

# Manual of integrated demographic forecasting for local planning in Wales

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# 1 Introduction

## 1.1 Aims and origins of the manual

This manual has the aim of boosting confidence in local demographic forecasting. It is an area essential to local planning. Demographic forecasts are specified in government planning guidance as the starting point for assessing housing need as a platform for statutory development plans. These in turn direct developers towards land set aside for housing or employment, so there are big stakes involved. Furthermore the guidance not only demands that government forecasts be interpreted. It demands that each local planning authority assess the inputs and assumptions made by the government against a variety of alternatives using evidence-based modelling:

“Local planning authorities will need to have a clear understanding of the factors influencing housing requirements in their area over the plan period. The latest Welsh Government local authority level Household Projections for Wales... provide estimates of the future numbers of households and are based on population projections and assumptions about household composition and characteristics. ... Local planning authorities will need to assess whether the various elements of the projections are appropriate for their area, and if not, undertake modelling, based on robust evidence, which can be clearly articulated and evidenced, to identify alternative options.” (Welsh Government 2016 Planning Policy Wales: pp131-132, section 9.2.2)

Yet there have been few written aids to support the work of those who have to interpret and make demographic models for local planning. Welsh Government guidance (WAG 2006, WG & WLGA 2014) give not much more than a sweeping encouragement to undertake demographic forecasts. Professional planning degrees and their textbooks hardly mention the practical tools and skills needed. Academic demography courses tend to be sociological and statistical and rarely applied to planning issues.

The need for local demographic analysis is no less today than in the heyday of strategic planning in the 1970s. In spite of the loss of senior and experienced staff through cuts to local government spending, the responsibilities of each local council are more rather than less..

A report commissioned by RTPI Cymru and led by Cardiff University made various recommendations for training which have been emphasised by RTPI Cymru as follows:

“We stress the urgent need for the development of skills to ensure LPAs [Local Planning Authorities] have the technical knowledge and statistical ability to undertake the work outlined in PPW para 9.2.2, which includes modelling to provide alternative scenarios to the Welsh Government’s projections. Resources for such training is a major concern for RTPI Cymru, given continued budget constraints for LPAs and we believe that the RTPI, Welsh Government and other stakeholders should work together to deliver further training and skills development opportunities on interpreting, adapting and refining household projections data for land use planning

purposes as set out in the recommendations of this research.” ( Harris, Smith and Webb, 2016: introductory note).

This manual, and the training courses which it follows, are part of an attempt to improve skills and capacity for demographic modelling within planning. The second and practical part of the manual is based on the POPGROUP software which has grown to be the industry standard for local authority demographic modelling (University of Manchester, 2014).

This manual is of course not the last word. Indeed the production of a good manual inevitably undergoes development and revision if it is at all successful. The comments of readers to point out errors or omissions that could be rectified are welcome. If they are sufficient to suggest the manual has been useful, they may well also inspire a second improved edition.

## **1.2 Who is this manual for and how is it organised?**

This manual is intended to be useful for anyone thinking of local futures. Chapters 2, 3 and 4 make up Part I and explain the relationship between population and planning. They are about theory and strategy, but avoid technicalities. They are intended to be accessible to all who will need to interpret and to commission demographic modelling as well as those who will undertake the modelling itself.

Chapter 2 provides a framework for considering how demographic forecasts underpin much of planning, at the same time as plans must affect population. It makes the case that this feedback can be represented in modelling by two stages, which provide the framework for the later practical part of the manual. The official forecast and improvements to it represent a ‘continuity forecast’ that continues recent levels of change and what is foreseeable about the future but not under the control of planners. The second stage includes constraints that represent the politicians’ and planners’ input, which in particular affect where people will move to live. The chapter defines what is meant by projections and integrated demographic forecasts, gives three case studies, and reviews who needs forecasts.

This manual does not make a strong distinction between ‘projections’, ‘forecasts’, ‘scenarios’ and ‘predictions’. Government produces projections of population and households, but no-one is very interested in projections that do not indicate a likely outcome, so they are reasonably taken as forecasts. The term prediction is too insensitive to the uncertainty that surrounds all scenarios of the future. The manual tends to use the terms forecast or scenario for all the different projections of the past into the future.

Chapter 3 provides a summary of the methods used to project population, households and labour force into the future using assumptions about components of change. These assumptions are based in evidence of what characterises each area as different from others. The chapter distinguishes population forecasts from the forecasts of households and the labour force that are derived from the population forecasts. It defines the links between households and the demand for dwellings, and between the labour force and the demand for jobs.

Chapter 4 performs two functions. It lists the data inputs to an integrated forecast of population, households and the labour force, and it discusses the reliability of these inputs and the final forecasts. This manual takes the planning policy advice to assess the appropriateness of inputs to the demographic forecasts, and emphasises the uncertainty that surrounds the future. While planners

are often receptive to the concept of uncertainty, they rarely have it quantified for them. How planners can respond to uncertainty is briefly discussed; planning regulations tend not to encourage contingency plans and flexible responses to unpredicted conditions.

Part II of the manual, comprising Chapters 5-8, is a practical guide for those who have to implement the framework laid out in Part I and get to grips with the POPGROUP software. It is focused on the statutory need to develop a Local Plan, though it will reward those who also support the planning of services more generally (for whom the general [POPGROUP guides](#) will also be of interest). The manual starts from scratch. It does require a reading of the software guides to install and use the software modules: POPGROUP, Derived Forecasts and Data Modules. Attendance on a software course will help but is not necessary to implement the manual. There are no mathematics – these are left to the Reference Manuals of the software. However, the reader will need their Excel and arithmetical wits about them. POPGROUP is not a black box, it merely provides a user-friendly environment and routines to replicate and extend official projections. The manual gives as much prescription as possible, but in the end the assumptions that the reader may change or test are entirely the responsibility of the reader to consider and subsequently defend.

Chapter 5 provides a step-by-step guide to creating a complete demographic model for one or more Welsh local authorities, starting with past data from 2001, continuing with the latest official population and household projections and unofficial labour force projections, and finishing with the links to dwellings and jobs. The chapter is entirely prescriptive.

Chapter 6 explains what POPGROUP does with data entries. POPGROUP files are all Excel files. Each file contains the assumptions for one type of input – for example births, or in-migration from other parts of the UK, or economic activity rates. The user's own Excel skills will help to navigate around the files. Results and user-requested tables and charts are saved on Excel sheets which can be amended for use in reports and presentations. The Chapter points out the structure of POPGROUP files to make it easier to interpret their contents and to amend them to indicate new assumptions.

Chapter 7 prescribes alternative scenarios to the official forecasts that are usually essential when developing a Local Development Plan (LDP). They are of three types, reflecting the framework described in Part I. The first scenarios update the official forecasts with more up-to-date information. The second set of scenarios test the sensitivity of the (possibly now improved) official forecasts to plausible alternative assumptions, to reflect the uncertainty of the future. This helps to put the principal forecast in context.

Chapter 8 addresses a series of issues that are often raised about demographic forecasts by local planners. It has the flavour of 'Frequently Asked Questions' with brief answers.

### **1.3 Can this manual be dipped into?**

The manual is intended to be dipped into. Some readers will concentrate only on the first part. Others will move straight into the practical second part and refer back to the first part as and when it is useful for them to do so. It is only necessary to follow the sequence of sections within Chapter 5, setting the platform for all the other demographic scenarios. Each section within each Chapter of part II ends with files saved and an end result achieved, ready for a break or a cup of tea.

Please enjoy the manual, and send comments and queries for supplements or a new edition.



# Part I: Population and Planning

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This part of the manual describes the two-way relationship between demographic change and planning, and the framework for implementing the relationship within a model of population, households and the labour force. It discusses the need for demographic modelling and the data used within it.

## 2 Who needs demographic projections?

*Summary:* Three case studies illustrate where predictions of the future help politicians and planners to determine the action they will take, without unduly hampering the room for independent plans which can themselves affect the future. The chapter recommends the strategy “*predict what you cannot control, and plan what is under your control*”. A review of the range of services which seek demographic projections stimulates a discussion of projectionists having many ‘governors’ each of whom may control a different part of the future. Finally, uncertainty is intrinsic to predictions; understanding its size and nature helps planners to make realistic flexibility and contingency plans a normal part of their work.

### 2.1 Introduction

This chapter aims to describe the relationship between planning on the one hand and predictions of the future population, households and the labour force on the other.

We make a demographic projection to better know the future population, households and labour force needing work. We acknowledge that it won’t be precisely accurate, but if it is based on an analysis of past trends and a good understanding of the dynamics of how populations change, then we can rest assured that it is the best projection that can be made. That’s what we need to foresee the number of children who will be in school and the number of schools they will fill, the number of households there will be and the land that will have to be found for the dwellings to house them, the demand for social and medical care for older people, and the number of residents looking for work. How could we possibly plan any of these things without a good forecast of the future?

Such a reasonable suggestion has nonetheless been condemned as a remarkably poor strategy for public services. For some it is a head-in-the-sand approach, because it ignores the social and political opportunity to plan the future, and replaces it with an approach of ‘predict and provide’. The critics say that demographic forecasting assumes that the future will be a continuation of past trends, and takes all the imagination out of planning.

Would it be better to begin not with demographic projections but a consideration of the population that political representatives would like to see? And on this democratic platform surely one can

encourage innovation and opportunities that did not occur in the past, and plan for a sustainable future as regards the environment and an improving quality of life? From this point of view, projections forward from the past are not a mild starting point for planning, but a wolf in sheep's clothing (Richard Bate, 1999; other critics include Glen Bramley 2014 and the Council for Protection of Rural England CPRE). Criticisms of the central role of demographic projections in local planning is that they inhibit change, secondly that they are circular in that supply stimulates demand, and thirdly that the projections and planning system does not allow plans to insist on sufficient affordable housing. When land is provided for housing needed, the critics say, developers provide housing not for those who need it but those who can afford it, and leave empty the land that is most difficult to develop (Green Balance, 2007).

And yet there are demographic insights that do make the future predictable; ignoring them would lead politicians and planners astray. The future number of children depends not just on family size but also on the number of women who live locally. That number of women we already know from each census and updated population estimates. We know too that we get older every year, by one year: the future number of elderly can be estimated quite well from the numbers alive today. We know that young adults are much more likely to migrate than people of any other age. And we know that patterns of fertility, mortality and migration are quite stable, they do not change rapidly. To ignore this evidence in favour of imagining futures that may be impossible would lead to wasteful planning and poor services.

Of course the reality of planning is that there is a conversation between demographic projections and planning. The relationship can be summarised as follows.

## **2.2 A strategy for combining projections and planning**

A useful approach is to separate that part of the future which is outside the planner's influence, from the remaining room for making a difference through planning. RJS Baker developed this approach at a series of talks on 'planning, forecasting and frustration in the public services' several decades ago (Baker, 1972 and c1980). He suggested that the aim should be to "predict what is not under the planner's control, in order to plan what is under the planner's control". This approach aimed to avoid planners being surprised but what they should have predicted, without enslaving them to a forecast of things they should take responsibility for. If the planner can understand the population change which any plan will have to cope with, then discussions can focus on a range of plans and scenarios that answer the population's needs within these constraints.

The solution is neither to only predict nor to only plan but to consider several questions:

- (a) Which plans need demographic forecasts?
- (b) What is it about population that is not under the planner's control and how can it be predicted?
- (c) How can the viability of alternative plans be evaluated for their impact on population?
- (d) What can planners do if what is not under their control is not closely predictable?

## **2.3 Which plans need an integrated demographic forecast?**

### **2.3.1 What is a demographic forecast?**

A demographic forecast is one that provides the age-composition of a defined area, by considering the births, deaths and migration that each age-group experiences. The *cohort component projection model* has become standard methodology in the UK and recommended by the United Nations generally. It is relevant wherever data sources allow measurement of population by age – the *cohort* in the name of the model – and measurement of births, deaths and migration – the *components* of population change.

### **2.3.2 Which plans need a demographic forecast?**

Any plan that is directed to particular age groups requires a demographic forecast. This covers just about every service from cradle to grave: infants and children’s centres, schooling, youth projects, apprenticeships, young adult health, services related to employment, adult care services and those care and health services taken up predominantly by older people.

However, many other plans which deal with the total population and appear not to be age-specific, also need demographic forecasts. This is because they address a need that is greater for some ages than others. Demand for housing, for jobs, and for health services are major areas of planning where the demand is closely related to the age composition of a population. To make a good forecast of the labour force available to take up jobs, the numbers at each age are needed because economic activity is so dependent on age, with no children and few older people working. Similarly, housing need is dependent on age. Children do not need extra housing units, while older people in the UK tend to live in smaller households and so require more housing as a proportion of their population. Housing need increases in an ageing population, not just in one where average household size is getting smaller. Household formation and economic activity rates, and many other derived characteristics have close relationships with age, and with sex. The theory of *derived forecasts* will be discussed further in the next chapter.

### **2.3.3 What is an integrated demographic forecast?**

In this document an integrated demographic forecast is:

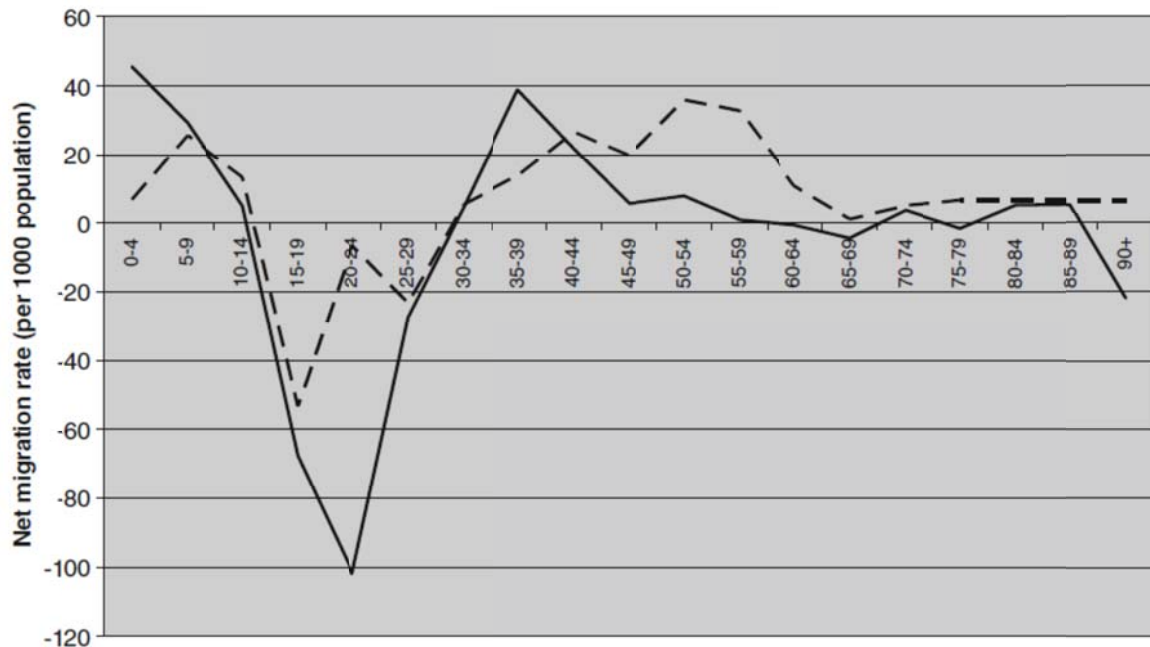
- A population forecast with its age and sex composition,
- Forecasts of households and the labour force derived from the future population and its age-sex composition,
- Forecasts of housing needed by the future number of households, and of jobs needed by the future labour force

This set of integrated forecasts of population, households and housing, labour force and jobs, are needed in particular in the development of local plans throughout the UK.

## **2.4 Three case studies of population and planning**

The three case studies confirm that a reliance on projections to 'predict and provide' is as unhelpful as remaining ignorant of projections. Planning for 'business as usual' in National Parks or in South East Wales implies the deepening of unsustainable ageing populations in the one case, and unequal living conditions in the other. Understanding the components of demographic change in each case identifies the pressure points that should be eased or avoided, and thus the challenges for the planners. In the case of Birmingham's ethnic composition, the dissection of population dynamics enables planners to see that future rapid change is a consequence of changes that are already in progress and cannot be avoided, at least at the level of the city as a whole. Investment and restructuring of housing and jobs markets may engineer changes in neighbourhoods but the larger picture of growing diversity is not amenable to significant change.

**Case Study: The ageing of National Park populations**



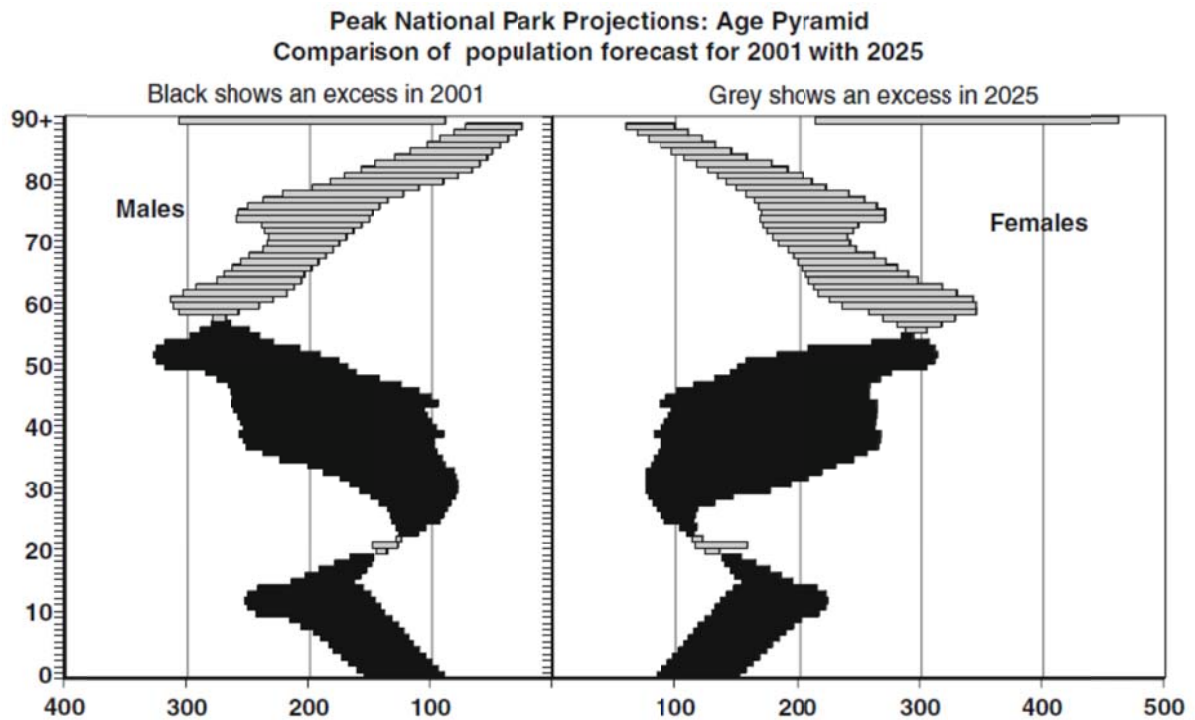
The net impact of migration measured for the Peak District National Park (—) and Cairngorms National Park (---), (Marshall and Simpson, 2009)

A ‘business as usual’ forecast extending recent fertility, mortality and migration experience into the future for two of Britain’s national parks showed that their current loss of young adults, although balanced in number by families with older adults, would lead to an increasingly elderly population. Because new building is restricted in national parks, “the number of new houses required to prevent the decline in the working age population is politically unfeasible. Policies that aim to change the migration age pattern and to cater for the needs of the elderly population are essential if the sustainability and vibrancy of local communities are to be maintained.” (Marshall and Simpson 2009: 107).

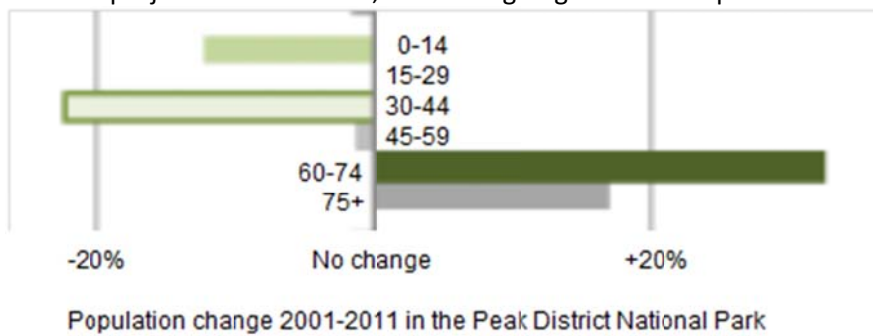
In the Peak District, more people were expected to migrate into the Park than out of it, but the older age structure of the incoming residents means that deaths outstrip births and the population will decrease if current trends continue. The average household size of older people is smaller, and so more dwellings would be needed even to keep pace with a smaller population, but the residents would not sustain a viable economic life.

These conclusions highlighted that planners’ key instrument of regulating land for housing would not be enough to avoid an unwanted outcome, and provoked discussion of policies to influence the *nature* of jobs, facilities and transport links that might attract or keep younger people in the Park areas.

**Case Study: The ageing of National Park populations, continued**



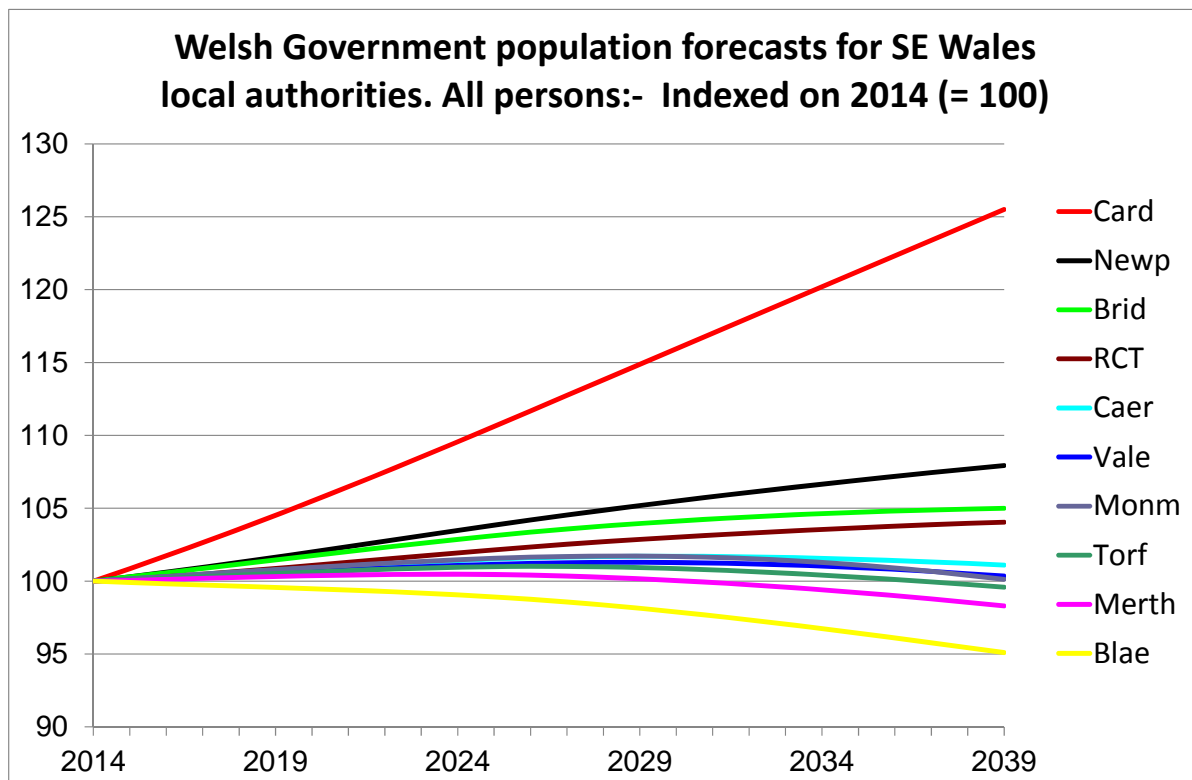
The 2011 Census showed that the Peak Park lost only 0.1% of its population during 2001-2011 rather than the projected loss of 2.5%, but that ageing continued apace.



