The Actuarial Profession
making financial sense of the future

CMI Critical Illness Investigation

2008 Healthcare Conference
Dublin, 16 May 2008

David Heeney, Chairman, CMI Critical Illness Committee

and

Dave Grimshaw, Secretary, CMI Critical Illness Committee

Agenda

- **CI Investigation Objectives and Progress**
- **Key Challenges**
- **Recent Progress**
- **Next Steps**

Where are we going?

Age x	Duration 0	Duration 1	Duration 2	Duration 3	Dur
17	0.000193	0.000251	0.000294	0.000337	0.0
18	0.000194	0.000251	0.000295	0.000338	0.0
19	0.000195	0.000253	0.000297	0.000340	0.0
20	0.000196	0.000254	0.000298	0.000342	0.0
21	0.000197	0.000256	0.000300	0.000344	0.0
22	0.000199	0.000258	0.000302	0.000347	0.0
23	0.000200	0.000260	0.000305	0.000350	0.0
24	0.000202	0.000263	0.000308	0.000353	0.0
25	0.000204	0.000265	0.000311	0.000357	0.0
26	0.000207	0.000269	0.000316	0.000362	0.0
27	0.000211	0.000274	0.000321	0.000368	0.0
28	0.000214	0.000278	0.000326	0.000374	0.0
29	0.000220	0.000285	0.000334	0.000383	0.0
30	0.000227	0.000294	0.000344	0.000394	0.0
31	0.000237	0.000306	0.000357	0.000409	0.0
32	0.000250	0.000320	0.000373	0.000426	0.0
33	0.000264	0.000337	0.000391	0.000446	0.0
34	0.000280	0.000355	0.000412	0.000469	0.0
35	0.000297	0.000376	0.000435	0.000494	0.0
36	0.000315	0.000398	0.000459	0.000521	0.0

How do we get there?

Age x	Duration 0	Duration 1	Duration 2	Duration 3	Dur
17	0.000193	0.000251	0.000294	0.000337	0.0
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Raw experience

Grossing-Up Factors

Progress to date (1)

- **Results for 1999, 2000, 2001, 2002 & quad released in May 2005**
- **Working Paper 14:**
  - **Detailed methodology underlying 1999-2002 results**
  - **Estimate of overall grossing-up factor**
- **Working Paper 18:**
  - **Responses to feedback on WP14**
  - **Reasons for not graduating (yet)**
- **1999-2002 data available to CMI members**
- **Working Paper 19: "Per-Policy" data submission**

Progress to date (2)

- 2003 Results released in April 2006:
  - Covered “quad offices”
  - data from several “new” offices not included
- Health Claims Forum guidelines published in November 2006
- Error in 2003 data from one office
  - highlighted in 2004 submission
  - Error corrected and new offices added
  - “2003 revised” results released in April 2007
- 2004 results released in April 2007:
  - Same offices as in “2003 revised”
- Working Paper 28 published in July 2007

Agenda

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- Key Challenges
- Recent Progress
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Key Challenges

- **claim date definitions**
- **claim development**
- **business growth**

The key challenge facing the CI investigation is that we collect settled claims, but want to measure experience in terms of diagnosed claims

Health Claims Forum consultation

Definition:

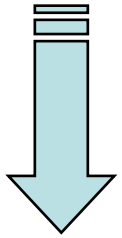
The date of diagnosis is **the date at which the critical illness definition was fulfilled**

Key Points:

- **Interpretation specified for April 2006 ABI definitions**
- **Companies asked to adapt these for older and non-ABI definitions -**
  - **Where there is a clear event date – use that (e.g. Heart Attack)**
  - **Where it is a degenerative disease then allow for permanence to be established**
- **Adoption date: 1st January 2007**

Health Claims Forum Consultation – the future

- **Adoption of HCF guidelines will:**
  - **improve consistency between offices**
  - **improve consistency over time with offices**
  - **increase recording of 'Date of Diagnosis'**



