Session 181: ILEC Potpourri

SOA Antitrust Compliance Guidelines
SOA Presentation Disclaimer

2019 ANNUAL MEETING & EXHIBIT

Analytics in Experience Analysis

Brian D. Holland, FSA, MAAA

Session 181 - ILEC Potpourri

October 30, 2019

SOCIETY OF ACTUARIES®

SOCIETY OF ACTUARIES
Antitrust Compliance Guidelines

Active participation in the Society of Actuaries is an important aspect of membership. While the positive contributions of professional societies and associations are well-recognized and encouraged, association activities are vulnerable to close antitrust scrutiny. By their very nature, associations bring together industry competitors and other market participants.

The United States antitrust laws aim to protect consumers by preserving the free economy and prohibiting anti-competitive business practices; they promote competition. There are both state and federal antitrust laws, although state antitrust laws closely follow federal law. The Sherman Act, is the primary U.S. antitrust law pertaining to association activities. The Sherman Act prohibits every contract, combination or conspiracy that places an unreasonable restraint on trade. There are, however, some activities that are illegal under all circumstances, such as price fixing, market allocation and collusive bidding.

There is no safe harbor under the antitrust law for professional association activities. Therefore, association meeting participants should refrain from discussing any activity that could potentially be construed as having an anti-competitive effect. Discussions relating to product or service pricing, market allocations, membership restrictions, product standardization or other conditions on trade could arguably be perceived as a restraint on trade and may expose the SOA and its members to antitrust enforcement procedures.

While participating in all SOA in person meetings, webinars, teleconferences or side discussions, you should avoid discussing competitively sensitive information with competitors and follow these guidelines:

- Do not discuss prices for services or products or anything else that might affect prices
- Do not discuss what you or other entities plan to do in a particular geographic or product markets or with particular customers.
- Do not speak on behalf of the SOA or any of its committees unless specifically authorized to do so.
- Do leave a meeting where any anticompetitive pricing or market allocation discussion occurs.
- Do alert SOA staff and/or legal counsel to any concerning discussions
- Do consult with legal counsel before raising any matter or making a statement that may involve competitively sensitive information.

Adherence to these guidelines involves not only avoidance of antitrust violations, but avoidance of behavior which might be so construed. These guidelines only provide an overview of prohibited activities. SOA legal counsel reviews meeting agenda and materials as deemed appropriate and any discussion that departs from the formal agenda should be scrutinized carefully. Antitrust compliance is everyone's responsibility; however, please seek legal counsel if you have any questions or concerns.

Presentation Disclaimer

Presentations are intended for educational purposes only and do not replace independent professional judgment. Statements of fact and opinions expressed are those of the participants individually and, unless expressly stated to the contrary, are not the opinion or position of the Society of Actuaries, its cosponsors or its committees. The Society of Actuaries does not endorse or approve, and assumes no responsibility for, the content, accuracy or completeness of the information presented. Attendees should note that the sessions are audio-recorded and may be published in various media, including print, audio and video formats without further notice.