Source: ONS (2013)

**Case Study: Cardiff and South East Wales**

Cardiff has attracted many government and head-office jobs resulting in net in-migration of residents, as well as commuters. Official projections and calculations of ‘Objectively Assessed Need for housing’ for Cardiff and the surrounding local authorities of South East Wales are based on a continuation of past demographic trends. These show a continuing emptying of the poorest Valley districts that have already been hardest hit by the shift from industrial to service industries, at the same time as adding more housing to Cardiff.



Wales Government 2014-based principal projections

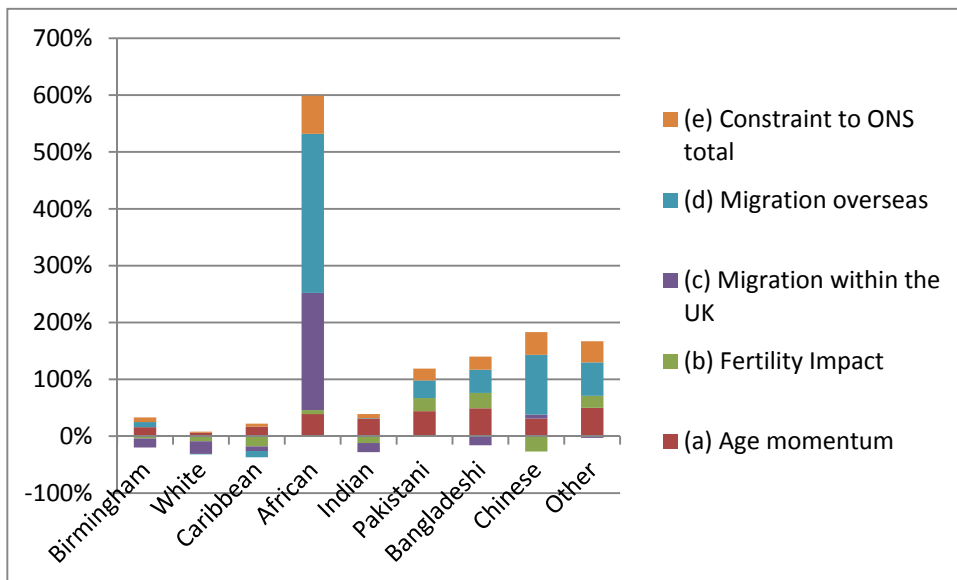
Although a continued focus on development in Cardiff is logically unsustainable, it is difficult to promote development away from Cardiff’s political and transport connections, and the high price of Cardiff land is attractive to developers. A strategic plan to locate housing or development in the Valleys would re-invigorate those districts, and demographic modelling straightforwardly shows the links between housing, jobs and services that each population needs. But such a plan would require major transport and infrastructure investment. It would require political agreement across all local authorities and is unlikely to happen without regional and national leadership.

For South East Wales, the official projections indicate outcomes with different interest to each player. Balancing those interests requires strong planning structures and political will. The default under Welsh planning regulations has been to build to meet the ‘business as usual’ projections, but would not address the difficult future for residents of all districts concerned.

**Case Study: Ethnic composition in Birmingham**

Like many British cities, Birmingham’s ethnic composition has changed rapidly, a decreasing white population at the same time as growing minority populations. The minority populations of Birmingham will in their aggregate become a majority in the next decade.

Despite assumptions by many commentators that ‘white flight’ is the main cause, demographic analysis suggests otherwise. Counter-urbanisation began with rising living standards and car ownership in the 1950s, before immigration filled the gaps in the city housing and labour markets. Minority populations once settled have left inner city areas as fast as the white population (Finney and Simpson, 2009). The change in composition is instead due to a combination of continued immigration and the children of the migrants. The children come of age, add to housing need, and the pressure for movement out from the inner city continues.



Projected population change in Birmingham 2001-2025, for each ethnic group  
 Source: calculated from Simpson (2006: 10)

Demographic projections show clearly that a major source of the growth of Birmingham’s Asian populations is its current young age structure. Without further immigration, and with no internal migration by any ethnic group, the Asian population would still grow by around 20%. No planner can change the ages of residents already in Birmingham. This entirely predictable growth of diversity is something for planners to acknowledge and work with. For city planners, continued immigration and continued migration out of inner city areas by all ethnic groups are also given parameters, not amenable to their control.

This case study also shows that out-migration does not mean a smaller population. In Birmingham as in most cities with a young population, the excess of births over deaths more than balances the out-migration.



## **2.5 Who uses demographic forecasts?**

A 1990 survey in the UK prepared with the help of the British Society of Population Studies and UK government gained 278 responses, finding projections of major or central importance across private and public sectors and with particular importance in local government (Joshi and Diamond, 1990: 4). Uses covered recruitment and personnel, marketing, investment, location, transport, planning, housing, education, welfare (general, health, elderly and children), research, teaching and other uses. Demographic projections – whether population, household or labour force – were particularly central to plans with time horizons of ten years or more, but not exclusively so. One third of respondents made their own projections.

The authors summarised the survey’s findings in words that could have been used today: “While customers are on the whole satisfied with official projections, the need for better local projections was a recurrent theme. Information on internal migration, and variant assumptions about its course were in strong demand, as were better and more up-to-date baseline data on the present. Improved methodology for local projections and training in it is called for” (p1).

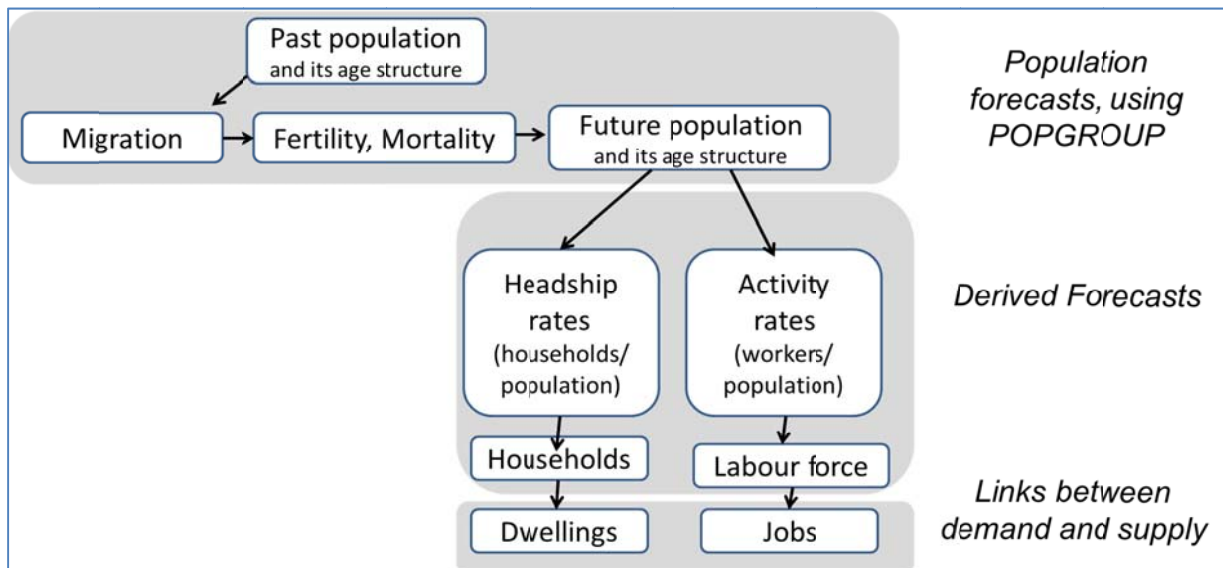
The variety of demographic forecast and their use in planning was emphasised in a parallel publication on local and small area projections, where examples were given of school roll forecasts for planning investment in new schools, forecasts of young adult men to plan the boundaries of reorganised police force divisions, forecasts of drive-time catchment population for potential new superstores, and the private and public health services’ use of forecasts with detail of young and elderly, household composition and ethnic group (Woodhead and Dugmore, 1990).

### 3 How are integrated demographic forecasts made?

*Summary:* This chapter describes the methods behind an integrated set of demographic forecasts. After an overview, it separately describes each of population forecasts, households and the labour force. The link between households and housing, and between the labour force and jobs are specified, and the way in which targets for housing and jobs can be used to constrain a population forecast and thus calculate the implications for services. Forecasting work does not provide just one answer but explores different scenarios, as described in the final section.

The chapter aims to provide a practical overview of forecasting methods, which are standard ones in use in the UK and worldwide. It also names the files which the POPGROUP software uses to hold assumptions about the future. For a fuller treatment of the demographic methods, refer to demography textbooks such as Rowland (2003). The POPGROUP software manuals contain sections on the calculations it uses to implement the methods.

#### 3.1 The framework



The diagram summarises the information that is used and produced in an integrated demographic forecast. Each part of the diagram is discussed in subsections of this chapter.

#### 3.2 Population forecasts

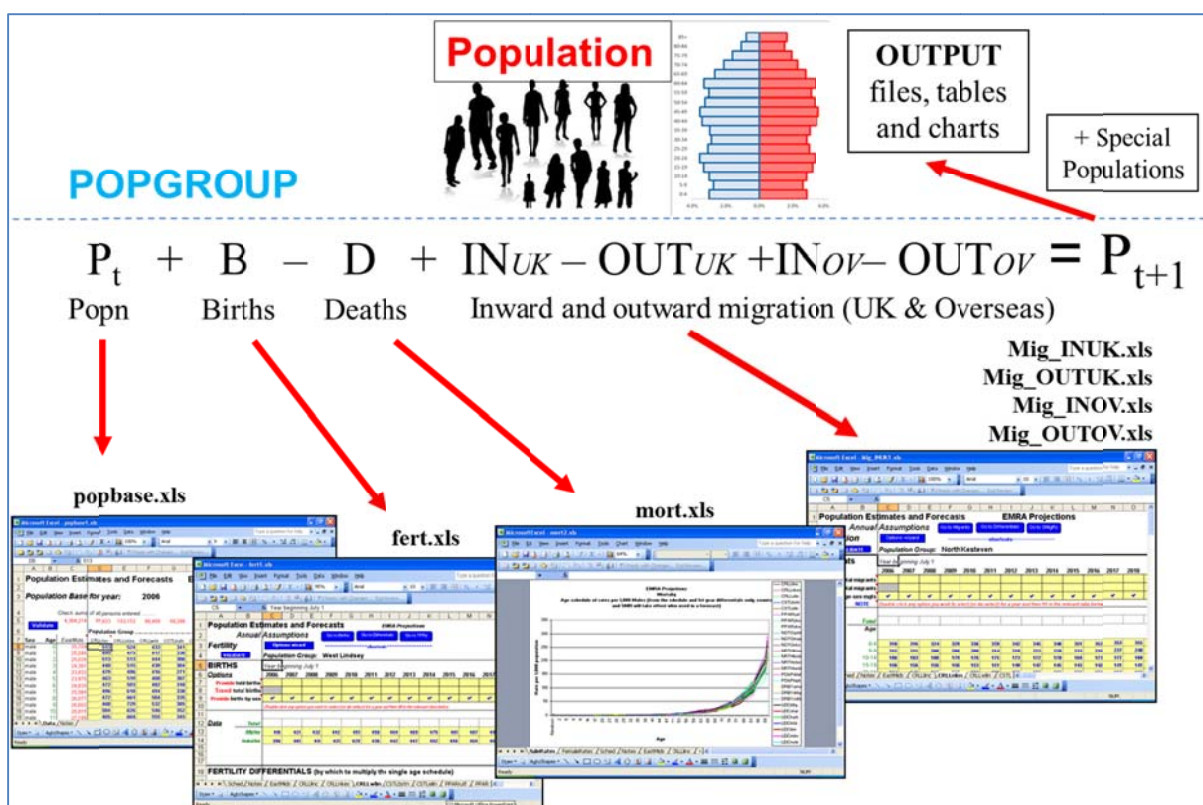
##### 3.2.1 The cohort component projection model

Population forecasts employ a *cohort component projection model*. 'Cohort' refers to age, and 'component' refers to the components of population change: births, deaths and migration. The fundamental balancing equation specifies how the components of population change affect the population from one year to the next. This is described in the chart below, where the POPGROUP files associated with each input are also named and summarised with a screen-shot.

Separate files contain the starting or *base* population, the assumptions about births, about deaths, and about each of four migration flows. The migration flows can be named by the user but are by

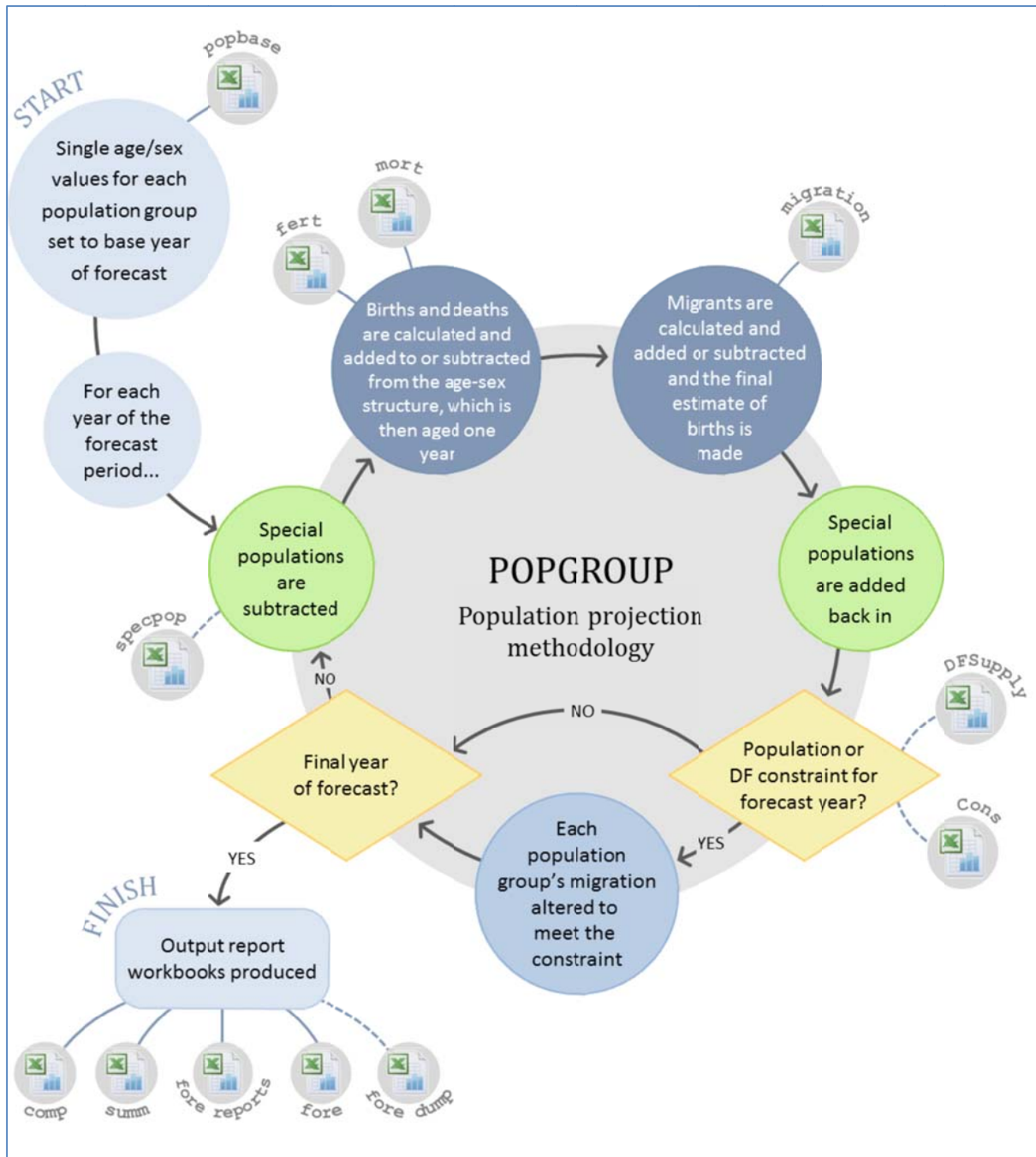
default the in- and out-migration between the area of interest and the rest of the UK, and between the area of interest and overseas.

The software implements this equation for each of the years of the forecast, and does so for each age 0, 1, 2 up to 89 and the final age-group of all people aged 90 and over. For example births are calculated dependent on the numbers of women at each age between 15 and 49, but only affect the population aged 0 in the next year. Deaths affect every age, but particularly older ages. Migration also affects all ages, though it is most frequent among young adults. Those assumptions about the age-distribution of fertility, mortality and each migration flow are contained on the input files and may be changed by the user.



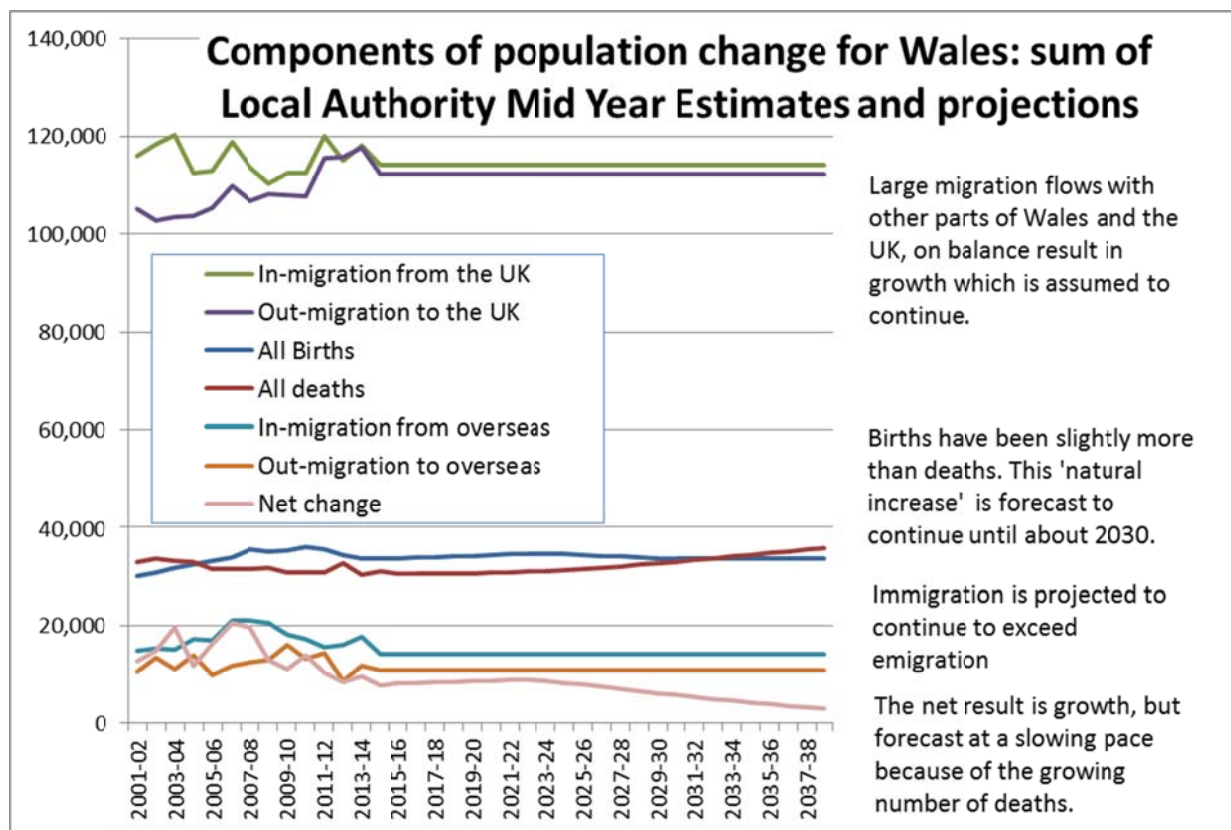
The next diagram shows the cycle each year that POPGROUP employs to create the population forecast, starting at the top with the base population, using the equation in the previous diagram.

‘Special populations’ are mentioned in both diagrams. This is an optional facility to forecast some populations separately. In Wales, England and Scotland, residents in the armed forces and in prisons are separated in this way, because they are not included in UK estimates of migration and the size and age structure of these special populations tends to be static: while the individuals get older, the numbers leaving at older ages and joining at younger ages balance, to maintain a constant number and composition. The POPGROUP software keeps this information in a separate file, which can also be used to specify expected changes in the numbers and age-composition of each special population.



### 3.2.2 Components of population change for Wales and its local authorities

The chart below summarises the components of change in Wales as a whole over the years 2001-2014 as estimated by the Office for National Statistics, and as projected forward by the Welsh Government. These are the sum of the 22 local authorities. It is shown here for illustration and is not the same as the official national population projections for Wales, which is projected separately for use in planning at an all-Wales level.



The local authority values are of each component of change and are calculated for each age group and males and females separately, for use in local demographic forecasting. Local authorities do differ substantially. The official local authority forecasts are summarised by Welsh Government (2016). An illustration of the differences is shown in this table, which summarises the natural change and the net impact of migration, for each local authority. Natural change is births minus deaths. The net impact of migration is the balance of all in and out migration whether within Wales, the UK or overseas. It shows the average annual change in each of three past periods, and the average over the projection period 2014-2039.

Analysis of population change, past and future												
	2001-2004			2004-2009			2009-2014			2014-2039		
	Natural change	Net migration	Total change	Natural change	Net migration	Total change	Natural change	Net migration	Total change	Natural change	Net migration	Total change
Wales	-0.1%	0.6%	0.5%	0.1%	0.5%	0.5%	0.1%	0.2%	0.3%	0.0%	0.2%	0.2%
Isle of Anglesey	-0.2%	0.6%	0.5%	-0.1%	0.4%	0.3%	0.0%	0.1%	0.1%	-0.2%	0.0%	-0.1%
Gwynedd	-0.2%	0.7%	0.5%	0.0%	0.3%	0.3%	0.0%	0.3%	0.3%	0.1%	0.2%	0.3%
Conwy	-0.5%	1.3%	0.8%	-0.4%	0.8%	0.4%	-0.3%	0.6%	0.3%	-0.4%	0.4%	0.1%
Denbighshire	-0.3%	0.6%	0.3%	-0.2%	0.3%	0.1%	-0.1%	0.1%	0.1%	-0.2%	0.3%	0.1%
Flintshire	0.1%	0.1%	0.2%	0.2%	0.1%	0.3%	0.2%	0.0%	0.2%	0.1%	0.0%	0.1%
Wrexham	0.0%	0.1%	0.1%	0.2%	0.4%	0.7%	0.3%	0.2%	0.5%	0.1%	0.2%	0.4%
Powys	-0.3%	1.1%	0.8%	-0.2%	0.7%	0.5%	-0.2%	0.1%	-0.1%	-0.4%	0.1%	-0.3%
Ceredigion	-0.3%	0.4%	0.2%	-0.2%	-0.1%	-0.3%	-0.1%	0.3%	0.2%	0.0%	0.4%	0.3%
Pembrokeshire	-0.2%	1.2%	1.0%	-0.1%	1.0%	0.9%	-0.1%	0.4%	0.3%	-0.3%	0.2%	0.0%
Carmarthenshire	-0.3%	1.1%	0.7%	-0.2%	0.8%	0.6%	-0.1%	0.3%	0.2%	-0.2%	0.3%	0.1%
Swansea	-0.1%	0.8%	0.7%	0.0%	0.6%	0.6%	0.1%	0.4%	0.5%	0.1%	0.3%	0.3%
Neath Port Talbot	-0.2%	0.9%	0.7%	0.0%	0.4%	0.3%	0.0%	0.2%	0.1%	-0.1%	0.1%	0.1%
Bridgend	0.0%	0.8%	0.8%	0.1%	0.8%	0.9%	0.1%	0.4%	0.5%	-0.1%	0.3%	0.2%
The Vale of Glamorgan	-0.1%	0.8%	0.8%	0.1%	0.5%	0.7%	0.2%	0.1%	0.2%	0.0%	0.1%	0.0%
Rhondda Cynon Taf	0.0%	0.3%	0.3%	0.1%	-0.1%	0.1%	0.2%	0.0%	0.2%	0.1%	0.0%	0.2%
Merthyr Tydfil	-0.1%	0.0%	-0.1%	0.1%	0.6%	0.7%	0.2%	0.1%	0.3%	0.0%	-0.1%	-0.1%
Caerphilly	0.1%	0.4%	0.5%	0.2%	0.3%	0.5%	0.2%	0.1%	0.3%	0.1%	-0.1%	0.0%
Blaenau Gwent	-0.3%	0.0%	-0.4%	-0.1%	0.2%	0.2%	0.0%	-0.1%	-0.1%	0.0%	-0.2%	-0.2%
Torfaen	0.0%	-0.1%	-0.1%	0.1%	0.0%	0.2%	0.1%	-0.1%	0.1%	0.0%	-0.1%	0.0%
Monmouthshire	-0.1%	1.2%	1.1%	0.0%	0.6%	0.6%	-0.1%	0.5%	0.4%	-0.3%	0.3%	0.0%
Newport	0.2%	0.2%	0.4%	0.3%	0.3%	0.6%	0.4%	0.0%	0.4%	0.3%	0.0%	0.3%
Cardiff	0.2%	0.5%	0.7%	0.5%	0.8%	1.3%	0.6%	0.4%	1.0%	0.6%	0.3%	0.9%

Note: 'Net migration' for years 2001 to 2011 includes the 'unattributable population change' (UPC) during that decade that was established after the 2011 Census. This may have been unrecorded migration as is assumed in this table, but it may also be due partly or entirely to errors in either the 2001 or the 2011 estimates. When Welsh government sets its assumptions for local authority migration using the average of the past years 2009-2014, it leaves out the UPC.