Lower risk of error due to estimating diagnosis dates from settled claims

Claims typically take 6 months to settle

- Approx. observed intervals between claim dates:
  - Date of Diagnosis

114 days

  - Date of Notification

55 days

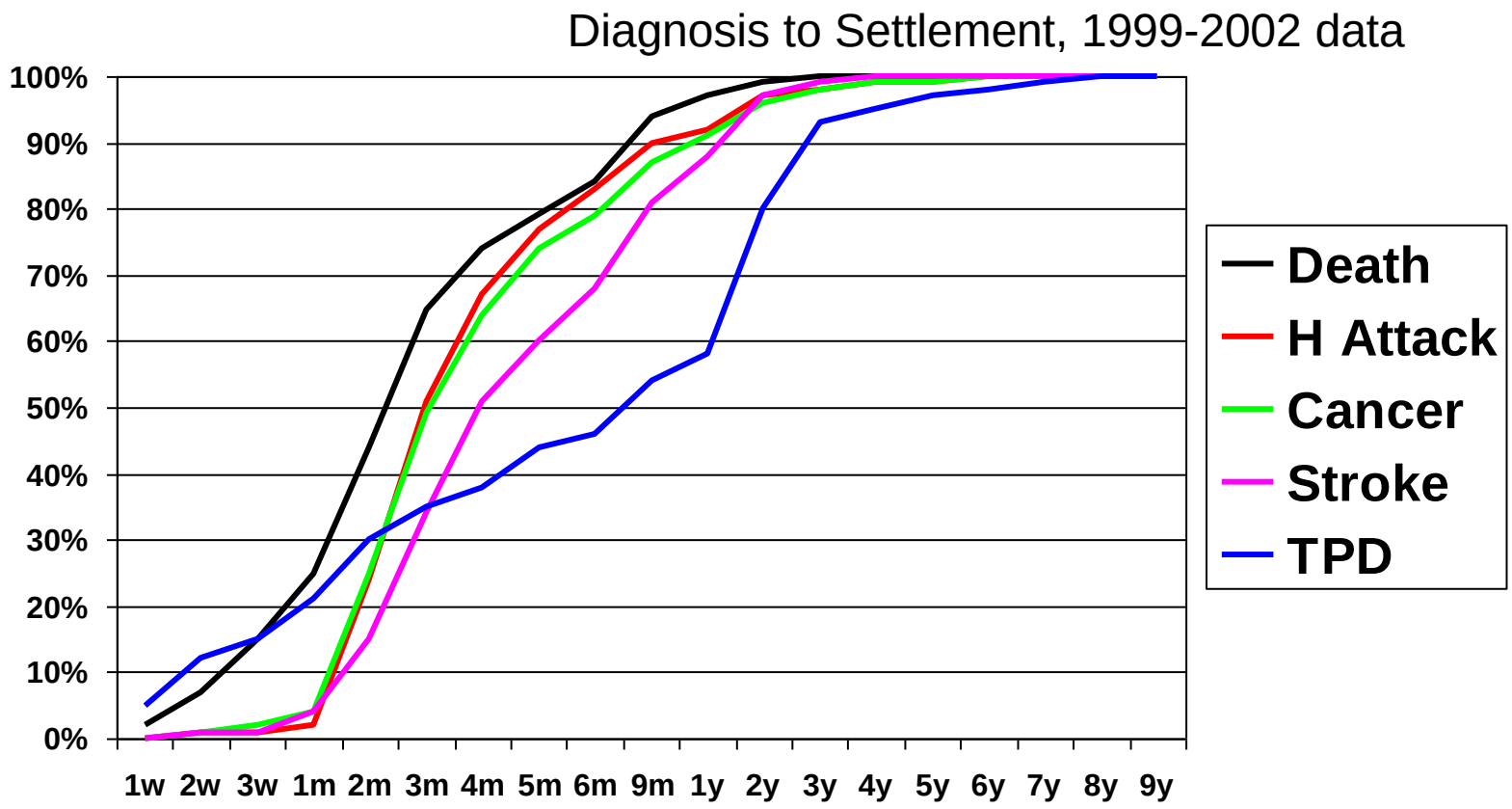
  - Date of Admittance

7 days

  - Date of Settlement

1999-2002 data

But development patterns vary by cause

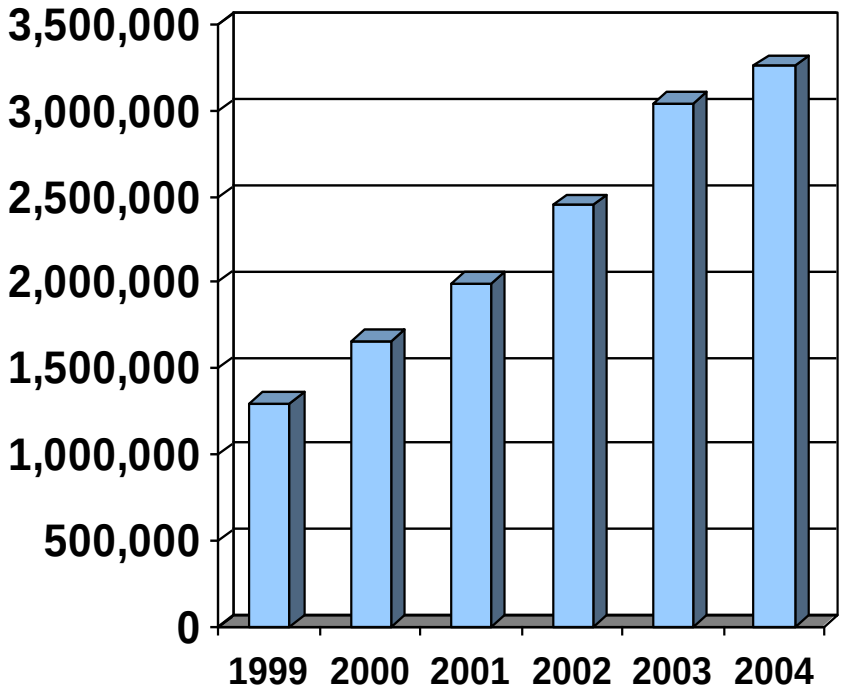


And often we only have settlement date

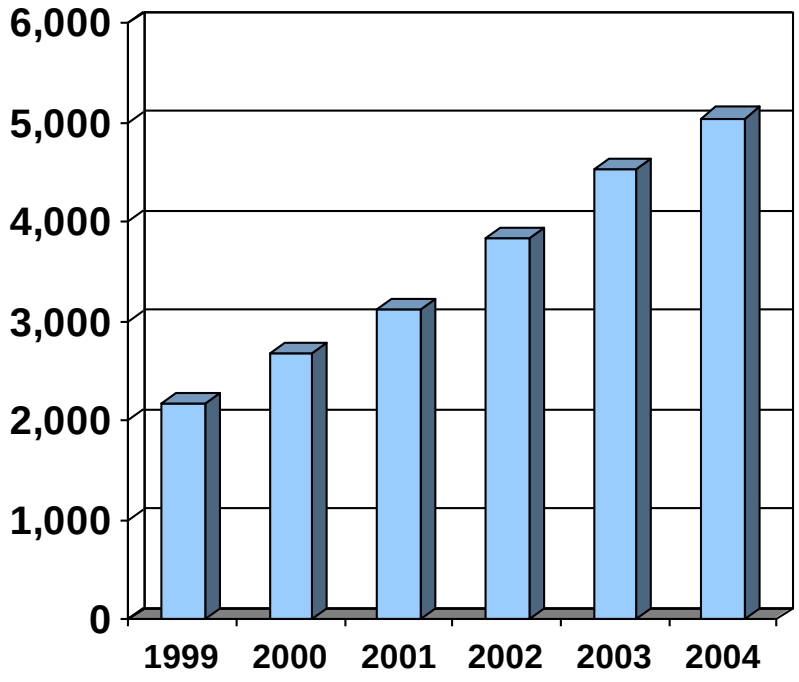
- Date of diagnosis is estimated where not known
- The date of diagnosis is used to correctly calculate the age and duration but not to re-allocate claims in or out of the analysis
- This would not be a major issue with a stable portfolio
- BUT VOLUMES HAVE INCREASED RAPIDLY
- The effect of this is that 1999-2002 results are under-stated by a factor of the order of 15%
- This factor will vary between offices according to the growth rate in their claims portfolio