2019 ANNUAL MEETING & EXHIBIT

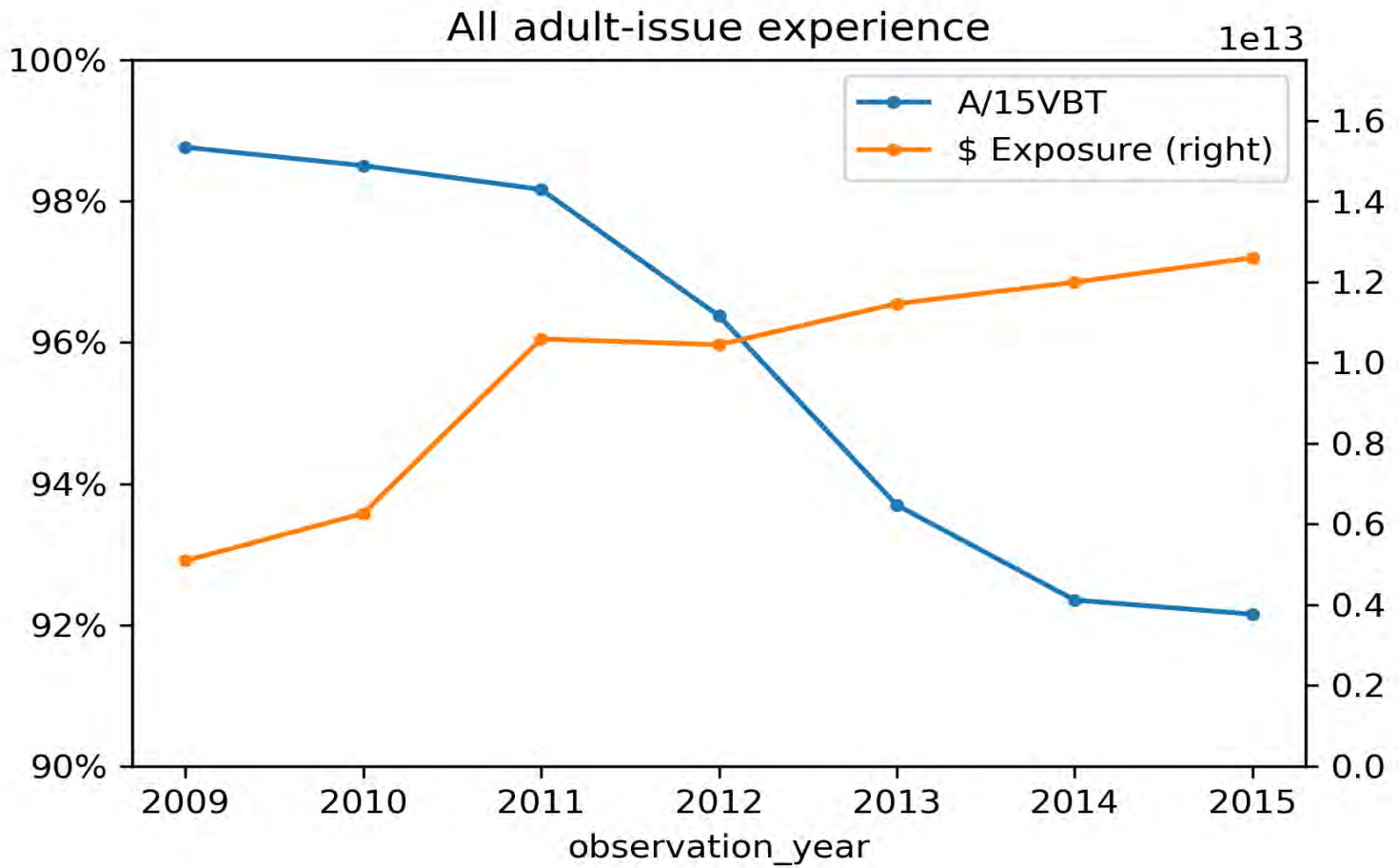
Recent ILEC data: Total experience

SOCIETY OF ACTUARIES®

Q: How much data for 2009-15?
A: So much data: but slim in pockets

	Exposure (Bil $-Yrs)	Exposure, Policy-Yrs (M)	Claims ($Bil)	Claims Policies (M)
Full dataset	71,095	352.5	179	3.4
Adult issues	68,447	282.2	177	3.2
Adult issues, face>$25k	67,899	222.6	162	1.0

Adult issues, Actual/2015VBT, by Amount



A/15VBT has flattened out.

Exposure doubled 2010-1!

Influx of new exposure is further from 15VBT.

Question:
Did rates go up or down?

For future:
What could happen when more companies come in?

2019 ANNUAL MEETING & EXHIBIT

Rollforwards

SOCIETY OF ACTUARIES®

Rollforwards: what's the point?

- Mix of business is different each year.
- A standard table will be high or low in some area.
- Purpose: speak to the questions:
  - Did the shifting mix cause the change in A/T?
  - Did changing A/T cause the change in overall A/T?
- Real answer: some of each – so how much?

Note – here I'm saying A/T for actual / table, for those of us who don't expect the table.

Work in development to address these topics. Adult issues only, all face amounts, by face amount (not count)

Rollforward: how does it work?

The actual/15VBT in one year is the one from the prior year plus a few changes: changes from three pieces:

- updating **ratios** of actual/vbt $\Delta \mathbf{r}_y \cdot \mathbf{w}_y$
- updating **weight** among the cells $\mathbf{r}_y \cdot \Delta \mathbf{w}_y$
- A covariance effect $\Delta \mathbf{r}_y \cdot \Delta \mathbf{w}_y$

$$R_y = \frac{\sum_i Actuals_{yi}}{\sum_k TabularExpecteds_{yk}} = \sum_i \left(\frac{Actuals_{yi}}{TabularExpecteds_{yi}} \right) \left(\frac{TabularExpecteds_{yi}}{\sum_k TabularExpecteds_{yk}} \right) = \sum r_{yi} w_{yi}$$