The table is has many details. It helps to understand how the official principal population forecast continues established differences between local authorities, but that local circumstances have also changed. For example:

- Cardiff has had higher growth than the rest of Wales throughout the past decade and a half, and is projected to grow more than twice as fast as any other Wales authority area.
- Powys is projected to lose population faster than other authorities, continuing the trend of the past decade. This is not because of the number of people moving away, which has in fact been fewer than those moving in: the net migration is positive in each past period and in the forecast. The loss is due to the age of the Powys population and of those moving in. The figures are not shown in this table, but on balance it is older people who move into Powys and younger people who move out. This means that there are considerably more deaths than births in Powys. For this reason natural change is negative, and the population has reduced.
- The South Wales Valleys authorities have tended to lose population through migration.

### 3.2.3 The POPGROUP software

POPGROUP implements the cohort component projection model for the user's areas. It is a model maker because when setting up a model the user can specify:

- How many areas to forecast (up to 40 in one model), and the name of each area.
- The four flows of migration. The defaults are in and out flows between each area and the rest of the UK, and in and out flows to overseas. These could be changed, for example to within Wales and everywhere else, or to have a single migration flow to the rest of the

world. The latter option is often used for small areas when there is no reliable information on the origins and destinations of migrants.

- Whether special populations will be forecast separately, and if so the name of each special population.

When POPGROUP sets up a population model according to the options chosen by the user, it places empty Excel files as 'skeleton files'. These have all the labels and structure helpful to enter data.

The details of the data entry options and how they are implemented in a population forecasts are fully described in the software manual (Edge Analytics, 2013). Directions for getting started quickly are described in later chapters.

### **3.2.4 Where do the data come from?**

The POPGROUP software itself has no data. It is suitable for any areas in any part of the world. It has very few assumptions which the user is unable to amend. It is not a black box.

However, the data has to be entered to run a forecast. When a user has to gather all the data and make all the assumptions about the future, then independence and clarity comes at the cost of the work required to source and enter each component of data required for a projection.

Help is at hand. The POPGROUP community of users and its owners the Local Government Association have provided Data Modules, which automate model creation and filling of data for the official population projections of each country in Great Britain. This means it is very straightforward as described in later chapters to gain all the inputs and to replicate the official forecast, for any local authorities that subscribe to the annual service package.

The user then has the easier task of amending the inputs in order to run alternative scenarios.

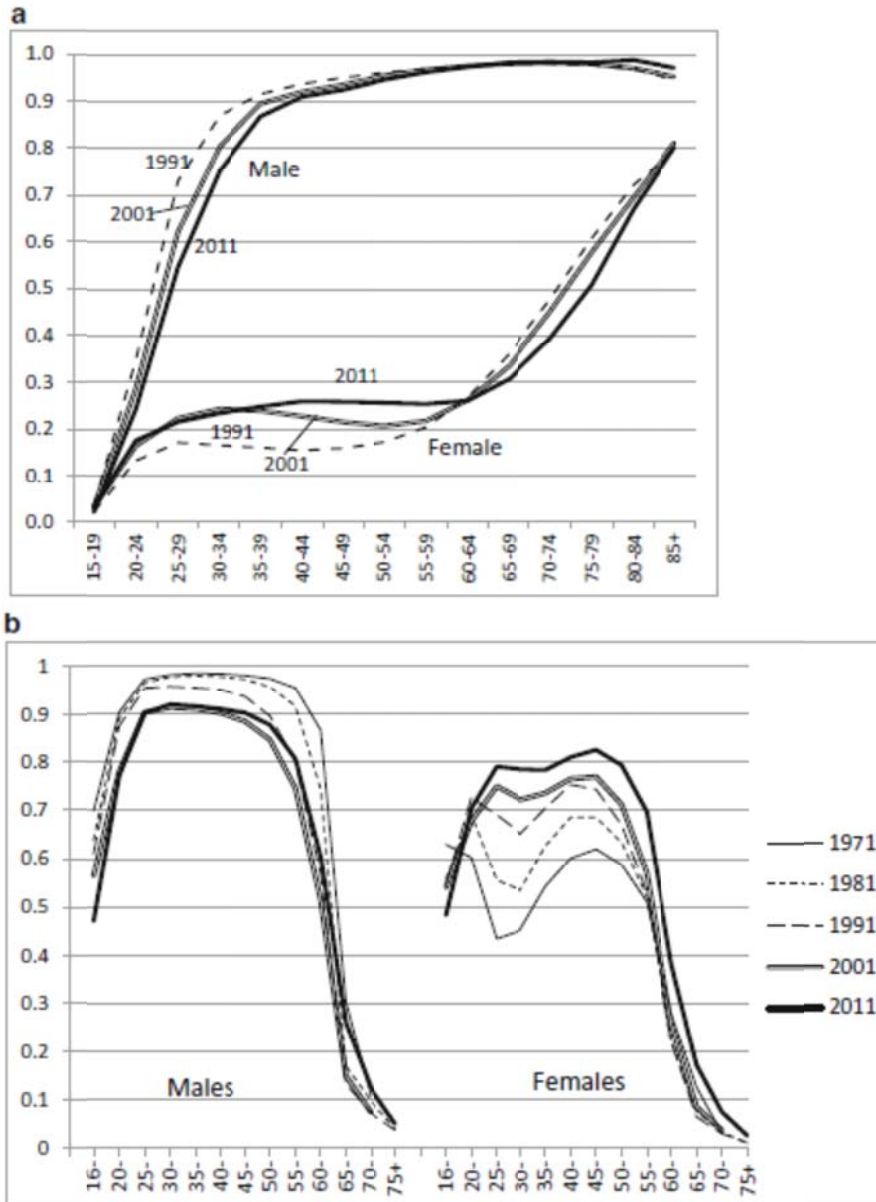
## **3.3 Derived forecasts of households and the labour force**

### **3.3.1 What is a derived forecast?**

Many characteristics are closely related to the age-composition of the population. This includes household formation and economic activity:

- Smaller households tend to be of the elderly and of young people singly or in couples without children. Larger households are occupied by children and their parents, once communal establishments like care homes, prisons and armed forces barracks are excluded.
- Economic activity is zero for children, rises during young adulthood until by age 25 it is around 90% of the male population and 80% of women, before falling, especially after age 60 to be very low among the elderly.

Different but strong age-patterns are associated with many health conditions, the need for adult care, and the demand and take-up of many services. Each of these can be *derived* from the projected future population and its age-structure. The age-pattern of the rates (economic activity, household membership, disability, and so on) may be assumed to be constant, or be forecast to change in the future.



**(a) Age-specific headship rates for England, and (b) Age-sex specific economic activity rates for England and Wales.** Sources: (a) DCLG (2015c). In this source, the ‘head’ is a statistical representative, calculated in a way which favours the male in a couple. (b) Population Censuses 1971-2011. ‘70-74’ refers to 70 and older in 1971; 75+ was not recorded in 2001; school leaving age was raised from 15 to 16 in 1972. Reproduced from Simpson (2016: Figure 16.2).

### 3.3.2 How is a derived forecast calculated?

The future characteristic is projected by multiplying the future population of age-sex group by its rate for the characteristic.



Future population with the characteristic at age a for sex s

= Future population at age, sex s

x Future rate for the characteristic at age a, sex s.

The total population with the characteristic is the sum across all the age-sex groups. For example the future labour force is the number of economically active men and women summed across all ages. The information about younger and older workforce is also useful in its own right.

This simple derivation of the forecast characteristics of a population can be elaborated in the software to cope with some common needs, as described next.

### 3.3.3 Derived Forecasts software

Derived Forecasts is the module within POPGROUP software which implements a generalised approach to applying age-and-sex-specific rates to a population forecast.

Derived Forecasts is a model *maker* in the sense that the user sets up a forecasting model by telling the software these details:

- How many areas to forecast (up to 40 in one model), and the name of each area.
- The name of the characteristic, and the name of the rates that relate it to the population (such as Labour force, and economic activity rates; or Households, and Household membership rates).
- The age-sex groups that data will be provided for. Dependent on the data available and the nature of the characteristic, the age-sex groups may be broad, and do not need to cover every age.
- The name of each category of the characteristic. For example household projections often project each type of household separately.
- Whether there is to be an adjustment to the population. This allows, for example, the user to specify what number or percentage of the population is not in households, before applying household membership rates.
- Whether there is to be an adjustment after the projection. In the case of Wales household projections which begin by forecasting the number of people in one-person, two-person, three-person, four person and other households, this adjustment divides by the household size to derive a forecast of the number of households. It could be a multiplier of costs per household, to forecast waste disposal.

When Derived Forecasts sets up a model according to the options chosen by the user, it places empty Excel files as 'skeleton files'. These have all the labels and structure helpful to enter data.

### 3.3.4 Where does the data come from?

The user may define their own Derived Forecasts model and then take responsibility for finding and entering the data inputs.

As with POPGROUP, there are Data Modules, which automate model creation and filling of data for the official sub-national household projections of each country in Great Britain. This means it is very

straightforward as described in later chapters to gain all the inputs and to replicate the official forecast, for any local authorities that subscribe to the annual service package.

There are no official labour force forecasts in Britain. A Data Module provides a labour force forecast for any local authority or set of local authorities, using census data from 2001 and 2011, and a variety of chosen data.

The user then has the easier task of amending the inputs in order to run alternative scenarios.

### 3.3.5 Household projections in Wales, Scotland and England

The government agency of each of the countries of Britain calculates household projections differently. It was partly in response to the development of different approaches that developed in the 2000s after devolution, that the Derived Forecasts model was created with generalised options that would cope with all approaches as well as other types of derived forecast.

The table compares the four different approaches.

Derived unit	Age-sex categories	Types of household	Rate	Factor
England (under review 2017)	Stage 1, 36 age-sex. Stage 2, 10 age (persons) including 0-14, 15-24, ending 85+.	17 household types	Household representative	Not used
Wales	32 age-sex, including 10-15, 16-18, 19-24, ending 85+	12, HH size included to 5+	Household membership (does not require identification of a head or representative)	Household size
Scotland	17 age (persons) including 10-15 and 16-19, ending 90+	7, HH size included to 3+	Household representative	Not used

The approach used in Wales differs from that used in England and in Scotland. Its age groups are designed to better fit ages when many young adults are changing their housing circumstances by identifying school leaving age and entering higher education. Wales avoids identifying a representative of the household, by choosing to relate population age and sex composition to the *membership* of each household type. Once the composition of household types throughout the population has been forecast, the population in each type is divided by that type's average household size to forecast the number of households of each type.

This approach used in Wales has led to a set of household types that is defined largely by household size. Apart from avoiding the need to identify household representatives, the approach also gives the number of people of each age in each household type. Thus the number of older people in two-person households, and the number of children in lone-parent households is an output of the projections in Wales, but not in England or Scotland where only the age of household heads or representatives is considered. The Northern Ireland Statistics and Research Agency also uses household membership rates in their household projections.

One drawback of the household membership approach used in Wales is that it is conceptually less clear why membership rates might be constant over time or continue their growth or decline. Suppose there are more children in one year than another, for the same number of adults. That should result in a greater number of larger households, but no more households in total. But the membership rate approach will add to the types of households children already live in. Similarly it is not clear why changes in children's membership rates should continue to develop in the future as they have in the past, as the approach used by Welsh Government assumes.

### **3.4 Dwellings and jobs, not the same as households and the labour force**

#### **3.4.1 The links between demographic forecasts and the demand for dwellings and jobs.**

In the context of land use planning, the official demographic forecasts of households, and the unofficial forecasts of the labour force, stop short of what planners need to know: the demand for housing units or dwellings, and the demand for jobs. The links between these have usually been defined in Britain as follows:

$$\text{Dwellings} = \text{Households} * (1 - \text{sharing rate}) / (1 - \text{vacancy rate} - \text{second homes rate} - \text{holiday homes rate})$$

$$\text{Jobs} = \text{Labour force} * (1 - \text{unemployment rate}) / (\text{commuting ratio})$$

$$= \text{Labour force} * (1 - ([\text{unemployed living in area}]/[\text{employed} + \text{unemployed living in area}])) / ([\text{employed residents living in area}] / [\text{jobs in area}])$$

The demand for dwellings is more than the expected number of households, because a proportion of dwellings is always vacant or used for second homes or holiday homes. Households sharing a dwelling (ie, behind the same front door with some common space) bring the demand for dwellings down but this factor is relatively small.

The demand for jobs in an area may be more or less than the labour force in an area. Although significant unemployment always means that there will tend to be fewer jobs than people looking for them, commuting affects this balance in very different ways in each area. If the commuting ratio is say 1.1, this means that there are more employed residents than jobs in the area, so in net terms 10% of those employed work outside the area. As this is a net balance, the numbers commuting in either direction will be considerably more than this.

### 3.4.2 Where does the data come from?

These links between demand (households, labour force) and supply (housing, jobs) are not part of the Data Modules that POPGROUP provides. A simple ratio of households/dwellings, and labour force/ jobs is available from the last censuses. The individual factors (sharing, vacancies, second/holiday homes, unemployment and the commuting ratio) should be used where available so that consideration of alternative values can be discussed and implemented. Input to POPGROUP is described in a later chapter

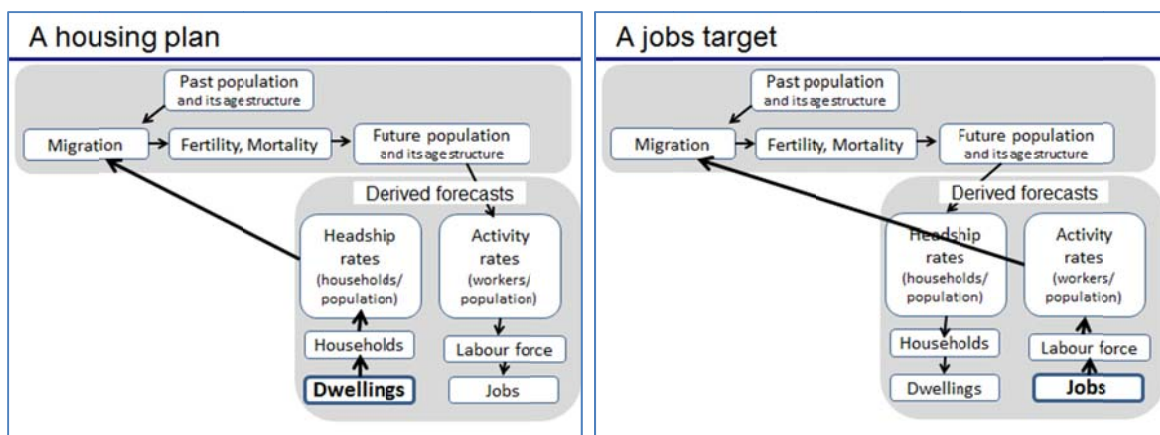
It should be borne in mind that small changes in the factors that link supply and demand can have a big impact on projections of housing need, as emphasised in the next chapter. The estimates used will therefore come under scrutiny.

## 3.5 Feedback from plans for dwellings or jobs to migration and population

### 3.5.1 Housing-led and jobs-led forecasts

Up to this point, this manual has been describing the ‘business as usual’ perspective, one of continuity. It has reviewed the methods that implement the framework of forecasting diagrammatically proposed at the beginning of this chapter. They answer the major question asked by the planner and enshrined as the starting point of planning policy for local plans: What is the future housing need of this area, if its demographic development continues as official statistics expect?

But it is not the only question the planner asks. The second question is: What would the demographic development be if a plan was successfully implemented to build X houses, or provide Y jobs? This is the feedback illustrated in the two diagrams below which complement the one at the start of the chapter. They illustrate housing led forecasts, sometimes called ‘dwelling led’ forecasts, and jobs-led forecasts, sometimes called ‘economic led’ forecasts. As can be seen in the diagram, a jobs target leads to an altered population forecast because of changed migration, and follows through to the implications for households and housing.



### 3.5.2 Migration is altered to meet the target

The demographic model calculates how the target of dwellings or jobs affects migration by attracting more in-migration, or deterring some of the out-migration, or a combination of the two. If the target

is below the demographic demand, then it is restricting population and the model will respond by reducing in-migration, or increasing out-migration.

The impact of a target may not be to affect migration. New jobs may be taken by commuters, affecting the commuting ratio. New housing may lie empty, or may change the household formation so that existing residents spread out into the new housing without releasing any housing for extra migration. The person responsible for projections has to think this through, and justify any changes to the inputs that go with the target of jobs or housing.

The software solves the biggest modelling headache. It uses the migration patterns of the area and the household formation patterns of the area, to compute the impact of a plan, if it is achieved, on the areas' population. The mathematical details are in the POPGROUP reference manual (Edge Analytics, 2013), and discussed with examples in Simpson (2016).

### **3.6 Scenarios**

In most local planning, there is not just one forecast that everyone agrees to, but many forecasts that suggest alternative futures. A LDP adopts one forecast to set the housing and employment land allocations, but in order to adopt that forecast it is usual that many others have been considered.

'Scenarios' are simply different sets of assumptions that give rise to alternative forecasts. Scenarios are, broadly speaking, of two types. The first addresses the uncertainty about the trend based scenario. The demographer should provide a trend-based projection of population, with alternatives that are also indicated as equally likely due to past fluctuations in fertility, mortality and migration. Through sensitivity testing with clearly feasible alternatives, the likelihood of a range of scenarios should be provided to the planner. This completes the first two parts of Baker's framework introduced in Chapter 2.

Once the planner has determined possible actions to be taken, the demographer is then asked to forecast the effect of such action. This is achieved through further modelling to test the impact on population of housing or job targets. The demographer should once again be clear about the assumptions made, and also describe the uncertainty in the estimates of the effect of the planner's proposed actions. This completes the final two parts of Baker's framework.

There are other approaches to scenarios which might intend to force planners' attention away from the past trends by imagining plausible different futures (Ramirez and Selin 2014).

A formal set of scenarios that are essential to explore is provided in the second part of the manual in Chapters 5 - 7, following Baker's framework. Chapter 5 presents the continuity forecast predicting what might happen without planners' intervention. Chapter 6 explains how to amend this scenario. Chapter 7 presents scenarios which improve the continuity forecast, assess its uncertainty, and assess the consequences of plans.

## 4 Data used in integrated demographic forecasts, and their reliability

*Summary:* This chapter lists the data used in integrated demographic forecasts, and notes their reliability. There is very little research that quantifies the quality of each input into the forecasts, or the quality of the forecasts themselves. However, the review in this chapter suggests the following results:

Population forecasts can be expected to be inaccurate. The inaccuracy of the total population of a local authority is about 2% after one year with an increase of about 0.3% with each year into the future so that forecasts of population are about 3.5% inaccurate on average after 5 years, and 5% inaccurate after 10 years. The base year also affects accuracy – forecasts with a base year a long time after the previous census will be less accurate.

Household forecasts can be expected to be a little more inaccurate than population forecasts, as they include further inputs that will add inaccuracy.

Small inaccuracies in variables that are applied to the whole population can result in a large change in measured housing need, because measured housing need is the *marginal* change in demand for housing each year. These include:

- The proportion of housing that is vacant, and the proportion of second or holiday homes.
- The unemployment rate, when growth in jobs leads a plan for new housing
- The commuting ratio, when growth in jobs leads a plan for new housing

### 4.1 Variables that are measured and projected into the future for an integrated demographic forecast

The table below lists the inputs to integrated demographic forecasts and comments on how they are used, their reliability, and their importance in the context of local plans. The table is divided into the elements of the integrated forecast:

- Population forecast
- Household forecast
- Labour force forecast
- Links between households and housing units
- Links between the labour force and jobs

POPULATION PROJECTION	Government methods of extrapolation to the future	Evidence of uncertainty	Comment on the planning context
-----------------------	---	-------------------------	---------------------------------

Population in the most recent year	The base population: census or updated Mid-Year Estimate. Not extrapolated.	Sometimes doubted, but the 2011 Census was the best since at least 1981, with very few challenges.	Not a subject of dispute.
Births, represented in the future by age-specific fertility rates	Same national trend for every area, starting at local recent estimate. Short-term trend, long-term convergence to about two children.	The most uncertain component of population projections nationally, affecting future children. In 2011 at 1.91, UK fertility was 10% over the figure predicted in 2002-4, but close to the figure predicted in 1992.	Has no impact on housing requirement for 15 years. Not a subject of debate.
Deaths, represented in the future by age-sex-specific mortality rates	Same national trend for every area, starting at local recent estimate. Expected continued decrease in mortality at older ages.	Uncertain component, only significantly affecting elderly. Inaccuracy in projected deaths about one third that affecting births, and up to now mortality rates have always been over-estimated.	Has impact through number of elderly requiring housing. Planners have relatively little measurable impact on mortality. Not a subject of debate.
Migration  (1) Migration within the UK, represented by out-migration and in-migration counts. (3) Migration with overseas, represented by out-migration and in-migration counts	Welsh Government (as ONS) maintains the experience of the five years before the projection, except in rare cases where evidence shows that is unsustainable.	Thought to be the most unpredictable component of sub-national population projections, though there have been no empirical studies. See comments outside this table, on accuracy of sub-national population projections.	Strongly debated, based on (a) the relevance of the past five years to represent the future; (b) the sustainability of alternative levels of migration implied by jobs or housing investment.
Armed forces and prisoners	Assumed a constant population with a constant age structure.	Unpredictable.	Not usually subject to planning impact or debated.
HOUSEHOLD PROJECTION	Government methods of extrapolation to the future	Evidence of uncertainty	Comment on the planning context

People not in households, represented by age-sex specific counts	Taken from the last Census, assumed to be a constant number at each age below 75 and a constant percentage of the population at each age 75 and above.	No studies of accuracy. Has significant impact on elderly but rarely at other ages.	Not a subject of dispute. Would be relevant when social care policy and insurance systems change.
Household membership rates, which are the people in each of 12 household types, as a proportion of the population, defined separately for each age-sex group. Household types are one person, two adults without child, one adult with one child, three adults, etc.	Taken from 2001 and 2011 Censuses for each area, extrapolated after 2011 using a standard exponential curve with decaying rate of growth.	No studies of accuracy; the impact of plausible alternative futures is often calculated and is significant, but not as important as the size and age composition of population change. Long term steady trends to smaller households since 1950s have clearly changed since about 2000, so the accuracy of past projections would be little guide to accuracy of current projections.	Changing membership rates have much less impact on household projections than does population change. However, it is still significant marginal change affecting housing need, and is subject of fierce debate, currently centred on a disputed relationship to economic recession and the disputed impact of disputed economic recovery.
<b>LABOUR FORCE PROJECTION</b>	Not undertaken by government.	Evidence of uncertainty	Comment on the planning context



Economic activity rates, age-sex-specific proportions of people working or unemployed as a proportion of the population.	The OBR undertakes national projections but are not intended for use in local plans. Local projections are made by Councils and other planners, usually based on recent census, trends over time, and the changing state pension age.	No studies of accuracy; the impact of plausible alternative futures is calculated and is significant.	Increasing economic activity would mean that more jobs are taken by existing residents and therefore do not require extra housing. Projected rates are hotly debated when a forecast is led by jobs growth.
<b>LINKS BETWEEN HOUSEHOLDS AND HOUSING</b>	Not undertaken by government.	Evidence of uncertainty	Comment on the planning context
Vacant housing, as a proportion of all housing	Usually based on past census, or Council Tax or similar records	No research results.	Claims of future reduction in the vacancy rate are made, and reduce the housing need but are difficult to justify.
Second or holiday homes, as a proportion of all housing	Usually based on past census, or Council Tax or similar records	No research results.	Usually assumed not to change in the future.
Households sharing a housing space, as a proportion of all households.	Usually based on past census	No research results.	Low and usually assumed not to change in the future.
<b>LINKS BETWEEN LABOUR FORCE AND JOBS</b>	Not undertaken by government.	Evidence of uncertainty	Comment on the planning context

Unemployment, represented by age-sex specific unemployment rates	Usually based on recent experience, sometimes an optimistic view taken.	No research results.	Reduced unemployment would mean more jobs taken by the existing population and less need for new housing in a forecast led by jobs growth.
Commuting, represented by the ratio of workers who live in the area to all those with a job in the area.	Usually based on past census.	No research results.	A lower ratio means less net in-commuting, and therefore more need for housing workers locally, in a forecast led by jobs growth.