Growing Exposure 1999-2004

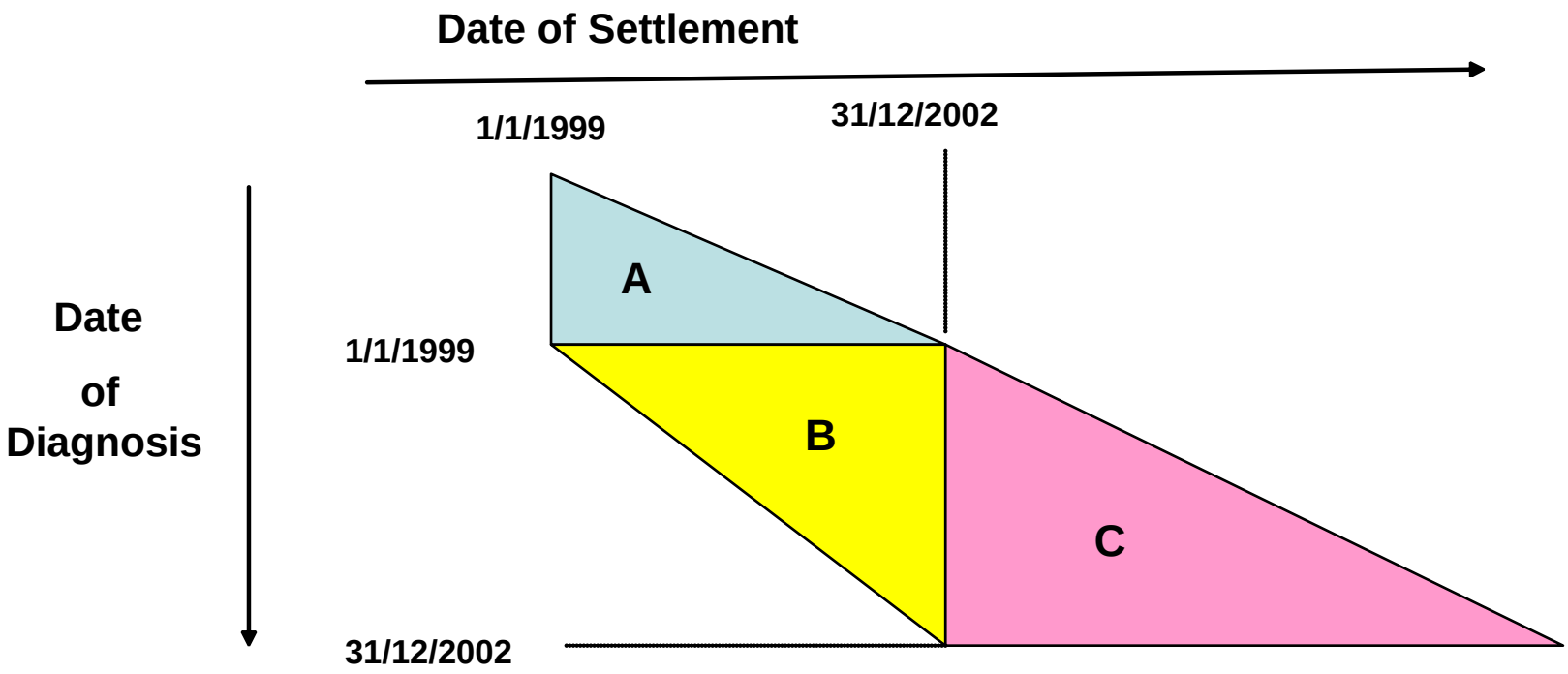
Exposure



Settled Claims



Date of Diagnosis v Date of Settlement



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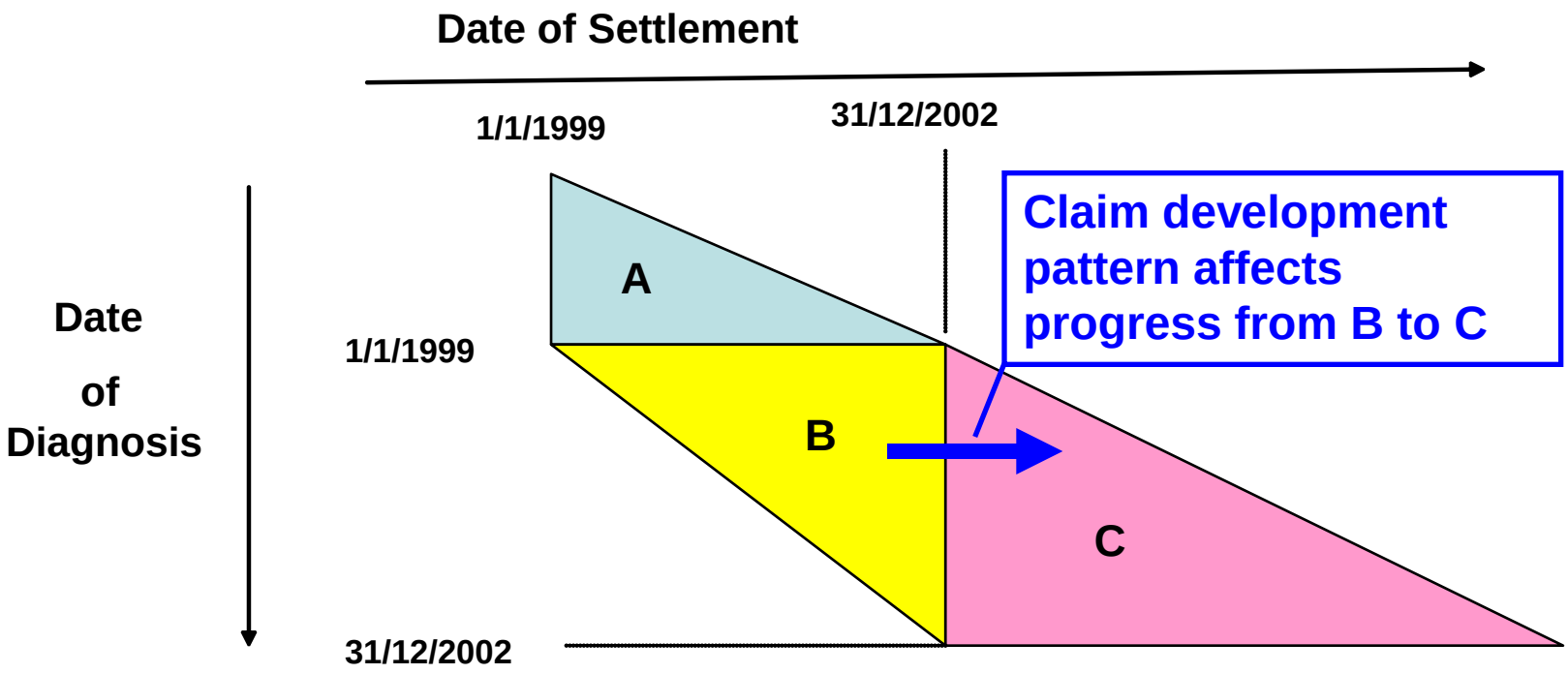
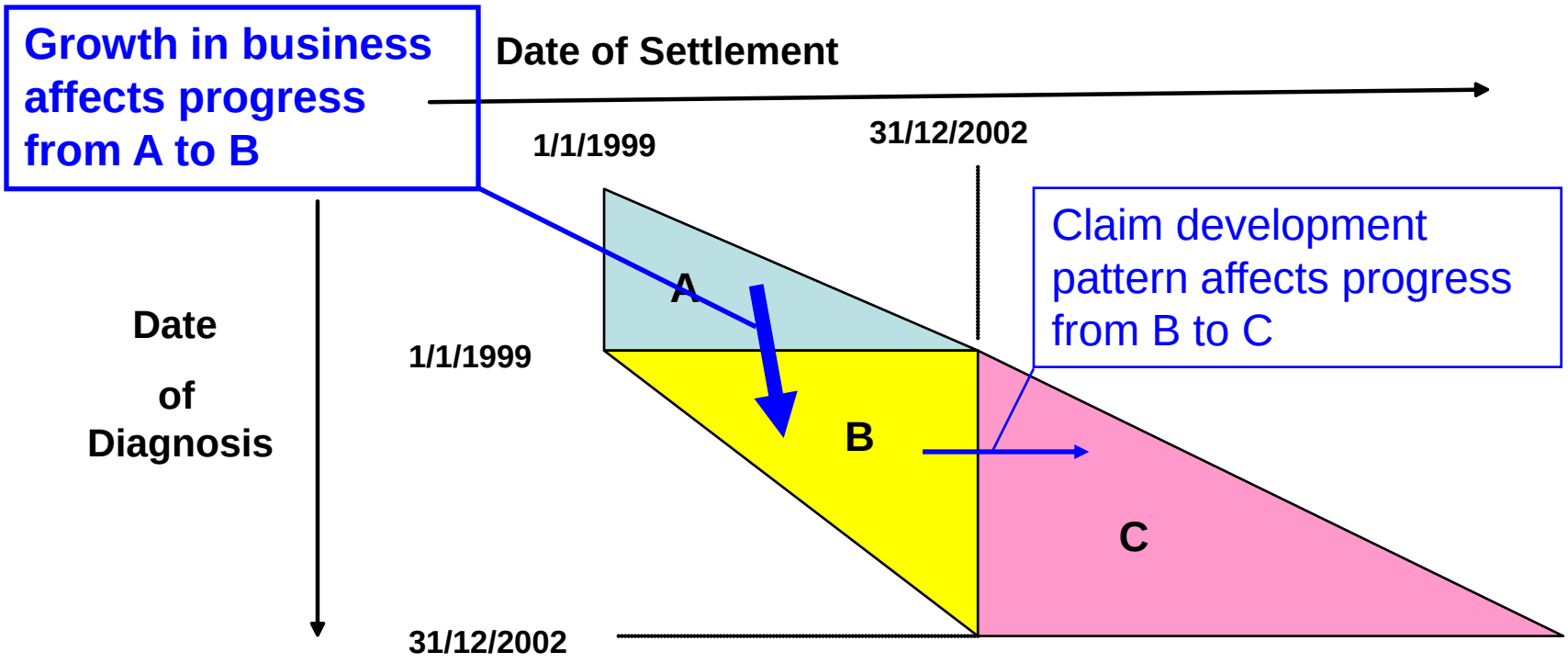
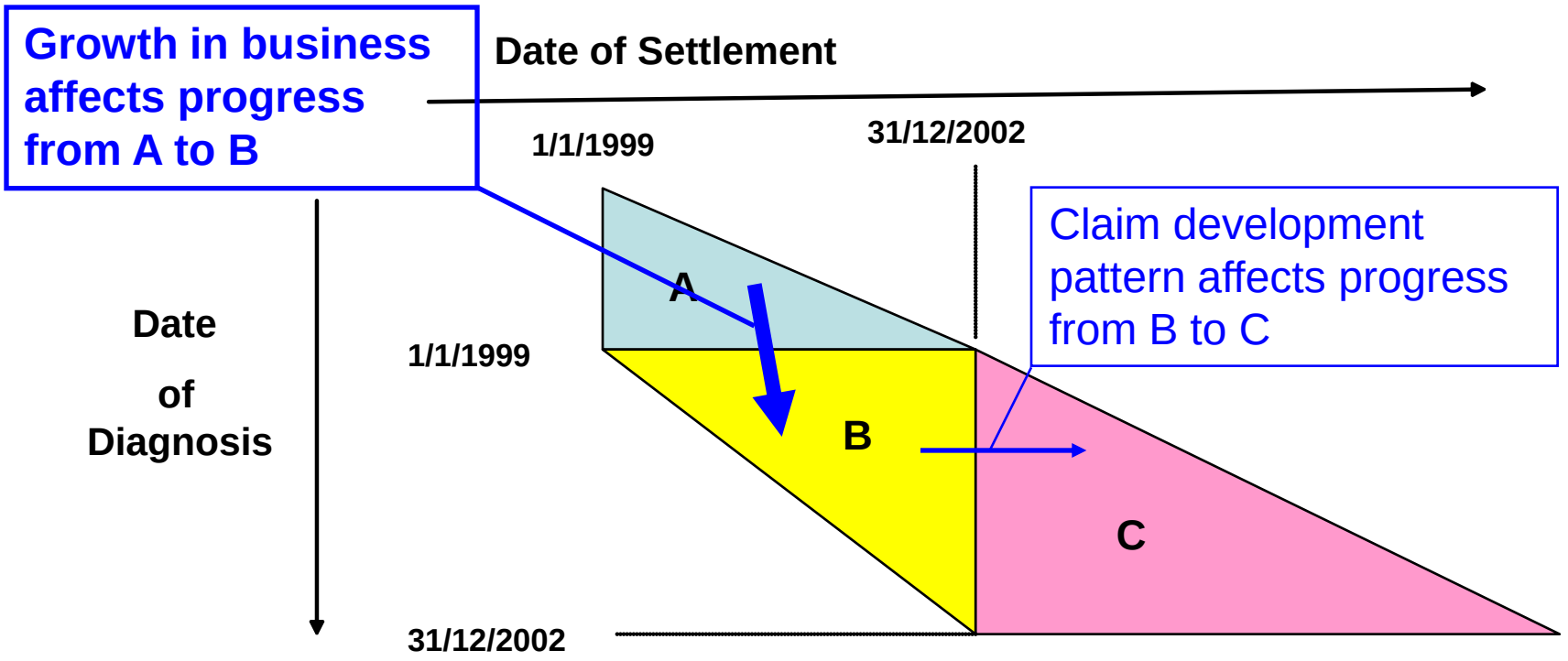


Date of Diagnosis v Date of Settlement



Date of Diagnosis v Date of Settlement



(A + B) x (1 + grossing-up factor) = (B + C)

Impact of growth in exposure on Grossing-Up Factors

- **Guidelines provided in Working Paper 14:**

Annual rate of growth in expected claims	Approximate grossing-up factor
Nil	100%
10%	107%
20%	112%
30%	117%
50%	124%
75%	132%
100%	139%

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New Methodology

The key challenge facing the CI investigation is that we collect settled claims, but want to measure experience in terms of diagnosed claims

- **Grossing-up factors attempted to allow for this, but …**
  - **Difficult to interpret, as mix growth in business and claim development,**
  - **Difficult to apply to subsets of the data, and**
  - **The new approach makes better use of the data we have**

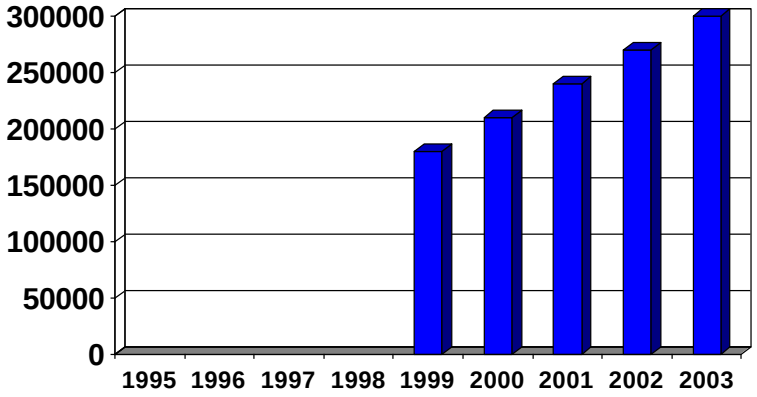
New Methodology

- The approach starts with estimating prior years' in force data and hence exposure
- … from which we estimate diagnosed claims in each year (at each age and duration) using an initial set of claim rates
- … we then apply a claim development distribution to estimate settled claims in each year
- … these can be compared to known settled claims to release more accurate results
- … and equating estimated settled claims with known settled claims will generate a set of diagnosed claim rates

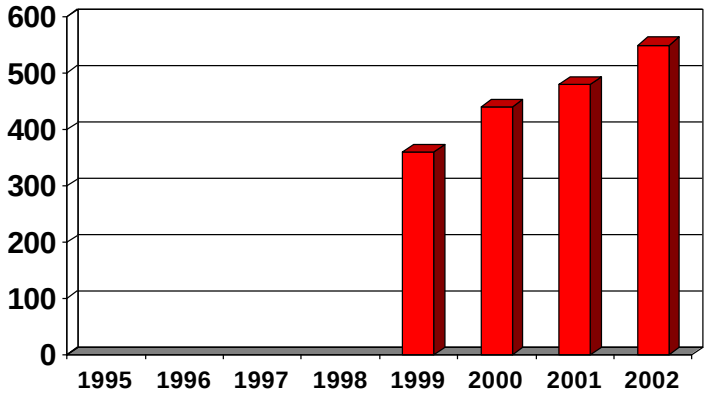
New Methodology

- **The approach starts with:**
  - **the known in force data (1/1/1999 to 1/1/2003) and**
  - **the known settled claims (1999 to 2002)**

