



Government Actuary's Department



Firefighters' Pension Schemes (England)

Actuarial valuation as at 31 March 2016
Advice on assumptions

Date: 28 February 2019

Author: Chris Mulholland



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1 Executive summary

This report contains our recommendations for the best estimate assumptions to be set by the Home Secretary for the 2016 valuation of the Firefighters' Pension Schemes (England) ('the Schemes').

- 1.1 An actuarial valuation of the Firefighters' Pension Schemes (England)¹ ('the Schemes'), is being carried out as at 31 March 2016. The 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 Home Secretary, having obtained advice from the scheme actuary. Direction 19(c) requires the assumptions to be the Home Secretary's best estimates.
- 1.2 GAD is the appointed scheme actuary to the Schemes. This report has been commissioned by the Home Office and sets out GAD's formal advice to the Home Secretary on the actuarial assumptions to be adopted where these are not otherwise specified. The advice covers the assumptions to be set by the Home Secretary. The main advised assumptions are summarised in Table 1 with further detail in Appendix A.
- 1.3 This report relates to demographic assumptions, ie assumptions about member behaviours. When considering appropriate assumptions, 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 completed actuarial valuation of the Schemes was carried out as at 31 March 2012. Many of the assumptions put forward in this report are the same as adopted for that valuation. The changes are:
 - > Rates of pensioner mortality have been updated to reflect recent experience (and the HMT directed assumption for future changes in mortality has been updated to reflect changes in population mortality as reflected in the updated ONS population projections³).
 - > Age retirement (ie normal health) rates for members with 1992 Scheme benefits have been updated to align more closely with experience over 2012-2016.

¹ As provided by The Firefighters' Pension Scheme Order 1992 (SI 1992/129) (as amended), The Firefighters' Pension Scheme (England) Order 2006 (SI 2006/3432) (as amended) and The Firefighters' Pension Scheme (England) Regulations 2014 (SI 2014/2848) (as amended).

² Certain assumptions are specified in the Directions.

³ From the 2012 based ONS projections to the 2016 based ONS projections.



- > The amount of pension assumed to be commuted for a cash lump sum at retirement has increased in respect of members with 2015 Scheme service.
- 1.5 The following chapters and appendices provide more detail on the advice, supporting analysis and an indication of the magnitude of financial impact of each assumption on valuation results. They also contain important background information about the context of this advice and its limitations.
- 1.6 The estimated financial impact of changing assumptions is shown in Table 1 below. These have been calculated in an approximate way and are intended to provide a broad indication of the impact and are not definitive.
- 1.7 This report was provided to the Home Secretary in draft form, and was also circulated to the Firefighters' Pension Scheme Advisory Board (England) in draft in September 2017. Since the draft version, the main changes have been to update our advice regarding the commutation assumption and to include two additional appendices regarding assumptions for data uncertainty and Special members. This report has been signed alongside the formal valuation report. The Home Secretary 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.

Compliance and quality standards

- 1.8 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 ⁴	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁵	
			Employer contributions (2019-23) – past service impact ⁶ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁷ (% of pay)
Pensioner baseline mortality⁸	Aligned to standard SAPS table ^{9,10}			
Current pensioners (normal and ill-health)	113% x S2NMA	A combination of the existing assumption and the 2012-2016 experience, and including the use of an 'amounts' based analysis.	+1.5%	+1.7%
Future pensioners (normal and ill health)	113% x S2NMA			
Dependants	100% x S2DFA			

⁴ In general, our recommendations are for the same assumptions to be used for males and females. As 95% of members are male, there is insufficient data to analyse female members separately, other than for dependant pensioners who are mostly female.

⁵ The financial impacts have been estimated on an approximate basis using the 2012 valuation results and long term financial assumptions, and should only be used as a guide to the approximate size of the impact. Each impact is specific to the change described and a combination of assumption changes will not necessarily equate to the sum of the individual impacts.

⁶ Impact on uncorrected employer contribution rate of spreading change in past service liabilities over 15 years.

⁷ Total change in employer rate of spreading past service and allowing for future service impacts.

⁸ As directed by HMT, future improvements in mortality assumed to be in line with those underlying the most recent ONS population projections. The financial impact shown relates only to the change in baseline mortality.

⁹ SAPS tables are published by the Actuarial Profession and the S2 series is based on the experience of self-administered pension schemes from 2004 to 2011. The S2 series has separate standard tables, including those based on experience of members retiring in normal health (S2NMA), in ill-health (S2IMA) and for widows (S2DFA).

¹⁰ 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.



Assumption ⁴	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁵	
			Employer contributions (2019-23) – past service impact ⁶ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁷ (% of pay)
Age retirement				
1992 Scheme protected, tapered and unprotected members with more than 16 years' service at March 2012	Age and service based rates, with many retiring on reaching 30 years' service and all retiring by age 60.	In light of 2012-2016 experience.	Not material	Not material
1992 Scheme unprotected members with less than 16 years' service at March 2012	No retirements before age 55. Age and service based rates, with many retiring at age 55. All assumed to retire by age 60.	Based on the assumption for the protected group, but with no allowance for retirement before age 55. There is, however, no relevant evidence yet.		
2006 Scheme (protected, tapered and unprotected)	All retire at age 60.	Small amount of 2012-2016 experience close to previous assumption.	No change in assumption.	
Special retained members (protected, tapered and unprotected)	All retire at age 55.	Insufficient evidence. Proposal allows for the full take up of benefits at the earliest time at which they become available on an unreduced basis in the modified scheme.	New assumption.	
2015 Scheme - new entrants	25% retire at 55 and remainder retire at 60.	Insufficient evidence. Proposal makes a reasonable allowance for the take up of benefits at the earliest time at which they become available and is in line with the assumption that was adopted for the 2012 valuation and used for the scheme reform work. To be kept under review.	No change in assumption.	



Assumption ⁴	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁵	
			Employer contributions (2019-23) – past service impact ⁶ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁷ (% of pay)
Ill-health retirement				
Incidence	Same assumptions for males and females. Increasing by age: around 0.03% at age 30, 0.10% at age 40 and 0.50% at age 50.	No change from 2012 assumption. In light of 2012-16 experience.		No change in assumption.
Upper/lower-tier split	40% on upper-tier.	No change from 2012 assumption. 2012-2016 experience data inconclusive.		No change in assumption.
Withdrawal				
Regulars (and Special retained)	Same assumptions for males and females. Decreases with age: 1.1% at age 25, 0.3% at age 45.	No change from 2012 assumption. 2012-2016 experience is higher than 2012 assumption but events during 2012-16, and emerging experience since 2016, suggest it is not expected to be a reliable indicator of future trends.		No change in assumption.
Standard retained	Nine times the regular withdrawal rates.			
Death before retirement				
	Same assumption for males and females. Increasing by age: 0.02% at age 30, about 0.04% at age 40, 0.08% at age 50.	No change from 2012 assumption. In light of 2012-16 experience.		No change in assumption.



Assumption ⁴	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁵	
			Employer contributions (2019-23) – past service impact ⁶ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁷ (% of pay)
Promotional salary scale				
Regular firefighters	Service based scale: large increases for first four years, 0.7% a year for next 8 years, then about 1.2% a year up to 30 years, with a lower increase thereafter.	No change from 2012 assumption. In light of 2012-16 experience.	No change in assumption.	
Retained firefighters (including Special members)	Age related scale: about 1% a year up to age 50, 0.4% a year thereafter.	No change from 2012 assumption. In light of 2012-16 experience.	No change in assumption.	
Commutation				
1992 Scheme - protected	0% of pension commuted.	Cost neutral commutation terms.	No change in assumption.	
2006 Scheme (Special retained) - protected	0% of pension commuted.	In line with 1992 Scheme assumption noting materiality.	New assumption.	
1992 Scheme - unprotected and tapered	0% of 1992 Scheme and 8.75% of 2015 Scheme pension commuted.	1992 Scheme offers a significantly greater lump sum for pension given up, but experience indicates members will still commute some of their 2015 Scheme pension.	Not material	-0.3%
2006 Scheme (Special retained) - unprotected and tapered	0% of 2006 Modified Scheme and 8.75% of 2015 Scheme pension commuted.	Updated as per the assumption for 1992 Scheme unprotected and tapered members.	New assumption.	
For all other members the directed commutation assumption of 17.5% of pension applies.				



Assumption ⁴	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁵	
			Employer contributions (2019-23) – past service impact ⁶ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁷ (% of pay)
Family statistics				
Proportion married	75% at retirement (consistent assumptions for existing pensioners).	No change. In light of 2012-2016 experience.		
Proportion partnered	80% at retirement (consistent assumptions for existing pensioners).	No change. In light of 2012-2016 experience.	No change in assumptions.	
Age difference	Males 3 years older than partner.	No change. In light of 2012-2016 experience.		
Remarriage	No allowance.	No change (no evidence).		



2 Introduction

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

- 2.1 An actuarial valuation of the Firefighters' Pension Schemes (England) ('the Schemes') is being undertaken as at 31 March 2016. The Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended) ('the Directions') require that, unless specified otherwise¹¹, the actuarial assumptions to be adopted for this valuation are the responsibility of the Home Secretary, having taken advice from the scheme actuary. Direction 19(c) requires the assumptions to be the Home Secretary's best estimates.
- 2.2 GAD is the appointed scheme actuary to the Schemes. This report is addressed to the Home Secretary 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 Home Secretary to determine the required best estimate assumptions.
- 2.3 The advice covers the main assumptions to be set by the Home Secretary. 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

Appendix B includes details about the modelling approach and other calculation assumptions as required to complete the valuation, Appendix C sets out assumptions made for data uncertainties, Appendix D includes sensitivities around the choice of assumptions set by the Home Secretary and Appendix E sets out assumptions for the calculation of the prior value of the cost cap fund in respect of Special retained members of the 2006 Scheme as at 31 March 2015.

¹¹ Certain assumptions are specified in the Directions.



- 2.4 This report was provided to the Home Secretary in draft form, and was also circulated to the Firefighters' Pension Scheme Advisory Board (England) in September 2017. Since the draft version, the main changes have been to update our advice regarding the commutation assumption and to include two additional appendices regarding assumptions for data uncertainty and Special members. This report has been signed alongside the formal valuation report. The Home Secretary 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.
- 2.5 The Schemes' administrators supplied data on the experience of the membership of the Schemes over the four-year period to 31 March 2016. We have used this data to analyse the Schemes' experience in order to develop our advice on the assumptions. Our report, *Firefighters' Pension Schemes (England): Actuarial Valuation as at 31 March 2016: Report on valuation data*, also finalised today, 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.
- 2.6 When considering appropriate assumptions, experience (both recent and longer term) generally provides the most reliable evidence when considering best estimates of future experience. However, robust analysis of scheme experience will only be possible where there is both sufficient quality, and quantity, of data. The level of reliance that can be placed on any assumptions derived from the analysis will also vary depending on these two factors. Anticipated future events may also influence how assumptions are set.
- 2.7 It is generally accepted that larger datasets will be subject to less volatility and statistical variation, and may be less prone to the impact of errors in individual records. For the smallest public service pension schemes it may therefore not be possible to undertake, in isolation, a statistically reliable analysis of that scheme's own experience. For other schemes it may only be possible to complete a reliable analysis of certain aspects of the scheme's own experience.
- 2.8 The Schemes in aggregate are a relatively small public service pension scheme with around 86,000 members. In this report we propose to set certain assumptions based on an analysis of the Schemes' own experience over the four year period from 31 March 2012 to 31 March 2016. Other proposed assumptions have been recommended on the basis of, or in conjunction with, the outcome of the previous analysis carried out for the 31 March 2012 valuation, covering experience over the five year period to that date.
- 2.9 Where the scheme membership data is not sufficient for the scheme actuary to carry out a robust analysis of that aspect, the Directions require the report to include a statement to that effect. We have included comments to this effect in Section 3, with additional information included, where necessary, alongside the analysis for each assumption.



- 2.10 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 Home Secretary 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 membership of the Schemes. The Home Secretary should consider whether there is any reason why the approach taken to setting the assumptions would be inappropriate.
- 2.11 We are content for the Home Secretary 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.
- 2.12 Third parties whose interests may differ from those of the Home Secretary should be encouraged to seek their own actuarial advice where appropriate. Other than to the Home Secretary, GAD has no liability to any person or third party for any act or omission taken, either 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 Home Secretary'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; and
- > relevant data from any other sources.

Different populations

- 3.3 The Directions require this actuarial valuation of the Fire Schemes to cover both the scheme established under the Public Service Pensions Act 2013¹² ("2015 Scheme") and the previous pension schemes ("pre-2015 schemes"), being the 1992 Scheme and 2006 Scheme. Assumptions appropriate to both the 2015 Scheme and the pre-2015 schemes are required for the valuation. The Directions also require assessment of benefit accrual costs over the **implementation period**¹³. 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 3 distinct groups of members.
- > Those with full protection and remaining in the pre-2015 schemes 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.