In summary, the most important uncertain variable that affects the assessment of total housing need is migration. It can vary from year to year and directly increases or decreases the number of people and households in an area.

The target in a plan for releasing land for new housing is based on the projected *increase* in housing need. This increase is usually quite small relative to the total housing need, most of which is provided for by the existing stock.

Some variables apply to the whole population or housing stock, and therefore may have small uncertainty but can have a big impact on estimated housing need. For example, a reduction of one percentage point in the housing vacancy rate would accommodate almost exactly an extra 1% of households, reducing the need for *total* housing by 1%. This will often be a significant proportion of the extra housing needed over the period of the plan: the projected household growth for Wales as a whole is 10% over 25 years.

The variables that are projected and apply to all the population and can impact significantly on the marginal need for extra housing because they are also subject to uncertainty over time include that link households to dwellings, and the labour force to the number of jobs:

- The proportion of housing that is vacant
- The proportion of second or holiday homes
- The unemployment rate
- The commuting ratio

For example, when a plan for jobs growth is used to lead to an assessment of housing need, it will involve a commuting ratio: the ratio of workers resident in an area divided by the jobs in that area. It

might be measured from the past census as 1.1 for example, indicating out-commuting, and kept constant in the future. However, if the future commuting ratio was just 1.0 rather than 1.1, then about 10% of *all* jobs would be taken by commuters, making a significant reduction in the local housing need. Assessed housing need is sensitive to assumptions about unemployment and commuting.

## **4.2 Uncertainty in the projections – evidence from ONS and others**

Following Nico Keilman (2007) and many other authors, it is fair to insist that errors are inherent to forecasting, and that users of forecasts should be informed about the magnitude of those errors.

There have been various studies of the accuracy of national projections. Generally there is less accuracy, in percentage terms, for projections of periods further from the present, and less accuracy for smaller areas. There is less accuracy for forecasts of the numbers of children due to the difficulty of predicting future fertility. Keilman suggests that one should with 80% confidence expect the UK total population to be between exactly accurate and 2% away from its prediction 10 years away, and up to 5% away from its prediction 20 years away. He suggests that UK national projections have been accurate in their mortality and migration assumptions similarly as other European countries, though less accurate in their fertility assumptions. Shaw (2007) found past projections of the UK total population to be about 3% to 7% inaccurate on average for forecasts 25 years ahead. While expressed in different terms, these are similar estimates of inaccuracy for UK national projections. Shaw found no tendency to over- or under-estimate the total population, though this lack of bias was the happy accident of forecast errors for births, deaths and migration compensating each other in the projections he looked at. A decade later, ONS (2015a) found a tendency to underestimate the UK population of 2013, as the migration since the 1990s had been underestimated.

Accuracy for subnational areas is rarely assessed, the exception being two studies by ONS. They found that its projections of local authority total populations in 2006, made 6-10 years before, were on average 5% inaccurate, either too high or too low (ONS 2008: p6). Projections made 2-3 years ahead were on average 2% inaccurate. The most recent study (ONS 2015b) compared various projections of English local authority projections of 2011. Leaving aside London, there was an average inaccuracy of 3% only 1 year ahead in the total local authority population, about 1% of which was due to error in the base year itself. Projections 5-6 years ahead entailed 3-4% average inaccuracy. One cannot be sure that these average inaccuracies will apply for a new projection made now, but they do give an evidence-based estimate of the accuracy one should expect to take into account.

It would be a crude but not unreasonable starting point, and perhaps a conservative estimate on this evidence, to suggest that projections of the population total of a local authority have been, on average, inaccurate by an amount equivalent to about 2%, plus 0.3% extra each year ahead of the projection. Thus 3.5% inaccuracy should be expected after 5 years and 5% after 10 years. Household projections add further assumptions and therefore increase rather than decrease this inaccuracy.

### 4.3 The influence of models chosen and extrapolation methods chosen, on results or their certainty

There is not a bias built into the models themselves. The standard demographic projection models simply represent various dynamics of demographic change that unarguably exist: we get older each year by one year; the number of their births follows from the number of women and the proportion of women who have children; there is by definition one household representative in each household; everyone lives in one and only one type of household, and so on. The accuracy of projections depends on the accuracy of the assumptions made, rather than the demographic models themselves.

But might the methods of projecting forward fertility, migration, household formation and so on be biased, so that they always over-project or under-project? Extrapolation to the future is intrinsically uncertain; we can find patterns for each variable in the past, but cannot be sure that the future will repeat those patterns. However, there is no evidence or reason to believe that the practice of government departments in basing sub-national assumptions about the future on the experience of the most recent years, installs a bias into the projections towards under- or over-projection.

The one assumption that might be questioned is that of a constant number of migrants in the future. For the areas growing most rapidly like Cardiff, this means that its *rate* of growth tails off a little, as the constant migration becomes less as a proportion of the growing population over time. This may be realistic.

A phenomenon known as ‘assumption lag’ can occur when projectionists fix on a target level of demographic change and repeat the same assumption even after evidence has been pointing in a different direction. Assumption lag is the delay in changing the target before the new evidence has taken hold as a confirmed new trend. Assumption lag occurred for fertility in the 1970s when decreasing fertility was thought to be temporary for many years before a long-term lower target of replacement fertility was put in place. This in turn has been further lowered, after a delay, as fertility continued well below replacement level. The opposite happened since 2001, when assumptions did assumed the upturn in fertility was temporary.

Similarly there has been debate in the UK about smaller households, with many arguing that the recent end of a steady increase in single person and small households is temporary. The consequence would be that previously established trends should be used in updated projections rather than projecting forwards the recent stability for some age groups. To what extent this slowing of the trend to smaller households is temporary, or whether an assumption that this change is temporary would turn out to be another example of assumption lag, cannot be known at the moment. It won’t be known until the future has become the present.

Uncertainty is the Achilles heel of projecting and forecasting which should, as already stressed, be measured and taken account of in planning. Projectionists must identify and use emerging new trends, but always acknowledge that projections contain inherent uncertainty.

Such discussions and arguments are often held in a local context because they have such an impact on local plans, but the issues are usually ones that apply to all local areas and should be partially resolved by studies and reviews with a national or international perspective with national authorities involved in assessing the evidence.

#### **4.4 How does planning handle the inevitable uncertainty of projections?**

When a decision maker is able to take forecast uncertainty into account, this may lead to better decision making. If he or she knows the expected penalties incurred by acting on over-estimates and under-estimates, an optimal strategy can be chosen.

But the planning system does not take uncertainty into account. Inaccuracy in population projections reaches about 5% when looking 10 years ahead according to the summary of empirical studies given above. Household projections add further assumptions and therefore increase rather than decrease this inaccuracy. This average level of inaccuracy is not far from the target of land release in many local authorities as a percentage of the housing stock. What is the impact on the built environment if the planned housing is not after all needed, or if it is only half the real need? Knowing that there is this degree of uncertainty, how should the demographers and the planners respond?

Responding to uncertainty is not simply a technical question. The uncertainty, based on how unpredictable the past has been, may not indicate random pressures that planners have to respond to. It could instead be taken as a measure of how much extra room there is for planners to influence the future.

But if the planning regulations are taken as a given, there is still the question of how to respond to the knowledge of uncertainty in the projections. For demographers, it should be a priority to establish a range of planning-relevant feasible projections, and in particular a minimum and maximum range of very plausible alternative Objectively Assessed Need (OAN). There are methods of 'probabilistic projections that may one day be able to provide suitable confidence intervals around each of the outputs from demographic projections. Currently it is more realistic to project forward the impact of alternative migration assumptions based on experience of the past that could easily be repeated. One technique is to use the second-most-extreme values experienced over the past decade to indicate a range that could well be repeated, and providing the population, household and labour force projections implied by that range of feasible scenarios. Making that technique and others available and accepted would be a useful contribution from the projectionists, highlighting in a practical and transparent way the uncertainty in the projections.

Those in the planning system could use that information, whether they are concerned with local issues, or as Planning Inspectors, or as national policy advisors. The costs of over- and under-provision of land for housing, for example could be weighed against the likelihood of each eventuality. Policy might respond to uncertainty cautiously by releasing land with highest priority for development and then responding according to a review of delivered developments. However, if restricted land supply deters population growth, then this caution would itself be self-fulfilling. Some over-arching planning policy would need to ensure provision of housing needs regionally and nationally.

## Part II: Practical Implementation

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This part of the manual is for those who wish to create an integrated demographic model for one or more local authorities of Wales.

To implement it, your local authority will need to purchase the software POPGROUP v4 and Derived Forecasts V1, and subscribe to the annual service package which includes Data Modules containing data from official estimates and projections. The local authority license to the software allows any number of users within the local authority, but prohibits passing the software to third parties. The current costs to local authorities are a one-off £3,000 for the software, and £450 annually for the service package, with discounts if previous versions had already been purchased or more than one year of the service package is bought.

If you wish to make a model that includes more than one local authority area, contact [popgroup@edgeanalytics.co.uk](mailto:popgroup@edgeanalytics.co.uk) to request the Data Modules that include the areas you need. By default the Data Modules are restricted to one area to reduce the risk of third parties using them for other purposes, but the service package allows your access to other areas in Wales.

You will need to install the software using the guides that accompany it. This manual assumes that the software is installed on a computer's C: drive, but the software and the instructions in this manual will operate if the software is installed in any location. Simply substitute the path of your location, for the C: drive.

Sometimes instructions and screenshots may slightly vary from what the user encounters. Data Modules may change after publication of this manual and may not provide filenames exactly as displayed in the manual. Different versions of Excel may lead to screenshots in the manual that are not exactly as seen by the user. However, the differences should be minor and logic will usually indicate the differences which will not stand in the way of progressing with the text.

The software is in such frequent use that it is impossible to break it and there are very few bugs that make it malfunction. However, the complexity of Excel and the varying environment of every computer means that Excel does crash occasionally, leading to a frozen screen or an error. The best strategy is to close down Excel completely and open the relevant files again. That solves the majority of problems. If a fault persists that may be due to a POPGROUP error, or if you require advice about the operation of POPGROUP, contact [popgroup@edgeanalytics.co.uk](mailto:popgroup@edgeanalytics.co.uk).

Use the software manuals. The software is not a black box so do not expect to click a couple of buttons and have it all happen for you. Chapter 5 is prescriptive and Chapter 6 explains the structure of POPGROUP files and how to change them. However, when you make alternative scenarios in Chapters 7 and 8, you will need to work to understand how the changes you make have affected the results, so that you can explain them to others. The intention of the manual is to make your choices and their implementation easier, but it cannot be wholly prescriptive.

## **5 Using POPGROUP to build the platform for scenarios and Local Development Plans: an integrated demographic forecasts for local authority areas**

*Summary.* This chapter provides practical instructions to achieve a demographic model that integrates the official forecasts of population and housing, and an accepted forecast of the labour force, together with the links to housing and jobs.

Once the model has been set up, subsequent chapters will recommend scenarios to test the sensitivity of the forecasts to alternative assumptions, and further scenarios are recommended to explore the implications of plans for house-building and the implications of targets for employment growth. These involve straightforward small amendments to the input files created in this chapter.

### **5.1 What will be achieved and how long will it take?**

#### **5.1.1 Aim and style**

From this point in the manual, the style is didactic and practical to achieve an integrated demographic forecast to inform planning, as discussed in previous chapters. In this chapter the instructions achieve a complete model of population, households and labour force, with links to housing and jobs. They use data that replicate the latest official forecasts<sup>1</sup> and are supplemented with acceptable data for a labour force forecasts and for converting between households and housing, and between the labour force and jobs.

The manual has been written with a reader in mind who is either scoping the work to be done, or doing it, or both these things. The work is that of a research or information scientist, but is achievable by anyone comfortable with multiple Excel files and Windows folders who has set aside time to support the planning processes of a local authority. This chapter outlines the steps to create a model in a fairly mechanical straightforward way, making use of the Data Modules provided by the POPGROUP service package available to local authorities, and commonly available census data.

#### **5.1.2 How long will it take, depending on experience?**

An experienced user could achieve all that is in this chapter in two hours. However users following this guide may be new users of the software who will wish to consider each step and explore output in order to become confident in the work achieved. This of course will take longer and a full day should be set aside.

It is likely and helpful that the person following this guide has attended a POPGROUP training course to familiarise themselves with the concepts involved. However, this guide and the manuals and other guides provided with the software are sufficient for someone persistent and patient to successfully develop all the results described.

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<sup>1</sup> At the time of writing in April 2017, the latest official forecasts are the 2014-based projections from Welsh Government for population and households. When these are updated in 2018 or 2019 to 2016-based projection, the same instructions will be valid for those new government releases, substituting the appropriate years.

## **5.2 Choose your local authority area(s)**

The user may embark on a model of just one local authority or of several neighbouring authorities, or of all local authorities in Wales. A model of more than one authority requires more data and will be somewhat slower to prepare and to run, but is no more complex or difficult to manage than a model of one authority.

Once the areas have been specified (section 5.4 below), it is not possible to add authorities or remove them; a new model would be required. It is therefore sensible to choose the area or areas that are definitely going to be needed in planning work of the near future. Once experience has been gained with outputs of high priority, it will be straightforward to create a new model of more areas when the need arises.

## **5.3 Make sure you have installed the relevant software and Data Modules**

To follow the steps in this chapter it will be necessary to have the following software and Data Modules for all the areas you are considering. Edge Analytics provides the Data Modules on behalf of the Local Government Association to local authorities signed up to the annual service package. By default the Data Module may include only data for your own authority. If you wish to make a model of more than one authority, request Data Modules that include all the areas you need before you make a start.

- POPGROUP version 4.0 or more recent
- Derived Forecasts version 1.0 or more recent
- Welsh Government 2014-based sub-national population projections Data Module (WG2014POP)
- Welsh Government 2014-based sub-national household projections Data Module (WG2014HH)
- Wales sub-national 2011-based labour force projections Data Module (WAL2011LF)
- Wales Mid-Year Population Estimates Data Module (WALMYEandChange)

Install the POPGROUP and Derived Forecast software and the Data Modules, as instructed in the manuals provided by Edge Analytics when supplying the software.

- Manuals that include instructions for installation are also available at <http://www.edgeanalytics.co.uk/popgroup-manuals-guides.php>.
- Make sure that the Options for Excel are adjusted as advised in the manuals provided with the software. This is essential to allow the 'macros' that drive the software to work.

## **5.4 Create your own model for the official continuity population projection**

Run the Data Module for Welsh Government 2014-based sub-national population projections (WG2014POP). Use the Manual accompanying the Data Module. Check that you have the latest version of the Data Module – if the Manual refers to including Mid-Year Estimates, then do include them. If not Section 5.7 below will instruct you on adding Mid-Year Estimates.



It is suggested that when asked for a Model ID, you choose: <area(s)>\_2014POP. In the examples in this guide the name WalesUAs\_2014POP has been used. If you were creating a model for Gwynedd you would enter as Model ID: Gwynedd\_2014POP, or for a model for all South East Wales authorities you might choose the Model ID: SEWales\_2014POP.

It takes a few minutes to create a model for you and run the 2014-based projections for your areas, saving the assumptions as input files and the results as output files. The results files will be left open. You may explore them now or close them and explore later.

## **5.5 Create your own model for the official continuity household projection**

Run the Data Module Welsh Government 2014-based sub-national household projections (WG2014HH). Use the Manual accompanying the Data Module.

It is suggested that when asked for a Model ID, you choose: <area(s)>\_2001HH to indicate it is a household projection model, and the data start in 2001. Census values of household membership rates are included for 2001 and 2011 and interpolated between those dates before the projection of rates starts.

It takes a few minutes to create a model for you and run the 2014-based projections for your areas, saving the assumptions as input files and the results as output files. A results file will be left open. You may explore results now or close the file and explore later.

## **5.6 Create your own model for the unofficial continuity forecast of the labour force**

Run the Data Module for 2011-based sub-national population labour force projections (WAL2011LF). Use the Manual accompanying the Data Module.

It is suggested that when asked for a Model ID, you choose: <area(s)>\_2001LF to indicate it is the labour force projection and the data start in 2001. Census values of economic activity are included for 2001 and 2011 and interpolated between those dates before the projection of rates starts.

It takes a few minutes to create a model for you and run the 2011-based projections for your areas, saving the assumptions as input files and the results as output files. A results file will be left open. You may explore results now or close the file and explore later.

## **5.7 Create models that include population estimates back to 2001 in the same model as the forecasts**

The models so far created begin in 2014 for population forecast, and in 2001 for the household and labour force forecasts.

To put the projections in context, and to help calculate evidence-based alternative assumptions, it is very helpful to have data from the past included in the models. POPGROUP has developed a Data Module for past Mid-Year Estimates, and a facility to join these to a population forecast.

In the near future (perhaps during the latter half of 2017), a version of the Wales population projection Data Module will automatically add the Mid-Year estimates from 2001 to 2014 to the projected populations after that year, as already happens for local authority areas in England. You can check whether the Wales development has been planned for release or has a date for release, by enquiring to [popgroup@edgeanalytics.co.uk](mailto:popgroup@edgeanalytics.co.uk).

In the meantime, follow the instructions in Appendix A to create a model that starts in 2001 for population. This is fiddly work to be patient with for half an hour to an hour. It is recommended that you use a Model ID: <area(s)>\_2001POP.

## **5.8 Add the DFSupply files for dwellings and for jobs**

Now add the link between households and the dwellings that the households fit into, and the link between the labour force in an area and the people who work in that area. These are the final pieces of the jigsaw to link population to plans for housing and jobs. They link the demographic demand (households, labour force) and the supply that approximately meets that demand (housing, jobs). The data is held in POPGROUP files of the type DFSupply.

This section describes where to put relevant data from the censuses in POPGROUP's DFSupply files. These data are acceptable for a standard first assessment of the future demographic demand for housing and for jobs. A later chapter discusses where more up-to-date or complete data might be found.

### **5.8.1 The relationship between households and housing**

- From your folder of population skeleton files \1. POPGROUP V4.0\<<areas(s)>\_2001POP-skel, open the file **DFSupply.xls**
  - This is an empty file created for you by the Data Module. Amend the Notes sheet as follows, so that it looks like the screen shot below.
  - The 2011 data for Wales do not differentiate between vacant households and households for holiday and second homes, so leave the default option which asks for only the ratio between households and dwellings (derived units and supply units).
  - Type a note about the source of the data you are about to enter.
  - Type 'Dwellings' in the box 'Enter a title for the supply units'.

Documentation of the information contained in this workbook	
<p>This workbook allows POPGROUP to convert between a derived forecast (e.g. households, labour force) and a supply forecast (e.g. dwellings, jobs). A single conversion ratio (derived units)/(supply units) is the default, but separate components may be provided by the user, by selecting from the following:</p> <p>Single conversion ratio derived units/supply units <input checked="" type="radio"/></p> <p>Households to dwellings: separate rates for vacancy, holiday home and sharing <input type="radio"/></p> <p>Labour force to jobs: separate rates for unemployment and commuting <input type="radio"/></p> <p>Data from the 2001 and 2011 Censuses</p>	
<p><b>Last Updated:</b> 20-Apr-15</p>	
<p>Enter a title for the supply units</p> <p>Dwellings</p>	

- On each area sheet, copy the area’s households/dwellings for 2001 to 2011, given in Appendix B of this Chapter. Remember to ‘paste as values’, without the formatting. By leaving later years blank, the value for 2011 will be used in the projection.

Population Estimates and Forecasts		Training RTPI											
Derived/Supply units conversion information		Gwynedd											
		Forecast Years											
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
7	Single conversion ratio derived units/supply units	86.8%	86.7%	86.6%	86.5%	86.5%	86.4%	86.3%	86.2%	86.2%	86.1%	86.0%	

- Validate the file and Save as... **DFSupplyDwellingsCensus.xls** in your POPGROUP input folder. Do not save it in the skeleton folder, which is only for empty POPGROUP files.

### 5.8.2 The relationship between the labour force and jobs

The same type of DFSupply file is used. Separate rates for unemployment and the commuting ratio are used.

- From your folder of population skeleton files \1. POPGROUP V4.0\<areas(s)>\_2001POP-skel, open the file **DFSupply.xls**
  - This is an empty file created for you by the Data Module. Amend the Notes sheet as follows, so that it looks like the screen shot below.
  - Change the option to choose ‘Labour force to jobs: separate rates for unemployment and commuting’.
  - Type a note about the source of the data you are about to enter.
  - Type ‘Jobs’ in the box ‘Enter a title for the supply units’.

Documentation of the information contained in this workbook	
<p>This workbook allows POPGROUP to convert between a derived forecast (e.g. households, labour force) and a supply forecast (e.g. dwellings, jobs). A single conversion ratio (derived units)/(supply units) is the default, but separate components may be provided by the user, by selecting from the following:</p> <p>Single conversion ratio derived units/supply units <input type="checkbox"/></p> <p>Households to dwellings: separate rates for vacancy, holiday home and sharing <input type="checkbox"/></p> <p>Labour force to jobs: separate rates for unemployment and commuting <input type="checkbox"/></p>	
<p>Data from 2001 and 2011 Censuses</p>	
<p><b>Last Updated:</b> 20-Apr-15</p>	
<p>Enter a title for the supply units</p> <p>Jobs</p>	

- On each area sheet, copy the area’s unemployment and commuting ratio for 2001 to 2011, given in Appendix C of this Chapter. Remember to ‘paste as values’, without the formatting. By leaving later years blank, the values for 2011 will be used in the projection.
- Hover over the red triangles (Excel comments) to see the definition of each variable so that you better understand what the model expects in these sheets.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	<b>Population Estimates and Forecasts</b>		<b>Training RTP1</b>											
2			<b>Pembrokeshire</b>											
3	<b>Derived/Supply units conversion information</b>													
4			Forecast Years .....											
5	<input type="button" value="Validate"/>													
6			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
11	Unemployment rate		6.5%	6.5%	6.4%	6.4%	6.3%	6.3%	6.3%	6.2%	6.2%	6.2%	6.1%	
12	Commuting rate		1.06	1.06	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.03	1.03	
15			Rules											

- Validate the file and Save as... **DFSupplyJobsCensus.xls** in your POPGROUP input folder. Do not save it in the skeleton folder, which is only for empty POPGROUP files.

### 5.9 Run the integrated demographic forecast from POPGROUP

You now have all the files ready to run an integrated demographic forecast using the Welsh Government Mid-Year Estimates and Population Projections, with the consequences for households and demand for housing, and for the labour force and demand for jobs.

Remember that this will be a ‘continuity forecast’, one that assumes that the levels of population change and all the relationships between population, households and labour force measured from recent years for your local area(s) remain the same in the future.

When you reproduced the household and labour force projections earlier in this chapter, you used Data Modules that produced models of households and labour force respectively in the Derived Forecasts software. You might have explored them using that software, which retains all the details of age and sex and rates of household formation and economic activity.