In Force at 1 Jan

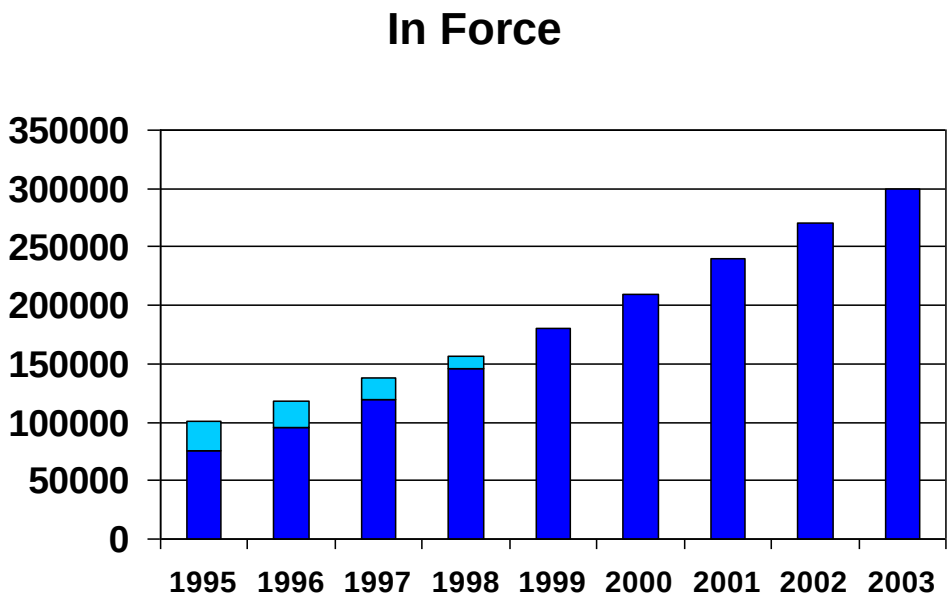


Settled Claims



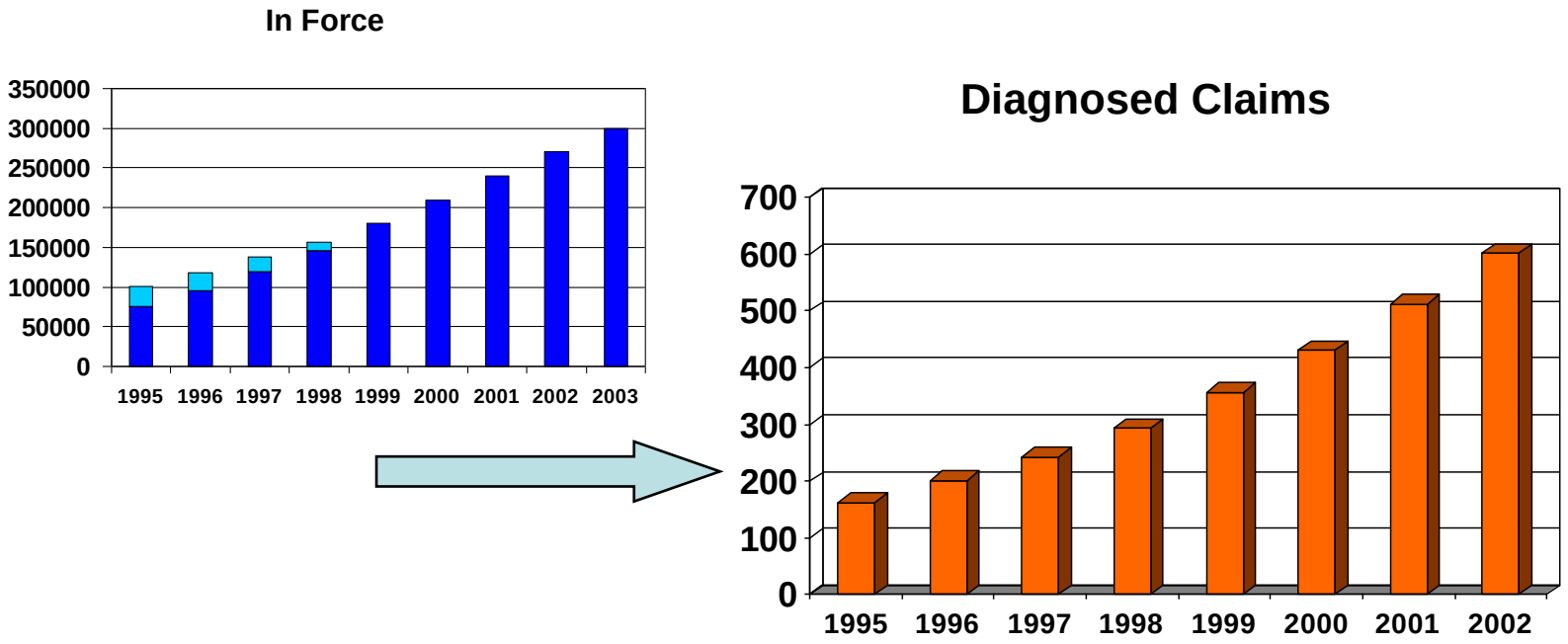
New Methodology

- From the known in force, we estimate prior years' in force data:
  - Part of this is a roll-back of known data *(including adjusted age and duration)*
  - And part is an estimate of the business that went off before data submitted to CMI
- Hence exposure in each year



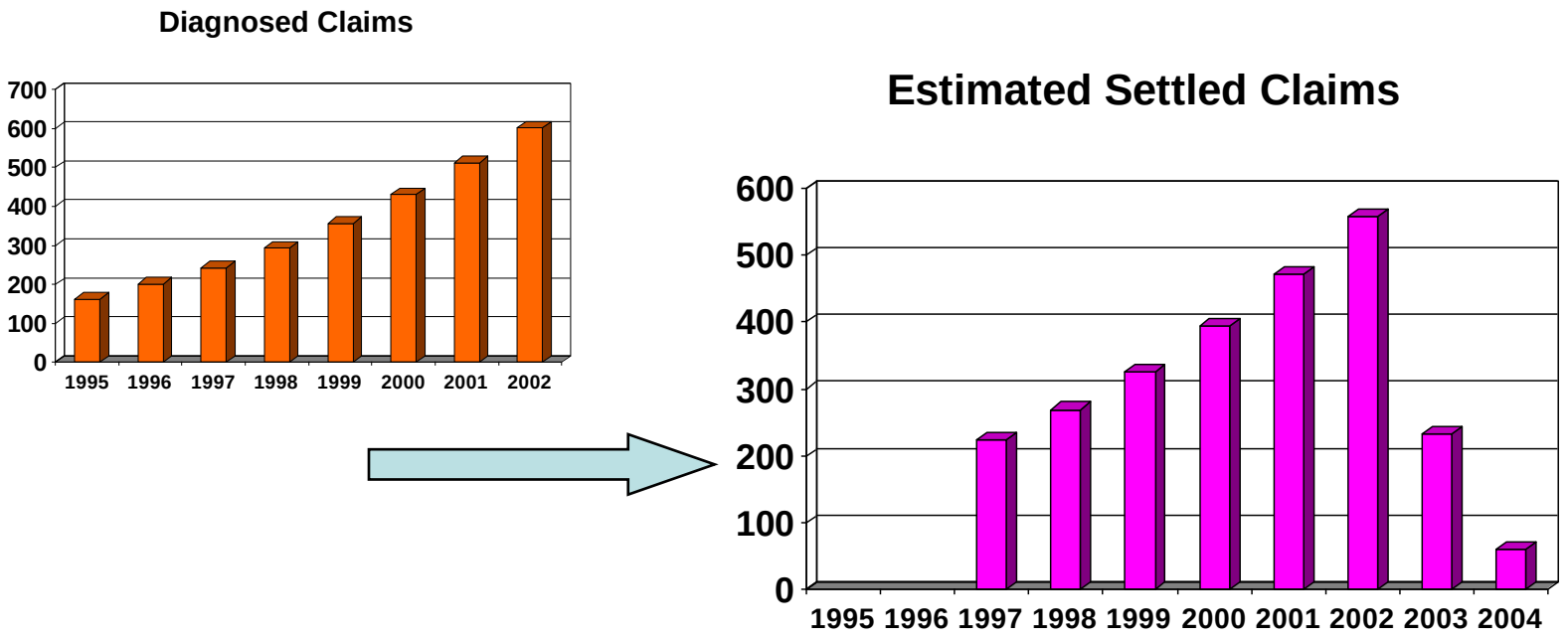
New Methodology

- **From the estimated exposure in each year we estimate diagnosed claims in each year (at each age and duration) using an initial set of claim rates**



New Methodology

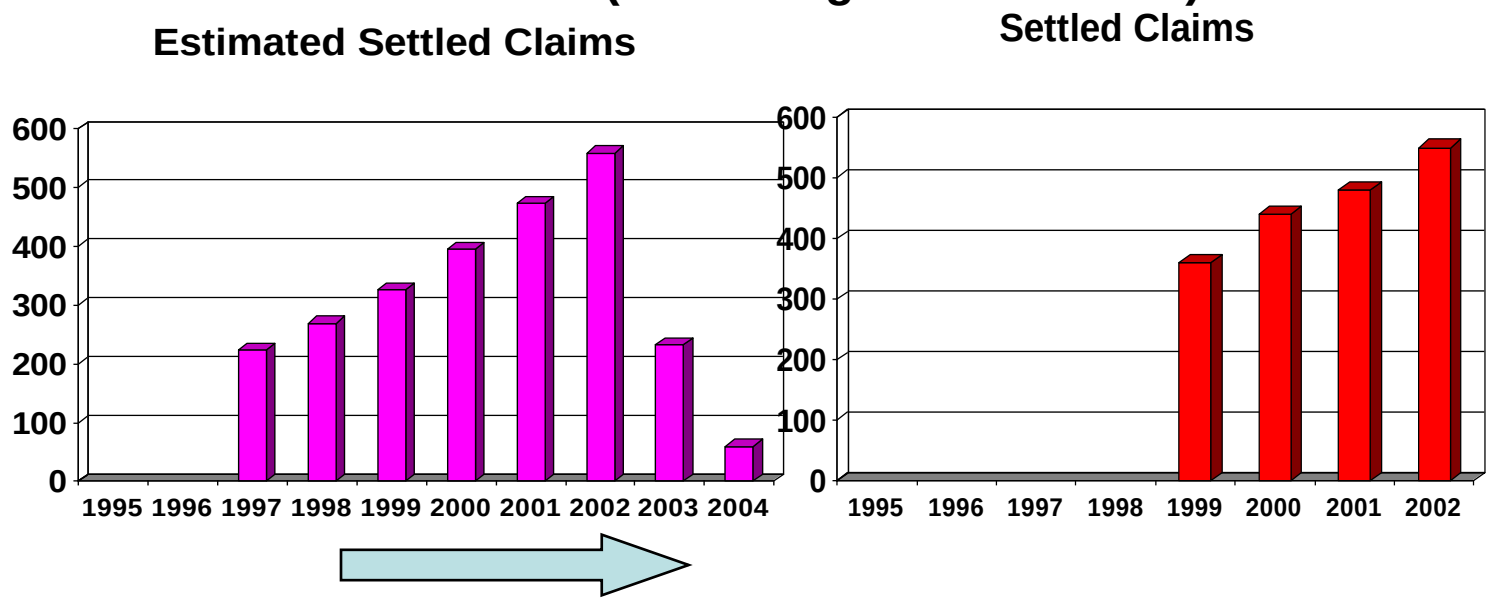
- **From the estimated diagnosed claims in each year we can estimate settled claims in each year (at each age and duration) using an assumed claim development distribution**