¹² http://www.legislation.gov.uk/ukpga/2013/25/pdfs/ukpga_20130025_en.pdf

¹³ 1 April 2019 to 31 March 2023



- > Members with service in both the 2015 Scheme and a pre-2015 scheme (including members with tapered protection). Over time, as the proportion of 2015 Scheme service increases, the retirement behaviours are expected to become increasingly influenced by the provisions of that scheme.
- 3.5 Within the 2006 Scheme and 2015 Scheme, members are separately identified as either regular firefighters or retained firefighters. There are no retained firefighter members of the 1992 Scheme.
- 3.6 Where relevant we indicate in each of the following chapters the relative importance of each set of assumptions to the groups of members identified above.

Relative importance of assumptions

- 3.7 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. Appendix D provides an indication of the sensitivity of the valuation results to the particular assumptions under consideration.

Males and Females

- 3.8 There are relatively few female firefighters (ie less than 1% of pensioner members and less than 5% of active members are female) and as such it is not possible to perform any separate robust experience analysis for females. Our analysis therefore covers male members only. We recommend that the same assumptions are used for male and female firefighters in any given sub-group, based on the analysis of the males in the sub-group. We do not expect the use of different assumptions for females would have a material impact on the valuation results.
- 3.9 The only exception is for dependant pensioners, who are nearly all females. Therefore, the analysis and proposed assumption for these members is based entirely on an analysis of the females in this sub-group.

Special Retained Members

- 3.10 An amendment¹⁴ to the 2006 Scheme regulations made in February 2014 introduced a modified section of the 2006 Scheme for retained firefighters who were employed in England during the period 1 July 2000 to 5 April 2006 to provide them with access to a pension scheme (known as 'Special' members). The Special members could purchase past pensionable service in the modified section of the 2006 Scheme from the date their service began or from 1 July 2000, if later.

¹⁴ http://www.legislation.gov.uk/ukxi/2014/445/pdfs/ukxi_20140445_en.pdf



- 3.11 Special members were not present in the 2012 valuation, so there are no existing assumptions for them. Therefore, we have considered assumptions for these members in this report and set out in the relevant sections where assumptions for Special members differ from those for standard 2006 members for use in the 2016 valuation.
- 3.12 We have also considered assumptions for Special members for the purposes of calculating the prior value of the cost cap fund as at 31 March 2015. The Directions require that the assumptions used for this purpose are the assumptions adopted at the 2012 valuation. As no such assumptions already exist for Special members, we have set out proposed assumptions for these members in Appendix E that are consistent with those adopted for standard retained members at the 2012 valuation.



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.

- 4.1 The assumptions we recommend for baseline pensioner mortality for the 2016 valuation may be summarised by reference to standard mortality tables as follows. The corresponding assumptions for the 2012 valuation are also shown.

Table 4.1: Recommended mortality assumptions

Baseline mortality	2012 valuation		2016 valuation	
	Standard table ¹⁵	Adjustment*	Standard table ¹⁶	Adjustment*
Current normal and ill-health pensioners	S1NMA	113%	S2NMA	113%
Future normal health pensioners	S1NMA	110%	S2NMA	113%
Future ill-health pensioners	S1IMA	100%	S2NMA	113%
Dependants	S1DFA	100%	S2DFA	100%

*An adjustment of 113% means that mortality rates are 13% higher than in the standard table.

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

¹⁵ SAPS (S1) tables are published by the Actuarial Profession and based on the experience of self-administered pension schemes over the period 2000 to 2006. The 'S1' series has separate standard tables based on experience of members including those retiring in normal health (S1NMA), members retiring in ill-health (S1IMA) and for female dependants (S1DFA).

¹⁶ 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 includes separate standard tables based on experience of male members retiring in normal health (S2NMA) and in ill health (S2IMA) and for female dependants (S2DFA). The S3 series of tables were released by CMI on 5 December 2018 and these updated mortality tables cover experience between 2009 and 2016. The final tables are unchanged from the working paper issued during 2018, from which GAD concluded that moving to the S3 tables would likely have no material impact on the valuation results as a whole. It therefore remains appropriate to use the S2 tables for the current valuation.



Comparison of expected pensioner longevity

4.3 The table below gives a comparison of the resulting life expectancies¹⁷ (allowing for future improvements) assumed for the 2012 valuation and recommended for the 2016 valuation. The life expectancies shown under each column are calculated using the following assumptions:

- > The mortality assumption adopted for the 2012 valuation allowing for ONS 2012 future mortality improvements
- > The mortality assumption adopted for the 2012 valuation changed from a 'lives' to 'amounts' basis (see paragraphs 4.9 to 4.14)
- > As previous column, but with life expectancies calculated from the year 2016, rather than from 2012.
- > As previous column, but using ONS 2016, rather than ONS 2012.
- > The proposed mortality assumption for the 2016 valuation allowing for ONS 2016 future mortality improvements (on an 'amounts' basis)

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

Base table:	2012 assumption (lives)	2012 assumption (amounts¹⁸)	2012 assumption (amounts¹⁸)	2012 assumption (amounts¹⁸)	2016 assumption (amounts)
Future mortality improvements:	ONS 2012	ONS 2012	ONS 2012	ONS 2016	ONS 2016
Effective year for life expectancies:	2012	2012	2016	2016	2016
Current pensioners (normal and ill-health)					
Member aged 50	37.2	37.5	38.0	36.7	36.8
Member aged 55	31.9	32.3	32.8	31.5	31.6
Member aged 60	27.0	27.3	27.7	26.5	26.6
Member aged 65	22.1	22.4	22.9	21.7	21.7
Future pensioners (normal and ill-health) – current age 45¹⁹					
Member life expectancy from age 50	37.8	38.2	38.7	37.2	37.4
Member life expectancy from age 55	33.2	33.5	34.0	32.6	32.7
Member life expectancy from age 60	28.7	29.0	29.4	28.0	28.1
Member life expectancy from age 65	24.3	24.6	25.0	23.6	23.7

¹⁷ Cohort life expectancies based on ages shown in the effective year, ie allowing for future mortality improvement.

¹⁸ At the 2012 valuation it was not possible to carry out an 'amounts' based analysis but sufficient data was available at the 2016 valuation to carry out an 'amounts' based analysis on the 2012-16 data and to show the 2012 valuation assumption on an 'amounts' rather than 'lives' basis, assuming the relationship between the two had been the same in 2012 as in 2016. These columns show the impact of changing the 2012 valuation assumption to an 'amounts' basis. See paragraphs 4.9 to 4.14 for further details.

¹⁹ Life expectancies for future pensions based (on a combined health basis) on 2012 valuation assumptions use 113% of S1NMA base table to follow an approach consistent to the proposed 2016 assumptions.



Use of the assumption

- 4.4 Pensioner mortality is a key valuation assumption and is a measure of how long members retiring in normal or ill-health, or their dependants, are expected to live and receive benefits.

Analysis and setting the assumption

- 4.5 We have analysed the actual pensioner mortality experience over the four-year period to 31 March 2016 for male retirements and female dependants. There is insufficient data to carry out a credible analysis for female retirements and male dependants. For these groups we have proposed use of the same standard mortality tables as those applying to members of the opposite sex. This is consistent with the approach adopted at the 2012 valuation.
- 4.6 For those groups where a credible analysis is possible, we have analysed the actual pensioner mortality experience over the four-year period to 31 March 2016 on an 'amounts' basis. To derive an assumption on an amounts basis we have compared the actual amounts of pension ceasing on deaths with those amounts 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 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 below. The figures shown are the ratios of actual to expected death rates with expected rates based on the 2012 valuation assumptions, 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. 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 averaging between the 2012 assumption and the 2012-2016 experience, weighted appropriately.
- 4.8 We recommend that the mortality assumption for future pensioners, for both normal and ill-health retirement, is the same as the assumption proposed for current pensioners. This is a change from the 2012 approach which used:
- > 100% of a standard ill-health mortality table for future ill-health retirements; and
 - > an adjusted standard normal health mortality table, with the adjustment calculated such that the combination of expected future normal and ill-health retirements would have the same mortality as the assumption for current pensioners (both normal and ill-health).



This change in approach is not expected to have a material impact on the valuation results, but has the advantage that it is easier to understand and is consistent with the approach taken by other public sector pension schemes which use a combined normal and ill-health mortality assumption for current pensioners.

Table 4.3 – Variation in rates of death by scheme year

Year	Combined normal health and ill-health males (Actual / Expected based on 2012 assumption*)
2012-2013	91.3%
2013-2014	90.1%
2014-2015	85.8%
2015-2016	81.1%
Overall	86.8%

*2012 baseline with ONS-2014 improvements

‘Amounts’ analysis vs ‘lives’ analysis

- 4.9 Provided adequate data is available, mortality can be analysed on either a ‘lives’ basis or an ‘amounts’ basis:
- > A lives basis gives an equal weighting to every member of the population being analysed.
 - > An amounts basis weights the experience by the size of each member’s pension (with the longevity of those with larger pensions given more of a weighting).
- 4.10 There is much evidence²⁰ to demonstrate that the size of pension is positively correlated with longevity, ie on average those with bigger pensions live longer. For a population with significant variation in the characteristics of the membership and in the amounts of pension being paid, an amounts mortality analysis is generally expected to show lower rates of mortality than a corresponding lives analysis.
- 4.11 Where possible it is usually preferable to use an amounts analysis rather than a lives analysis to set the mortality assumption for an actuarial valuation as in an amounts analysis the weighting given to different members’ mortality experience more closely reflects the relative size of their financial liabilities to the pension scheme.

²⁰ For example see CMI self-administered Pension Schemes Mortality Committee, Working Paper 65: *Analysis of the mortality experience of pensioners of self-administered pension schemes for the period 2004 to 2011, April 2013.*



- 4.12 At the 2012 valuation it was not possible to complete an amounts analysis as data on pension amounts at death was not available. Therefore, a lives analysis was done and this was used to set the assumptions which were adopted for the valuation. GAD's *Advice on assumptions* report dated 6 March 2015 included the following comment:

... we have carried out our analysis on a 'lives' basis, which considers the number of deaths without weighting by pension amount. We consider this to be a reasonable method for the Schemes, as the underlying population is largely homogeneous, and so pension amounts are less widely spread than would be the case in a more diverse scheme. However, if the amounts data were available it is possible that analysis could lead to different mortality assumptions.

- 4.13 For the 2016 valuation it has been possible to do an amounts analysis and a lives analysis. The amounts analysis results in mortality rates that are about 5% lower than the lives analysis over the period 2012-2016. However, this difference varies significantly for each year of the 2012-16 period, reflecting the volatility that might be expected with the relatively small amount of data being analysed. We have therefore considered the equivalent analysis from the larger Police Pension Scheme, which is the public service pension scheme with a membership profile most similar to the Fire Schemes. This showed a 4% difference between the lives and amounts analysis, with this difference being stable for each year across the 2012-16 period. We have therefore assumed that the difference between a lives and an amounts analysis at the 2012 valuation would have been in the region of 4% adjustment to the standard table.
- 4.14 As discussed in paragraph 4.7, we propose to set the 2016 assumptions by averaging between the observed 2012-16 experience and the 2012 assumption. Before doing this averaging, we have subtracted 4% from the adjustment made to the standard table in the 2012 assumption, to give what we estimate the 2012 assumption would have been had we been able to do an amounts analysis at the time (ie we have assumed that the 2012 assumption was 109% of the S1NMA table rather than 113% of S1NMA which was actually used for the valuation).

Results of analysis

- 4.15 Table 4.4 sets out the number of pensioner deaths and amount of pension ceasing due to deaths over the inter-valuation period. These figures exclude:
- > normal health and ill-health deaths from 17 fire authorities (which represent about 25% of the pensioner membership)
 - > dependants deaths from 28 fire authorities (covering around 50% of all dependants)

where the data provided about deaths did not appear credible. Figures are shown separately for males retiring in normal or ill-health and for female dependants. In each case these are compared with the expected figures from the 2012 valuation assumption (with ONS-2014 improvements) and with the unadjusted 2016 base table.