Now we will run those derived forecasts in the background of a POPGROUP forecast. The advantage is that the integrated forecast is speedy. However, be aware that the only output from the derived forecasts that is retained on POPGROUP files is the total number of households and demand for dwellings, and the total labour force and demand for jobs. These will be available graphically from the Charter facility, and as a table on the Comp (components) output file.

- From your folder of population input files **\1. POPGROUP V4.0\<areas(s)>\_2001POP-inp**, open the file **Scenario\_WG2014\_Principal.xls**
  - On the 'Run\_Details' sheet, amend the Scenario ID by adding 'Integrated', so that it reads 'WG2014\_PrincipalIntegrated'. This ID summarises what the forecast will be: it will be no different to the WG2014 forecast, but integrated with households and labour force.
  - On the 'Constraints\_and\_Impacts' sheet, add the file names about households and the labour force, so that POPGROUP knows what assumptions to make to produce those outputs. When you have added the files, this sheet will look like the screen shot below. Wherever there is a red box in the screen shot, double click that cell and navigate to the file to click on it and 'open' so that its path and name is written in the cell.
    - These files hold assumptions and are held in three different folders. Be careful to look for them in the right places:
      - From the household input folder, fill three files for the 'First Derived Forecast':
        - Rates: **DFRates\_WG2014HH.xls**
        - Population Adjustment: **DFPopAdjust\_WG2014HH.xls**
        - Factors: **DFFactor\_WG2014HH.xls**
      - From your labour force input folder, fill one file for the 'Second Derived Forecast':
        - Rates: **DFRates\_Constant.xls**
      - From your population input folder, fill the supply files in each panel, and the constraints file at the top of the sheet:
        - Supply: **DFSupplyDwellingsCensus.xls**
        - Supply: **DFSupplyJobsCensus.xls**
        - Constraints: **Cons\_MYE.xls**

Note about **Cons\_MYE.xls**. This file only has the Mid-Year Estimates up to 2014, not the Welsh Government forecasts as constraints. We use this one so that alternative scenarios will only be constrained to the Welsh Government results up to 2014, not in later years when you want the alternative assumptions to alter the results.

## Population Estimates and Forecasts

### Constraints and impacts on derived forecasts

Double-click to browse for workbook names

<b>Annual Constraints</b>	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001POP_inp\Cons_MY E.xls
<input type="button" value="CheckFiles"/>	
<b>First Derived Forecast</b>	
Rates	C:\Forecast\2. DF\WalesUAs_2011hh_inp\DFRates_WG2011HH.xls
Population Adjustment	C:\Forecast\2. DF\WalesUAs_2011hh_inp\DFPopAdjust_WG2011HH.xls
Sub-Population	
Factors	C:\Forecast\2. DF\WalesUAs_2011hh_inp\DFFactor_WG2011HH.xls
Supply	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001POP_inp\DFS\Supply\DW ellingsCensus.xls
<b>Second Derived Forecast</b>	
Rates	C:\Forecast\2. DF\WalesUAs_2001LF_inp\DFRates_Constant.xls
Population Adjustment	
Sub-Population	
Factors	
Supply	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001POP_inp\DFS\Supply\JobsCensus.xls

- When the assumptions have been filled as in the above screenshot, click the 'CheckFiles' button. POPGROUP will open each file and check it is the correct type for each entry. If there are no errors, it will write the label you have put for each type of file on its right.
- Return to the 'Run\_Details' sheet to run the forecast
  - Check that you have changed the Scenario ID to add the word Integrated
  - Run the integrated projection by clicking on 'RUN THE MODEL'.
  - Click to accept warnings unless an error is described, when you will need to check the relevant file, correct the errors and run the forecast again.
- When complete, POPGROUP will save the forecast output files in your output folder and leave some of them open.

### 5.10 Exploring the outputs: useful summaries and analyses

Now that you have an integrated forecast, this section lists some analyses you might try out, to help you understand what it says about your area, and how it is expected to change in the future if recent demographic characteristics remain unchanged.

These are not step-by-step instructions. Learn by exploring the software and files. You cannot break the software. If Excel freezes or gives you a Windows error, it is usually best to close all Excel files

and start the task again. You can also get help by using the reference manuals to POPGROUP and Derived Forecasts, and the User Guides listed on Edge Analytics' POPGROUP pages.

### 5.10.1 Chart the demographic demand for dwellings and for jobs

- From the Reports output file's Charter sheet (which by default is left open after running a projection),
- Click on **Select component/population summary**, choose the indicator 'Change in Dwellings over previous year' near the bottom of the list, by clicking on it and then OK
- Then **Produce the charts**. This is the demographic demand for housing based on all the assumptions you have entered or taken from the official projections.
- Remember that you can save a chart on its own sheet for later use by clicking on **Save the charts just produced**. Once saved, the chart is not protected. You can alter its titles, axes, options and fonts just like on any other Excel file.
- Produce other time series charts that interest you.
- Try to Save the file. You can always come back for more.

### 5.10.2 View the changing age-sex structure using dynamic population pyramids

- From the Reports' Charter sheet, **Run the flying pyramids program**, and follow its instructions to choose area(s). Use the slider at the top to change year.
- The file is saved in your output file when you first use this option. You can save any changes, or simply run it again when you need to.
- Those with Ceredigion or Gwynedd in their model will notice how the assumptions retain too many male students from their universities, so that a bulge of males appears in the forecast. This is a known issue with the migration data used for the Welsh Government projections. You may wish to work with Welsh Government to run alternative scenarios with more realistic assumptions.

### 5.10.3 How important is migration to changing your total population?

- From the Reports' Reporter sheet, **Produce analysis of population change between selected years**. You must choose two years but you may choose more, eg 2001, 2014 and 2039. Scan down the results to see the amount of change altogether and the decomposition into migration and 'natural change'. Natural change is the balance of births and deaths.
- Was the balance between migration and natural change similar in the past and the future? You may wish to calculate change as an annual average to be able to easily compare more than one period with different numbers of years.
- Each Report is an Excel sheet like any other and is not protected, so you can make changes and calculations just as you would on any other Excel file.

**5.10.4 Check out the components file, with the projected number of households, dwellings, labour force and jobs, and other useful information.**

- Also left open on finishing a forecast is its Comp output file, standing for components of change. You will find it has a sheet for each area with values every year. Look at a sheet to see that it contains:
  - Indicators of births, deaths and migration each year, with summary indicators of fertility, mortality and migration.
  - Summaries of the impact of natural change, migration and total change in population, and the crude birth, death and net migration rate. The crude rates divide by the population size, so that you can easily compare the influence of each component of change. The rates are crude because they take no account of the age structure of the population. For example, an older population will naturally have a higher crude death rate.
  - A summary of the population in broad age groups.
  - Indicators of age structure: dependency ratios and average age.
  - The population impact of a constraint. In your forecast, this row may be 0 or blank in every year. In the years 2002-2011 it may contain the net adjustment for the ‘Unattributable Population Change’ between the censuses of 2001 and 2011, as mentioned above.
  - *The indicators of households, dwellings, labour force and jobs, and their change each year.* This is where you will find data of direct relevance for LDPs.
    - You are likely to use the information from these panels of data from each scenario that you produce when developing a LDP or its review.
    - There is at present no facility to include these indicators in POPGROUP’s comparison of scenarios. You may well copy these data into your own files to compare. Or use the ‘flat file’ option mentioned in the next bullet point
  - Finally, the number of armed forces and prisoners included in the projection.
- On the notes sheet there are two often underused sections, and a list of warnings.
  - At the top of the Notes sheet, the options below are available to produce a ‘flat file’ with all the sheets’ data, that can be appended to similar data from other scenarios. This makes it possible to compare outputs using pivot tables, or analysis software such as Access, SPSS or other. Consult the POPGROUP reference manual for further detail if necessary. Try it with default settings and see what you get.

<p><b>Produce flat file</b></p> <p>Clicking the button will copy all data from this components file onto a single sheet in another workbook (for pivots, etc)</p>	<p>C:\Forecast\1. POPGROUP v4.0\WalesUAs_2001POP_out\FlatComp_WG2014_PrincipalIntegrated.xls</p>	<p>&lt;&lt; Append to (blank if not to be appended)</p> <p>&lt;&lt; Save flat file with this name (may be blank if to be appended to an existing file)</p>
---	--	--

- Column A contains the notes from Scenario file and all the POPGROUP input files it named. It provides all the documentation of the forecast.
- Below the notes is a list of warnings. When a constraint has been used, there are often a large number of warnings that are not of concern. The constraint in the forecast you have run adjusts each migration flow to make sure that the population agrees with the mid-year estimates exactly in every year. The warnings will usually



refer to the frequent occasions when a migrant flow for a single year of age has few people in it and is less than the required adjustment. In that case the flow is adjusted to zero, and the rest of the adjustment is made by adding to the opposite flow. The listing of all these warnings is probably overly informative. The POPGROUP manual explains how constraints work in detail.

## 6 How do entries in POPGROUP affect the results of a forecast?

*Summary:* The previous chapter gave a step-by step guide to setting up the integrated forecast for your local authority area(s). Most of the data and assumptions in the forecast had been filled in automatically by the Data Modules, to replicate the Welsh Assembly population and household forecasts.

The art of demographic projections for LDPs is to consider alternatives – as required by planning policy. So it is necessary to understand how to change the assumptions and get new results. This chapter describes what POPGROUP does with each of the assumptions that are in its files. It shows how the user can change those assumptions.

It is worth taking the time to look at your input files as you read this chapter, to get a feel for the structure of the input sheets and how they can be changed. Do this before the next Sections where you will create your own scenarios.

POPGROUP and Derived Forecasts files have different characteristics, and are dealt with separately.

The Reference Manuals have the full specification and mathematics of how each assumption on the input files is used to compute the forecast. This section gives an overview that is useful for each user to know so that they can amend input files with confidence.

### 6.1 Types of POPGROUP file: -skel, -inp, -out folders

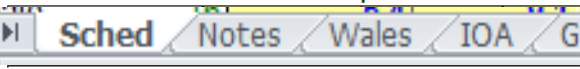
Looking within your POPGROUP folder on your computer, you will have a set of three subfolders for your model that begins in 2001. The name of each folder will be your model ID followed by -inp, -out or -skel. You will become very familiar with the different functions of each folder:

- skel:** This folder of skeleton files holds one file for each component of population change. These files are empty, ready to fill with assumptions. The user will only occasionally open these files to enter assumptions from scratch, but it is usually easier to amend an input file that already has some assumptions in it. The skeleton files cannot be used in a forecast because they do not have assumptions in them.
- inp:** This folder holds input files filled with assumptions for use in a forecast. The user will often have more than one input file for each component of population change. A forecast is defined on a special input file called a scenario file. It names the input files to be used for the forecast.
- out:** This folder holds the output files. Each output file is identified by the scenario ID it was produced from.

## 6.2 When you make changes to a file, save it with a new name

Before going further, a warning! If a change is made to a file, it is a change to the assumptions. Save it with a new file name, to distinguish it from the assumptions before the changes. In your folder of input files you may already have more than one file of the same type, for example two 'DFSsupply' files. It is worth keeping the same name stem (the first letters) for files of the same type, so that you know them apart.

## 6.3 Sheets on a POPGROUP input file

<p>Open some of the input files, and notice their <b>structure</b>. Most POPGROUP input files have several sheets:</p> <ul style="list-style-type: none"> <li>○ A '<i>Schedule</i>' sheet, with the rates that are specific to each individual year of age (fertility rates, mortality rates, and migration rates).</li> <li>○ A '<i>Notes</i>' sheet, that documents where the data came from.</li> <li>○ A sheet with assumptions that apply to all areas.</li> <li>○ A sheet for each area.</li> </ul>	<p>The sheets on a POPGROUP input file:</p>  <p>The Constraints and Population Base input files do not have a '<i>Schedule</i>' sheet, because they do not deal with <i>rates</i> of population change.</p> <p>The <i>scenario</i> input file is unique. It lists the input files for a particular projection. It does not contain data.</p>
---	--

## 6.4 An ordered calculation: schedule, differentials, summary rates, and counts, and constraints

The examples below explain the relationships between different parts of the data. The examples are for fertility; follow them on your file.

In summary, 'Age specific rates' for fertility, mortality and migration are on the schedule ('*Sched*') sheet. They can be altered during the projection using 'Differentials' and 'Summary rates' on the other sheets. However, 'Counts' take precedence over rates, differentials, and summary rates. Finally Constraints are implemented at the end, and can override the migration even when these have been entered as Counts.

### 6.4.1 Notes for documentation

The 'Notes' sheet explains what is on the file and where it came from. You should edit this whenever you change the assumptions.

An accurate and comprehensively completed notes sheet is a very useful reminder of how you created your projection, so it is well worth taking the time to keep it up-to-date.

Documentation of the set of Fertility parameters contained in this workbook
Fertility differentials on sheet 'Wales' taken from 2014 NPP on (Standard_Wales_2014.xls), with start year of 2014
Area counts of births by sex from ONS MYE outputs added by Data Module. 2002 to 2014
Fertility differentials on <All areas> sheet taken from the 2014 NPP on (Standard_Wales_2014.xls), with start year of 2014
The average fertility rates for the five years leading up to mid-2014 (in Schedule sheet) and assumed from the NPP for Wales (in <All areas> sheet).
Further details on WG 2014-based SNPP at: <a href="http://gov.wales/docs/statistics/2016/160929-local-authority-population-projections-2014-based-en">http://gov.wales/docs/statistics/2016/160929-local-authority-population-projections-2014-based-en</a>

### 6.4.2 Schedule of age-specific rates

Open **fert\_WG2014.xls** or your equivalent. Notice:

On the 'Sched' sheet you will see *Age-Specific Rates*, in this case of fertility.

The data can be input for single years of age in this sheet, and gives a starting point for probability of giving birth at each age. Areas which don't have their own age profile in the schedule will use the 'Standard' schedule.

The mortality and migration files also have a '*Sched*' sheet to identify the age profile of mortality and migration rates in each area.

If there are entries you want to know more about, refer to the POPGROUP reference manual.

Hover over a red triangle for more information (in this case it spells out Age Specific Fertility Rate). Try one of the other red information points.

The tick indicates that the Option has been chosen to enter ASFRs for this area.

You can turn this on or off by double clicking in the box.

If the box is unticked, you can't enter data, and any data which has already been entered in the related data entry cells will be greyed out, and won't be used in the projections calculation.

		IOA
ASFR	<input checked="" type="checkbox"/>	
Boys/1000 girls	<input checked="" type="checkbox"/>	
Mixed parentage births	<input type="checkbox"/>	

Double click

		Age specific fertility		Population
		Standard	IOA	
TFR*		1.78	2.12	
female	15	2.1	4.1	
female	16	5.4	9.1	

Data entry areas are shaded yellow. In Anglesey, it is projected that there will be 4.1 live births per 1000 women aged 16 during the year.

The red values are not data entry; they are calculated by POPGROUP from the data entry.

### 6.4.3 Differentials adjust the age-specific rates in each year

Click on the sheet for total of areas, scroll down a little to 'Differentials'.

They are used to multiply the values on the 'Sched' sheet so that fertility rates can change over time.

- A differential more than 1 increases the fertility rate.
- A differential of less than 1 decreases the fertility rate.
- A differential of 1 means the same fertility rate as on the '*Sched*' sheet.

Option chosen to enter age-specific differentials:

FERTILITY DIF				
<b>Options</b>				
	2013-14	2014-15	2015-16	2016-17
Provide total				
Trend total				
Provide age values		✓	✓	✓
Trend age values				
<b>Data</b>				
	<b>Total</b>			
	<b>Age</b>			
female	15-19	1.00	0.96	0.95
female	20-24	1.00	0.98	0.97
female	25-29	1.00	1.01	1.01

In the 2014-based Wales projections, it is assumed that teenage fertility will decrease. The Schedule refers to 2014–15, so the differential for that year is 1.00.

### 6.4.4 Summary rates scale the initial rates up or down

A facility not used in the Welsh Government forecasts is to assume an overall summary rate: the Total Fertility Rate, the Standardised Mortality Ratio, or the Standardised Migration Ratio.

The entry can be made on an area sheet, and the space for it is at the bottom of the sheet. Scroll down to see it as shown here.

If entered it would amend the rates at each age so that in summary they were consistent with the summary rate provided.

TOTAL FERTILITY RATES			
Year beginning July 1			
<b>Options</b>			
	2001-02	2002-03	2003-04
Provide TFR			
Trend TFR			
<i>Double click any option you wish to s</i>			
<b>Data</b>			
	<b>TFR</b>		

### 6.4.5 Counts take precedence over rates

For the years where numbers of demographic events are known, or have been assumed, these take precedence. POPGROUP will use this number in the forecast. It will also scale the preliminary rates that were calculated from the Schedule, Differentials and Summary rates, so that they are consistent with the counts provided. The adjusted rates are used for the output files.

<p>Go to the sheet for an area, notice the counts of Births.</p> <p>When a count of births is given, it overrides anything the fertility rates may indicate.</p>	<p>Option chosen to enter counts of boys and girls born:</p> <div style="border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="3">Year beginning July 1</th> </tr> <tr> <th>2001-02</th> <th>2002-03</th> <th>2003-04</th> </tr> </thead> <tbody> <tr> <td colspan="2"><b>BIRTHS</b></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="2"><i>Options</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Provide total births</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Trend total births</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Provide births by sex</td> <td></td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> <tr> <td colspan="5" style="text-align: center; color: red; font-size: small;">Double click any option you wish to edit</td> </tr> <tr> <td colspan="2"><b>Data</b></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">Total</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">Males</td> <td style="text-align: center;">317</td> <td style="text-align: center;">363</td> <td style="text-align: center;">383</td> </tr> <tr> <td></td> <td style="text-align: center;">Females</td> <td style="text-align: center;">322</td> <td style="text-align: center;">289</td> <td style="text-align: center;">334</td> </tr> </tbody> </table> </div> <p style="margin-left: 20px;">This many births were recorded each year. ←</p>			Year beginning July 1			2001-02	2002-03	2003-04	<b>BIRTHS</b>					<i>Options</i>					Provide total births					Trend total births					Provide births by sex		✓	✓	✓	Double click any option you wish to edit					<b>Data</b>						Total					Males	317	363	383		Females	322	289	334
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### 6.4.6 Constraints

Constraints are held on the 'Cons' type of file. It allows entries of population, housing or jobs. In each case the software will use that information to alter the migration in a forecast so that there is just the number of migrants to fulfil the constraint.

<p>Open the file <b>Cons_Principal.xls</b>.</p> <p>Scroll down to see the data. The Population constraint may be a total, 5-year age groups, or single years of age.</p>	<p>Option chosen to constrain the forecast to a fixed population:</p> <div style="border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th>2002</th> <th>2003</th> <th>2004</th> </tr> </thead> <tbody> <tr> <td colspan="2"><b>Population Constraints</b></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="2"><i>Options</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Provide total population</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Provide population by sex &amp; age</td> <td></td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> <tr> <td colspan="5" style="text-align: center; color: blue; font-size: small;">Rules Double click any option you wish to edit</td> </tr> <tr> <td colspan="2"><b>Data</b></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">Total</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">5-year age/sex</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Sex</td> <td style="text-align: center;">Age</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> </div>			2002	2003	2004	<b>Population Constraints</b>					<i>Options</i>					Provide total population					Provide population by sex & age		✓	✓	✓	Rules Double click any option you wish to edit					<b>Data</b>						Total					5-year age/sex				Sex	Age			
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<b>Data</b>																																																			
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	5-year age/sex																																																		
Sex	Age																																																		

## 6.5 Derived Forecasts input files

Derived Forecast files for households and the labour force are also held in separate folders for:

- skel**: Skeleton files, one of each type, with no assumptions.
- inp**: Input files, filled with assumptions.
- out**: Output files, the results from a forecast.

## 6.6 Entries on Derived Forecasts input files

The Derived Forecast input files are generally simpler than those on POPGROUP input files. They generally have the following sheets:

**Notes:** for documentation.

**Default:** information which will apply to all areas if information is not provided on the area sheet. It is not used on the integrated forecasts for local authorities.

**Area sheet(s):** information must be available for at least the first year of the model. After that year, values may be missing and are interpreted as follows. If there are no further values at all, the last value is kept constant. If there is a gap before a value in another year, the gap is filled by linear interpolation.

Red information notes are available in many cases, to give on-screen help for how the software will interpret data entry in different parts of the input files.

## 7 Essential alternative scenarios

*Summary.* These are essential scenarios that each Local Plan is likely to consider. Each scenario means a new forecast in POPGROUP. Each scenario is described below, with brief instructions indicating the files that will be changed. The scenarios are of three types.

- Scenarios that update with improved data the demographic demand for housing provided by the continuity forecast.
  - Recent mid-year estimates.
  - Improved data for the demand-supply links.
  - Corrected migration data for students
  - Known major changes to the population in communal establishments
- Scenarios that help to judge the uncertainty of the continuity projections by exploring alternative trajectories of fertility, mortality and migration: trajectories that are realistic alternatives based on past fluctuations outside the control of local planners.
  - High and low variants of fertility and mortality
  - Migration based on data for years other than 2009-14.
  - Alternative household formation rates
  - Alternative economic activity rates
- Scenarios that explore plans for levels of housebuilding or jobs growth independent of demographic demand.
  - Jobs growth provided from past experience or economic forecasts
  - Housing growth based on past building rates

### 7.1 Update the demographic continuity forecast with improved data

#### 7.1.1 Recent mid-year estimates

In June 2016 the mid-year estimates for 2015 were released, in June 2017 the mid-year estimates for 2016 will be released, and the following June those for mid-2017 will be released. These contain relevant evidence for the changing demographic demand for housing in a local authority area and should be included in the model as follows:

- Use the Data Module WALMYEandChange to add births, deaths, migration and the mid-year estimate itself to your integrated model.
- Run the model again. Without any further changes, the forecast will start from a different point (the most recent mid-year estimate), but the assumptions for future levels of change will be the same as in the Welsh Government 2014-based projections.
- Consider the changes in fertility, mortality and migration and decide whether the assumptions for the future remain sensible. Changes to the Welsh Government assumption are unusual in LDP evidence, but would be necessary if there have been shifts in demographic experience that have significant impact on projected demand for housing.
- You will be able to see the differences that the new evidence makes for the first years after 2014 by comparing the births, deaths and migration flows in the Welsh Government



principal projections and those in the MYEs. After you have made the new projection, you can make this comparison from the two forecasts' **comp** output files, or by using the PGCompare utility held in your POPGROUP folder.

### 7.1.2 Improved data for the demand-supply links

In section 5.8 the links between households and housing and between the labour force and jobs were entered on DFSupply files using default data available from the census for all local authorities. The files were saved in the POPGROUP input folder. Consider whether there are improved data for these:

- **DFSupplyDwellingsCensus.xls**
  - Do you have reliable data for vacancy rates for your area(s)? If so, change the option to 'Households to dwellings: separate rate for vacancy rates holiday homes and sharing'. Use your data for vacancies and the census data from Appendix B (or other local data) to compute rates of holiday homes and sharing.
  - Consider whether constant rates in the future is an assumption that can be improved upon.
  - If you make changes, amend the Notes, Validate, and save with a different file name.
- **DFSupplyJobsCensus.xls**
  - Do you have more reliable rates for unemployment or the commuting ratio than provided by the 2011 Census? If so, change the data in this file.
  - Amend the Notes, Validate, and save with a different file name

### 7.1.3 Corrected migration data for students

The Welsh Government 2014-based projections for Gwynedd and Ceredigion suffer from estimates of future migration that seem not to recognise the full extent of male students' migration away after their studies. This is most clear when running the flying pyramids output available from the Charter sheet in the –reporter output file.

- If a more plausible set of migration data can be estimated, substitute it in the input file for out-migration to the UK, **Mig\_INUK\_WG2014.xls**. Amend the Notes, Validate, and save the file with a new name.

### 7.1.4 Known major changes to the population in communal establishments

The Welsh Government 2014-based projections assume a constant population in armed forces, prisons, and more generally in communal establishments, based on the 2011 Census. This is the most usual assumption throughout the UK. If there are known changes since 2011 or in the process of being implemented in the near future, consider changing these assumptions.