$R_y = \mathbf{r}_y \cdot \mathbf{w}_y$, weighted actual/table in each cell

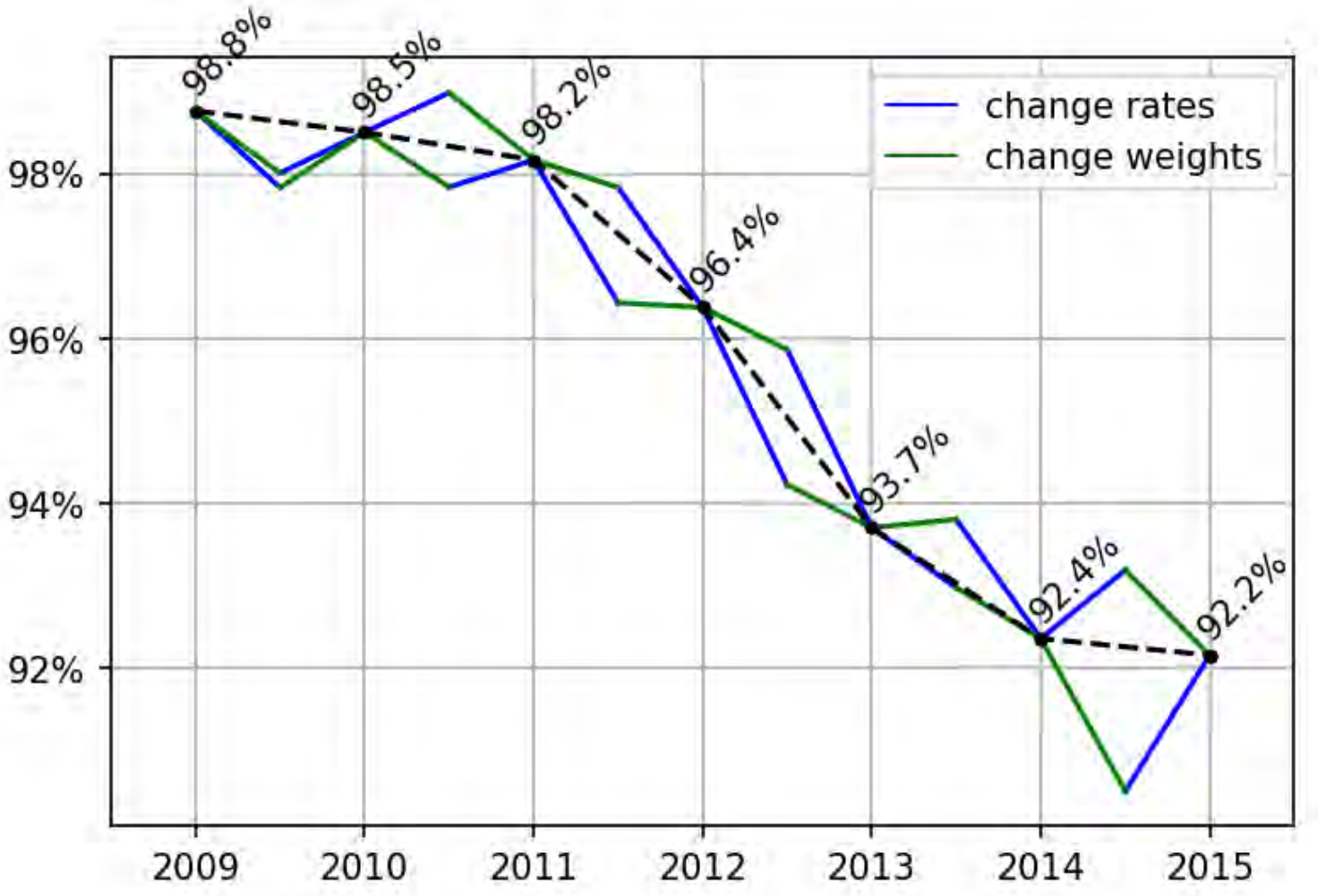
$R_{y+1} = \mathbf{r}_{y+1} \cdot \mathbf{w}_{y+1} = \left(\mathbf{r}_y + \Delta \mathbf{r}_y\right) \cdot \left(\mathbf{w}_y + \Delta \mathbf{w}_y\right)$, expanding that out...

$$R_{y+1} = R_y + \left(\Delta \mathbf{r}_y \cdot \mathbf{w}_y\right) + \left(\mathbf{r}_y \cdot \Delta \mathbf{w}_y\right) + \left(\Delta \mathbf{r}_y \cdot \Delta \mathbf{w}_y\right)$$

About that covariance-type component $\Delta \mathbf{r}_y \cdot \Delta \mathbf{w}_y$

- If both the ratio and the weight for a cell increase, that pushes the overall ratio even more.
- If both decrease: ditto
- If they move in opposite directions: overall ratio drops
- If one doesn't move: no impact
- Other notes:
  - Aggregation level matters.
  - Cells with exposure in one year but not the other have an undefined A/Table.
    - I'm using the other year's A/Table in that case to avoid some arbitrary impact.
  - There's room for more work: where certain odd years moved for example.