Table 4.4: Pensioner mortality experience 2012-2016

Category	Number of deaths included in analysis	Pension amount ceasing due to deaths £'000s (pa)	A/E* relative to the 2012 valuation assumption [†]	A/E* relative to the S2 Base Tables [†]
Members (male)	1,489	22,101	86.8%	104.2%
Dependants (females)	500	2,625	98.5%	99.4%

*A/E is actual divided by expected on an amounts basis

[†] With ONS-2014 improvements in each case

Results of Analysis: Combined male normal health and ill-health pensioner mortality

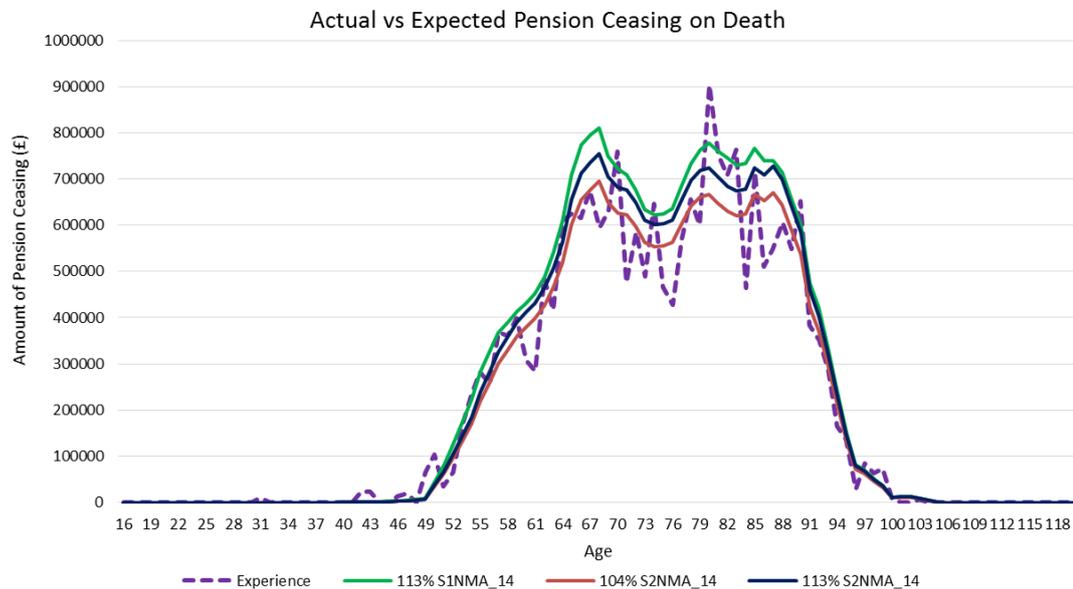
4.16 Graph 4.1 below shows, by age, a comparison of:

- > the actual mortality experience (amount of pension ceasing) for male normal and ill-health pensioners over the four year period (purple dashed line).
- > the expected amount of pension ceasing based on the 2012 valuation assumption²¹ (green line).
- > the 'best fit' of experience to the most appropriate S2 base table²¹ (red line).
- > the proposed assumption for the 2016 valuation (blue line).

²¹ With ONS-2014 improvements.



Graph 4.1: Combined male normal health and ill-health pensioner mortality experience 2012-2016



Comments on analysis

- 4.17 The experience suggests lower levels of mortality overall than expected based on the 2012 assumption.
- 4.18 Table 4.4 shows that the actual amount of pension ceasing on death for members was about 87% of that assumed relative to the 2012 assumption. This is a significant change and is relatively low compared to the equivalent analysis from the other main public service pension schemes in England. This may be a consequence of the increased level of volatility in mortality experience that might be expected from the Fire Schemes, being a relatively small public service scheme, or could be a result of any deaths being underreported in the data that was provided to GAD by the fire authorities. To help reduce the impact of the latter, we have removed any fire authorities from the analysis where the membership reconciliation was poor. However, this does not mean that this risk is removed from the remaining data used for the analysis.
- 4.19 The recommended assumption (shown by the blue line in Graph 4.1), has been derived by taking an average of the 2012 assumption (converted to an 'amounts' basis) and the 2012-16 experience. A 2/3:1/3 weighting of the 2012 assumption and the 2012-16 experience has been used. This approach:
- > makes allowance for the relative amounts of mortality data underlying the 2012 assumption and the 2012-16 analysis;
 - > helps reduce volatility from relatively large changes in the mortality assumption from one valuation to the next; and
 - > helps to reduce the risk that the mortality assumption is significantly impacted by any deaths that might have been underreported in the mortality data over 2012-16.

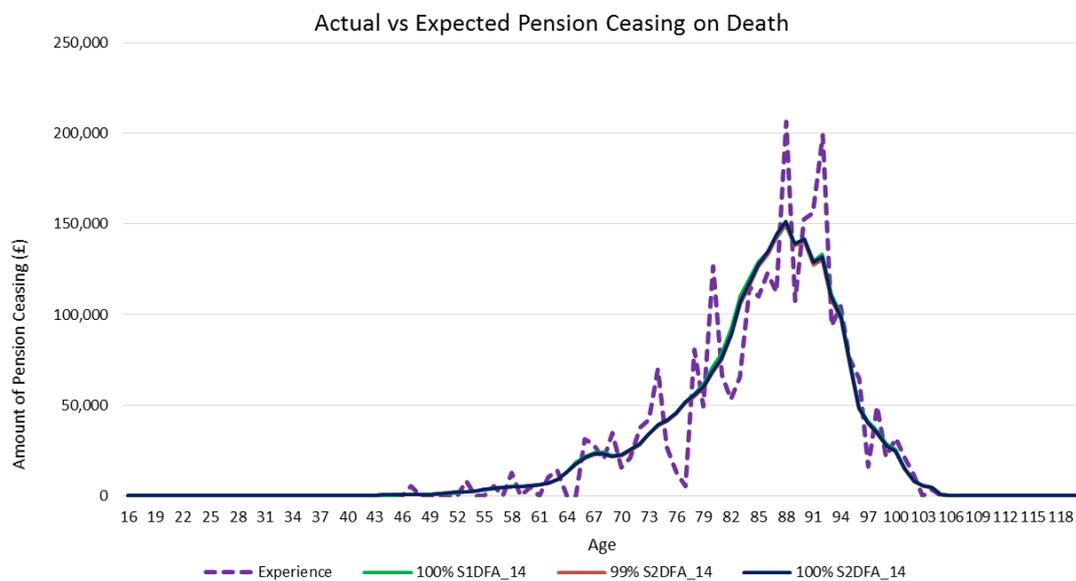


Results of Analysis: Dependant pensioner mortality

4.20 Graph 4.2 below shows, by age, a comparison of:

- > actual mortality experience (amount of pension ceasing) for female dependants over the four year period (purple dashed line).
- > expected amount of pension ceasing based on the 2012 valuation assumption²² (green line).
- > the 'best fit' of experience to the most appropriate S2 base table²² (red line).
- > the proposed assumption for the 2016 valuation (blue line)

Graph 4.2: Female Dependants mortality experience 2012-2016



Comments on dependants analysis

- 4.21 It can be seen that most lines on the graph above are very close together, which reflects the proposed assumption being very similar to the best fit to the experience and also very similar to the 2012 assumption.
- 4.22 The best fit of experience equates to using 99% of the standard S2 table for dependants. However, given the small amount of dependant death data (500 deaths), there is not sufficient evidence to suggest a different assumption than using the unadjusted standard mortality table for dependants. We therefore recommend that 100% of the S2DFA table is adopted as the assumption at the 2016 valuation.

²² With ONS-2014 improvements.



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

- 5.1 We recommend that rates of age retirement are set separately for the following groups of members:
- > 1992 Scheme members who have full protection, tapered protection or are unprotected but have significant 1992 service (greater than 16 years' service at 31 March 2012).
 - > Unprotected 1992 Scheme members with less than 16 years' service at 31 March 2012.
 - > Members with any standard 2006 Scheme service (ie including protected, tapered and unprotected members).
 - > Special members with any modified 2006 Scheme service (ie including protected, tapered and unprotected members).
 - > 2015 Scheme members with no previous service in the pre-2015 schemes.

Sample age retirement rates are provided in Appendix A. This approach to setting assumptions was adopted for the previous valuation (other than for the new assumption for Special members). There is not yet any evidence on which to reconsider this approach.

Members with 1992 Scheme service

- 5.2 For protected members (who will remain in the 1992 Scheme until retirement), we recommend maintaining the 2012 assumption for all members except those listed in paragraph 5.3 for whom we recommend that an adjustment is made to reflect experience between 2012 and 2016. Both age and service are taken into account in the retirement rates. Many members are assumed to retire on reaching 30 years' service and all are assumed to retire by age 60.
- 5.3 The groups of members for whom we recommend a change to the retirement assumption are:
- > Members reaching age 50 with less than 30 years' service (we recommend increasing retirement rates for these members).
 - > Members reaching age 55 with less than 30 years' service (we recommend decreasing retirement rates for these members).



- 5.4 For members with taper protection and unprotected members with more than 16 years' service (at March 2012), we recommend the same assumption as for protected members above. This is consistent with the approach taken in 2012 and reflects an expectation for the 1992 Scheme benefits, rather than 2015 Scheme benefits, to drive member behaviours.
- 5.5 For unprotected members with less than 16 years' service (at March 2012), we recommend maintaining the approach used to set the 2012 assumptions with allowance for the adjustments made in paragraph 5.3. This is consistent with the approach taken in 2012 and reflects an expectation for the 2015 Scheme benefits to have some influence over member behaviours, in particular the availability of a reduced early retirement pension at age 55 in the 2015 Scheme. The retirement rates for this group assume no members retire before age 55 and most members retire at age 55. For example, for members who joined before age 25, about 99% are assumed to retire at age 55, and for members joining at age 30 (and over) about 40% are assumed to retire at age 55.

Members with standard 2006 Scheme service

- 5.6 We recommend that members with 2006 Scheme service are assumed to retire at age 60. This applies to protected members, members with tapered protection and unprotected members who have joined the 2015 Scheme.

Special Retained Members

- 5.7 Under the pension arrangements of the modified section of the 2006 Scheme, all Special retained members are eligible to retire at age 55 with an unreduced pension. Therefore, we propose that protected Special members take up their benefits at age 55, with this being the earliest available opportunity to draw an unreduced pension.
- 5.8 We propose that unprotected and tapered Special members are also assumed to retire at age 55 in the 2015 Scheme, as a (reduced) 2015 Scheme pension is available from that age.

New entrants to the 2015 Scheme

- 5.9 Our recommended assumption is:
- > 25% of members reaching age 55 are assumed to retire immediately; and
 - > all remaining members will retire at age 60.
- 5.10 The assumption is intended to make a reasonable allowance for the take-up of benefits at the earliest time at which they become available (with reduction for early payment) and is the same assumption that was adopted in the 2012 valuation and is consistent with the assumption adopted for the scheme reform work.



Deferred Members

- 5.11 We recommend it is assumed that deferred members will take their pension at their deferred pension age. Deferred members can take a reduced pension before deferred pension age, but the reduction is actuarially neutral so allowance for this would not have a material impact on the valuation results.

Previous valuation assumptions

- 5.12 The proposed assumptions are identical in nature and effect to those which were adopted for the 2012 valuation for all categories of members except for some 1992 Scheme members. The changes recommended for these members are described in paragraph 5.3. There are also new assumptions for the Special retained members.

Use of the assumption

- 5.13 Age retirement rates specify the rate at which members are assumed to retire on grounds other than ill-health and therefore potentially include allowance for retirements before or after Normal Pension Age.
- 5.14 In the 1992 Scheme, members can retire on an unreduced pension once they have completed 25 years' service if they are aged 50 or over, and most members can retire from age 55 regardless of service. There is no actuarially reduced early retirement option.
- 5.15 Members in the 2006 Scheme can retire unreduced at age 60 from active service and from age 65 if deferred members. Active members can take actuarially reduced early retirement from age 55 up to age 60; the reduced pension is with reference to a pension payable from age 65.
- 5.16 Members in the 2015 Scheme can retire unreduced at age 60 from active service and from State Pension Age if deferred members. Active members can take an actuarially reduced early retirement from age 55, with reference to a pension payable from age 60.

Analysis and setting the assumption

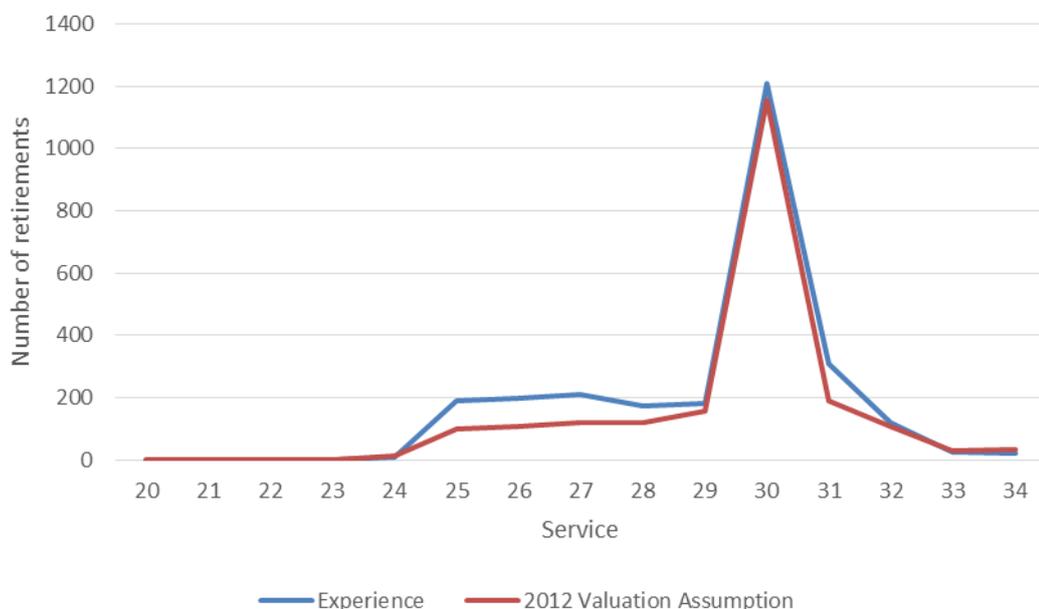
- 5.17 For the purposes of considering the assumptions appropriate for the first group of members outlined in 5.1 above (ie those continuing in the 1992 Scheme after 31 March 2015 or with significant 1992 Scheme service in 2012) we have compared the actual rates of age retirements over the four-year period to 31 March 2016 to the expected rates based on the corresponding 2012 valuation assumptions.
- 5.18 After excluding from our analysis 18 fire authorities (covering around 30% of active scheme members) and some individual retirements from the remaining authorities, where the data did not appear reliable, there were 2,668 age retirements over the four-year period to 31 March 2016 compared to an expected 2,345 retirements based on the 2012 assumptions.