- Population in armed forces and prisons: held on **specpop\_WG2014.xls** in the POPGROUP input folder. Make amendments, amend the Notes, Validate, and save the file with a new name.
- Communal establishments: held on **DFPopAdjust\_WG2011HH.xls** in the DF folder for household forecast input files. Communal establishments include those in care homes, student halls of residence, as well as armed forces barracks and prisons. Make amendments, amend the Notes, Validate, and save the file with a new name.

### 7.1.5 A new principal demographic continuity forecast for your area(s)

If you have changed any of the input files due to improved information in this section, run a new integrated demographic projection:

- Open the scenario\_WG2014\_PrincipalIntegrated.xls from your POPGROUP input folder.
- Amend the Scenario ID so that this new forecast does not overwrite the existing Welsh Government forecast. For example, delete 'WG', because it is no longer the Welsh Government demographic forecast.
- For each file that you have improved, amend the files on this scenario, so that they refer to your new improved assumptions. They may be either the files listed on the Run\_Details sheet, or the files listed on the Constraints\_and\_impacts sheet.
- Amend the notes and run the Scenario.
- Use PGCompare or the output files to assess the impact that the improved data have made.

This scenario is now your starting point for other scenarios in the following sections. It is your currently best forecast of demographic demand using recent data for your area(s).

## 7.2 Scenarios to judge the uncertainty of the continuity projections

The principal demographic forecast that expresses continuity of the recent past can be considered a best estimate of the future demographic demand. But the future is not certain. Although planners and politicians find it difficult to plan to take account of uncertainty and prefer to work with a single forecast, they do find it useful to know the likely range of possible futures.

This section provides a series of variants that may be considered as not more likely than the principal forecast, but quite likely based on the past variation in fertility, mortality and migration that is beyond the control of planners.

The suggested strategy is that each variant is made as an alternative forecast, and that the range of forecasts is presented with commentary about how important is uncertainty about each component to the forecast demographic demand for housing.

### 7.2.1 High and low variants of fertility and mortality

Welsh Government provide high and low variants of natural change. Run them.

- If you are following this manual after the Data Module for Welsh Government 2014-based population projections has been amended to include mid-year estimates, the scenarios for these variants will already have been provided in your input folder.
- If you are following this manual after the Data Module for Welsh Government 2014-based population projections has been amended, then running them is straightforward as follows
  - Open the scenario\_WG2014\_PrincipalIntegrated (or your improved principal scenario from section 7.1).
  - Amend the files for fertility and mortality to name the files for high fertility and high life-expectancy.
  - Change the scenario ID to refer to HighNaturalChange.
  - Amend the notes and Run the Scenario.

- Repeat these steps with the files for low fertility and low life expectancy, a scenario ID referring to LowNaturalChange.
- If you suspect that the high or low variants for fertility or mortality are extreme, you can confirm this (or dampen your suspicions!) by looking at the output from the projections for Total Fertility Rate and Standardised Mortality Ratio. This could lead you to implement more realistic variants that you feel would give a better idea of possible variation in the future.

### **7.2.2 Migration based on data for years other than 2009-14**

- Welsh Government provides a scenario for migration based on the average migration for the past 10 years 2004-2014. Run it.
  - As in the previous section, this is straightforward but differs dependent on whether the scenario has been provided with the Data Module.
  - Compare the difference. Which is most likely to be an indication of future migration?

You have the both UK and overseas past migration measured in the Mid-Year Estimates, in each of the four migration files. If you updated the files with most recent Mid-Year Estimates (see 7.1 above), these data extend beyond 2014.

- Compile these migration data of Mid-Year Estimates from the POPGROUP input files in a separate Excel file and compute the net impact of migration each year, for each age group and for the total.
  - You can do this for UK migration and overseas migration separately.
  - Through charts, study the changing impact of migration over time, in total and its age-sex-structure.
- There will always be fluctuations of the number of migrants from year to year.
  - However, if you feel that the average migration during 2009-2014 is unusual in a way that might change the results of a demographic forecast, then define a different assumption based on your data analysis and compare its results with the principal integrated forecast.

There are two separate questions about migration that may be important in your local authority. These are dealt with in the next chapter:

- Constant future number of migrants (as Welsh Government has assumed) or constant rates as might be appropriate in areas of changing population size (as Powys Council has argued).
- Unattributable Population Change between the 2001-2011 censuses is not included in the Welsh Government migration figures on which migration between 2009 and 2014 is assessed. If it is likely to be due to one of the migration streams being incompletely measured, an adjustment to the levels of migration is in order.

### **7.2.3 Alternative household formation rates**

The Welsh Government household projections continue the change in 'household membership rates' that was observed between the 2001 and 2011 Censuses (see chapter 3 for more detail of their method). In fact the change in household membership rates was not as great in that decade than in previous decades, but the continued tendency to smaller households does have some impact.

There is debate about whether the economic pressures for young adults to stay at their parental home or return to it, will continue in the future. It is worth exploring the uncertainty of the principal projection of demographic demand for housing due to alternative reasonable assumptions about household membership rates.

- An easy way to assess the impact of changes in household membership rates is to use the *Decomposition* of household change provided by the Derived Forecasts **DFReporter** file.
  - Find **DFReporter\_WG2011HH\_Principal.xls** in the DF output folder for your household model.
  - On the Reports sheet, amend the report options to choose 'Decomposition' between the years 2001, 2011 and a relevant future year of the LDP.
  - It will tell you the impact on demographic demand of the changing population (its size and its age structure both impact on housing need), and the impact of changing household membership rates.
- An equivalent way of investigating the impact of changing household membership rates is to run a forecast where the household membership rates do not change after 2011.
  - Find the file **DFRates\_WG2011HH.xls** in the DF input folder for your household model.
  - Delete all the rates after 2011. The assumption will be that the rates stay the same after that point. Amend Notes, Validate and save with an appropriate name.
  - Run the integrated projection again, with amended Scenario ID, and name the new DFRates file on the scenario's 'Constraints\_and\_impacts' sheet.
  - Alternative assumption for just some age groups and types of household?
- Test an additional scenario for household membership rates that answers the queries from possible critics. For example, examine **DFRates\_WG2011HH.xls**. If the membership rates for one and two-person households at ages 15-34 are projected to fall, amend them to keep them constant.

#### **7.2.4 Alternative economic activity rates**

The default economic activity rates used in the integrated forecast are constant after 2011, for each age and sex, based on the local experience taken from the latest census. The Labour Force Data Module created for you several alternative sets of rates. Two of them apply to the local 2011 rates the change in economic activity for the UK expected by two studies: the Office for Budget Responsibility (OBR), and the European Commission (EC). These make assumptions that result in continued increase of women's economic activity and some increase in older person's economic activity expected from the rise in age of entitlement to a state pension.

Neither the OBR nor the EC projection of economic activity rates is convincing for use in local economic plans. Both for example assume a constant rate of economic activity for young people, and each differs significantly in its projection for those of prime working age and for older people.

Nonetheless, these two alternatives are useful for exploring the impact on uncertainty in the future labour force.

- Run the integrated forecast, changing the scenario ID and on its Constraints\_and\_impacts' sheet replace the economic activity rates file with the one in your labour force model's input folder, containing the OBR or the EC projection of rates.

In the context of assessing need for housing, the economic activity only has an impact when implementing demographic forecasts led by an estimated level of jobs growth. In that context more attention should be paid to economic activity. Brief notes are provided in Chapter 8.

### **7.3 Scenarios that explore plans for levels of jobs growth of or housebuilding independent of demographic demand.**

The integrated forecast provides an assessment of housing need based on continuity in the demographic development of the local authority's population, assuming levels of change remain. The forecast quantifies housing need and many details of population composition, particularly its future age composition, which are useful for planning public services.

When there is an expectation about future economic development, or future housing development, that will come to fruition independently of demographic development, then the population will be affected by these firm plans and targets. This was discussed in section 3.5 above. POPGROUP allows future growth in jobs, or future change in the size of the housing stock, to 'lead' a demographic projection in exactly this way. Migration is adjusted so that it fills the extra jobs or housing. This may be an increase or decrease of migration, depending whether the extra jobs or housing were more or less than implied by continued demographic development.

It must be remembered that the population and housing need that is assessed from these policy-led forecasts are only as realistic as the policy that drives the forecast. The need assumes the policy is implemented and achieved in full

#### **7.3.1 Jobs growth provided from past experience or economic forecasts**

If an economic forecast independently provides a level of jobs growth, this should be considered as an option to lead the assessment of housing need.

- Express jobs growth as a net increase in number of jobs each year, either constant over a period, or changing from year to year.
- Insert this increase in jobs each year on the constraints file **cons\_MYE.xls** in your POPGROUP input folder:
  - Double click to tick the option on Row 8 'Provide change in total supply units', for each year of the constraint
  - Enter the growth in jobs under each chosen year, on Row 15.
  - If your model has several areas, each must have a constraint entered in the same years.
  - Amend Notes, Validate, Save with an appropriate new name.
- Open the integrated scenario
  - Provide a new scenario ID.
  - Name the new constraints file on the 'Constraints\_and\_impacts' sheet.

- POPGROUP will assume that the constraint refers to the information in the First Derived Forecast on the 'Constraints\_and\_impacts' sheet. So the files for the first and second derived forecasts must be swapped.
  - Select the same two economic activity and jobs files but do so by double clicking in the panel for the 'First Derived Forecast', replacing what is there. Delete the names of the other files in that panel.
  - Select the same household and dwellings files but do so by double clicking in the panel for the 'Second Derived Forecast', replacing what is there.
  - You might use the screen shot in Section 5.9 to remind yourself of the files that need to be included, but the contents of the First and Second derived forecasts will be swapped over.
- Use the check files to validate the types of files you have entered.
- Run the scenario from the 'Run\_Details sheet'.

Other issues relating to 'jobs-led' forecasts are briefly discussed in Chapter 8.

### **7.3.2 Housing growth based on past building rates or other possible futures**

A housing plan may have already been proposed, or a building rate be believed because it is the same as or related to the past building rate. In these cases, POPGROUP will calculate the future population that is consistent with the planned house-building. This will be useful, for example in showing the implied future number of school children and demand for other services.

- Express the house-building rate as a net change in number of dwellings each year, either constant over a period, or changing from year to year.
- Insert this change in dwellings each year on the constraints file **cons\_MYE.xls** in your POPGROUP input folder:
  - Double click to tick the option on Row 8 'Provide change in total supply units', for each year of the constraint
  - Enter the change in dwellings under each chosen year, on Row 15.
  - If your model has several areas, each must have a constraint entered in the same years.
  - Amend Notes, Validate, Save with an appropriate new name.
- Run the integrated scenario with new scenario ID, naming the new constraints file on the 'Constraints\_and\_impacts' sheet. The household and economic activity files need not be changed.

## 8 Further issues in demographic forecasting

*Summary:* This chapter considers other issues that arise when considering the assessment of future housing need using demographic projections. It highlights particular issues and questions that have arisen in past development of plans, or in training with POPGROUP software, and indicates how the issue might be approached. The response in each section consists of a brief commentary rather than a full treatment of the issue.

### 8.1 The age composition of migration: what is its impact on population and housing need?

Two populations can receive the same number of in-migrants and out-migrants but have very different population growth.

- If more elderly people arrive in an area than leave it, its population will age faster, the need for housing will be greater because older people usually live alone or only with one other person. Thus while the population and the labour force may reduce, the demand for housing may not reduce. This is a situation common in the National Parks and in some local authorities that have retirement in-migration.
- If more younger people arrive in an area than leave it, the area is likely to have more families, more births than deaths, and tend to have a growing population. This is a situation familiar to Cardiff and generally the most urban areas.

Section 7.2.2 advised a simple investigation of the changing level and age-structure of migration, in case it has changed in ways that help to indicate the level and composition of future migration.

‘Zero net migration’ is a scenario that can be easily implemented in POPGROUP to help to assess the impact of the age-structure of in- and out-migration. The appropriate comparison is a ‘natural change’ scenario with no migration at all.

The production of ‘Zero net migration’ and ‘natural change’ scenarios is described in the [POPGROUP ‘How to’ guide no. 1](#), and consists of these steps:

*Zero net migration:*

- Open the four migration input files from your POPGROUP input folder
- Save the in-migration files for UK and for Overseas with different names, replacing the text ‘WG2014’ with ‘TotalEqualtoOut’.
- On the two in-migration files choose on each area sheet (not the ‘all areas’ sheet) the option to ‘Provide total migrants’ in each year (image box 1) for the years from 2014-15.
- From each out-migration file, copy the total

		In-migration file					
		2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
5	<b>Migrants</b>						
6	<b>Options</b>						
7	Provide total migrants	✓	✓	✓	✓	✓	✓
8	Trend total migrants						
9	Provide age-sex mgt	✓	✓	✓	✓	✓	✓
10	NOTE						
11							
12	<b>Data</b>						
13	Sex						
14	Age						
15	male	0-4	102	109	109	109	109
16	male	5-9	81	73	73	73	73
17	male	10-14	52	52	52	52	52
18	male	15-19	558	633	633	633	633
47	female	55-59				73	73
48	female	60-64				70	70
49	female	65-69	56	51	51	51	51
50	female	70-74	62	47	47	47	47
51	female	75+	141	120	120	120	120
52		All Females	2,884	2,940	2,940	2,940	2,940
53		All Persons	5,760	5,706	5,706	5,706	5,706

migrants each year (Image box 2) for the years from 2014-15.

- Paste these totals in the in-migrants file of the same type (UK, and Overseas) (Image box 3), from 2014-15.
- For each in-migration file, amend Notes, Validate and Save.
- Run the scenario (new scenario ID, and naming the two new in-migration input files).

*Natural change:*

- Run a further scenario that is for no migration at all, a 'natural change', where all four migration files are omitted from the scenario
- Compare the two scenarios with PGCompare.

## **8.2 Can we plan a change in the composition of migration?**

If an area has suffered regular depletion of population and workforce through young out-migration in net terms, whether or not it has been coupled with elderly in-migration, it is a natural to question whether a change in migration could be achieved to retain more people within the local workforce.

To be part of an accepted local plan, the means must be clear and most likely will already be in place. In other words, an aspiration will not be good enough.

Nonetheless, the demographic analysis may be helpful in explaining and convincing planners and politicians that some population trends will not change unless plans are put in place to attract a different composition of migrants, or deter the out-migration of migrants of particular age groups.

## **8.3 Rates of migration or numbers of migrants: which best indicates the future?**

Welsh Government projected the future by holding steady the number of migrants at each age-sex group, after monitoring the previous five years 2019-14. Chapter 7 suggested different ranges of years which might be averaged.

However, there may be a conceptual problem in keeping constant numbers of migrants. Powys has argued for its LDP reviewed in spring 2017 that its forecast of a reducing population made constant numbers of migrants unrealistic. The numbers of out-migrants should fall with time rather than stay the same.

Powys based its demographic projection on rates for out-migration based on the area's population, as that is the population 'at risk' of out-migrating. It used rates for in-migration from the UK too, but in POPGROUP these are based on the whole UK population, as that is the population 'at risk' of in-migrating. For in-migration from overseas, immigration, POPGROUP insists on numbers of people as one cannot easily define a rate from the rest of the world.

One could make the same argument for other areas. However, if the population has already been reducing or increasing, it would be most convincing to demonstrate that rates have already been more steady over time than are numbers of migrants. I am not aware of any empirical study that would support one approach over the other.



## 8.4 Brexit implications on migration and students

Who will dare predict future immigration and emigration, when the policies will undoubtedly change and are under debate, and there is in any case doubt over the impact of border controls on migration?

The best that can be done is to devise sensible scenarios, given the nature of current international migration to the local authority area(s). A change in total immigration or emigration can easily be entered on POPGROUP input files, as an additional entry to the number of migrants at each age-sex already assumed in the WG 2014-based projections. POPGROUP will scale all the age-sex counts proportionately to make them consistent with the total.

- Open the two Overseas migration input files from the POPGROUP input folder, named **Mig\_INOV\_WG2014.xls** and **Mig\_OUTOV\_WG2014.xls**.
- Note the total number of migrants recorded in the Welsh Government assumptions, written below the counts on a row titled 'All persons'.
- Double click to choose the option 'Provide total migrants' on row 7, under each year from 2014-15.
- Enter the scenario of a revised number of migrants on row 12, under each year from 2014-15.
- Run the Scenario and compare results with the principal integrated forecast.

## 8.5 Unattributable Population Change between the 2001-2011 censuses

After each census, lessons are learned about how well migration has been measured since the previous census. The migration estimates are often improved, but there still remains a portion of population change between the two censuses which is unexplained, called 'Unattributable Population Change (UPC)'.

The UPC is measured for each age and sex in each local authority. It is not included in past estimates of migration, because it may be due to:

- Error in any of the estimates of the four migration flows (in- and out-, with the UK or Overseas) during the decade,
- Error in the 2001 census
- Error in the 2011 census.

It is called 'unattributable' precisely because it is unknown which combination of these causes is at fault.

### 8.5.1 How big is the UPC for each local authority?

When you replicated the Welsh Government 2014-based forecast, and in the integrated forecast, POPGROUP had to allocate the difference between the estimates each year made with births, deaths and migration each year from 2001-2011, and the mid-year estimates which were a constraint on the projections during that time. This difference is the UPC and is recorded as the

impact of the constraint on the population. It is recorded in two places on the POPGROUP output files:

- On the output file 'comp' towards the bottom of each area sheet, as the 'Population impact of constraint'. The UPC is an addition of between two and four thousand for Wales as a whole, and different for each local authority.
- On the output file 'dump', towards the bottom of each area sheet, as the 'Impact of constraint (age at end of year)'. The UPC is given here for each age and sex. For Wales as a whole it is a reduction for age 15-19 and an addition for other ages, and is again different for each local authority.

### **8.5.2 Is the UPC due to errors in the censuses or to migration that wasn't fully measured?**

By its nature there is no straightforward answer to this question – that is why it has been named unattributable.

Ways of attempting to understand the source of UPC are:

- ONS provide a 68-page [report](#) and a [tool for analysis](#) of the UPC. These are detailed documents, but if the UPC is large for your area(s) then they will reward detailed study. Their title is 'Further understanding of the causes of discrepancies between rolled forward and census based local authority mid-year population estimates for 2011', published by ONS in September 2015.
- Close understanding of the census-taking and validation in 2001 and 2011 might suggest the extent to which the UPC may be due to their errors.

### **8.5.3 Should the UPC be included in demographic projections for the future, in case it is missed migration?**

ONS, and Welsh Government, consider that UPC should not be included in their analyses after the 2011 census, and have not included an allowance for it in the Mid-Year Estimates since 2011, or in their 2014-based projections.

If you can convincingly argue that the UPC must have been due under-estimated migration, then you can include it by making an adjustment to migration in your projections.

## **8.6 How can I make a target of constant population?**

Sometimes a local authority that Welsh Government has forecast to have a decreasing population asks 'How much housing would we need to stop the declining population?'. This is straightforward to answer in POPGROUP, using a constraint with the total population. Once you have the integrated demographic forecast:

- Open the 'Cons' file and save it with an appropriate new name.
- Choose the Population Constraints option 'Provide total population' for the first year in which you wish the population to be fixed.
- Choose the same option for the last year of the forecast.

- Enter the fixed population in the Data against ‘Total’ for the two years in which you have chosen that option. POPGROUP will assume that you want the same constraint for each year between these two years.
- Amend the notes, Validate and save the file.
- Open the integrated forecast’s Scenario file, give it an appropriate Scenario ID and specify this new Constraint. Amend the Notes, and run the scenario.
- Examine the output of ‘Change in Dwellings over the previous year’ on the ‘Comp’ output file. This is the housing needed to keep the constant population.

Be aware that POPGROUP uses the migration flows specified on the Scenario file to ‘fill up’ the population. By default, for a population constraint these are the international in- and out-migration flows. It may be that you would rather assume that it is UK flows of migration that will be adjusted by the software to meet a constant population target. In which case, before running the scenario, enter

Save your input files before running the model.

Migration Weights	
Pop'n	Derived units
50%	50%
50%	50%
0%	0%
0%	0%

zero into the two international flows under ‘Migration Weights’, and 50 for the UK out-migration. UK in-migration will adjust itself so that the weights add up to 100, as in the screenshot.

## 8.7 How can I make target of a constant labour force or constant working age population?

The options for constraints do not allow only part of the age-structure of the population to be constrained. However they do allow the labour force to be a constraint on a population forecast. This may be as appropriate a policy target as the total population to enable a sustainable local economy and community.

A constant labour force is straightforward to specify in POPGROUP ‘Cons’ file, using the option to enter a change in the number of ‘derived units’, which in the labour force forecast is the labour force itself. You can specify zero change to indicate a constant labour force. Once you have the integrated demographic forecast:

- Open the ‘Cons’ file and save it with an appropriate new name.
- Choose the Derived & Supply Unit Constraints option ‘Provide change in total derived units’ for the first year in which you wish the labour force to be fixed.
- Choose the same option for the last year of the forecast.
- Enter zero in the Data section against ‘Change in total no. of derived units’ for the two years in which you have chosen that option. POPGROUP will assume that you want the same constraint for each year between these two years.
- Amend the notes, Validate and save the file.
- Open the integrated forecast’s Scenario file, give it an appropriate Scenario ID and specify this new Constraint.
- Also swap the files for First and second derived forecasts, as your constraint refers to the labour force. It is a jobs-led forecast, which was discussed in Section 7.3.1.

- Amend the Notes, and run the scenario.
- Examine the output of 'Change in Dwellings over the previous year' on the 'Comp' output file. This is the housing needed to keep the constant labour force.

Be aware that POPGROUP uses the migration flows specified on the Scenario file to 'fill up' the population. By default, for a derived units constraint these are the UK in- and out-migration flows, as is probably appropriate in this scenario. If you felt that the migrants needed to keep a steady labour force be from overseas, then you would change the 'Migration Weights' on the scenario before running it.

POPGROUP adjust the migration flows to meet the constraint, by increasing the numbers at all ages. It is assumed that a different number of jobs will be filled by people with dependents, and not necessarily from outside the area but by people shifting jobs and those jobs being filled. Similarly the housing needed will not be filled only by those migrating for the jobs. So POPGROUP uses the local authority's age-structure of migration, and its economic activity rates at each age and sex, to calculate how many migrants of each age would be needed to produce the constant labour force.

The results may raise the question of whether the LDP can include measures to change the composition of migration or the economic activity of residents.

## **8.8 A demographic forecast led by jobs growth from an economic forecast**

The allowance for an aspirational target of jobs has been taken up as the 'new normal' in LDPs and has created a focus on the future of economic activity. All other things being equal, a growth in jobs beyond that expected from demographic change would require more land for housing to accommodate the extra workers and their families. However, if economic activity were to continue to increase as in the past decade in Britain, or if the rising age of entitlement to a state pension were to lead to significant increases in older people's economic activity, then those extra jobs would be taken by the existing population without any requirement for extra housing.

Realistic jobs growth and future economic activity have become much more central to the examination of local plans than hitherto. Official forecasts of economic activity do not exist in the UK, but are produced as the by-product of other research by the OBR and EC as described in Chapter 5. The methods of forecasting economic activity, and a comparison of OBR and EC projections is provided in an article in *Local Economy: Simpson (2017)*.

A target for jobs growth is used as constraint in POPGROUP. As described in the Section 7.3 above, POPGROUP adjusts migration and gives the user the consequences for population and need for dwellings.

When the target of jobs growth is from an economic forecast, some difficulty in interpretation can arise. The economic forecast may well include a population forecast as an input; to provide a consequent population forecast is circular and if the input and output populations are different, the result is of questionable value. Similarly, the economic forecast will have an assumption for future economic activity that may be hidden in methodology and therefore difficult to make consistent

with the assumptions used in the demographic forecast. These are challenges critically observed by the Planning Advisory Service (2014) and Peter Brett Associates (2014, appendix D).

In any case, a target of jobs growth should be acceptable in a LDP when that growth is clearly evidenced as the most likely outcome, not simply an aspiration. Most areas do have an aspiration for growth in jobs, but this would only be an outcome on a national scale if the economic activity of the population increased – there would be no consequence for migration or housing need.