NB Max interval from diagnosis to settlement
= 2 years in this illustration

New Methodology

- We then compare estimated settled claims in 1999-2002 with known settled claims in 1999-2002 (at each age and duration)



- This can be used to present the results (for a given base table and claim development distribution)
- Or we can amend our assumption regarding claim rates to get the best fit and a set of diagnosed claim rates

New Methodology

Working Paper 28:

- **Explanation of new methodology**
- **Example of an initial application**
  - **Focus on the roll-back of in force**
  - **Results only - didn't go as far as claim rates**
- **Demonstration that results are not overly sensitive to the assumptions (especially off rates)**

New Methodology

Subsequently:

- Limited feedback on Working Paper 28
- "System" developed to allow a more accurate implementation
  - WP28 used simplistic spreadsheet application
  - More accurate calculation of exposure, using actual dates of commencement, affects duration 0 results (in particular)
- Claim development distribution
  - WP28 used a single distribution (from WP14)
  - GLM analysis suggests cause of claim and office are significant but need to assess for other factors
  - Parametric model

New Method: Claim development distribution

- **Features of a parametric model:**
  - **Smooth fit**
  - **Probability of settlement for every delay**
  - **Entire distribution can be easily summarised**
  - **Provides mean, variance, etc**
  - **Goodness of fit can be tested**
  - **Fit can be obtained from limited data**
  - **Predictive power (?)**

New Method: Claim development distribution

- **Parametric modelling focused on distribution between diagnosis and settlement**
- **Calculation complicated by:**
  - **Left censoring because diagnosed in prior year and "exposed to settlement" before investigation period**
  - **Right censoring because diagnosed in investigation period and "exposed to settlement" in subsequent years**
  - **Investigation period varies between offices**
  - **Increasing % of dates of diagnosis recorded over time**

New Method: Claim development distribution

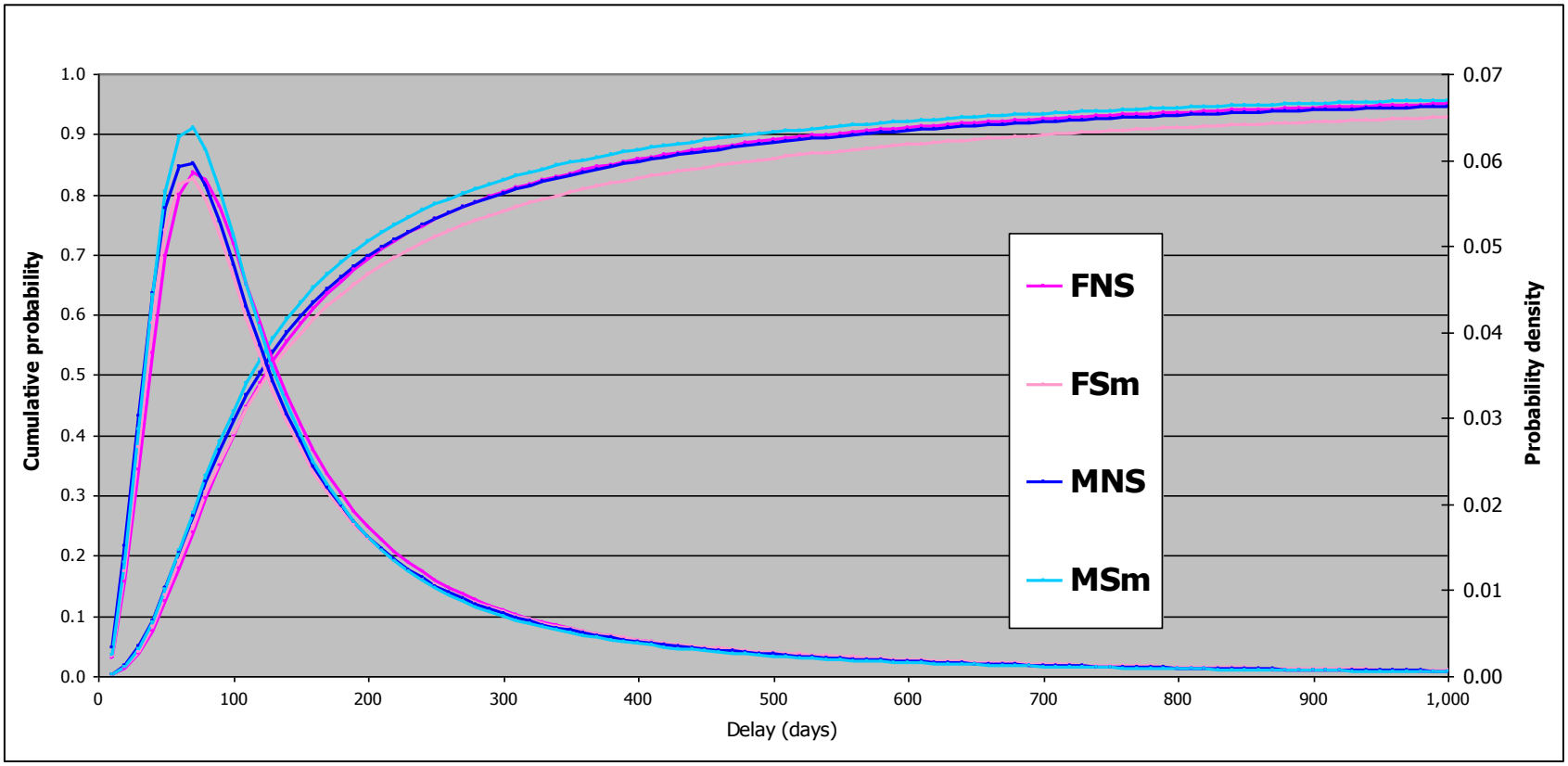
- **Initial findings from parametric modelling:**
  - **Burr distribution provides reasonable fit**
  - **Probability density function:**

$$f(x) = \frac{\alpha\gamma\lambda^{\alpha}x^{\gamma-1}}{(\lambda + x^{\gamma})^{\alpha+1}}$$

  - **3 parameters give reasonable flexibility over:**
    - **Peak rate of settlement (α)**
    - **When peak rate occurs (λ), and**
    - **Thickness of tail (γ)**

New Method: Claim development distribution

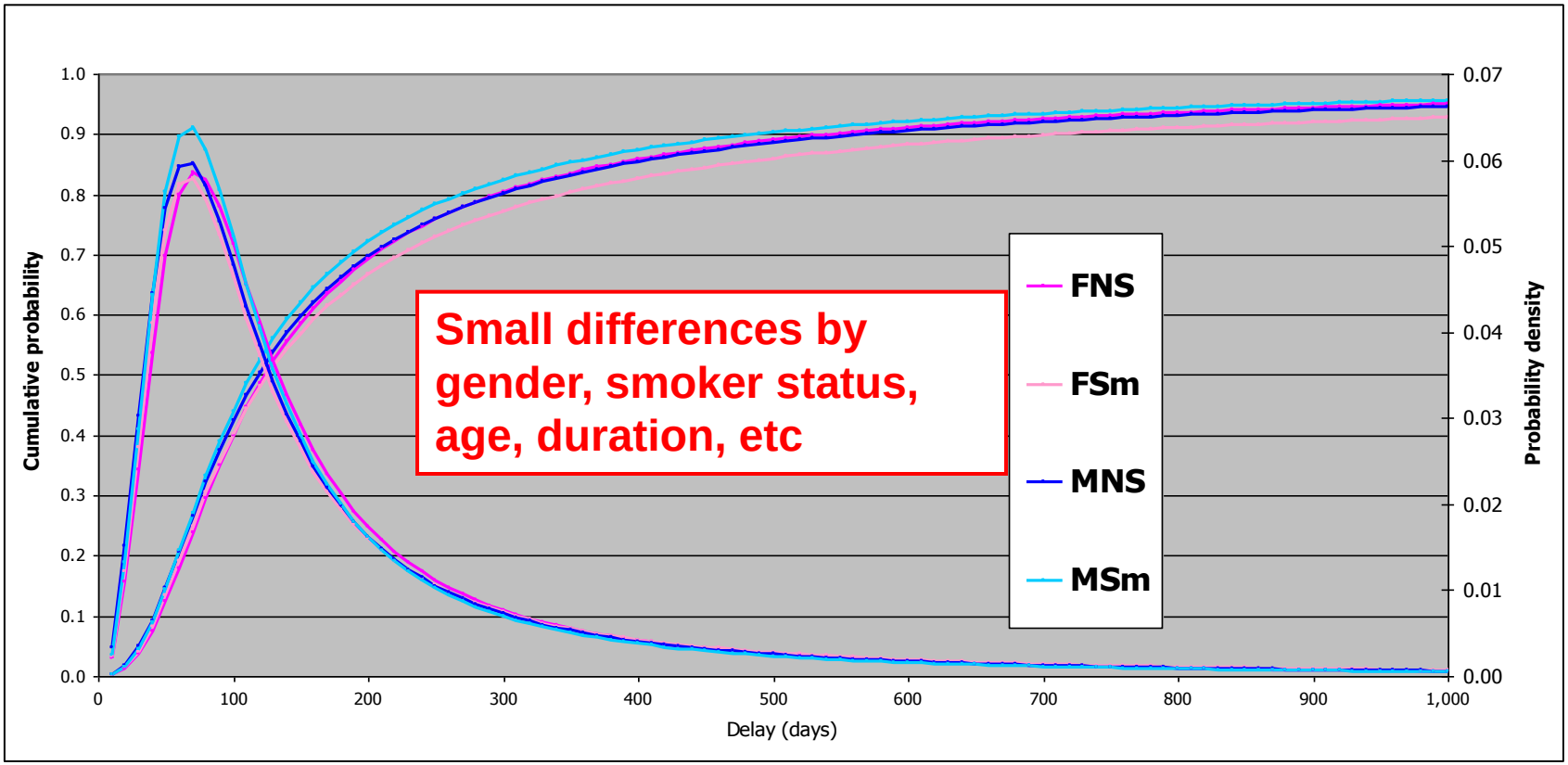
- **Initial findings from parametric modelling:**