All products: sequential rollforward



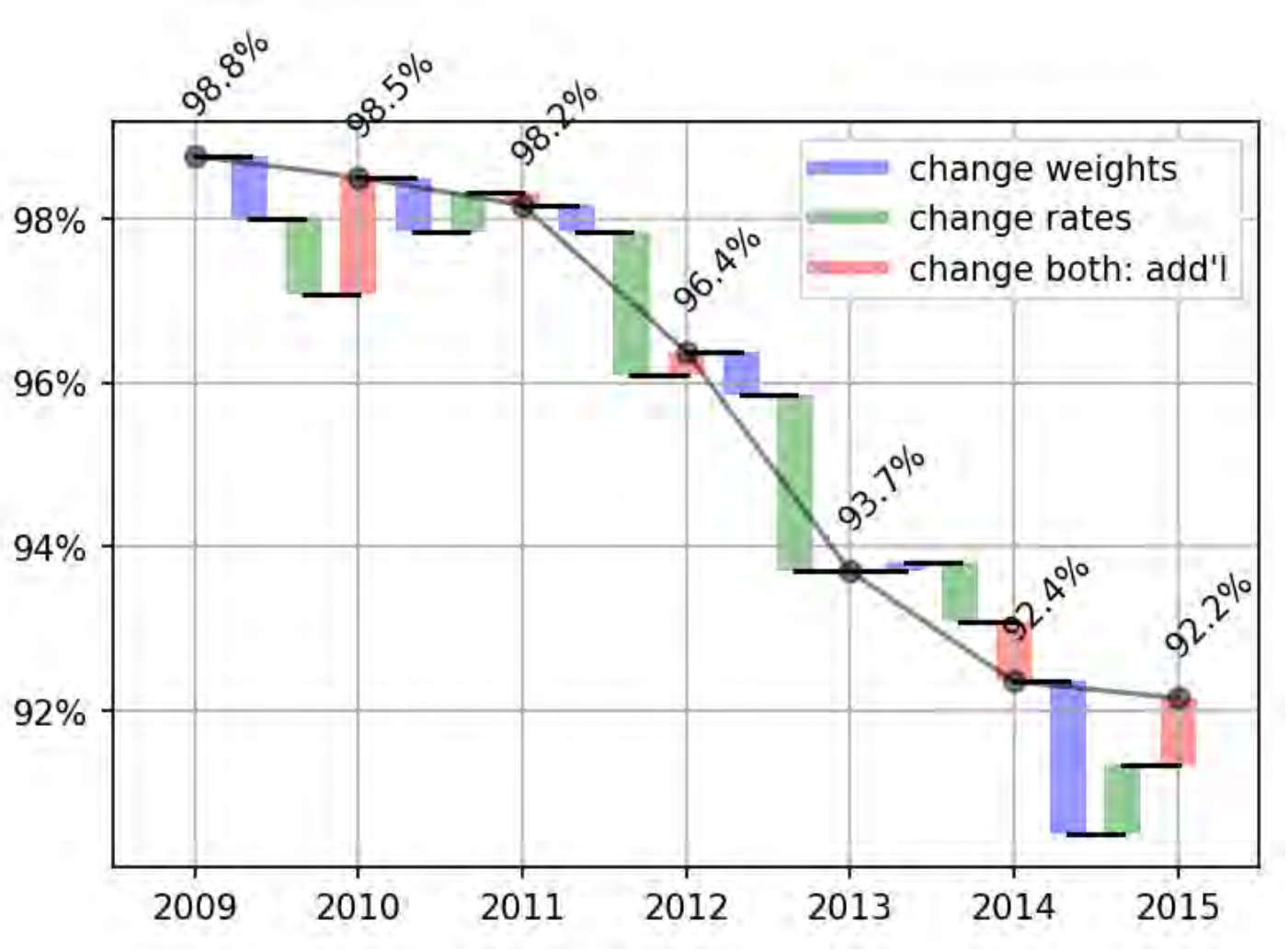
Change one, then the other. Covariance term lands in 2nd step.

From 2009-2010 big changes in mix lead to odd results:

In 2015 (from 2014 study to 2015 study) the A/15VBT went up, had been going down.

Explanations for 2014-5?
- Slower mortality improvement?
- Changed company mix?

All business: waterfall: all 3 components



Waterfall presentation:

The covariance term makes a difference – even where results are not obviously weird.