## **8.9 Why can't I fix average household size for the future, to indicate higher or lower scenarios?**

Average household size is a convenient summary of how people fit into households. It is one of the outputs from the Derived Forecasts model of households. But average household size is not very useful for tracking changes in household formation. This is mainly because it includes children, who do not form households. Average household size has decreased considerably during the last century, for example, but this is mainly due to smaller households, not to how adults choose to or can afford to live together. Similarly the increase in fertility in the 2000s led to an increased average household size, and confounds the analysis of whether changing household size means that young people can find independent housing.

For that reason, demographic analysis focuses on household formation at each age. A chapter in a recent book for the British Society of Population Studies review the various influences on household formation but still finds it difficult to predict which are temporary and which are permanent or structural shifts (Berrington and Simpson, 2016). It does find that the main drivers of household change in the future will continue to be changing total population and its age composition, rather than rates of household formation.

## **8.10 How does POPGROUP deal with the capacity of an area?**

The term capacity is one often used in planning guidance, to allow that a LDP may heed an area's environmental capacity, its infrastructure capacity, and its market capacity.

The capacity of an area is not an input to POPGROUP as such, but would be calculated by planners from separate analyses of the environment, infrastructure and market, and then included in POPGROUP as a constraint. The constraint would be expressed as a maximum dwelling stock or a maximum annual growth. Then the practical way of including it in a demographic forecast would be as follows:

- Run the integrated forecast without the capacity constraint.
- Observe the years in which the dwelling stock or its growth is forecast to exceed the capacity.
- Run the forecast again with a new constraint input file (**cons.xls**) containing the capacity for those years.
- POPGROUP will change the migration to ensure that the forecast does not exceed the capacity.

### **8.11 How can I compare several POPGROUP forecasts of housing need?**

Housing need is expressed in POPGROUP as the change in number of dwellings each year in the future, on the 'Comp' output file referred to in various places already. The '-reports' output file retrieves information from the 'Comp' file to make its time series charts, so housing need can also be charted automatically from the '-reports' file's Charter sheet.

However, the PGCompare utility which is used to compare more than one forecast retrieves information from the 'summ' output file and housing need is not one of the indicators it uses.

To compare housing need from several POPGROUP forecasts, copy the results from each forecast's 'Comp' file into a separate Excel file. If you are comfortable with formulae in Excel you can use them from a separate Excel file to point to the housing need on different 'Comp' files. Then make further summary tables or charts from the compiled data.

### **8.12 National Park Areas**

Wales' three National Parks are projected by Welsh Government separately from local authorities. The Welsh Government 2014-based projections of both population and households are due for publication in May 2017, a few months later than the local authority projections discussed in this manual.

Welsh Government uses POPGROUP for the National Park projections and is likely to be able to provide the National Park authorities with the projections in POPGROUP format. The software can be used to explore the results and make alternative scenarios as advised in this manual. There are no POPGROUP Data Modules for the National Parks, so there will be extra work for the user to locate and enter the relevant data from the Census and from Mid-Year Estimates.

### **8.13 Small areas within local authorities**

#### **8.13.1 Welsh Government guidance**

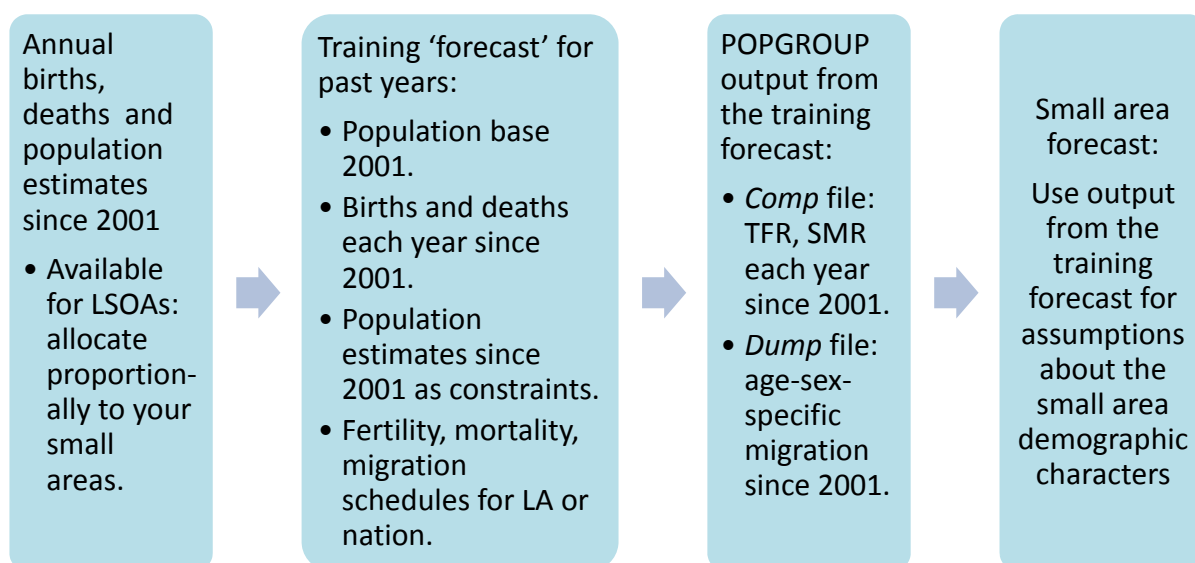
The Welsh Government and Welsh Local Government Association (WLGA) guidance on 'Getting started with your local housing market assessment' (WG and WLGA, 2014: pages 12-13) suggests two methods for allocating housing need to areas within the planning authority. Option A shares the household projection for the whole authority to each sub-area according to the share of households or population at the past census or most recent population estimate. Option B shares the projected growth in households to each sub-area according to the allocated housing in the current LDP. The two methods would give different results whenever the population growth is in different areas from the current planned housing developments. The choice between the two methods is left to the local authority.

Both methods ignore the varying demographic characteristics of smaller areas, and both methods give only an allocation of the total number of households, with no indication of the population structure that is needed to quantify need for services.

### 8.13.2 Feasibility of small area forecasts in POPGROUP software

POPGROUP is a framework for forecasting the population of any area. Only the Data Modules are restricted to the government projections for local authorities. A demographic model for smaller areas is often implemented by local authorities or for them using POPGROUP software, with all the features described in this manual for local authority areas. The practical difficulty is the effort required to access and enter the relevant data into a POPGROUP models of population, households and the labour force for smaller areas.

There are no data published for fertility rates, mortality rates or migration for smaller areas. For this reason it is usual to develop small area forecasts in four stages as laid out below:



This strategy is very similar to that used in official forecasts: use past data to judge the local area’s characteristics, and then forecast forward by respecting the differences between each area. In POPGROUP the assumptions are under the user’s control, and can be varied according to local knowledge of each area.

There is considerable experience to draw upon. Since the 1970s planning authorities have united their planning information with demographic information to monitor and project forward population and housing in small areas. In Scotland, the NRS provided each local authority with small area forecasts of population and housing for a set of areas of their choice, and published these in 2016 along with documentation and advice (NRS, 2016). Documentation based on an earlier version of POPGROUP but still useful in defining the production processes of small area forecasts is held on the [legacy POPGROUP site](#). In Wales Gwynedd began a project in 2017 to provide small area forecasts.

### 8.13.3 Notes on small area forecasts

*Which small areas?* Locally-defined areas; often neither LSOAs nor wards but areas relevant to services. It may be that there is demand for more than one set of small areas. It is useful for accuracy if the areas are approximate aggregates of the areas for which births, deaths and population estimates are available.

*Why?* Assess the impact of housing development on schooling and other services. Assess relative demand for services aimed at young people, at elderly people, through health services, and so on. Assess population change expected from areas with newly immigrated communities

*How small can an area be?* The limiting factor is not so much the area or the size of the population but its stability. If there are institutions which may change rapidly, these are most likely to upset a population projection. A very rough guide might limit populations to 3,000 or more, but smaller populations can be stable, and large populations can be unstable.

*What other methods are available?* See above for discussion of the Welsh Government/WGLA options. These are much simpler, but ignore the age structure of each area. For really small areas (< 3,000 pop?), simpler methods can be considered

*Should institutions be forecast separately as in the Welsh Government sub-national projections?* If there are data for the residents in the armed forces, in prisons, or higher education students, and if it exists for several years in the past, then there is one strong argument for using them. It is that changes in those special populations in the past would lead to estimation of past migration that would be misleading as an indication of the future. However it is not necessary. Furthermore, if the data that exist are only for one recent year, or if the special populations have been stable, then estimating them separately can lead to other problems that are better avoided.

*Which data should be used for the population projections?* As indicated above: population estimates by age and sex, births by sex, and the total number of deaths or deaths by age and sex, for each year since 2001. These are available from ONS for LSOAs or electoral wards which should then be aggregated to the areas that are going to be forecast.

*What should be the base year?* In these notes it is assumed that 2001 will be the base year. The information on births, deaths and population exists from that year, and a longer run of past information is very helpful in monitoring local areas and in formulating sensible projections for the future. However, a base year of 2011 could also be chosen, reducing some of the inputs at the cost of some of the intelligence created about the past of each area.

*How is migration estimated for small areas?* Census data for small areas is not detailed enough, and excludes emigration. The net impact of migration can be derived by deducting births and deaths from population change, at each age. So the strategy for small area forecasts relies on the change in population estimates from each year to the next. This provides an estimate of *net* impact of migration at each age separately for males and females, for each of the past years. The information about the past is examined, averaged, and used to set the assumption for future years.

- For example, if there are 15 thirty-year olds in one year and 20 thirty-one-year olds the following year, then after taking account of deaths in the year (which would be tiny at that age) there must have been a net in-migration of five people.
- This is the calculation that POPGROUP makes when implementing a constraint. It allocates migration to each migration stream but it is the net amount that is estimated precisely.
- There is no knowledge about whether it is UK or overseas migration. For this reason, the POPGROUP model is usually specified with only two flows of migration for each small areas: in from everywhere else, and out to everywhere else.



*Which data should be used for household formation rates and economic activity rates?* The 2011 Census gives the characteristics of smaller areas with detail of age and sex. These should be used to compute small areas rates, if they are given in census output with sufficient detail. If they are only given for broader categories of age or sex or household type, then either (a) set up the Derived Forecasts models with this broader definitions, or (b) use the broader census counts to adjust the council area rates so that they reflect what is known of the local area. Technically the method usually involves these steps:

- Multiply the detailed council area rates for 2011 by the smaller area's age-sex population for 2011.
- Aggregate the results to match the categories available in the census for each small area (eg. of household type by age by sex, or economic activity by age by sex). This gives counts for each small area that would be expected if the small area had the same characteristics as the council area.
- Derive a multiplier for each broad group by dividing the small area count from the census by the count calculated using council area rates. If this is more than 1, it indicates by how much the local area rates must be higher than the council area rates, and if it is less than 1, it indicates by how much the local area rates must be lower than the council area rates.
- Adjust the detailed council area rates using the multipliers calculated in the previous point.

*Is local population really so strongly related to housebuilding?* This is a good question that can only be answered by examining past population change and past change in dwelling stock, for each local area.

*How can we judge the reliability of small area forecasts?* As with any forecast, it is worth trying to assess the uncertainty attached and reduce it where possible. Try these options:

- Test the impact of different assumptions.
- Impose a constraint of the council area's projections. This will impose consistency. However, if it is one area that is particularly difficult to forecast and is in error, then the constraint may be at the cost of increasing the errors of other small areas.
- Consult those who know the local areas well, by sharing draft forecasts.
- Publish forecasts only as far forward as is necessary, perhaps five or ten years.

*How many resources will this take?* The NRS project for 32 Councils was undertaken over twelve months, involving one person full time and the active involvement of several others. Planning and implementing the data entry, assumption-setting and report-writing will involve a major part of somebody's work for a month and quite possibly longer than this. The investment has to be justified by small area forecasts results being used in town planning and service planning. Models for small areas can be commissioned from consultancies - Edge Analytics have delivered such models for several local authorities. If this is the route taken, the commissioning authority should ensure that it receives all POPGROUP files – setup and documented input files as well as output files – so that it can update and develop further scenarios in house.

## **8.14 School roll forecasting information systems**

The main input for school roll forecasts that can be synchronised with the demographic modelling described in this manual, is the number of future births. Other than this, most local authorities have found that their frequent information from school roll monitoring is the best basis for a separate system of school roll forecasting. There is no one system that has been gained practical acceptance across a range of local authorities, but a number of attempts have been made to summarise the features of school roll forecasting. In the bibliography these are referred to in Simpson (1987, 2011).

### **8.15 Pupil yield from new housing**

A key planning issue, although separate from preparation of a local plan, is the impact on school rolls of new housing. There are various options. A traditional method is to research the type of residents from the past census or from a house-to-house survey, and to compute a 'pupil yield' directly from these data. Figures between 2 and 6 children of each school year from each 100 houses are typical results of such surveys.

However, new housing is filled partly from the local neighbourhood. The assumption that all the children in new housing are 'extra' is often optimistic. At the other extreme, new housing may be targeted at older people or couples without families, but those moving to the new housing will leave housing that is available for residents who do have children.

POPGROUP allows a constraint of a number of extra dwelling units, which can be used to assess the impact on population, including children of school age. In contrast to the approach that focuses on the occupants of new housing, POPGROUP assumes that there will be shifting around the existing and new stock, so that the overall impact of extra dwelling units will be to attract migrants of the same type that the area usually attracts. It uses their age and sex composition and their household formation rates, to fill the extra dwelling units. The advantage of the demographic approach within POPGROUP is that it also provides a year-by-year forecast that takes into account the number of children migrating but also the numbers likely to be born in subsequent years. After 25 years, the pupil yield has been noted to be between 4 and 10 children of each school year from an extra 100 dwellings, depending on the local authority.

Whether the model is for the local authority as a whole or for small areas, the strategy for assessing the impact of extra housing on the number of children aged 5-15 would be as follows:

- Run the integrated forecast with a housing constraint of zero dwellings each year in each area. Alternatively, a constraint reflecting the expected housebuilding without the extra housing that is under investigation. Record the number of children each year of the forecast.
- Run the integrated forecast with a housing constraint that additionally records the extra housing under investigation. Record the number of children each year of the forecast.
- Compare the two forecasts.

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## Appendix A: Adding Mid-Year Estimates from 2001 to the 2014-based population projections

This is an appendix to Chapter 5, referred to in Section 5.7. After you have run the Data Module to create 2014-based population projections for your area(s), follow these steps to add the Mid-Year Estimates for previous years, unless the Data Module already did this for you. Wherever there are questions asked by the software when you are running it, unless you know you have made an error, click 'accept'.

### A.1 Set up a population model starting in 2001

- From your folder **\1. POPGROUP V4.0\**, open the file **MODEL\_SETUP\_<area(s)>\_2014.xls**
  - This is the file created for you by the Data Module. It specifies your model's nature, including which area(s) you chose for your model.
  - Make no changes to it at all except to the base year and the Model ID, as follows.
- Change the base year from 2014 to 2001 and the Model ID from 2014 to 2001, as indicated in the screenshot below
  - Your Model ID will have your area(s)' description rather than 'Wales\_UAs' in the screenshot, and your own text rather than 'Training RTPI'.
- Change no other settings. Click the blue button to set up the new model.
  - Click OK to questions that will be asked as the model is being set up.
  - When complete, a new model will have been created starting in 2001, but have no data in it. The next sets of instructions remedy this.

### POPGROUP Population Estimates and Forecasts

#### **Model Setup Information**

*POPGROUP version 4*

When complete, click this **SETUP** button to create the skeleton input workbooks

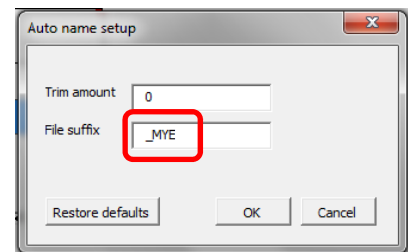
File Header:	Training RTPI
Base Year of population data:	2001
Model ID, to name folders:	Wales UA: 2001 POP
Location of folders:	C:\Forecast\1. POPGROUP v4.0\
Workbook containing standard rates:	

- Save the file using 'Save as...', in the directory it came from, amending the name to change 2014 to 2001. This is simply to document what you have done.

### A.2 Add the Mid-Year Estimates, births, deaths and migration from 2001 to 2014, to your new model that starts in 2001

- From your folder **\3. Data Modules\WALMYEandChange**, open the file **DM\_WAL\_MYEandChange\_Setup.xls**
- Change or choose options highlighted in red in the screenshot below, ie

- Tick 'Load data into PopBase?'
- Tick 'Leave it out' for Unattributable Population Change
  - This will not affect the projection. It is discussed elsewhere.
- Click on 'Autoname options' and change \_1 to \_MYE, as in the screen-shot to the right
- Click on 'Auto name'.
- Double-click on the box under 'Existing POPGROUP input workbooks' to the right of 'Folder'. Navigate to the skeleton folder of your new model, which will be called '<area(s)\_2001POP\_skel'. Click
- Double-click on the box under 'Destination input workbooks'. Navigate to the input folder of your new model, which will be called '<area(s)\_2001POP\_inp'.
- Your screen should look the same as that shown below (without the red boxes!). However, the folder names will indicate your area name(s) rather than 'WalesUAs' in the screenshot below.
- When each of these changes has been made and no others, click the button 'Next'.



**POPGROUP**  
Wales MYEandChange Data Module

Data Module data folder: C:\Forecast\3. Data Modules\WAL\MYEandChange\Data

Datasets: WALPopEsts\_2001\_02Data.xls  
WALPopEsts\_2002\_03Data.xls  
All datasets from 2001-02 to 2013-14 selected

Load data into PopBase?

Include Unattributable Population Change:  in UK migration  in international migration  leave it out

Existing POPGROUP input workbooks:

Folder: C:\Forecast\1. POPGRUP V4.0\WalesUAs\_2001POP\_skel

Destination input workbook: C:\Forecast\1. POPGROUP V4.0\WalesUAs\_2001POP\_inp

Fertility	Fert	Fert_MYE
Mortality	Mort	Mort_MYE
Migration - Internal In	Mg_INUK	Mg_INUK_MYE
Migration - Internal Out	Mg_OUTUK	Mg_OUTUK_MYE
Migration - International In	Mg_INOV	Mg_INOV_MYE
Migration - International Out	Mg_OUTOV	Mg_OUTOV_MYE
Constraints	Cons	Cons_MYE
Base Population	PopBase	PopBase_MYE

- When POPGROUP has checked that your names match those in the Mid-Year Estimates, Click 'Copy' to copy the data to your files.

- When the copying is complete (it may take some time), save the file using ‘Save as...’, in the directory it came from, amending the name to add your Model ID. This is simply to document what you have done.
  - You will find that there are now files in your new model’s input folder, each containing data up to the latest Mid-Year Estimate.

### A.3 Join the Welsh Government 2014-based population projections to your model that now has 2001-14 Mid-Year Estimates

- From your folder \1. POPGROUP V4.0\, open the file **JoinPOPGROUPmodels.xls**
  - This is a utility that can be used to join any two models together, so long as they share the same areas.
- Change or choose options as in the screenshot below, ie
  - Double click under ‘Model input workbooks with EARLIER base year’ and find your 2001-based population model’s input folder, click OK. This will also automatically fill the destination folder for the JOINED data.
  - Double click under ‘Model input workbooks with LATER base year’ and find your 2014-based population model’s input folder, click OK. In each case your folders will have the model ID you chose to reflect your areas, rather than the ‘WalesUAs’ of the screenshot below.
  - Choose each input workbook individually. First the EARLIER files that have the MYE data. Then the LATER files that have the 2014 projection data.
  - Choose the option for ‘Output filename options’ that is ‘Use same names as later base year files’. The joined files will be the 2001 model folder, with the name ‘WG2014’ to indicate they have the WG 2014-based projection data in them.
  - When complete, click the grey button at the bottom, ‘Setup model join and review labels’.

Join POPGROUP models

Data from the POPGROUP input workbooks (column E) will be added to the input workbooks (column C) and saved as the workbooks given in column G

Model input workbooks with EARLIER base year

Model input workbooks with LATER base year

Destination: Input workbooks containing JOINED data

Tick to copy formulae, leave blank to copy values

	Model input workbooks with EARLIER base year	Model input workbooks with LATER base year	Destination: Input workbooks containing JOINED data	Copy schedule sheet	Copy all-groups sheet	Copy each group sheet	Copy notes
Folder:	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001POP_inp	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2014POP_inp	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001POP_inp				
	Input workbook name (earlier base year)	Input workbook name (later base year)	Name of new input workbook				
Fertility	Fert_MYExls	Fert_WG2014.xls	Fert_WG2014.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mortality	Mort_MYExls	Mort_WG2014.xls	Mort_WG2014.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Migration Internal In	Mig_INUK_MYExls	Mig_INUK_WG2014.xls	Mig_INUK_WG2014.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Migration Internal Out	Mig_OUTUK_MYExls	Mig_OUTUK_WG2014.xls	Mig_OUTUK_WG2014.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Migration Overseas In	Mig_INOV_MYExls	Mig_INOV_WG2014.xls	Mig_INOV_WG2014.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Migration Overseas Out	Mig_OUTOV_MYExls	Mig_OUTOV_WG2014.xls	Mig_OUTOV_WG2014.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Constraints	Cons_MYExls	Cons_Principal.xls	Cons_Principal.xls	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Output filename options

Enter new file names

Overwrite earlier base year files

Use same names as later base year files

Clear warnings and errors

Setup model join and review labels

- POPGROUP will open all the files and check that the labels match. It will leave you looking at a list of the areas on your two sets of files, for you to check that it has matched them correctly.



- If so, click on ‘Join the models!’. If not, revise the labels and make amendments, but this should not be necessary if you have used data from the Data Modules as above.
- When the copying is complete, there will probably be a ‘Warning: Existing data overwritten’. This refers to the fact that notes about the estimates have been overwritten by notes about the population projections, which is acceptable.
- Save this file with an amended name as a record of what you have done. For example **JoinPOPGROUPmodelsWG20012014.xls**.

#### A.4 Join the Welsh Government 2014-based variant assumptions to the Mid-Year Estimates

To take advantage of Welsh Government work on variants, join their 2014-based files to the Mid-Year Estimates. Since only one file of each type can be named when joining models, you will have to repeat the steps of the previous section but this time specify the variant projection files for the ‘Model input workbooks with LATER base year’, rather than the main Welsh Government files. One extra run creates joined files for the high fertility, high life expectancy and 10yr average migration files. A final run creates joined files for low fertility and low life expectancy.

You can use the utility file you saved in the previous section to save repeating some of the entries, or it may still be open. The ‘Join POPGROUP models’ utility will look as below before running it.

- Amend the files shown in the red box.
- To automatically have the output file names named from the later base year files (as highlighted in red), you will probably have to click to a different option and then back onto that option.

Join POPGROUP models to create WG variants for high natural change and 10 year average migration. Then click on ‘Setup model join and review labels’, and finally after reviewing labels, ‘Join the Models!’:

**Join POPGROUP models**

Data from the POPGROUP input workbooks (column E) will be added to the input workbooks (column C) and saved as the workbooks given in column G

Tick to copy formulae, leave blank to copy values

		Destination: Input workbooks containing JOINED data			Double click to select/deselect			
		Copy schedule sheet	Copy all-groups sheet	Copy each group sheet	Copy notes			
Folder:	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001_inp	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2014_inp	C:\Forecast\1. POPGROUP V4.0\WalesUAs_2001_inp					
	Model input workbooks with EARLIER base year	Model input workbooks with LATER base year						
	Input workbook name (earlier base year)	Input workbook name (later base year)	Name of new input workbook					
Fertility:	Fert_MYExls	Fert_WG2014_HighFertility.xls	Fert_WG2014_HighFertility.xls		✓	✓	✓	✓
Mortality:	Mort_MYExls	Mort_WG2014_HighLifeExpectancy.xls	Mort_WG2014_HighLifeExpectancy.xls		✓	✓	✓	✓
Migration Internal In:	Mig_INUK_MYExls	Mig_INUK_WG2014_10YrAv.xls	Mig_INUK_WG2014_10YrAv.xls		✓	✓	✓	✓
Migration Internal Out:	Mig_OUTUK_MYExls	Mig_OUTUK_WG2014_10YrAv.xls	Mig_OUTUK_WG2014_10YrAv.xls		✓	✓	✓	✓
Migration Overseas In:	Mig_INOV_MYExls	Mig_INOV_WG2014_10YrAv.xls	Mig_INOV_WG2014_10YrAv.xls		✓	✓	✓	✓
Migration Overseas Out:	Mig_OUTOV_MYExls	Mig_OUTOV_WG2014_10YrAv.xls	Mig_OUTOV_WG2014_10YrAv.xls		✓	✓	✓	✓
Constraints:	Cons_MYExls							

Clear warnings and errors

Output filename options

Enter new file names

Overwrite earlier base year files

Use same names as later base year files

Setup model join and review labels

Join POPGROUP models to create WG variants for low natural change. Then click on ‘Setup model join and review labels’, and finally after reviewing labels, ‘Join the Models!’:



of course may not be the case. If you have better information, include it for the years 2001 to 2010.