1999-2004 data; accelerated business only

New Method: Claim development distribution

- **Initial findings from parametric modelling:**



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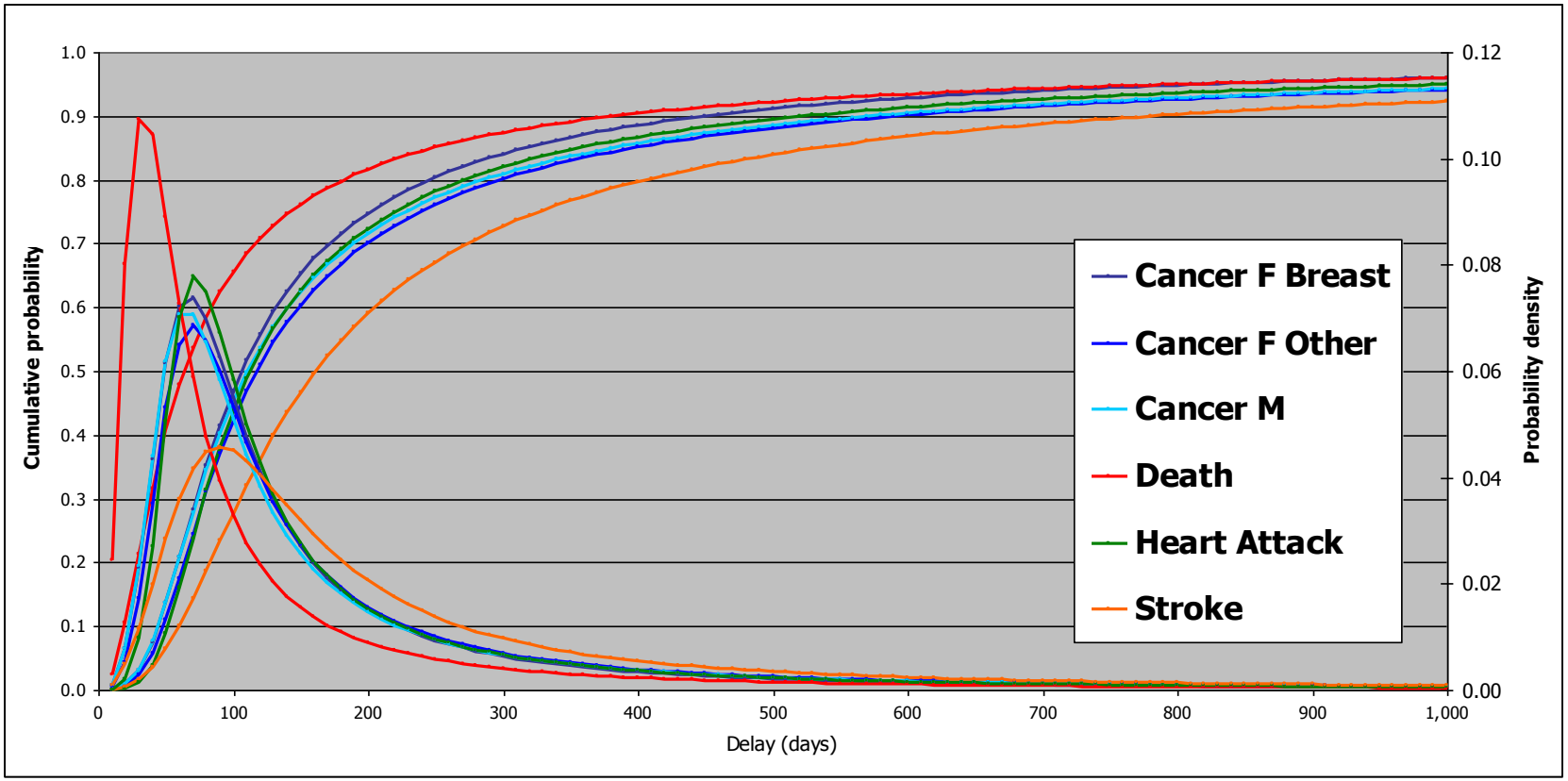

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New Method: Claim development distribution

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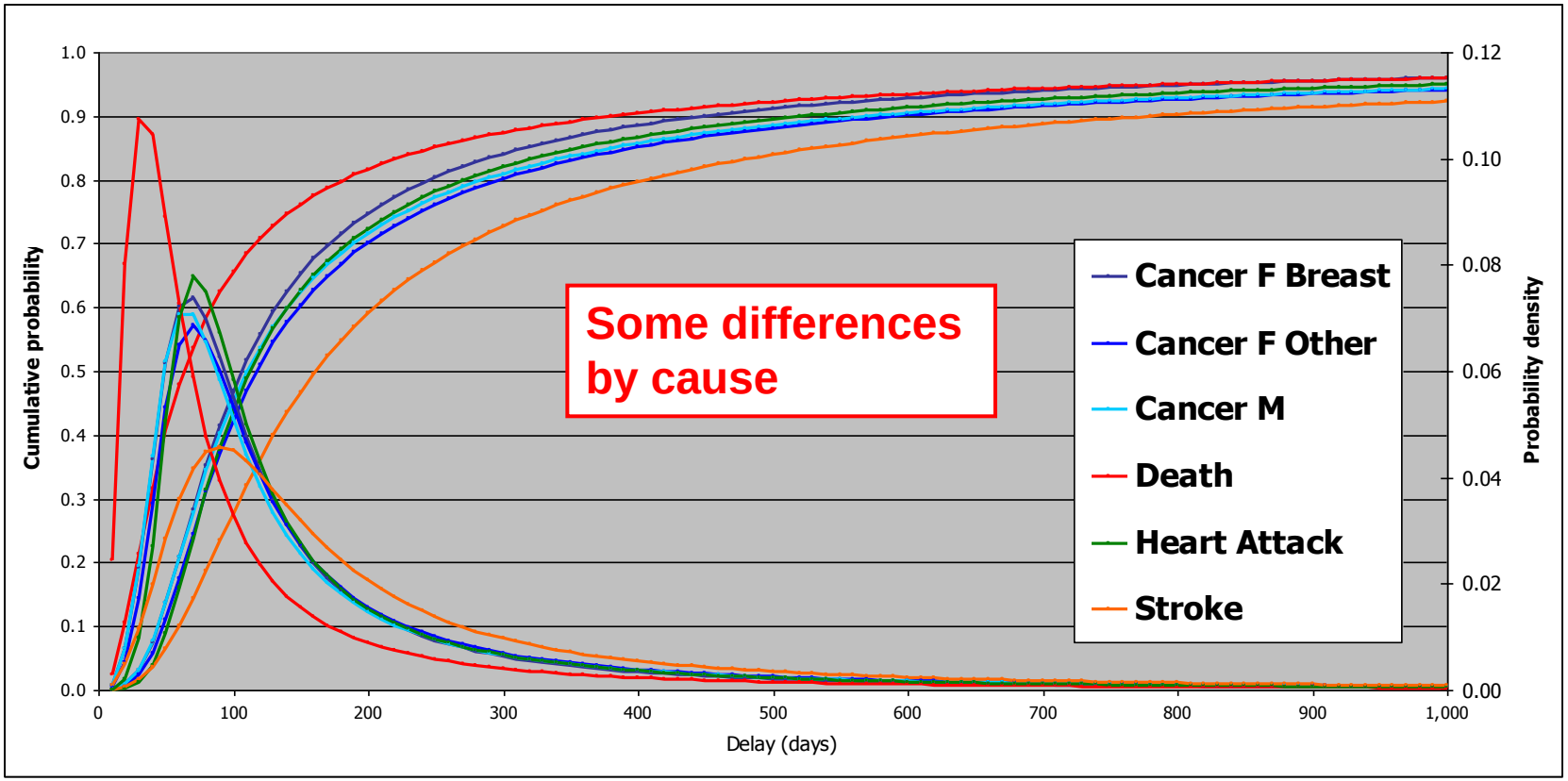


1999-2004 data; accelerated business only

New Method: Claim development distribution

- Initial findings from parametric modelling:
- Little variation by most risk factors
  - Reasonable to use a single claim development distribution within the new methodology at an “All Causes” level
- Significant variation by cause:
  - Death shorter, stroke longer
  - Can also apply the new methodology at a “Cause Specific” level and derive cause-specific claim rates
  - Cause-specific should of course sum to all causes….