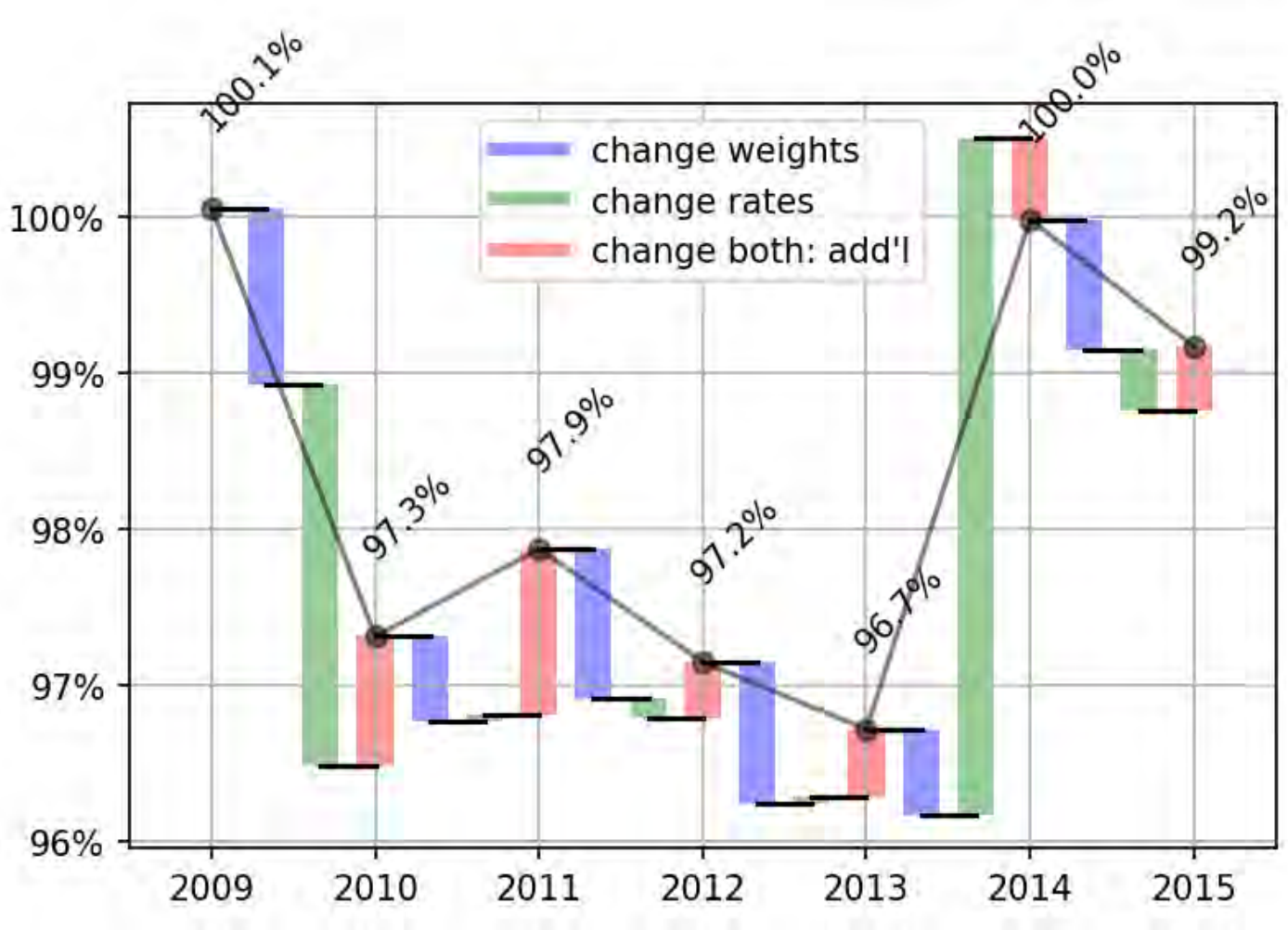
Rollforward components

	R	r dw	dr w	dr dw	Total (next R)
2009	98.8%	-0.8%	-0.9%	1.4%	98.5%
2010	98.5%	-0.7%	0.5%	-0.2%	98.2%
2011	98.2%	-0.3%	-1.7%	0.3%	96.4%
2012	96.4%	-0.5%	-2.2%	-0.0%	93.7%
2013	93.7%	0.1%	-0.7%	-0.7%	92.4%
2014	92.4%	-1.9%	0.8%	0.8%	92.2%

Component terms:

- dr w: change from updating just rates
- r dw: change from updating just weights
- dr dw: additional change from updating both