- Close the 2014 file.
- Save the 2001 skeleton file, with name ‘SpecPop\_WG2014’.

### A.6 Run the 2014 principal projection in your model with the 2001 Mid-Year Estimates included

You now have a model that starts at the 2001 population, has the births, deaths and migration flows each year from 2014 until 2014, and then has the assumptions for the 2014-based Welsh Government principal population projection.

- Open the scenario file from your 2001 model’s skeleton folder, **POPGROUP\_Scenario.xls**.
- Fill it with the information requested as indicated by red boxes in the screenshot below.
- Double-click on each of the boxes for ‘Input Workbook names’ to find each file
  - Include the **PopBase\_MYE.xls**. This refers to 2001 (you could change its name to Popbase\_2001.xls to be clear about this).
  - Include the other input files that refer to WG2014, all in your 2001 model’s input folder. Use the guide in the screenshot below.

## POPGROUP - Population Estimates and Forecasts

*POPGROUP version 4*

### Training RTPI

RUN THE MODEL

#### Information for this scenario

**Scenario identifier:** WG2014\_Principal

**Contact details (to be included on all output files)**

Organisation/Department Name:

Other information (e.g. contact details)

Final year for this forecast 2039

Default folder for the input workbooks:

Folder for the output workbooks:

**Input workbook names**

Base population	PopBase_MYE
Births & fertility	Fert_WG2014
Deaths & Mortality	Mort_WG2014
In-migration from the UK (optional)	Mg_INUK_WG2014
Out-migration to the UK (optional)	Mg_OUTUK_WG2014
In-migration from Overseas (optional)	Mg_INOV_WG2014
Out-migration to Overseas (optional)	Mg_OUTOV_WG2014
Special Groups (optional)	specpop_WG2014

Save your input files before running the model.

Migration Weights	
Pop'n	Derived units
0%	50%
0%	50%
50%	0%
50%	0%

- Move to the second sheet of the Scenario file, ‘Constraints\_and\_Impacts’. Double-click in the box of ‘Annual constraints’ and navigate to the input folder of your 2001 model, and

select the 'Con\_Principal.xls' file. This is the file that has the exact results of the 2014-based projection from Welsh Government.

**Population Estimates and Forecasts**

**Constraints and impacts on derived forecasts**

*Double click to browse for workbook names*

**Annual Constraints**

**First Derived Forecast**

*Rates*

*Population Adjustment*

*Sub-Population*

*Factors*

*Supply*

- Click back to the Main sheet 'Run details', and click to 'Run the model'.
- The results files will be left open. You may explore them now or close them and explore later.
  - Each table and chart will now include the official historical series from 2001 as well as the official projection after 2014.
  - These extra data are very useful to put the projection into the context of recent change.
  - The past data are also useful to help compute alternative scenarios as discussed in Chapters 6 and 7.
- Your scenario will have been saved automatically as **Scenario\_WG2014\_Principal.xls**. Check that it is in your input folder.

## Appendix B: Households and Housing, census data

This is an appendix to Chapter 5, referred to in Sections 5.8 and 7.1.2.

### Households/Dwellings Ratio 2001 and 2011, interpolated for the intervening years

The data are suitable for entering into the **DFSupplyDwellings.xls** file described in Section 5.8.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
WALES	<b>94.9%</b>	94.8%	94.7%	94.6%	94.6%	94.5%	94.4%	94.4%	94.3%	94.2%	<b>94.1%</b>
Anglesey	<b>91.4%</b>	91.4%	91.4%	91.4%	91.4%	91.4%	91.4%	91.4%	91.4%	91.4%	<b>89.5%</b>
Blaenau Gwent	<b>94.3%</b>	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%	<b>95.2%</b>
Bridgend	<b>96.5%</b>	96.5%	96.5%	96.5%	96.5%	96.5%	96.5%	96.5%	96.5%	96.5%	<b>95.2%</b>
Caerphilly	<b>96.3%</b>	96.3%	96.3%	96.3%	96.3%	96.3%	96.3%	96.3%	96.3%	96.3%	<b>96.5%</b>
Cardiff	<b>97.1%</b>	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	<b>96.3%</b>
Carmarthenshire	<b>94.8%</b>	94.8%	94.8%	94.8%	94.8%	94.8%	94.8%	94.8%	94.8%	94.8%	<b>93.7%</b>
Ceredigion	<b>93.9%</b>	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	<b>91.3%</b>
Conwy	<b>93.5%</b>	93.5%	93.5%	93.5%	93.5%	93.5%	93.5%	93.5%	93.5%	93.5%	<b>91.2%</b>
Denbighshire	<b>95.9%</b>	95.9%	95.9%	95.9%	95.9%	95.9%	95.9%	95.9%	95.9%	95.9%	<b>95.1%</b>
Flintshire	<b>97.1%</b>	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	97.1%	<b>96.9%</b>
Gwynedd	<b>86.8%</b>	86.8%	86.8%	86.8%	86.8%	86.8%	86.8%	86.8%	86.8%	86.8%	<b>86.0%</b>
Merthyr Tydfil	<b>94.2%</b>	94.2%	94.2%	94.2%	94.2%	94.2%	94.2%	94.2%	94.2%	94.2%	<b>92.5%</b>
Monmouthshire	<b>95.8%</b>	95.8%	95.8%	95.8%	95.8%	95.8%	95.8%	95.8%	95.8%	95.8%	<b>95.5%</b>
Neath Port Talbot	<b>95.2%</b>	95.2%	95.2%	95.2%	95.2%	95.2%	95.2%	95.2%	95.2%	95.2%	<b>94.4%</b>
Newport	<b>96.6%</b>	96.6%	96.6%	96.6%	96.6%	96.6%	96.6%	96.6%	96.6%	96.6%	<b>96.4%</b>
Pembrokeshire	<b>88.9%</b>	88.9%	88.9%	88.9%	88.9%	88.9%	88.9%	88.9%	88.9%	88.9%	<b>87.6%</b>
Powys	<b>93.9%</b>	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	93.9%	<b>92.0%</b>
Rhondda, Cynon, Taff	<b>95.3%</b>	95.3%	95.3%	95.3%	95.3%	95.3%	95.3%	95.3%	95.3%	95.3%	<b>94.7%</b>
Swansea	<b>94.9%</b>	94.9%	94.9%	94.9%	94.9%	94.9%	94.9%	94.9%	94.9%	94.9%	<b>95.2%</b>
The Vale of Glamorgan	<b>95.6%</b>	95.6%	95.6%	95.6%	95.6%	95.6%	95.6%	95.6%	95.6%	95.6%	<b>96.2%</b>
Torfaen	<b>97.0%</b>	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	<b>95.8%</b>
Wrexham	<b>96.8%</b>	96.8%	96.8%	96.8%	96.8%	96.8%	96.8%	96.8%	96.8%	96.8%	<b>96.7%</b>

**Further household and housing information from 2001 and 2011 censuses**

The table below gives relevant census information but the 2011 Census did not distinguish between vacant housing and 2<sup>nd</sup>/holiday homes. If this distinction can be made using other information, then a more useful description of the link between households and housing can be made in demographic modelling (see section 7.1.2).

	Households		Dwellings		Sharing		Sharing%		Unoccupied		Unoccupied %		Vacant		2nd/holiday		2nd/holiday %			
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011		
WALES	1,209,049	1,302,676	1,274,500	1,383,814	1,317	1,707	0.1%	0.1%	66,768	82,845	5.3%	6.0%	51,252	n/a	4.0%	n/a	15,516	n/a	1.2%	n/a
Anglesey	28,356	30,594	31,035	34,168	8	15	0.0%	0.0%	2,687	3,589	8.7%	10.5%	1,524	n/a	4.9%	n/a	1,163	n/a	3.7%	n/a
Blaenau Gwent	29,583	30,416	31,385	31,952	-	-	0.0%	0.0%	1,802	1,536	5.7%	4.8%	1,765	n/a	5.6%	n/a	37	n/a	0.1%	n/a
Bridgend	53,342	58,515	55,255	61,445	45	53	0.1%	0.1%	1,958	2,983	3.5%	4.9%	1,816	n/a	3.3%	n/a	142	n/a	0.3%	n/a
Caepphilly	69,342	74,479	72,011	77,217	10	27	0.0%	0.0%	2,679	2,765	3.7%	3.6%	2,600	n/a	3.6%	n/a	79	n/a	0.1%	n/a
Cardiff	123,580	142,557	127,270	148,093	206	506	0.2%	0.4%	3,896	6,042	3.1%	4.1%	3,629	n/a	2.9%	n/a	267	n/a	0.2%	n/a
Cardiganshire	73,112	78,829	77,150	84,115	46	40	0.1%	0.1%	4,084	5,326	5.3%	6.3%	3,574	n/a	4.6%	n/a	510	n/a	0.7%	n/a
Ceredigion	30,972	31,562	32,976	34,569	110	100	0.4%	0.3%	2,114	3,107	6.4%	9.0%	1,150	n/a	3.5%	n/a	964	n/a	2.9%	n/a
Conwy	48,062	51,177	51,387	56,106	109	93	0.2%	0.2%	3,434	5,022	6.7%	9.0%	2,291	n/a	4.5%	n/a	1,143	n/a	2.2%	n/a
Denbighshire	39,889	40,546	41,604	42,648	63	89	0.2%	0.2%	1,778	2,191	4.3%	5.1%	1,431	n/a	3.4%	n/a	347	n/a	0.8%	n/a
Flintshire	60,539	63,781	62,376	65,795	44	43	0.1%	0.1%	1,881	2,067	3.0%	3.1%	1,751	n/a	2.8%	n/a	130	n/a	0.2%	n/a
Gwynedd	49,237	52,473	56,744	61,009	42	66	0.1%	0.1%	7,549	8,602	13.3%	14.1%	3,112	n/a	5.5%	n/a	4,437	n/a	7.8%	n/a
Merthyr Tydfil	23,145	24,264	24,567	26,245	17	9	0.1%	0.0%	1,439	1,990	5.9%	7.6%	1,391	n/a	5.7%	n/a	48	n/a	0.2%	n/a
Monmouthshire	35,194	38,233	36,737	40,044	59	34	0.2%	0.1%	1,602	1,845	4.4%	4.6%	1,322	n/a	3.6%	n/a	280	n/a	0.8%	n/a
Neath Port Talbot	57,609	60,393	60,504	63,978	102	39	0.2%	0.1%	2,987	3,624	5.0%	5.7%	2,889	n/a	4.8%	n/a	108	n/a	0.2%	n/a
Newport	56,535	61,172	58,543	63,445	78	160	0.1%	0.3%	2,086	2,433	3.6%	3.8%	1,996	n/a	3.4%	n/a	90	n/a	0.2%	n/a
Pembrokeshire	48,176	53,122	54,209	60,668	77	44	0.2%	0.1%	6,110	7,590	11.3%	12.5%	2,788	n/a	5.1%	n/a	3,322	n/a	6.1%	n/a
Powys	53,865	58,345	57,387	63,446	12	36	0.0%	0.1%	3,534	5,137	6.2%	8.1%	2,278	n/a	4.0%	n/a	1,256	n/a	2.2%	n/a
Rhondda, Cynon, Taff	94,553	99,663	99,190	105,269	122	41	0.1%	0.0%	4,759	5,647	4.8%	5.4%	4,599	n/a	4.6%	n/a	160	n/a	0.2%	n/a
Swansea	94,400	103,497	99,454	108,729	96	248	0.1%	0.2%	5,150	5,480	5.2%	5.0%	4,452	n/a	4.5%	n/a	698	n/a	0.7%	n/a
The Vale of Glamorgan	48,755	53,505	50,979	55,644	32	20	0.1%	0.0%	2,256	2,159	4.4%	3.9%	2,077	n/a	4.1%	n/a	179	n/a	0.4%	n/a
Tonfaen	37,577	38,524	38,726	40,224	5	5	0.0%	0.0%	1,154	1,705	3.0%	4.2%	1,117	n/a	2.9%	n/a	37	n/a	0.1%	n/a
Wrexham	53,226	57,029	55,011	59,005	34	39	0.1%	0.1%	1,819	2,015	3.3%	3.4%	1,700	n/a	3.1%	n/a	119	n/a	0.2%	n/a

## Appendix C: Labour Force and jobs, census data

These data are suitable for entering into the **DFSsupplyJobs.xls** file described in Section 5.8.

### Unemployment (unemployed / economically active) 2001 and 2011, interpolated for the intervening years

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Wales</b>	<b>5.7%</b>	5.8%	5.9%	6.0%	6.1%	6.1%	6.2%	6.3%	6.4%	6.5%	<b>6.5%</b>
Anglesey	<b>7.9%</b>	7.8%	7.8%	7.7%	7.6%	7.6%	7.5%	7.4%	7.3%	7.3%	<b>7.2%</b>
Blaenau Gwent	<b>8.4%</b>	8.7%	8.9%	9.2%	9.5%	9.7%	10.0%	10.3%	10.5%	10.8%	<b>11.1%</b>
Bridgend	<b>5.7%</b>	5.8%	6.0%	6.1%	6.2%	6.4%	6.5%	6.6%	6.8%	6.9%	<b>7.1%</b>
Caerphilly	<b>6.0%</b>	6.2%	6.4%	6.6%	6.8%	7.0%	7.2%	7.4%	7.5%	7.7%	<b>7.9%</b>
Cardiff	<b>4.9%</b>	5.1%	5.3%	5.4%	5.6%	5.8%	5.9%	6.1%	6.3%	6.4%	<b>6.6%</b>
Carmarthenshire	<b>5.7%</b>	5.7%	5.7%	5.7%	5.7%	5.8%	5.8%	5.8%	5.8%	5.8%	<b>5.8%</b>
Ceredigion	<b>5.0%</b>	5.0%	4.9%	4.8%	4.7%	4.6%	4.5%	4.4%	4.4%	4.3%	<b>4.2%</b>
Conwy	<b>6.1%</b>	6.1%	6.1%	6.1%	6.1%	6.2%	6.2%	6.2%	6.2%	6.2%	<b>6.3%</b>
Denbighshire	<b>5.5%</b>	5.6%	5.7%	5.8%	5.9%	6.0%	6.1%	6.1%	6.2%	6.3%	<b>6.4%</b>
Flintshire	<b>4.4%</b>	4.6%	4.7%	4.8%	4.9%	5.0%	5.1%	5.2%	5.3%	5.4%	<b>5.5%</b>
Gwynedd	<b>6.8%</b>	6.7%	6.6%	6.4%	6.3%	6.2%	6.0%	5.9%	5.7%	5.6%	<b>5.5%</b>
Merthyr Tydfil	<b>7.4%</b>	7.6%	7.7%	7.9%	8.0%	8.2%	8.3%	8.5%	8.6%	8.8%	<b>8.9%</b>
Monmouthshire	<b>4.0%</b>	4.1%	4.2%	4.3%	4.4%	4.4%	4.5%	4.6%	4.7%	4.8%	<b>4.9%</b>
Neath Port Talbot	<b>7.0%</b>	7.0%	7.0%	7.0%	7.1%	7.1%	7.1%	7.1%	7.2%	7.2%	<b>7.2%</b>
Newport	<b>6.2%</b>	6.4%	6.6%	6.7%	6.9%	7.1%	7.2%	7.4%	7.6%	7.7%	<b>7.9%</b>
Pembrokeshire	<b>6.5%</b>	6.5%	6.4%	6.4%	6.3%	6.3%	6.3%	6.2%	6.2%	6.2%	<b>6.1%</b>
Powys	<b>4.0%</b>	4.1%	4.1%	4.1%	4.2%	4.2%	4.2%	4.3%	4.3%	4.3%	<b>4.4%</b>
Rhondda, Cynon, Taff	<b>6.2%</b>	6.4%	6.5%	6.6%	6.7%	6.9%	7.0%	7.1%	7.2%	7.3%	<b>7.5%</b>
Swansea	<b>6.2%</b>	6.2%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	<b>6.1%</b>
The Vale of Glamorgan	<b>5.0%</b>	5.1%	5.3%	5.4%	5.5%	5.6%	5.8%	5.9%	6.0%	6.1%	<b>6.2%</b>
Torfaen	<b>5.6%</b>	5.8%	5.9%	6.1%	6.3%	6.4%	6.6%	6.7%	6.9%	7.1%	<b>7.2%</b>
Wrexham	<b>5.1%</b>	5.2%	5.3%	5.4%	5.5%	5.5%	5.6%	5.7%	5.8%	5.9%	<b>6.0%</b>

These data are suitable for entering into the **DFSupplyJobs.xls** file described in Section 5.8.

**Commuting ratio (resident and employed / working in area) 2001 and 2011, interpolated for the intervening years**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Wales</b>	<b>1.035</b>	1.035	1.036	1.036	1.037	1.038	1.038	1.039	1.039	1.040	<b>1.040</b>
Anglesey	<b>1.209</b>	1.214	1.218	1.223	1.228	1.232	1.237	1.242	1.246	1.251	<b>1.256</b>
Blaenau Gwent	<b>1.205</b>	1.214	1.223	1.233	1.242	1.251	1.261	1.270	1.279	1.289	<b>1.298</b>
Bridgend	<b>1.049</b>	1.046	1.043	1.041	1.038	1.035	1.032	1.030	1.027	1.024	<b>1.021</b>
Caerphilly	<b>1.340</b>	1.339	1.338	1.338	1.337	1.336	1.336	1.335	1.335	1.334	<b>1.333</b>
Cardiff	<b>0.788</b>	0.791	0.794	0.797	0.800	0.803	0.806	0.808	0.811	0.814	<b>0.817</b>
Carmarthenshire	<b>1.094</b>	1.095	1.096	1.096	1.097	1.097	1.098	1.098	1.099	1.099	<b>1.100</b>
Ceredigion	<b>1.033</b>	1.034	1.034	1.034	1.034	1.035	1.035	1.035	1.035	1.036	<b>1.036</b>
Conwy	<b>1.139</b>	1.136	1.134	1.132	1.130	1.127	1.125	1.123	1.120	1.118	<b>1.116</b>
Denbighshire	<b>1.028</b>	1.026	1.024	1.021	1.019	1.017	1.014	1.012	1.009	1.007	<b>1.005</b>
Flintshire	<b>1.062</b>	1.059	1.057	1.054	1.051	1.049	1.046	1.044	1.041	1.039	<b>1.036</b>
Gwynedd	<b>0.957</b>	0.956	0.956	0.955	0.955	0.954	0.953	0.953	0.952	0.952	<b>0.951</b>
Merthyr Tydfil	<b>1.071</b>	1.066	1.061	1.056	1.051	1.046	1.040	1.035	1.030	1.025	<b>1.020</b>
Monmouthshire	<b>1.107</b>	1.109	1.112	1.114	1.116	1.119	1.121	1.124	1.126	1.129	<b>1.131</b>
Neath Port Talbot	<b>1.152</b>	1.153	1.153	1.154	1.154	1.154	1.155	1.155	1.156	1.156	<b>1.156</b>
Newport	<b>0.813</b>	0.821	0.829	0.837	0.844	0.852	0.860	0.868	0.876	0.884	<b>0.891</b>
Pembrokeshire	<b>1.061</b>	1.058	1.055	1.052	1.049	1.046	1.043	1.040	1.037	1.033	<b>1.030</b>
Powys	<b>1.069</b>	1.069	1.068	1.067	1.067	1.066	1.065	1.065	1.064	1.063	<b>1.063</b>
Rhondda, Cynon, Taff	<b>1.216</b>	1.217	1.218	1.219	1.220	1.221	1.222	1.223	1.224	1.225	<b>1.226</b>
Swansea	<b>0.947</b>	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	<b>0.947</b>
The Vale of Glamorgan	<b>1.271</b>	1.274	1.277	1.281	1.284	1.287	1.291	1.294	1.297	1.301	<b>1.304</b>
Torfaen	<b>1.091</b>	1.087	1.082	1.078	1.073	1.069	1.064	1.060	1.055	1.051	<b>1.046</b>
Wrexham	<b>1.034</b>	1.036	1.038	1.041	1.043	1.045	1.048	1.050	1.052	1.054	<b>1.057</b>



### Further labour force and jobs information from 2001 and 2011 censuses

The table below gives the census information from which the two tables above were calculated. If other information that is more relevant, accurate or up to date is available, it should be considered to describe the link between labour force and jobs in demographic modelling (see section 7.1.2).

Aged 16-74	geography code	2001				2011			
		Economically active	Unemployed	Resident employed	Works in area	Economically active	Unemployed	Resident employed	Works in area
<b>Wales</b>		1,265,497	72,488	1,193,009	1,152,932	1,476,735	96,689	1,380,046	1,326,364
<b>Anglesey</b>	W06000001	28,544	2,253	26,291	21,745	33,023	2,381	30,642	24,405
<b>Blaenau Gwent</b>	W06000019	27,564	2,315	25,249	20,962	32,145	3,557	28,588	22,021
<b>Bridgend</b>	W06000013	56,330	3,198	53,132	50,666	66,449	4,687	61,762	60,466
<b>Caerphilly</b>	W06000018	71,974	4,346	67,628	50,487	84,932	6,731	78,201	58,647
<b>Cardiff</b>	W06000015	138,247	6,816	131,431	166,757	174,753	11,566	163,187	199,702
<b>Carmarthenshire</b>	W06000010	72,000	4,137	67,863	62,009	86,217	4,962	81,255	73,870
<b>Ceredigion</b>	W06000008	31,553	1,593	29,960	28,995	35,064	1,469	33,595	32,426
<b>Conwy</b>	W06000003	46,780	2,832	43,948	38,593	53,792	3,362	50,430	45,201
<b>Denbighshire</b>	W06000004	40,678	2,232	38,446	37,381	44,409	2,857	41,552	41,357
<b>Flintshire</b>	W06000005	72,946	3,246	69,700	65,656	78,957	4,332	74,625	72,020
<b>Gwynedd</b>	W06000002	50,657	3,459	47,198	49,334	57,995	3,176	54,819	57,626
<b>Merthyr Tydfil</b>	W06000024	21,619	1,608	20,011	18,680	27,833	2,481	25,352	24,856
<b>Monmouthshire</b>	W06000021	40,016	1,597	38,419	34,718	45,272	2,217	43,055	38,064
<b>Neath Port Talbot</b>	W06000012	54,087	3,772	50,315	43,665	64,110	4,630	59,480	51,434
<b>Newport</b>	W06000022	60,474	3,777	56,697	69,737	71,011	5,616	65,395	73,360
<b>Pembrokeshire</b>	W06000009	48,254	3,135	45,119	42,541	58,120	3,555	54,565	52,951
<b>Powys</b>	W06000023	59,449	2,390	57,059	53,366	66,846	2,928	63,918	60,142
<b>Rhondda, Cynon, Taff</b>	W06000016	94,876	5,927	88,949	73,167	108,730	8,104	100,626	82,073
<b>Swansea</b>	W06000011	94,597	5,821	88,776	93,788	111,460	6,831	104,629	110,469
<b>The Vale of Glamorgan</b>	W06000014	55,126	2,768	52,358	41,207	63,384	3,956	59,428	45,574
<b>Torfaen</b>	W06000020	39,248	2,205	37,043	33,941	43,820	3,163	40,657	38,863
<b>Wrexham</b>	W06000006	60,478	3,061	57,417	55,537	68,413	4,128	64,285	60,837

Sources: 2001 Census: Workplace theme table, Key statistics employment status. 2011 Census: WP604EW, Key statistics employment status.