Working Paper 33: scope

- **Claim development distribution**
  - Describe fitting of Burr model
  - Reconcile with "Working Paper 14" approach, and
  - Indicate sensitivities within model
- **Full implementation**
  - Describe the more robust application using monthly time intervals for a more accurate calculation of exposure
  - Reconcile with spreadsheet approach in WP28 (and released results)
- **Further analysis of 'off' rates**

Working Paper 33: outputs

- **Working Paper 33 will use the more robust application:**
  - **With a single set of time-dependent 'off rate' assumptions, and**
  - **A single claim development distribution (Burr model)**
- **… to produce 'All Office' results for accelerated business on a lives basis in 1999-2002**
- **Working Paper 33 will also indicate sensitivities to off rates and CDD**
- **Results for 2003 and 2004 will also be issued to member offices**

- **(Other results and All Causes & Cause-specific claim rates to follow)**

Working Paper 33: “realistic” results

- Working Paper 33 will include ‘All Office’ results for accelerated business on a lives basis for claims settled in 1999-2002
- Realistic … not necessarily definitive
- Depend on a substantial number of assumptions
  - A single set of time-dependent ‘off rate’ assumptions, and
  - A single claim development distribution (Burr model)
- More accurate estimation of exposure (by age and duration, in particular)
- … and appropriate to comparison with settled claims

Working Paper 33: “realistic” results

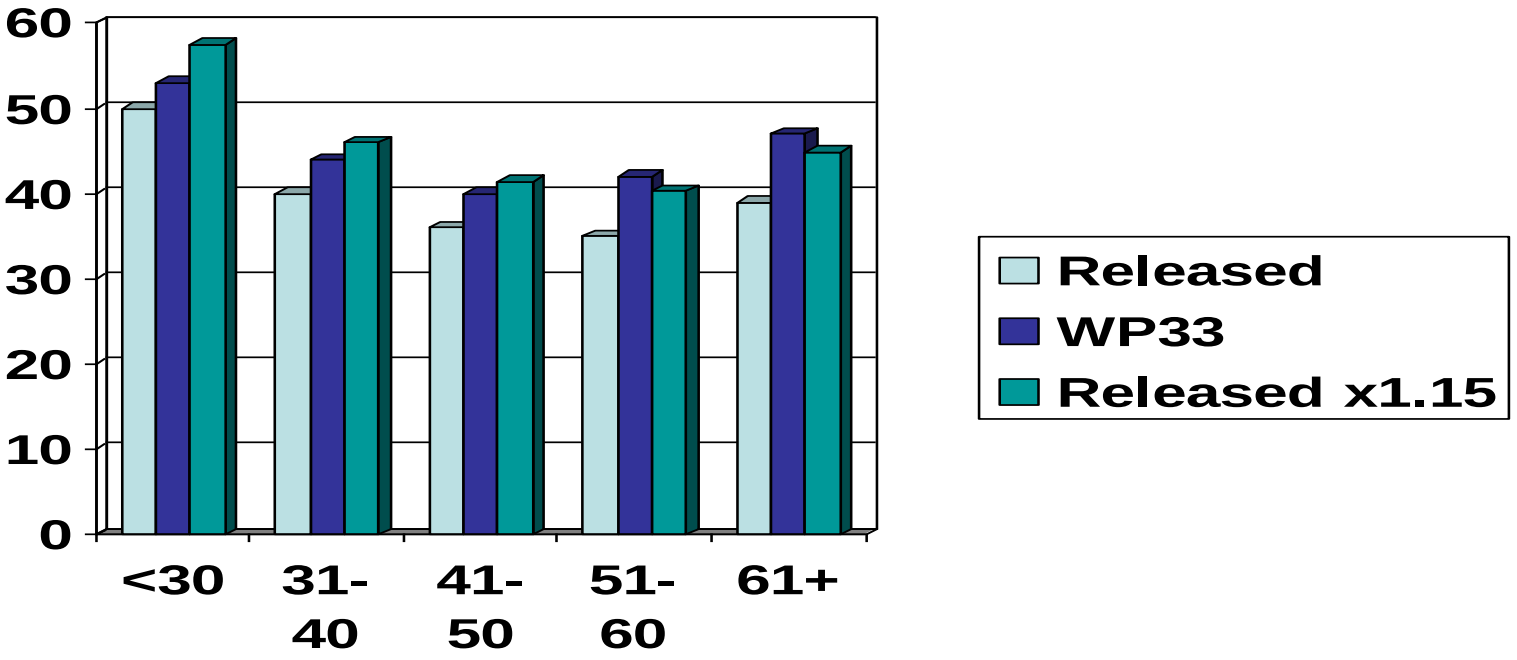
- **Overall results are very similar to released results adjusted for grossing-up factor:**

		Released	Released x 1.15	WP33
Male	NS	**38**	**44**	**43**
	Sm	**69**	**79**	**78**
Female	NS	**45**	**52**	**51**
	Sm	**57**	**66**	**65**

Results for full acceleration business 1999-2002, all ages & durations combined, lives, as % CIBT93

Working Paper 33: DRAFT results

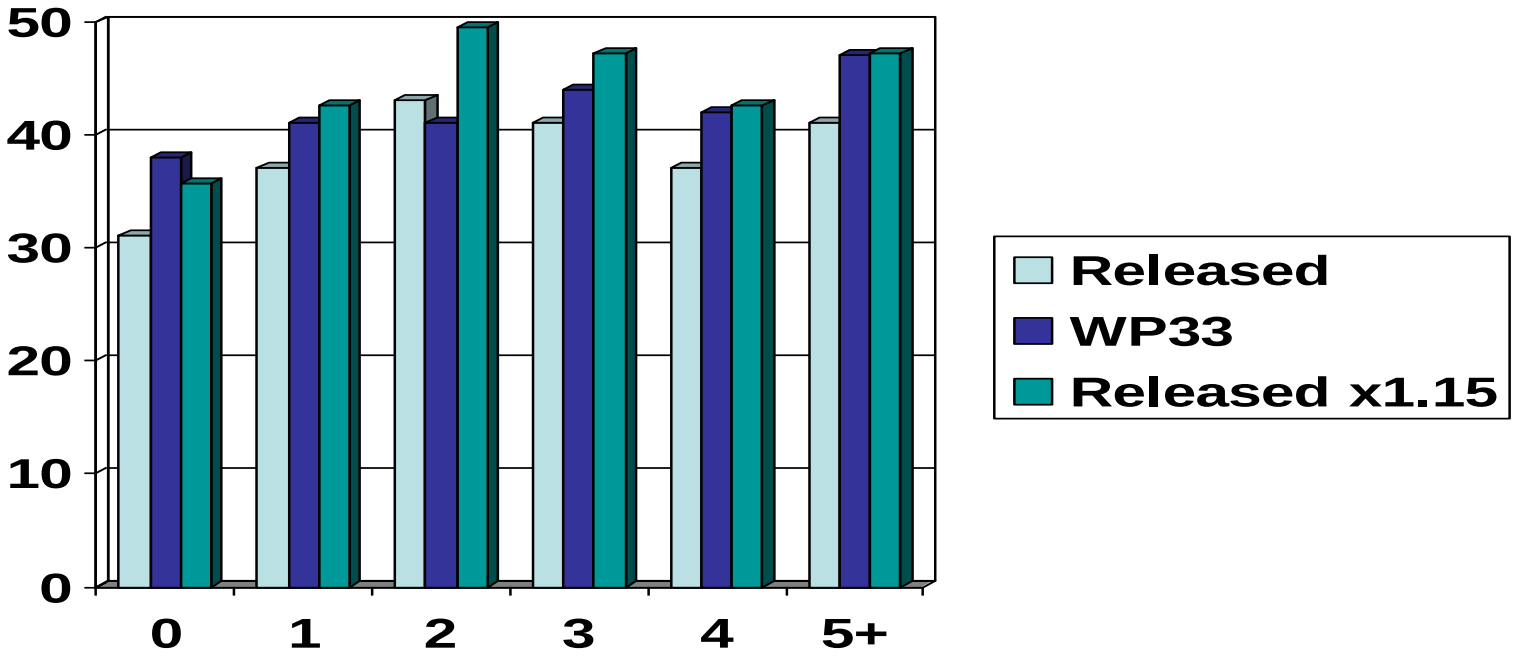
- **Comparison to released results varies by age:**



Results for Male Non-smoker full acceleration business 1999-2002, all durations combined, as % CIBT93

Working Paper 33: DRAFT results

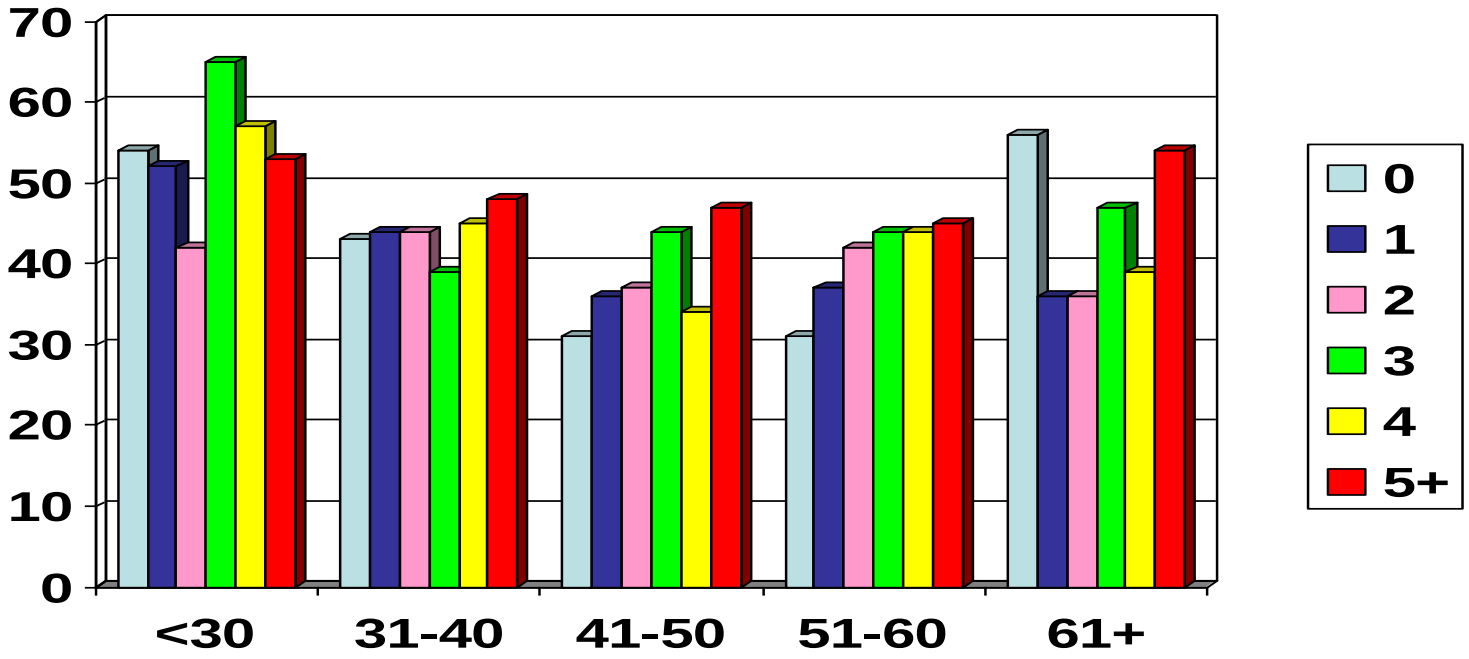
- … and by duration:



