumptions enable the average cost of accrual based on the proportions of members in each section/scheme in any period to be determined.

- > The overall active membership will be in receipt of pensionable pay for each relevant year equal to that assumed for forecasting purposes.

This assumption is required only to determine any contributions required for past service adjustments.

²² The Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended).



Grouping of individual active member records

- C.4 Individual active members have been grouped together for the purposes of calculating liabilities. This grouping is necessary to accommodate the volume of data within our valuation system. The approach taken to grouping the data has been tested to ensure it does not result in any distortion of the valuation results. The groupings are made for each section/scheme (i.e. NPA 60, NPA 65 or 2015), protection status (i.e. protected, tapered or unprotected) and based on the following criteria.

<i>Age</i>	<i>Age nearest</i>
<i>Service</i>	<i>Duration (years nearest)</i>

Accrual cost methodology

- C.5 When determining the costs of accrual as required by Directions 27(1)(d) and 40(1) the cost for members in each group at each relevant date (as identified from the membership projections) has been determined for each age and that rate has been applied to the total pensionable pay at each age to determine the average for the membership as a whole at each date. The cost over each relevant period has been taken as the average of the cost at the start and end of each period. The calculation allows for mortality improvements assuming the calculation date is the midpoint of each period.
- C.6 Direction 11 requires use of the projected unit methodology to determine the valuation results. Directions 14, 16 and 17 specify some modifications to the financial assumptions in the short term. An implication of the short term modifications is that the projected unit methodology is expected to result in an increasing standard contribution rate over successive periods. For example the cost of accrual under the existing scheme over the period 2016 - 2019 is lower than that over the period 2019 - 2023 (ignoring any redistribution of members between sections and into the 2015 scheme). This effect is not immaterial for final salary benefits but has no effect on the cost cap future service cost calculation since short term assumptions are explicitly disregarded for this purpose in Direction 40.
- C.7 Non-accruing benefits such as lump sums payable on death in service have been recognised only when a benefit payment is expected.

Guaranteed Minimum Pensions (GMPs)

- C.8 A global adjustment will be applied to reduce the past service liability in respect of estimated GMP entitlements for which provision of post SPA pension increases is not currently the responsibility of the scheme. The reduction makes allowance for the impact of the first and second interim solutions for equalisation and indexation, and is equivalent to a contribution rate adjustment of 0.9% over the 15 year period from the implementation date. This estimation has no impact on the calculation of the employer contribution correction cost.



Public Service Transfer Club (PSTC)

- C.9 Allowance has been made for the potential additional liabilities arising from inward transfers on PSTC terms. The financial impact is expected to be 0.1% of pensionable pay on the valuation results.

Final pensionable pay

- C.10 All liabilities have been based on pensionable pay at the effective date as provided by DfE. No explicit allowance has been made for the impact of prior years' earnings resulting in higher final pensionable pay for particular members since this effect is not expected to impact a material number of members.

Dependants' pensions

- C.11 No allowance has been taken for short term dependant pensions or children's pensions (other than those already in payment), on ground of immateriality.

Expenses

- C.12 No allowance has been made for expenses. Expenses are outside the valuation framework.

Early retirement factors

- C.13 When modelling retirement before Normal Pension Age where an actuarial reduction would be applied early retirement factors have been set equal to current factors (applied for the appropriate period before the normal pension age).

Deferred members over NPA

- C.14 Many of the records for deferred members aged over NPA are expected to relate to benefits which are unlikely to be claimed (e.g. partial refund cases or where preserved records have been incorrectly maintained after benefits have been put into payment). For this reason, and in agreement with DfE, we have assumed that only half of these members will ultimately claim their benefits. This approach is equivalent to a reduction in the contribution rate of 0.3% over the 15 year period from the implementation date, with no impact on the employer contribution correction cost.

Re-entry of members

- C.15 Re-entry of members to pensionable service has been modelled by the use of a 'net' withdrawal assumption for active members. This explicitly allows for a proportion of those leaving active service to return. No explicit allowance has been made in the valuation for a proportion of those deferred at the effective date to subsequently rejoin. However the analysis undertaken for active members, and the resultant 'net' withdrawal rates include those rejoining from deferred status and hence the valuation of active members implicitly includes some provision for deferred members to return.



Additional voluntary contributions

- C.16 Additional voluntary contributions paid to on a money purchase basis are paid in accordance with Regulations which are separate to the pension scheme regulations and have not been considered for the valuation. Additional voluntary contributions paid in accordance with the pension scheme regulations to secure added service or pension are taken into account as liabilities of the scheme.

Scheme pays

- C.17 Members can opt to use the scheme pays facility to pay HMRC for an annual allowance or lifetime allowance tax charge (i.e. the scheme pays the tax charge on behalf of the member for a corresponding reduction to the member's pension). Where members have opted to use this facility a lower liability has been valued for these members, to reflect a scheme pays pension debit. The notional fund allows for actual cash flows and reflects any tax charges paid by the scheme, therefore a corresponding lower notional fund has been valued. The impact of these will broadly net off for valuation purposes.

Member contribution yield over implementation period

- C.18 The latest TPS Annual Report and Accounts shows that the member contributions received by the scheme have averaged around 9.5% of pensionable pay across all members of the scheme. This is 0.1% of pensionable pay less than the target yield of 9.6% of pay. The member contribution rate tier thresholds are increased annually in line with the Consumer Price Index. DfE expects, based on projecting scheme membership using assumptions in line with those adopted for this valuation, that the member contribution yield will return to target over the period April 2019 to March 2023. DfE has therefore instructed us to adopt an assumption that the target yield is met on average over the future period under consideration in this valuation.