- 5.19 We have compared the actual rate of retirements to the expected rate from the 2012 valuation and the recommended assumption has been based on this comparison.
- 5.20 Assumptions appropriate for the unprotected 1992 Scheme members, with lower amounts of 1992 Scheme service, are set with reference to the assumptions for the group above (by assuming that members who would otherwise have retired before age 55, now retire at age 55), so no additional analysis is required.
- 5.21 There is a small amount of retirement data for the (standard) 2006 Scheme. Over the four year period to 31 March 2016 there were 95 retirements between the ages of 55 and 60 (inclusive). The average age at retirement for these members was 59. Due to the small amount of retirement data, concerns that some ill-health pensioners may also have been included in the data and the average retirement age being very close to the assumed retirement age of 60, we propose retaining the 2012 age retirement assumption for 2006 Scheme members.
- 5.22 There is insufficient data to undertake any analysis of retirements in the modified 2006 Scheme or in the 2015 Scheme.

Results of analysis for protected 1992 Scheme members

Graph 5.1: Actual retirements vs expected based on the 2012 assumption – Based on service at retirement





**Graph 5.2: Actual retirements vs expected based on the 2012 assumption –
Based on age at retirement**



Comments on results of analysis for protected 1992 Scheme members

- 5.23 Graph 5.1 shows a good alignment of experience against the 2012 assumption based on service with most members retiring upon reaching 30 years' service. This shows that service is the main driver of retirement patterns as might be expected with members looking to maximise their benefits in the scheme. However, slightly more people retired with between 25 and 29 years' service than expected. This might be explained by the change to allow commutation of pension above the 2.25 times pension limit, for members retiring with less than 30 years' service.
- 5.24 Graph 5.2 shows a comparison of experience against the 2012 assumption based on age. This shows that significantly more people than expected retired at age 50 and fewer people than expected at age 55. Note that this graph also shows retirements at age 49 as retirements have been analysed using the age recorded at the beginning of the scheme year of retirement.
- 5.25 Overall, we propose the following changes to the assumed rates of retirement:
- > An increase to the assumed rate of retirement for members who reach age 50 with between 25 and 29 years' service (as the number completing 30 years' service is in line with the existing assumption). The assumed probability of retirement has been increased from 5% to 25% for these members, which matches the assumption at age 50 to the 2012-16 experience at age 50.
 - > A reduction to the assumed rate of retirement at age 55 for members with less than 30 years' service (as the number completing 30 years' service is in line with the existing assumption). The assumed probability of retirement has been decreased from 79% to 41% for these members, which matches the assumption at age 55 to the 2012-16 experience at age 55.



- 5.26 These two changes also serve to approximately half the difference between the 2012 assumption and the 2012-16 experience, for members retiring with less than 30 years' service, as observed in Graph 5.1.



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 that a single set of assumptions is used for all members to allow for the incidence of ill-health retirement, ie applying both to those members who remain in the pre-2015 schemes and members of the 2015 Scheme. Assumed rates of ill-health increase with age but less than 1.5% of members are assumed to retire on ill-health grounds each year, even at the highest ages. Sample rates are provided in Appendix A.
- 6.2 We also recommend assuming that 40% of members retiring on ill-health grounds will receive the upper-tier benefits and the remaining 60% will receive the lower-tier benefits.

Previous valuation assumptions

- 6.3 The proposed 2016 assumptions for both the incidence of ill-health retirement and the proportion of members eligible for upper-tier benefits are the same as those adopted for the previous valuation.

Use of the assumptions

- 6.4 Ill-health retirement rates specify the rate at which members are assumed to retire on grounds of ill-health. The assumed eligibility for upper or lower-tier awards specifies the benefits which will be provided. The ill-health assumptions have a low impact on the overall results. The rates of mortality experienced after ill-health retirement are also relevant to the valuation calculations. Post retirement mortality is addressed in Chapter 4.



Analysis and setting the assumption

Ill-health incidence

- 6.5 After excluding from our analysis 15 fire authorities (covering about 25% of active scheme members) where the data did not appear to be reliable, there were 244 male ill-health retirements over the four-year period to 31 March 2016, compared to an expected 252 retirements based on the 2012 assumptions. Females were not included in the analysis as the numbers were too low to derive any meaningful conclusions.
- 6.6 We have compared the actual rate of ill-health retirements to the expected rate from the 2012 actuarial valuation and the recommended assumption has been based on this comparison.

Results of analysis

Graph 6.1: Actual retirements vs expected based on 2012 assumption

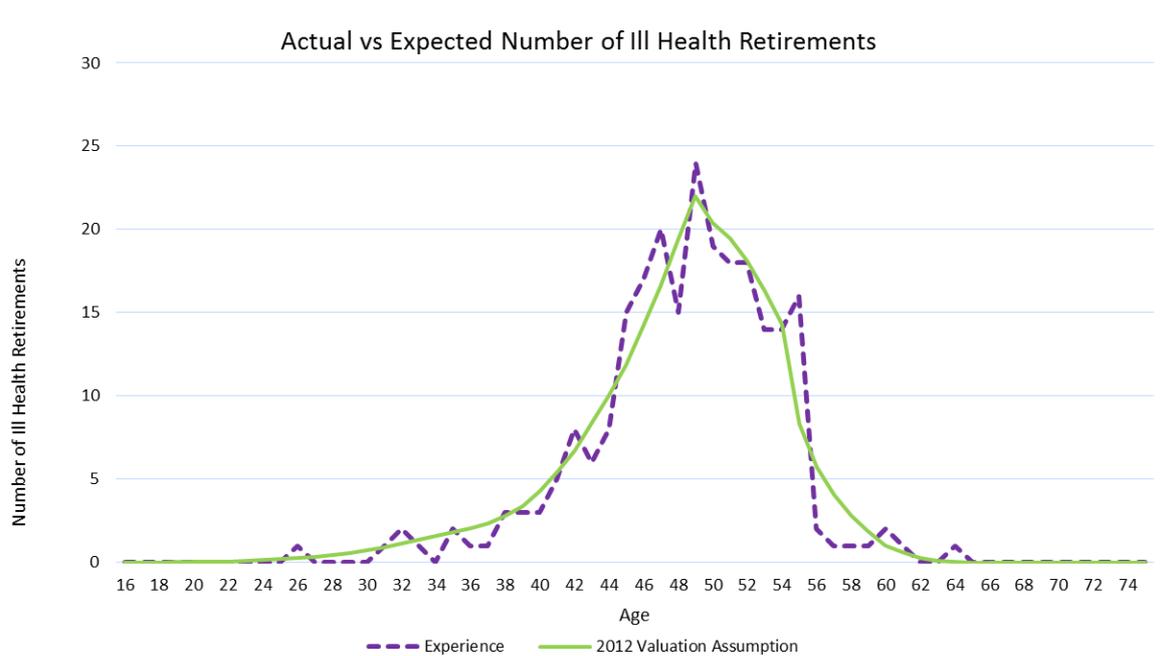




Table 6.1: Actual retirements vs expected based on 2012 assumption

Year	Actual ill-health retirements*	Expected ill-health retirements (under 2012 valuation assumption)	Actual / Expected
2012-2013	68	60	113%
2013-2014	58	63	93%
2014-2015	57	64	89%
2015-2016	61	65	94%
Total	244	252	97%

*for the 31 fire authorities included in the analysis

Comments on ill-health retirement analysis

- 6.7 There is a relatively low number of ill-health retirements each year, so significant fluctuation year on year is to be expected. However, over the four year period to March 2016, Graph 6.1 and Table 6.1 above show good alignment of experience compared to the 2012 valuation assumptions. Therefore, we recommend that the assumed rates of ill-health retirement used in the 2012 valuation are retained for the purposes of the 2016 valuation.

Split between ill-health tiers

- 6.8 We have also analysed the proportion of members with upper-tier benefits when retiring in ill-health during the four year period to 31 March 2016. Over this period, 138 or 57% of the 244 ill-health retirements were recorded as upper-tier benefits.
- 6.9 Table 6.2 below shows the proportion of ill-health retirements which are recorded as upper-tier for each year from 31 March 2012 to 31 March 2016.

Table 6.2: Actual retirements vs expected based on 2012 assumption

Year	Proportion of ill-health retirements recorded as upper tier*
2012-2013	84%
2013-2014	43%
2014-2015	46%
2015-2016	49%
Total	57%

*for the 31 fire authorities included in the analysis



- 6.10 The upper-tier proportion was 57% over the four year period to 31 March 2016, higher than the 40% assumed in the 2012 valuation. However, this is distorted by the figure for the year 2012-13 which is significantly higher. The secretariat to the Scheme Advisory Board have advised that complete recording of the ill-health tier in the valuation data did not commence until the year 2013-14 and therefore the data for 2012-13 may not be reliable. As such, we have removed the figures for the year 2012-13 from the analysis. The average upper-tier proportion for the remaining years reduces to 46%, which is much closer to the 2012 assumption.
- 6.11 The Department for Communities and Local Government and the Home Office have published membership statistics²³ for the Fire Schemes which show lower levels of upper-tier proportions than obtained from the analysis above (for example, 33% in the year 2015-2016). The difference might be explained if, in the data that GAD has received, some retirements have been recorded as upper-tier (perhaps by default) regardless of the actual tier of benefits that the member received.
- 6.12 On balance, given the two data sources suggest that the 2012 assumption is either slightly lower or slightly higher than the experience and this assumption is of low materiality to the overall valuation results, our proposal is to maintain the 2012 assumption (ie that 40% of ill-health retirements are upper-tier).

²³ <https://www.gov.uk/government/collections/firefighters-pension-scheme-statistics>



7 Voluntary withdrawal from service

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

Proposed assumptions for 2016 valuation

- 7.1 We recommend that for the purposes of the 2016 valuation separate withdrawal rates are used for regular and standard retained members. We propose that Special retained members are assumed to withdraw at the same rate as regular firefighters.
- 7.2 These withdrawal rates would apply equally to those members who remain in the pre-2015 schemes and those who join the 2015 Scheme.
- 7.3 The recommended rates decrease with age; for regular firefighters they are 1.1% at age 25 and 0.3% at age 45. Withdrawal rates for standard retained firefighters are nine times the regular firefighter rates.
- 7.4 Sample rates are provided in Appendix A. The same rates apply regardless of the length of the member's service, except that no withdrawal will be assumed for members entitled to immediate retirement benefits.

Previous valuation assumptions

- 7.5 The proposed 2016 assumptions are the same as those adopted for the previous valuation, other than the new assumption for Special retained members who were not present in the 2012 valuation.

Use of the assumption

- 7.6 Withdrawal rates specify the rate at which members are assumed to leave voluntarily before retirement (including opting out), becoming entitled to either deferred benefits or, for those with less than 3 months' service, a refund of contributions, or have chosen to transfer the value of their pension out of the Schemes.
- 7.7 There is insufficient evidence to indicate the level of members re-joining the Schemes after leaving. For the avoidance of doubt, all members assumed to withdraw are assumed not to re-join.

Analysis and setting the assumption

- 7.8 We have analysed the pattern of withdrawals from active male membership over the four-year period to 31 March 2016, after excluding data from 15 authorities (covering around 25% of active members) which was not considered reliable.
- 7.9 There were a total of 3,608 withdrawals over the period. This was significantly higher than the 1,546 withdrawals expected under the 2012 assumptions.



- 7.10 There are a number of reasons why events in the 2012-2016 period may mean that levels of withdrawal during the period are atypical and would not be expected to be repeated in future. These reasons include:
- > The increases to member contributions over the period since April 2012.
 - > The introduction of the 2015 Scheme on 1 April 2015.
 - > Continued public sector pay restraint.
- 7.11 For the 2006 Scheme, we have also analysed withdrawals for the subset of the membership with 2 or more years' service. The rates of withdrawal are slightly lower than those observed for the whole of the 2006 Scheme. This suggests that the higher than expected withdrawal rates may in part be due to members being auto-enrolled and then immediately withdrawing. Also, including short serving members in the analysis may give them undue weight when setting the assumption given their relatively low financial impact. Therefore, we have carried out analysis of the withdrawals in the 2006 Scheme by excluding members who left with less than 2 years' service.
- 7.12 Withdrawal data for the 2006 Scheme does not contain a credible split between withdrawals for regular and retained firefighters. Therefore, we have compared the total number of withdrawals in the 2006 Scheme against the total number expected, with the expected numbers based on the use of the separate withdrawal assumption for regular and retained 2006 Scheme members.
- 7.13 There was insufficient data to perform a credible analysis on withdrawal rates of female firefighters. We propose that the same withdrawal rates are adopted for both male and female members.
- 7.14 There was insufficient data to perform a credible analysis on the withdrawal rates from the 2015 Scheme. We propose that members are assumed to withdraw at the same rates adopted for the 2006 Scheme. This is consistent with the approach at the 2012 valuation.
- 7.15 There was insufficient data to perform a credible analysis of the withdrawal rates for Special retained members. As these members are accruing benefits similar in value to those from the 1992 Scheme and, by definition, have already been retained firefighters for at least 10 years (ie since before April 2006), we expect that they may be more likely to withdraw at lower rates, closer to those assumed for regular firefighters. Therefore, we propose that the withdrawal assumption for regular firefighters is adopted for the Special retained members.