Results for Male Non-smoker full acceleration business 1999-2002, all ages combined, as % CIBT93

Working Paper 33: DRAFT results

- **Initial selection?**



Results for Male Non-smoker full acceleration business 1999-2002, as % CIBT93

Working Paper 33: DRAFT results

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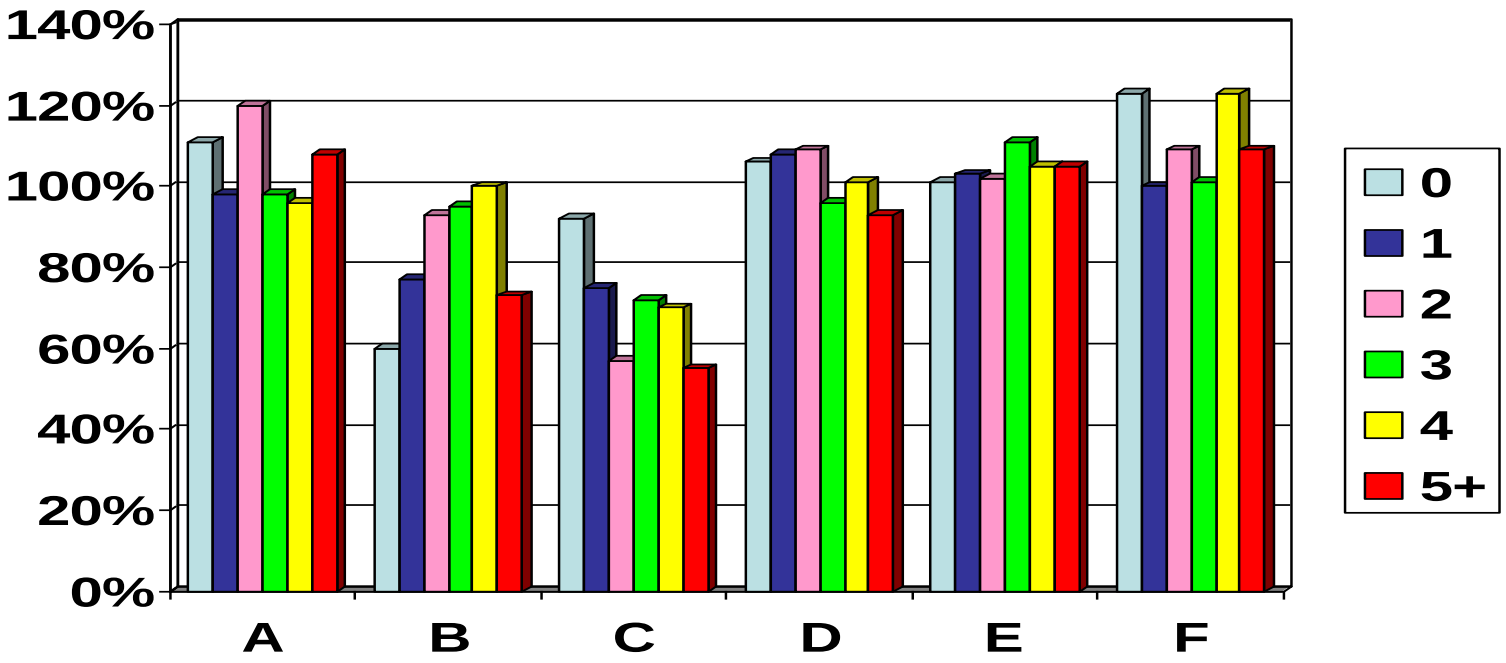


Results for full acceleration business 1999-2002 for 6 large offices as % all offices experience

Working Paper 33: DRAFT results

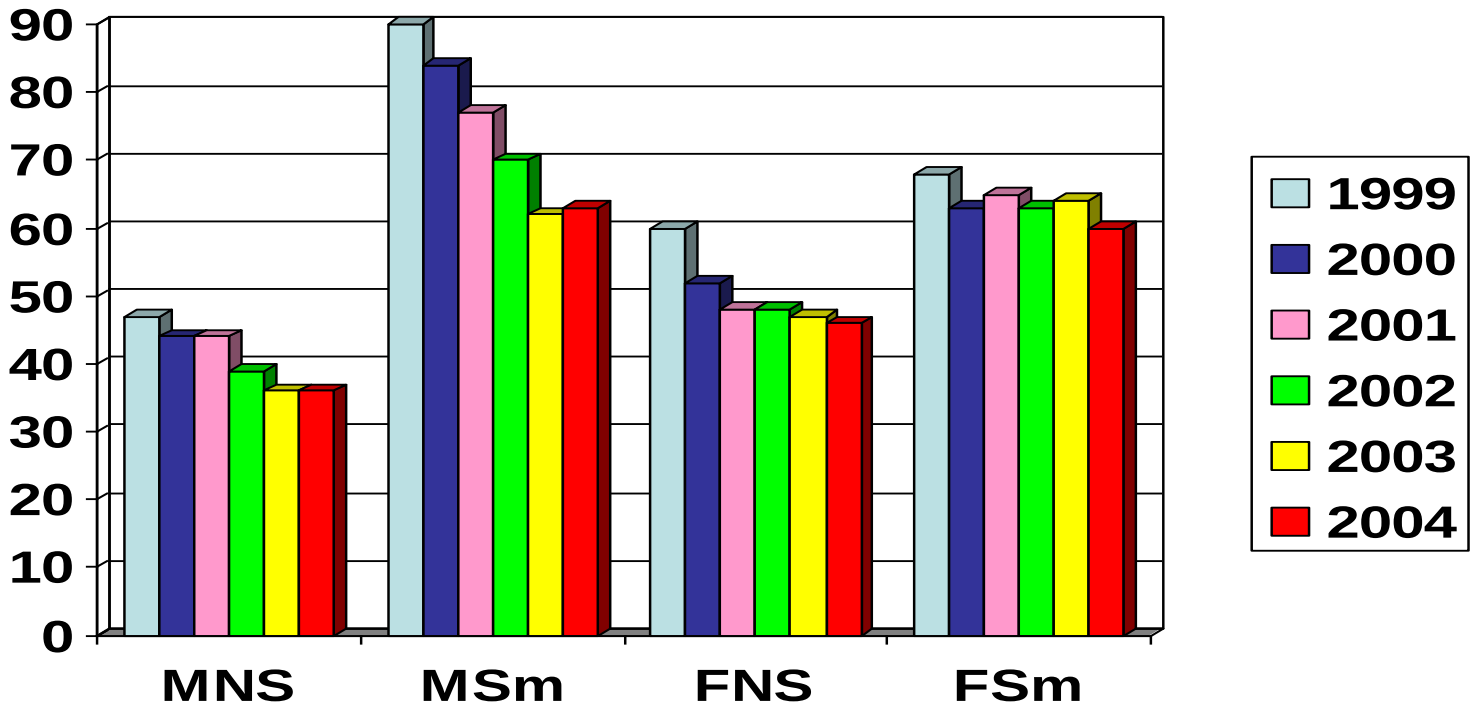
- **Smoker differentials?**

Age Band	Duration						
	0	1	2	3	4	5+	All
Males							
31-40	161%	175%	146%	181%	192%	102%	**154%**
41-50	309%	233%	217%	216%	203%	187%	**216%**
51-60	323%	225%	201%	192%	236%	187%	**212%**
All ages	**221%**	**187%**	**177%**	**183%**	**198%**	**161%**	**182%**
Females							
31-40	109%	125%	94%	102%	74%	124%	**107%**
41-50	109%	119%	124%	136%	148%	153%	**133%**
51-60	144%	141%	131%	179%	139%	151%	**147%**
~~**All ages**~~	~~**118%**~~	~~**126%**~~	~~**117%**~~	~~**127%**~~	~~**114%**~~	~~**147%**~~	~~**127%**~~

Ratio of smoker to non-smoker experience by age band and curtate duration for full acceleration business during 1999-2002

Working Paper 33: DRAFT results

- **Experience by year?**



Results for full acceleration business 1999-2004, all ages & all durations combined, as % CIBT93

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- **CI Investigation Objectives and Progress**
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Next Steps

- Complete & publish WP33
- Further analysis:
  - Amounts experience
  - Other factors: sales channel, product type, benefit amount, commencement year, office, …
  - Stand-alone business
- Use methodology to generate All Causes & Cause-specific claim rates
- Releasing 2005 results

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