Perm: waterfall

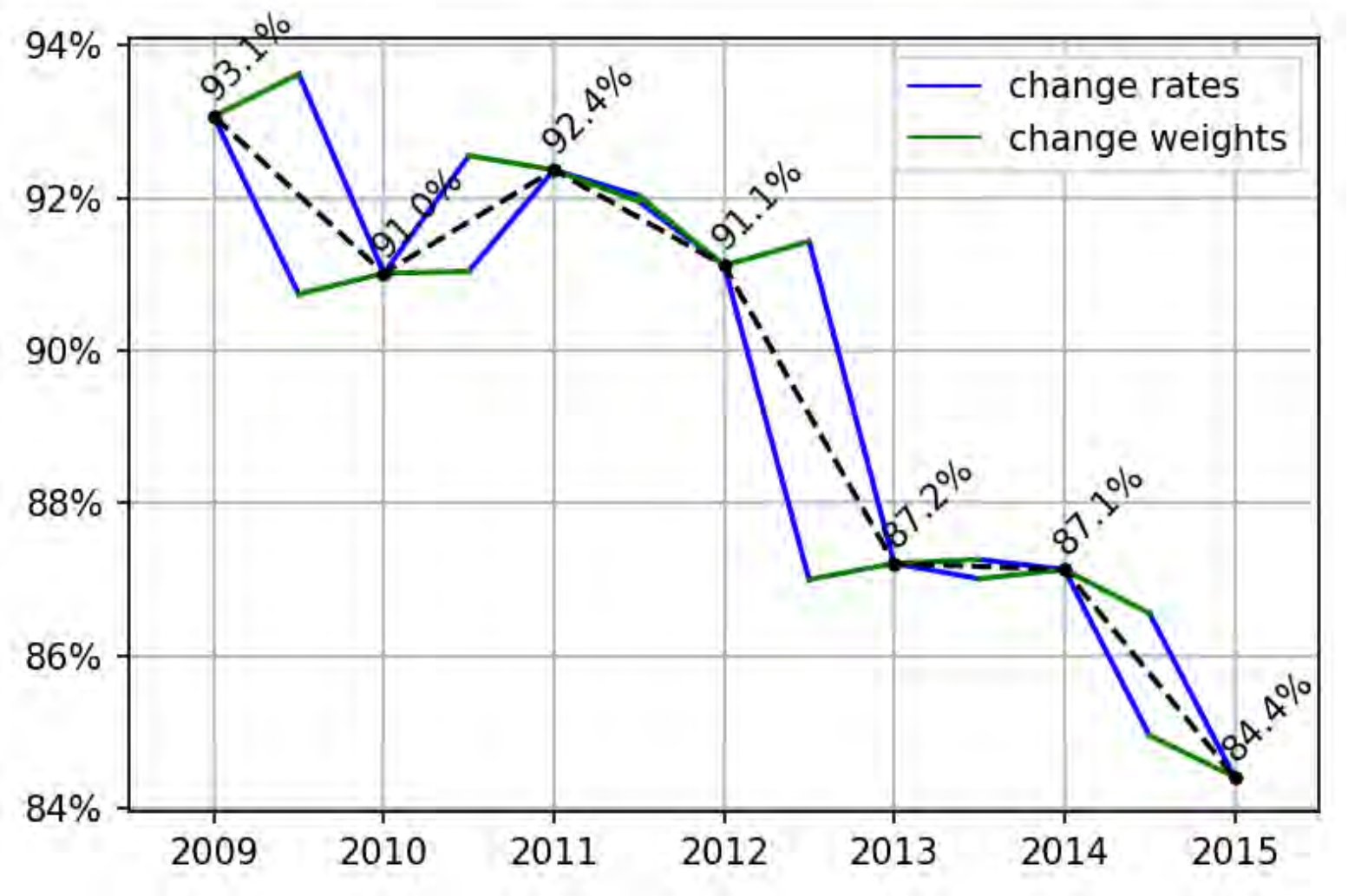


- Covariance term offsets only part of rate change in most years.
- 2010-11 had no change due to rates alone, but was large covariance impact.
- Massive rate impact in 2013-4 only partly offset by covariance.