Results of analysis

- 7.16 The analysis compares the actual number of voluntary withdrawals for males by age compared to the expected number based on the 2012 assumption. The analysis is split by 1992 and 2006 scheme membership and members who moved to the 2015 Scheme before leaving are shown under their pre-2015 scheme.



Table 7.1: Actual withdrawals in 2012-2016 vs expected

	Actual withdrawals	Expected withdrawals (under 2012 valuation assumption)	Actual / Expected
1992 Scheme	591	279	212%
2006 Scheme*	1,790	898	199%
Total	2,381	1,177	202%

* Excluding withdrawal by members with less than two years' service, so total numbers are lower than those in paragraph 7.9.

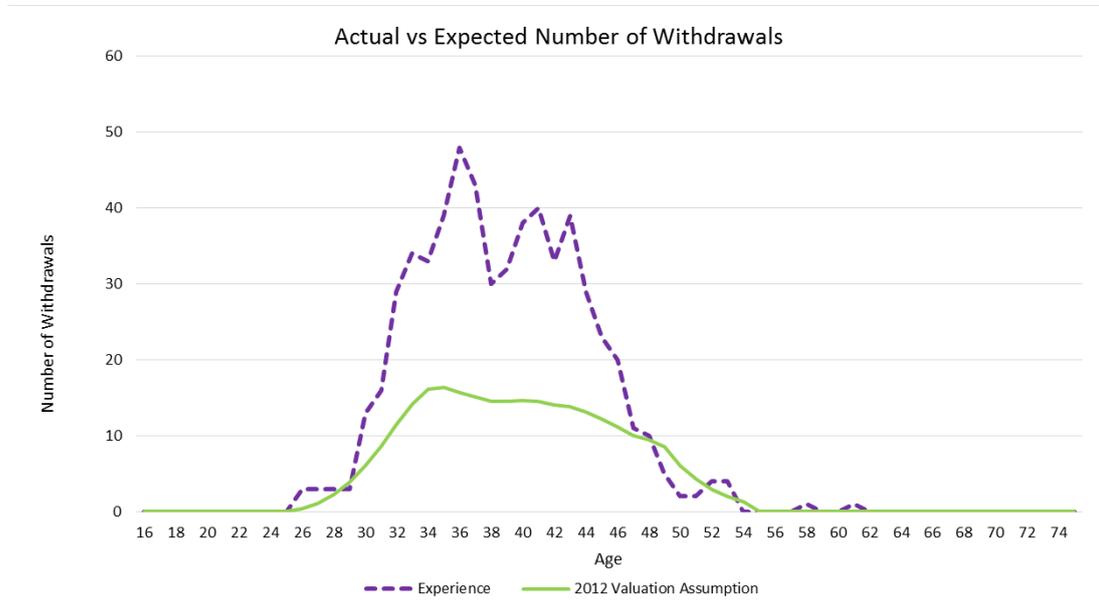
Table 7.2: Actual withdrawals for each year during 2012-16 vs expected

1992 Scheme	Actual withdrawals	Expected withdrawals	Actual / Expected
2012-13	116	82	141%
2013-14	128	74	174%
2014-15	235	66	359%
2015-16	112	57	196%
Total	591	279	212%

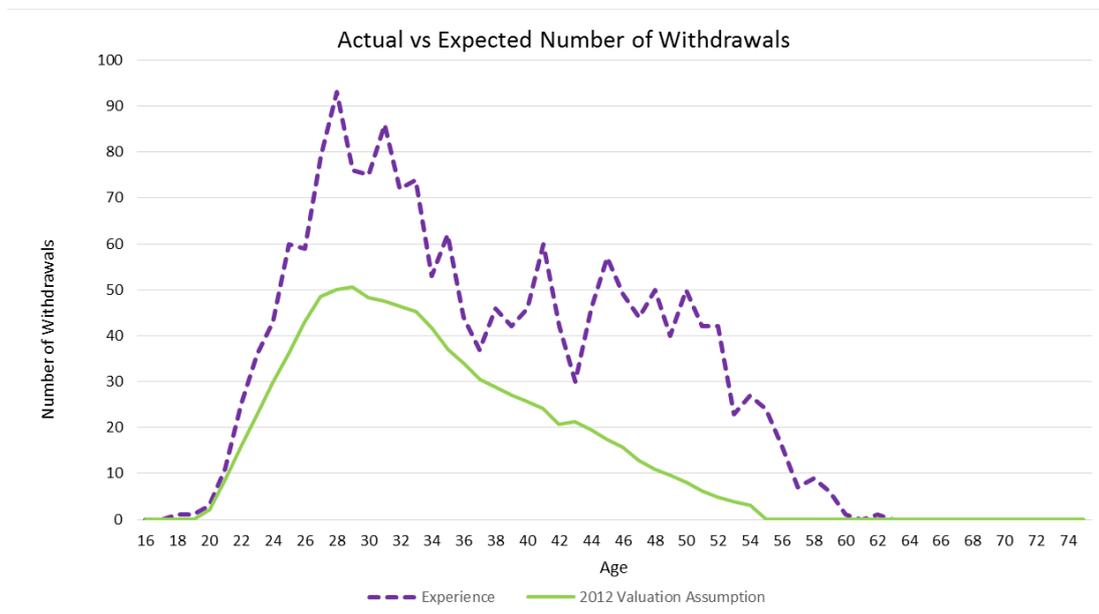
2006 Scheme	Actual withdrawals	Expected withdrawals	Actual / Expected
2012-13	452	198	228%
2013-14	494	214	231%
2014-15	498	229	217%
2015-16	346	257	135%
Total	1790	898	199%



Graph 7.1: Actual withdrawals in 2012-2016 vs expected – 1992 Scheme



Graph 7.2: Actual withdrawals in 2012-2016 vs expected – 2006 Scheme (Regular and Retained members combined)





- 7.17 Graphs 7.1 and 7.2 and Table 7.1 show that the actual numbers of withdrawals has been significantly higher (approximately double) than expected under the 2012 assumptions.
- 7.18 However, it is not clear whether the 2012-16 experience:
- a) is from an unusual period such that the experience is not expected to be repeated going forwards (we discussed some possible reasons for this in paragraph 7.10);
or
 - b) is likely to continue in the long term.
- 7.19 To assist with this, we have considered a different data source which is the opt-out data that the Home Office have collated that covers the period from April 2015 to December 2016. This period is useful as it includes the last year of the four year inter-valuation period included in the main analysis above, but also includes the first nine months of the period since then. We can then use this as an early indicator as to whether the higher levels of withdrawals observed over 2012-16 are continuing or starting to tail off.
- 7.20 The Home Office data showed 262 members left the pension scheme over the year 2015-16 (specifically those categorised as deferred, so were scheme members choosing to leave the scheme, as opposed to those opting out when first becoming a firefighter or opting out when becoming auto-enrolled). This compares to 98 equivalent leavers over the first nine months of 2016-17, which equates to about 130 leavers if grossed up to represent a full year. This represents a reduction of about 50% compared with 2015-16, which is the magnitude of change that would be required to return to withdrawal levels assumed at the 2012 valuation.
- 7.21 It can also be noted from Table 7.2, showing the number of withdrawals each year from the valuation data, that the number in 2015/16 was significantly lower than in the previous year and lower than all previous years in the analysis. This also suggests that there may be a trend towards lower levels of withdrawal than experienced over the whole of 2012-16.
- 7.22 Therefore, there is some evidence to suggest that the relatively higher levels of withdrawals during 2012-16 are not expected to be repeated going forwards. As such, we suggest that the 2012-16 experience is not used to set the withdrawal assumption at the 2016 valuation and no change to the assumption is made. The withdrawal assumption can be reviewed again at the next valuation once more post 2016 experience data becomes available.



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 a single set of assumptions for all members to allow for the possibility of death before retirement. Assumed rates of death before retirement increase with age but fewer than 0.5% of members are assumed to die before retirement each year, even at the highest ages. Sample rates are provided in Appendix A.

Previous valuation assumptions

- 8.2 The proposed 2016 assumptions are the same as those adopted for the previous valuation.

Use of the assumption

- 8.3 Death before retirement rates are used to allow for the possibility of deaths whilst in active service or whilst entitled to a deferred pension. The numbers of deaths observed annually, and the recommended rates to be assumed, are low, and thus this assumption has relatively little financial significance.

Analysis and setting the assumption

- 8.4 To formulate a recommended assumption we compared the scheme experience over the four year period to 31 March 2016 to the expected rates from the 2012 actuarial valuation. After excluding from the analysis 15 fire authorities (covering about 25% of the membership) where the data did not appear to be reliable, Table 8.1 shows the actual number of male deaths compared to the number expected under the 2012 valuation assumption. Females were not included in the analysis as the numbers were too low to derive any meaningful conclusions.



**Table 8.1: Deaths before retirement (male firefighters):
Actual deaths vs deaths expected under the 2012 valuation assumptions**

Year	Actual deaths*	Expected deaths (under 2012 valuation assumption)	Actual / Expected
2012-2013	16	12	134%
2013-2014	11	12	92%
2014-2015	9	12	74%
2015-2016	11	12	91%
Total	47	48	98%

*for the 31 fire authorities included in the analysis

- 8.5 Given the low number of deaths recorded each year we would expect to see significant year on year fluctuation in our analysis. However, over the four year period to 31 March 2016, Table 8.1 shows the total number of deaths was close to those expected. Therefore, we propose that the 2012 assumption is adopted for the 2016 valuation.



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 assumption

- 9.1 We recommend assuming separate scales of promotional increases for regular firefighters and retained firefighters. The increases for regular firefighters are dependent on service and are steeper at shorter durations of service. The increases for retained firefighters are assumed to be dependent on age. Sample values from the scale are provided in Appendix A.
- 9.2 We recommend assuming that promotional pay increases for Special retained members are equal to those of standard retained members.

Previous assumption

- 9.3 The assumptions adopted for the 2012 valuation are the same as those recommended for the 2016 valuation, other than for the new assumption for Special retained members.

Use of the assumption

- 9.4 For members of the (final salary) 1992 and 2006 schemes, their benefits are linked to pay at or near retirement. Their pay will generally increase through a combination of general annual pay awards, promotional increases and any ad-hoc adjustments (eg due to changes in crewing arrangements). To calculate an estimate of the level of benefit payable in the future requires assumptions for each of these components. The assumption for general pay awards is directed by HMT. The assumption for promotional pay increases, and any other ad-hoc increases is set by the Home Secretary.
- 9.5 The impact on the cost of the Fire Schemes of future pay increases will be more significant for those members with either full or tapered protection because they continue to accrue benefits linked to final pensionable pay for service beyond 31 March 2015.



Analysis and setting the assumption

- 9.6 To formulate a recommended assumption for promotional pay increases, we compared the scheme data to the assumption adopted for the 2012 valuation using a 'profile analysis'. For regular members, the profile analysis considers the overall active membership as at 31 March 2016 and compares average (WTE²⁴) pensionable pay at each length of service with that at other lengths of service. This analysis illustrates how average (WTE) pay varies by length of service. The profile analysis for retained firefighters is based on age rather than length of service. These differences in pay at each service length/age are then compared to the assumed promotional increases adopted for the 2012 valuation. The results of both profile analyses are discussed below.
- 9.7 We have made no explicit allowance for the current period of pay restraint in our analysis, on the basis that promotional/progression increases have not been significantly affected by this.
- 9.8 The profile analysis which has been completed suggests that the 2012 assumption for promotional increases remains appropriate. In the absence of any other evidence, we recommend that the 2012 assumption is maintained for the 2016 valuation.

²⁴ Whole-time equivalent

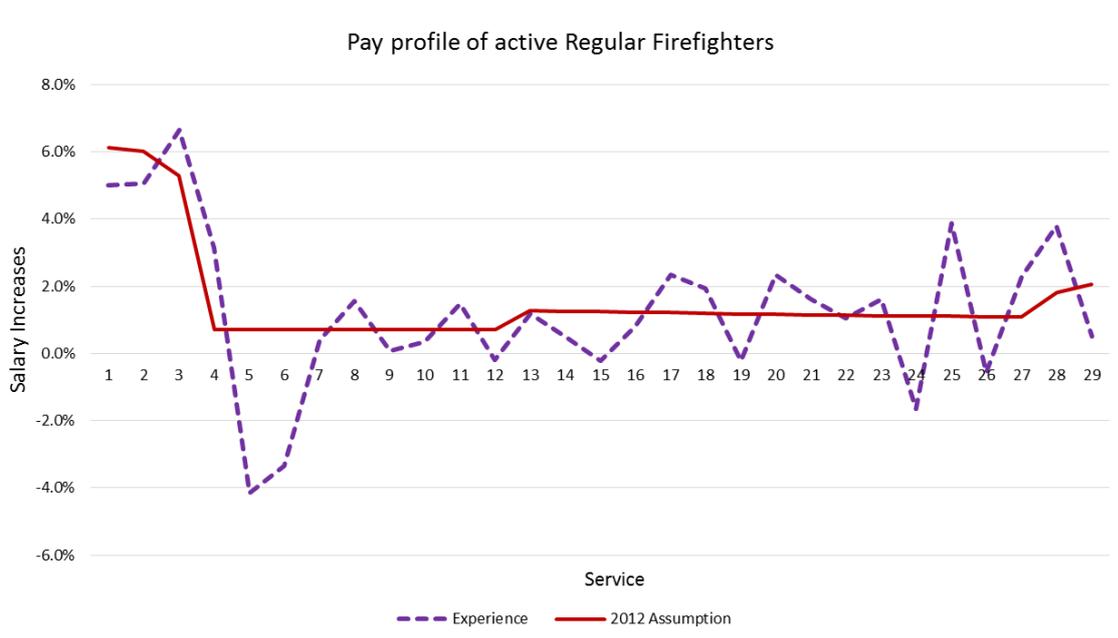


Results of profile analysis for promotional pay increases

Regular firefighter members

9.9 Graph 9.1 shows the change in average WTE pay for regular firefighters at each service length based on the 'profile analysis' of members at the valuation date (purple line). This is compared with the assumed increase from the service related promotional scale adopted for the 2012 valuation (red line).

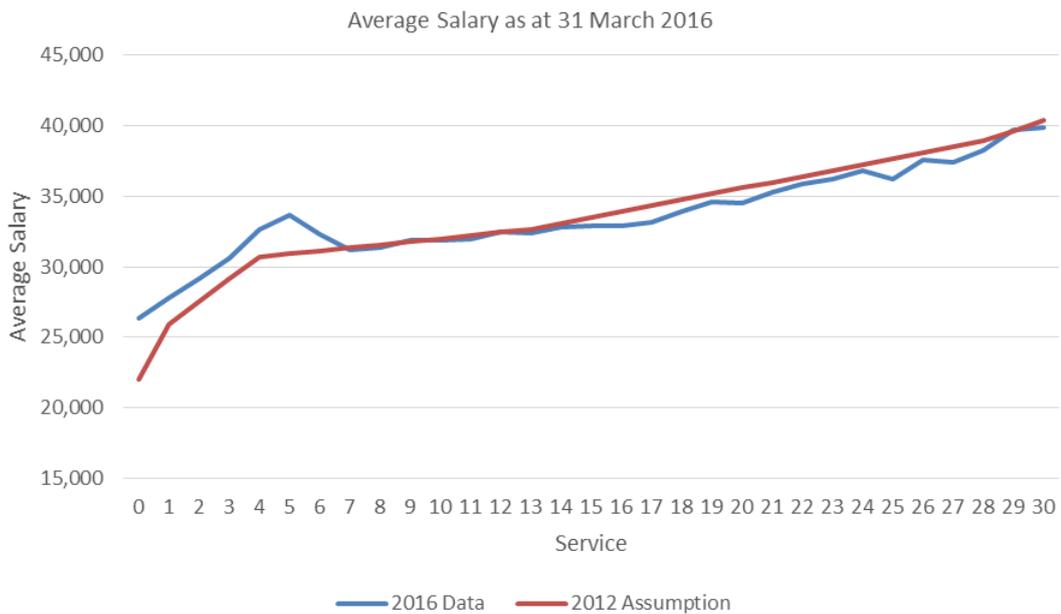
Graph 9.1: Change in average WTE pay at each service length for active population as at 31 March 2016 – Regular Firefighters





- 9.10 Graph 9.2 compares the average WTE pay of regular firefighters as at 31 March 2016 for each service length against the assumed salary at 31 March 2016 for each service length, using a starting salary of £22,017 (based on the 2015/2016 pay settlement) and the 2012 promotional salary assumption.

Graph 9.2: Average pay 31 March 2016 vs 2012 valuation assumption

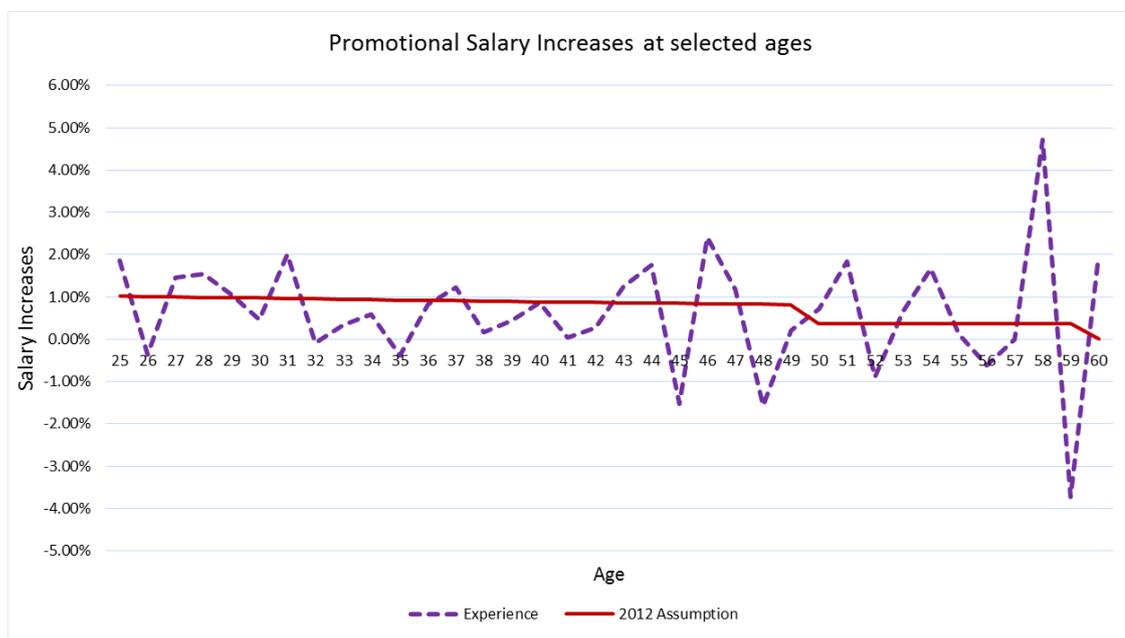




Retained firefighter members

- 9.11 Graph 9.3 shows the change in average WTE pay of retained firefighters at each age based on the 'profile analysis' of members at the valuation date (purple line). This is compared with the assumed increase from the age related promotional scale adopted for the 2012 valuation (red line).

Graph 9.3: Change in average WTE pay at each age for active population as at 31 March 2016 – Retained Firefighters



Comments on the analysis

- 9.12 The results of this analysis should be treated with some caution as the analysis is affected by the mixture of members at each service length and age. However, the profile analysis shows that experience has been broadly in line with the 2012 assumption for both regular and retained members.
- 9.13 There is some variation between experience and assumptions at the early years of service in both Graph 9.1 and Graph 9.2. However, the assumption at these lengths of service are less material to the valuation, as members with lower amounts of service have small accrued pensions linked to their final salary. In addition, the majority of these members will now be accruing benefits in the 2015 scheme, for which the assumption about promotional pay increases is much less significant.



Additional survivor analysis

- 9.14 The profile analysis does not capture the impact of any ad-hoc changes in pay, as discussed in paragraph 9.4, as that analysis looks at the profile of pay at one point in time.
- 9.15 Therefore, we have also carried out a separate 'survivor analysis' to compare increases in members' pensionable pay from 31 March 2012 to 31 March 2016 to those expected using known annual pay settlements (of 1% pa) and expected promotional increases using the 2012 assumption. This analysis excluded four fire authorities for whom the data format did not allow a ready comparison of members at both 2012 and 2016.
- 9.16 The survivor analysis was carried out in respect of 1992 Scheme members (including those who transferred to the 2015 Scheme) who were active members of the same fire authority in both 2012 and 2016. 1992 Scheme members were chosen for this analysis as they represent most of the final salary risk across the Fire Schemes and complications from additional retained membership records were avoided.
- 9.17 The analysis showed that the average total salary increase over the four year period to 31 March 2016 for these members was 7.6% (ie about 1.8% pa), compared to an expected increase of 8.4% (ie about 2.0% pa). Therefore, salary increases for 1992 Scheme members were slightly lower than assumed, but quite close to the assumption made (ie within 1% over the four year period).
- 9.18 Therefore, based on this analysis, there is no evidence to suggest that there has been a significant overall increase in members' pensionable pay from any ad-hoc changes to pensionable pay (such as different crewing arrangements) since 2012.
- 9.19 We recommend that the impact of any changes in crewing arrangements on pensionable pay is kept under review and the valuation assumption is updated, if appropriate, when more information becomes available.



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 that members are assumed to commute the following proportions of their pensions for cash. The assumptions are the same for men and women.

Table 10.1: Recommended commutation assumption for the 2016 valuation

Member with service in the following schemes	1992 Scheme only	2006 Scheme only	2006 Scheme (Special Retained Members) only	2015 Scheme only
Scheme pension commuted from	1992	2006	Modified 2006	2015
All members	0%	17.5% ²⁵	0%	17.5% ²⁵

Member with service in the following schemes	Mixed 1992 Scheme and 2015 Scheme		Mixed 2006 Scheme and 2015 Scheme		Mixed 2006 Scheme (Special Retained) and 2015 Scheme	
	1992	2015	2006	2015	Modified 2006	2015
All members	0%	8.75%	17.5% ²⁵	17.5% ²⁵	0%	8.75%

Use of the assumption

- 10.2 In the 1992 Scheme, members have the option to commute pension for a cash lump sum at retirement. The terms under which this option is offered is such that the valuation of the benefits would be the same whether or not allowance was made for members exercising these options. As such, for simplicity no allowance for members exercising these options is proposed for the valuation.

²⁵ Specified by HMT Directions.



- 10.3 Commutation factors for Special retained members are fixed and were set to reflect the commutation rates in the 1992 Scheme on the day before the amendment order to introduce the modified scheme was made. As Special retained members make up a very small proportion of the active population and because the commutation factors are close to the 1992 Scheme factors, we proposed that no allowance for Special members commuting pension for a cash lump sum at retirement is adopted for the 2016 valuation. This is consistent with the approach for 1992 Scheme members. We do not expect this assumption to materially impact the valuation.
- 10.4 In the standard 2006 Scheme and the 2015 Scheme, members may commute part of their pension for a lump sum at a rate of £12 for each £1 of pension given up, up to a limit of 25% of their pension. For these members, the assumption regarding the amount of pension commuted is important because the value of the pension given up, as assessed using the actuarial assumptions underlying the valuation is, on average, more than £12 and so commutation has a significant impact on total liabilities and contribution rates.
- 10.5 Differences between assumed and actual commutation experience in the 2006 and 2015 Scheme will feed through into the cost cap fund, but commutation experience in the 1992 Scheme will not.

Previous valuation assumptions

- 10.6 The proposed assumptions have been updated since the previous valuation. At the 2012 valuation, no allowance for commutation of 2015 Scheme pension was made for unprotected members of the 1992 Scheme and the HMT directed assumption for 2006 and 2015 Scheme pension (for members without service in other schemes) was that 15% of pension would be commuted. There were no assumptions for Special retained members as they were not present at the previous valuation.

Derivation of proposed assumptions

- 10.7 For the reasons set out in paragraph 10.2 and 10.3, for simplicity no allowance has been made for members commuting 1992 Scheme, or modified 2006 Scheme, pension for cash.
- 10.8 The assumption for commutation of standard 2006 Scheme and 2015 Scheme pension by members without service in other schemes is directed by HMT.
- 10.9 The recommended assumption for members with mixed 1992 Scheme and 2015 Scheme service is set by considering the potential behaviours of these members and data from any comparable experience, in the absence of any direct commutation experience for these members. 1992 Scheme members are entitled to commute up to a quarter of their pension on actuarially equivalent terms (in general – alternative limits apply to some members).



- 10.10 The terms available in the 1992 Scheme offer a significantly greater lump sum than would be available under the commutation terms of 12:1 offered in the 2015 Scheme. We would expect this to act as a substantial disincentive to commute pension in the 2015 Scheme, especially for those members with significant amounts of service in the 1992 Scheme (where the lump sum available from the 1992 Scheme is large). As such, we do not expect that former 1992 Scheme members will commute significant amounts of pension from the 2015 Scheme.
- 10.11 The Scheme Advisory Board have provided some data from the year 2016-17 from a subset of FRAs (representing about a third of the membership) for members retiring from the 1992 Scheme. This showed that in 63% of cases members incurred a tax charge when commuting. This tax charge can happen because members can commute 25% of pension (generally) and the commutation factors are higher than 20 at some ages. This data provides evidence that approximately half of members will commute additional pension when the effective terms (after tax) of that additional commutation are much less favourable than for the bulk of the pension that they can commute. Therefore, this situation has similarities with the decision to commute 2015 Scheme pension for unprotected 1992 Scheme members, so can inform the proposed assumption.
- 10.12 Allowing for the experience above, we propose that it is assumed that unprotected 1992 Scheme members will commute 8.75% of their 2015 Scheme pension. This is half of the proportion of 17.5% to be assumed for new entrants to the 2015 Scheme. We do not suggest that any averaging with the previous assumption is carried out in setting this assumption for the 2016 valuation, as the proposed assumption is based on new data that is now available, as opposed to a change in observed behaviours. As such the proposal to use half of the HMT directed assumption of 17.5% is based on the analysis of the new data, with some rounding to reflect the amount of data underlying the analysis.
- 10.13 Likewise, we propose that unprotected Special retained 2006 Scheme members will commute 8.75% of their 2015 Scheme pension for the same reasons.