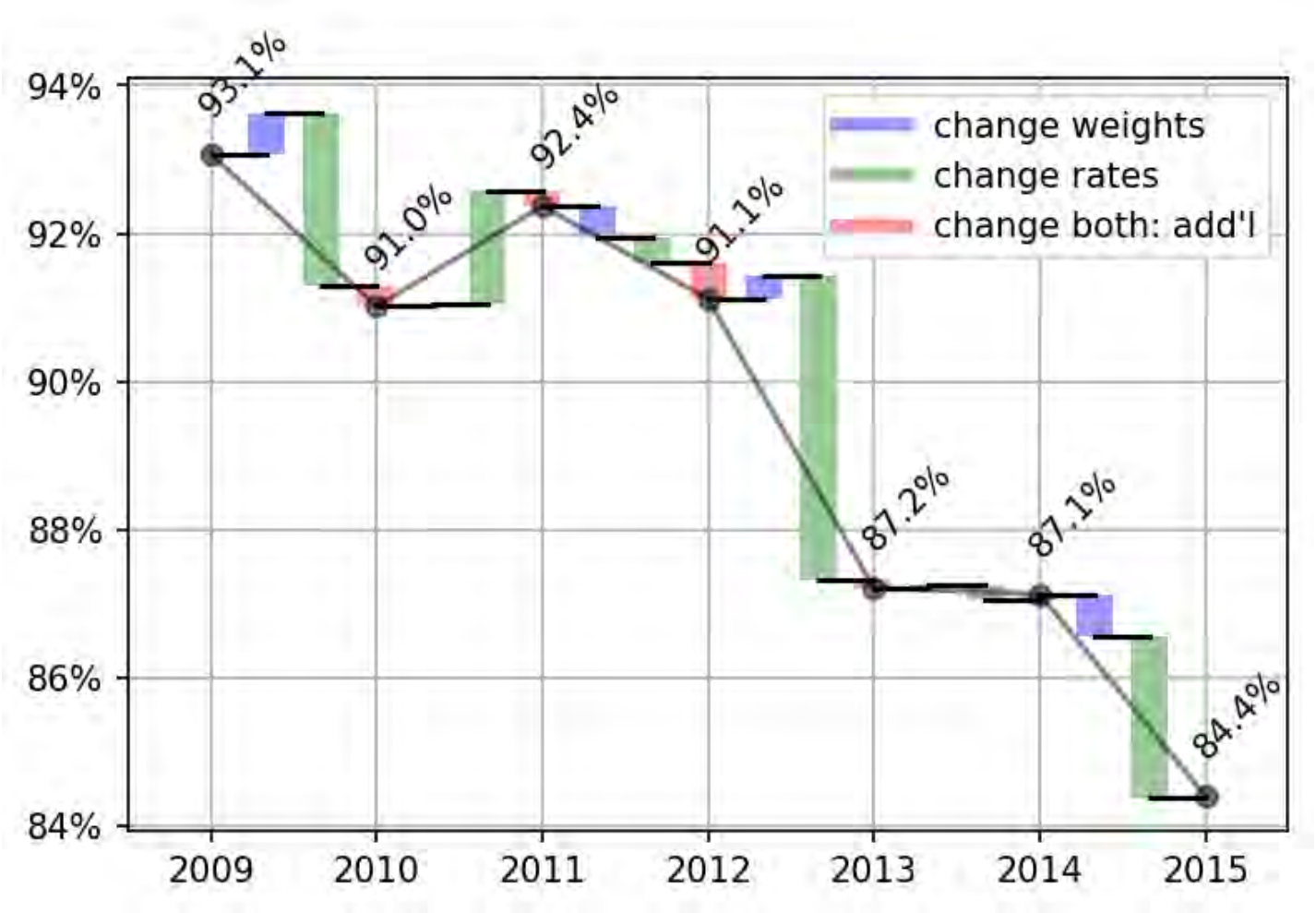
Rollforward components

	R	r dw	dr w	dr dw	Total (next R)
2009	100.1%	-1.1%	-2.4%	0.8%	97.3%
2010	97.3%	-0.5%	0.0%	1.1%	97.9%
2011	97.9%	-1.0%	-0.1%	0.4%	97.2%
2012	97.2%	-0.9%	0.0%	0.4%	96.7%
2013	96.7%	-0.5%	4.3%	-0.5%	100.0%
2014	100.0%	-0.8%	-0.4%	0.4%	99.2%

Term: sequential rollforward



Term: waterfall



- Very little covariance impact!
- Little weights impact!
- Dominated by several years with large drops vs 15VBT

Rollforward components

	R	r dw	dr w	dr dw	Total (next R)
2009	93.1%	0.6%	-2.3%	-0.3%	91.0%
2010	91.0%	0.0%	1.5%	-0.2%	92.4%
2011	92.4%	-0.4%	-0.3%	-0.5%	91.1%
2012	91.1%	0.3%	-4.1%	-0.1%	87.2%
2013	87.2%	0.1%	-0.2%	0.1%	87.1%
2014	87.1%	-0.6%	-2.2%	0.0%	84.4%