11 Family statistics

This chapter sets out our recommendation for the assumptions for 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.

Table 11.1: Recommended proportions married/partnered

		1992 Scheme	2006 Scheme and 2015 Scheme
		Proportion married ²⁶	Proportion partnered ²⁶
	Age		
Current pensioners (sample)	50	75%	80%
	60	75%	80%
	70	75%	78%
	80	63%	64%
	90	36%	36%
Future pensioners at retirement	75%	80%	

- > Members are assumed to be three years older than their partners.
- > No allowance is made for remarriage on the grounds of materiality.
- > All dependants are assumed to be the opposite sex to the member.

Previous valuation assumptions

11.2 All family statistic assumptions are the same as those adopted for the 2012 valuation.

²⁶ The assumptions are the proportion married/proportion partnered at the valuation date, for current pensioners, or at retirement, for future pensioners.



Use of the assumptions

- 11.3 Dependants' pensions²⁷ are provided to qualifying dependants on the death of a member. In the 1992 Scheme, dependants' pensions are payable to legal spouses and civil partners only. In the 2006 Scheme and 2015 Scheme, dependants' pensions are payable to qualifying partners as well as to legal spouses and civil partners. Assumptions are required for the proportion of members who are married or partnered to determine how many dependants' pensions will be paid. Assumptions are required about age differences between members and their spouses/partners as this affects how long dependants' pensions will be paid for.

Analysis and approach to setting the assumptions

- 11.4 To formulate a recommended assumption we compared the experience of the Schemes with the corresponding 2012 assumption. 10 out of 45 forces (covering around 20% of members) provided sufficient data to analyse. We analysed the proportion of male pensioner deaths giving rise to the payment of a surviving spouse's or partner's pension. The vast majority of deaths observed relate to 1992 Scheme members and so would qualify for a pension to a legal spouse or civil partner. The analysis therefore compared the experience with the 2012 assumption for proportions married (rather than partnered), which was based on the male population proportion married statistics published by the Office for National Statistics (ONS).
- 11.5 For current 2006 Scheme and 2015 Scheme pensioners, there is too little experience to carry out a credible analysis.
- 11.6 For future pensioners, the proportion married/partnered at retirement will be used in our calculations, rather than the proportion married/partnered at the valuation date. We recommend that the assumptions for proportions married/partnered at retirement for future pensioners are the same as the proportions married/partnered at the valuation date for current younger pensioners. For example, 75% of current male pensioners at age 60 are assumed to be married at the valuation date and 80% are assumed partnered. For consistency, 75% of future pensioners will be assumed to be married when they reach retirement and 80% will be assumed partnered at retirement.

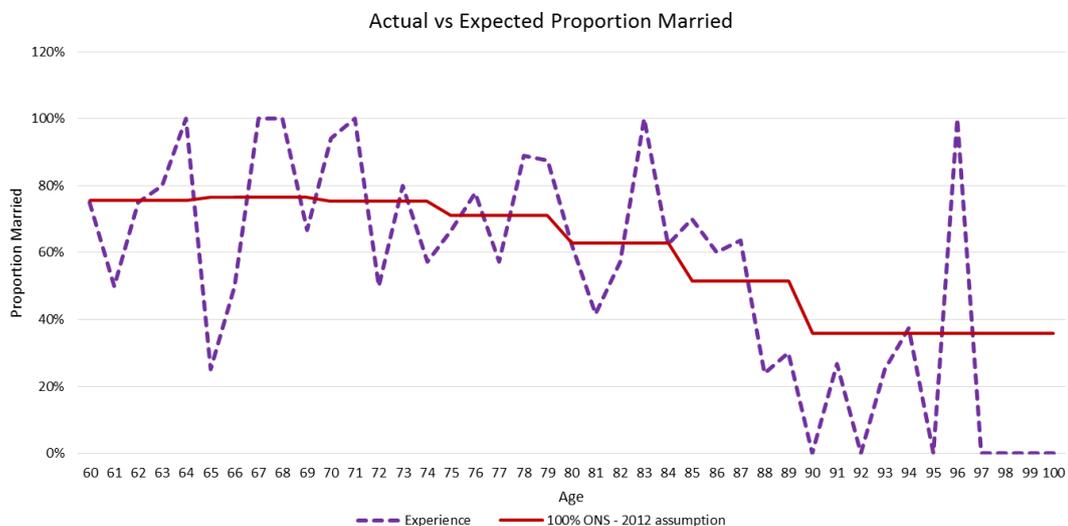
²⁷ Pensions are also payable to dependant children on a member's death but the costs of future children's pensions are not material overall and we therefore do not intend to make any allowance for them in the valuation.



Results of analysis: Proportions dying with dependant pension payable compared to 2012 assumption of proportion married

11.7 The graph below shows, by age, a comparison between actual and expected proportion of male members dying over the four year period to 31 March 2016 and leaving a dependant eligible for a contingent pension. Expected numbers are based on the proportions married assumption adopted for the 2012 valuation.

Graph 11.1: Male pensioners: Actual proportions married against expected based on 2012 valuation assumptions



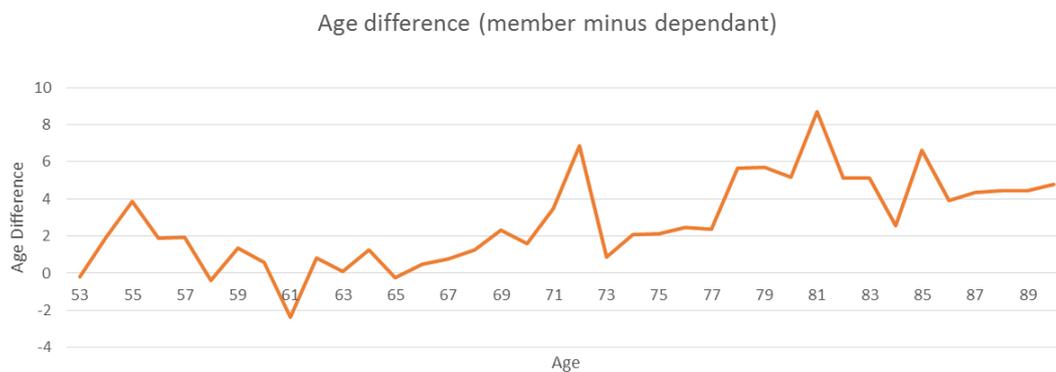
11.8 Graph 11.1 show that proportions married have been broadly in line with those assumed in the 2012 valuation. Given the small amount of recent experience data available to analyse, our recommendation is that the 2012 assumption for proportions married and proportion partnered are retained for the 2016 valuation.



Results of analysis: Age difference between member and dependant

- 11.9 346 male members had dependants' dates of birth which could be used in the analysis. We excluded data from fire authorities where dates of birth were missing or looked incorrect (eg where the dependant's date of birth was the same for many of the members).
- 11.10 Graph 11.2 below shows the results of this analysis.

Graph 11.2: Age difference (member age minus dependant age)



- 11.11 Graph 11.2 above shows that the limited available evidence suggests that members are typically between one and five years older than their dependants with an average of 3 years older. We therefore recommend that the 2012 assumption (that members are three years older than their dependant) is retained for the 2016 valuation.



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

Baseline mortality	Standard table ²⁸	Adjustment
Current pensioners in normal health and ill-health	S2NMA	113%
Future pensioners in normal health and ill-health	S2NMA	113%
Dependants	S2DFA	100%

As specified by HM Treasury, future improvements in mortality will be assumed to be in line with those underlying the ONS-2016 projections.

²⁸ From the 'S2' series of standard tables published by the CMI and based on the experience of self-administered pension schemes. Separate tables are available, including those based on experience of members retiring in normal health, ill-health and for dependants.



Age retirement from service

Table A2: Age retirement rates for 1992 scheme protected members, tapered members and unprotected members with more than 16 years' service at 31 March 2012

<i>Age at joining</i>	<i>18</i>	<i>19</i>	<i>20</i>	<i>21</i>	<i>22</i>	<i>23</i>	<i>24</i>	<i>25</i>	<i>26</i>	<i>27</i>	<i>28</i>	<i>29</i>	<i>30 and over</i>
Age													
50	0.795	0.795	0.795	0.250	0.250	0.250	0.250	0.250	0.000	0.000	0.000	0.000	0.000
51	0.490	0.490	0.490	0.795	0.020	0.020	0.020	0.020	0.050	0.000	0.000	0.000	0.000
52	0.490	0.490	0.490	0.490	0.915	0.020	0.020	0.020	0.020	0.050	0.000	0.000	0.000
53	0.490	0.490	0.490	0.490	0.490	0.975	0.020	0.020	0.020	0.020	0.050	0.000	0.000
54	0.490	0.490	0.490	0.490	0.490	0.490	0.975	0.020	0.020	0.020	0.020	0.050	0.000
55	0.660	0.660	0.660	0.680	0.705	0.725	0.750	0.975	0.410	0.410	0.410	0.410	0.410
56	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410	0.410
57	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410
58	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410
59	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410
60 and over	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Table A3: Age retirement rates for 1992 scheme unprotected members with less than 16 years' service at 31 March 2012

Age at joining	18	19	20	21	22	23	24	25	26	27	28	29	30 and over
Age													
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.995	0.995	0.995	0.993	0.995	0.997	0.996	0.983	0.472	0.462	0.451	0.440	0.410
56	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410	0.410
57	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410
58	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410
59	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410
60 and over	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Table A4: Age retirement rates for 2006 Scheme members and new entrants to the 2015 Scheme

Retirement Age	2006 Scheme – Standard (protected and unprotected)	2006 Scheme – Special (protected and unprotected)	2015 Scheme
55	-	1.000	0.250
56	-	-	-
57	-	-	-
58	-	-	-
59	-	-	-
60	1.000	-	1.000

III-health retirement from service

Table A5: III-health retirement rates for all members

Age	III-health retirement rate
20	0.00008
25	0.00016
30	0.00031
35	0.00063
40	0.00128
45	0.00260
50	0.00526
55*	0.01023
59*	0.01139

*rates are zero if above the retirement age of the relevant scheme



Voluntary withdrawal from service

Table A6: Withdrawal rates for all members

Age	Withdrawal rate		
	1992 scheme	2006 Scheme and 2015 Scheme - Regular and Special Retained	2006 Scheme and 2015 Scheme - Standard Retained
20	0.0106	0.0106	0.0954
25	0.0106	0.0106	0.0954
30	0.0106	0.0106	0.0954
35	0.0098	0.0098	0.0882
40	0.0061	0.0061	0.0549
45	0.0034	0.0034	0.0306
50	0.0019*	0.0019	0.0171
55	0.0000	0.0000	0.0000

* Rates are zero at age 50 if the member is eligible to retire on an unreduced pension

Death before retirement

Table A7: Death before retirement rates for all members

Age	Death before retirement
20	0.00014
25	0.00015
30	0.00021
35	0.00028
40	0.00038
45	0.00054
50	0.00079
55	0.00128
60	0.00196
65	0.00308



Promotional pay increases

Table A8: Promotional salary scales for Regular firefighter members

The proposed salary scale shows assumed pay progression in excess of general wage inflation in comparison to an index base of 100 at entry.

Service (years)	Promotional Pay for Regular Firefighters
0	100.0
5	140.4
10	145.4
15	152.2
20	161.6
25	171.1
30	183.6
35	190.1
40	190.1

Table A9: Promotional salary scales for Retained firefighter members (Standard and Special)

The proposed salary scale shows assumed pay progression in excess of general wage inflation with an index base of 100 at age 18.

Age	Promotional Pay for Retained Firefighters
20	102.2
25	107.7
30	113.2
35	118.7
40	124.2
45	129.7
50	135.2
55	137.7
60	140.2
65	142.7



Commutation of pension for cash at retirement

Table A10: Recommended commutation assumptions for the 2016 valuation

Members are assumed to commute the following proportions of their pensions for cash

Member with service in the following schemes	1992 Scheme only	2006 Scheme only	2006 Scheme (Special Retained Members) only	2015 Scheme only
Scheme pension commuted from	1992	2006	Modified 2006	2015
All members	0%	17.5%	0%	17.5%

Member with service in the following schemes	Mixed 1992 Scheme and 2015 Scheme		Mixed 2006 Scheme and 2015 Scheme		Mixed 2006 Scheme (Special Retained) and 2015 Scheme	
	1992	2015	2006	2015	Modified 2006	2015
All members	0%	8.75%	17.5%	17.5%	0%	8.75%

Family statistics

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

Proportion married	Proportion married or partnered
75%	80%

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

Age	Proportion married	Proportion married or partnered
50	75%	80%
60	75%	80%
70	75%	78%
80	63%	64%
90	36%	36%

Males are assumed to be three years older than their female partners.



Appendix B: Modelling approach and minor assumptions

Active membership projections

- B.1 Direction 11²⁹ 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 1992 Scheme and 2006 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 in the 1992 Scheme and 2006 Scheme. This implicitly requires the actuary to estimate the membership at future dates in order to determine the valuation results.
- B.2 Since the majority of members (around 65%) 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 schemes 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.
- B.3 The expected cost of accruing benefits over periods after effective date have been determined by assuming an overall stable population (age and pay profile) to end of implementation period. In particular:
- > Allow for the protected population to reduce over the projection period (ie to 2023) with a corresponding increase in those accruing benefits in the 2015 Scheme to maintain the stable population. SPA in the projected populations is determined by implied dates of birth and so the SPA mix changes over time despite the assumed stable population.
 - > Mortality is projected forward to the relevant year of use in all cases.
 - > The run off of the protected population is broadly linear from the relevant calculation date to the average age at which members of each identified group (eg 1992 Scheme, Standard 2006 Scheme, Special 2006 Scheme) are expected to retire.
- B.4 The expected cost of accruing benefits over periods after the effective date for calculating the employer contribution correction cost has been determined by assuming:
- > The aggregate membership has the same age/pay profile over all projection periods (i.e. to 2023) (and assuming all in the 2015 Scheme).

²⁹ The Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended) ("the Directions").



- > Allow for the actual membership (assumed) accruing benefits in the 2015 Scheme to change over the projection period (i.e. to 2023). SPA in the projected populations is determined by implied dates of birth and so the SPA mix changes over time despite the assumed stable population.
- > Mortality is projected forward to the relevant year of use in all cases.

Grouping of individual active member records

- B.5 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 protection status (ie protected, tapered or unprotected), section/scheme (ie 1992 Scheme, 2006 Scheme, 2015 Scheme and Modified 2006 Scheme), age, State Pension age and service.

Accrual cost methodology

- B.6 See B.3 and B.4. The cost over each relevant period has been taken as the average of the cost at the start and end of each period.
- B.7 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 over the period 2015 - 2019 is lower than that over the period 2019 - 2023 (ignoring any redistribution of members 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.
- B.8 Non-accruing benefits such as lump sums payable on death in service have been recognised only when a benefit payment is expected.
- B.9 Members accruing or expecting to accrue benefits at double rate (in the 1992 Scheme) are treated as though the overall expected benefit accrues uniformly over all service.

Guaranteed Minimum Pensions (GMPs)

- B.10 A global adjustment was applied to reduce the past service liability in respect of estimated GMP entitlements for which provision of post SPA pension increases is not the responsibility of the scheme. The reduction is equivalent to a reduction in the contribution rate of around 1.5% of pensionable pay 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)

- B.11 Allowance has been made for the potential additional liabilities arising from inward transfers on PSTC terms (because the transfer value is usually less than the cost of providing the service credit granted). If volumes of transfers continue at historic levels the financial impact is expected to be equivalent to an employer contribution cost of 0.2% of pensionable pay.

General pay increases

- B.12 Direction 17 sets out the general pay increases that are to be assumed for valuation purposes.

Final pensionable pay

- B.13 All liabilities have been based on pensionable pay at the effective date as provided by administrators. 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

- B.14 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

- B.15 No allowance has been made for expenses. Expenses are outside the valuation framework.

Early retirement factors

- B.16 When modelling retirement from the 2015 Scheme before Normal Pension Age where an actuarial reduction would be applied early retirement factors have been set equal to those which would apply using the long term assumptions under the Directions (applied for the appropriate period before the normal pension age).
- B.17 There is no option to retire from active service with actuarially reduced benefits in the 1992 Scheme.



Re-entry of members

- B.18 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.

Added Years

- B.19 In certain limited circumstances firefighters can purchase additional service. The added years data supplied to GAD could not be easily associated with the main pension data for firefighters who had purchased this option. Further, from the 2012 valuation, added years were deemed not to have a significant impact on the valuation results. As such, a pragmatic approach has been used to model added years in which an adjustment has been applied to increase the overall active members' liability to allow for added years which represents around 0.1% of the past service liability for active members.

Member contribution yield over implementation period

- B.20 The average member contribution yield expected over the implementation period is estimated to be 13.0% of pensionable pay. This calculation uses the employee contribution rates for each scheme, as set out in scheme regulations. This compares to an average member contribution yield of 13.2% of pensionable pay that was expected over the period from April 2015 to March 2019.

Treatment of Special retained members of the 2006 Scheme

- B.21 Special retained members of the 2006 Scheme generally took up their options to purchase past service during the year 2015/16. For the purposes of the calculation of the prior value of the cost cap fund at 31 March 2015, having taken instruction from the Home Office, the following approach has been taken.
- > All Special members are treated as being in pensionable service at 31 March 2015 and therefore part of the scheme membership at that date; and
 - > Liabilities of Special members at 31 March 2015 include all Special service that Special members have elected to purchase, net of the present value of any future employee contributions that are payable towards that service.
- B.22 The calculation of past service liabilities at 31 March 2016 for Special members paying by periodic contributions allows for their full past service to be recognised, net of the present value of any outstanding employee contributions at that date.



Other Direction interpretations

Directions 27 and 28 (contribution rates)

- B.23 27(1)(a) and 27(1)(c): For the purposes of spreading any past service surplus or deficit, the future payroll estimates provided by the Home Office to OBR (September 2017 return) have been used for the period up to 2019/20 (with the figures adjusted in the years 2020/21 to 2023/24 to convert from OBR pay growth assumptions to valuation assumptions). After 2023/24, payroll has been projected assuming a stable workforce size and using valuation assumptions.
- B.24 27(1)(c)(ii) and 28: Member contributions since the effective date based on actual (or expected) yield for past periods and periods up to 31 March 2019. Set equal to expected contribution yield from April 2019 based on current member contribution rates set out in scheme regulations. See B.19.
- B.25 27(1)(b) and 27(1)(d): See B.3 and B.4.

Directions 28, 31, 32(1), 33(2)(a) (and related) – member contribution yields

- B.26 See paragraph B.23.

Direction 30 – Prior value of the cost cap fund

- B.27 Liabilities in respect of past service for Special members of the 2006 Scheme is included in the liabilities as at 31 March 2015, as described in paragraph B.20.

Direction 32(1) – expected cost of benefits for past periods (for cost cap purposes)

- B.28 The contribution rate required to cover cost of benefits over 2015-16 is calculated by considering the membership over the period 2015-16.

Directions 32(1) and 40(1) – expected cost of benefits for future periods (for cost cap purposes)

- B.29 See B.4.

Direction 34 – benefits paid from 2015 Scheme during 2015-2016

- B.30 Estimated where data unavailable.



Appendix C: Assumptions made for data uncertainties

Summary

- C.1 Whilst comprehensive data was received from each Fire and Rescue Authority or via their appointed administrators for the 2016 valuation, some aspects of the data were incomplete and/or unreliable for certain elements of our valuation calculations.
- C.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 Schemes, assumptions are required 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 cost cap net leavers liability.
- C.3 Scheme specific assumptions are determined by the "responsible authority", which is the Home Secretary 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

- C.4 Membership data is provided by each Fire and Rescue Authority or via their appointed administrators 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 the Scheme's administrators to address some 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 to incorporate an allowance for the excluded records.
- C.5 Up-rating 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 up-rating approach assumes that the records with omissions or errors have the same average profile (age, sex, pay, service) as fully complete records. Some 3% of records were excluded from the 2016 valuation data and around 5% of records provided for the purposes of setting the initial cost cap fund.
- C.6 As noted, the approach taken to data omissions is to assume each record with missing data has the same average profile as the complete records and therefore there is a risk that this assumption is not appropriate. The table below indicates the extent to which the valuation results might be incorrect if the approach in fact under/overstates the liability for the omitted members by 10%, which we believe to be a reasonable level to consider.



	Impact of error in assumption for missing data (as % of pay)	
	Uncorrected employer contribution rate	Employer contribution correction cost
Actives (uprating applied: 1.06 for 2016 data, 1.05 for 2015 data)	0.1%	0.1%
Deferreds (uprating applied: 1.01)	Not material	nil
Pensioners (uprating applied: 1.01)	0.1%	nil

- C.7 The table above illustrates 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

- C.8 Each Fire and Rescue Authority or their appointed administrators supplied data on the experience of the Scheme's membership over the four-year period to 31 March 2016. Fully complete and comprehensive data about members moving status between certain dates (eg leaving active status due to death or retirement) 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.
- C.9 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 a proportion of the difference in experience since the 2012 valuation, for example in recommending the assumption for baseline pensioner mortality.



- C.10 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 employer contribution rates. 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.

Cost cap net leavers liability (CCNLL)

- C.11 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. CCNLL 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.
- C.12 To accurately calculate CCNLL 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 the CCNLL and it was not possible to make assumptions to adjust the data available to provide for a reasonable estimate of CCNLL to be calculated. The data available for the CCNLL calculation was particularly complex to use due to the adjustment for members re-joining the Schemes and the significant number of members with multiple data records in both the 2015 and 2016 data sets.
- C.13 For the purposes of determining the 2016 valuation results, we have adopted 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.
- C.14 We expect that the uncertainty introduced by the approach above is not more than ½% of pensionable pay.
- C.15 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 a small unattributed item.
- C.16 For the 2016 valuation, the CCNLL 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 CCNLL calculation is not critical for this valuation although it would become so in future valuations when a longer period is considered.



Appendix D: Sensitivity of valuation results to assumptions set by Home Secretary

D.1 The table below provides an indication of the sensitivity of the valuation results to the particular assumptions under consideration. The figures shown here are also provided in section 4 of the formal valuation report.

Table D1: Sensitivity of valuation results to assumptions set by the Home Secretary

	Addition to uncorrected employer contribution rate	Addition to employer contribution correction cost
Membership profile: 2 years older on average over implementation period	0.2%	0.2%
Mortality rates: 5%* heavier rates of pensioner mortality	(1.9)%	(0.8)%
Age retirement rates: All new entrants to the 2015 Scheme retire at age 55	(0.1)%	(2.6)%
Commutation (other than as directed) all unprotected members of the 1992 Scheme commute 17.5% of 2015 Scheme pension	(0.6)%	(0.4)%
Ill-health retirement: 5%* increase to assumed rates	0.1%	0.1%
Ill-health retirement: 5%* increase in proportion assumed to receive higher tier benefits	0.0%	0.0%
Proportions partnered: 5%* more members assumed to have qualifying partners at death	1.2%	0.5%
Resignations and opt outs: 5%* higher numbers assumed to leave voluntarily before retirement (net of rejoiners)	(0.1)%	(0.0)%
Promotional pay increases: 0.5% higher promotional pay increases than assumed	2.8%	2.5%

* All these represent multiplicative increases to rates, i.e. 5% means rates 1.05 times higher.

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

D.2 In each variant of Table D1 the sensitivity shown is in relation only to the change in the assumption described. The impact of a combination of assumption changes will not necessarily equate to the sum of the relevant rows above.



Appendix E: Assumptions for Special members at 31 March 2015

- E.1 Advice on assumptions for Special members of the 2006 Scheme for use in the 2016 valuation is provided in the main body of this report.
- E.2 Assumptions for Special members are also required in order to calculate the prior value of the cost cap fund as at 31 March 2015. The Directions require that the assumptions used for this purpose are the assumptions adopted at the 2012 valuation. As the Special members were not present at the 2012 valuation, there are no existing assumptions for them.
- E.3 We propose that the assumptions adopted for this purpose are as set out below.
- > Age retirement from service: Assume all retire at age 55.
For the 2016 valuation, it has been assumed that all Special members (including unprotected and taper protected Special members) will retire at age 55. There is no reason to believe that we would have come to a different conclusion if we had advised on this assumption at the 2012 valuation. Therefore, we propose that all Special members are assumed to retire at age 55.
 - > Voluntary withdrawal from service: Use the same assumption as per members of the 1992 Scheme.
For the 2016 valuation, it has been assumed that Special members will withdraw from service in line with the assumption for members of the 1992 Scheme. There is no reason to believe that we would have come to a different conclusion if we had advised on this assumption at the 2012 valuation. Therefore, we propose that Special members withdraw in line with the assumption for 1992 Scheme members from the 2012 valuation (which remained unchanged at the 2016 valuation).
 - > Commutation of pension for cash at retirement: Use the same assumption as per members of the 1992 Scheme.
For the 2016 valuation, it has been assumed that Special members will commute in line with members of the 1992 Scheme. There is no reason to believe we would have come to a different conclusion if we had advised on this assumption at the 2012 valuation. Therefore, we propose that Special members commute pension in line with the assumption used for 1992 Scheme members at the 2012 valuation (which is different from the assumption for 1992 Scheme members at the 2016 valuation).
 - > Other assumptions: Use the same assumptions as per standard retained members.
For the 2016 valuation, all other assumptions for Special members have been set to be the same as for standard retained members. There is no reason to believe we would have come to a different conclusion if we had advised on these assumptions at the 2012 valuation. Therefore, we propose all other assumptions are set to be those used for standard retained members at the 2012 valuation.