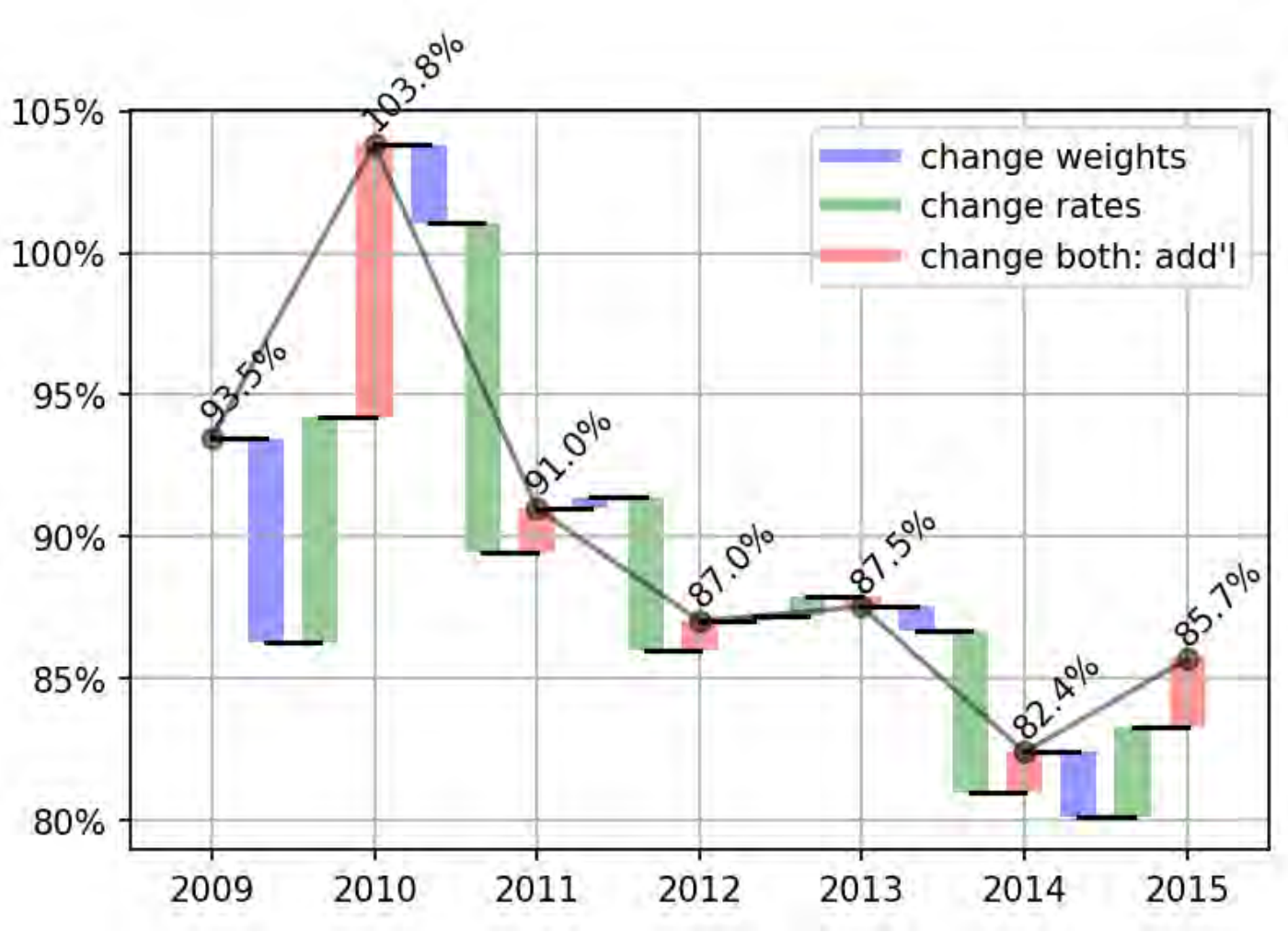
UL: waterfall

- Weight change impact mixed
- Large rate increase 2014-5
- Large covar 2013-14 downward

Rollforward components

	R	r dw	dr w	dr dw	Total (next R)
2009	104.8%	0.2%	5.9%	-3.1%	107.9%
2010	107.9%	-1.5%	4.4%	-2.0%	108.7%
2011	108.7%	2.1%	-3.1%	-0.6%	107.2%
2012	107.2%	-1.9%	-5.4%	0.7%	100.6%
2013	100.6%	0.9%	-2.9%	-2.9%	95.7%
2014	95.7%	-2.7%	6.1%	1.1%	100.3%

ULSG



- Some relatively large covar impacts were masked: 2009-10, 2014-5
- Recent years' rate impact is inconsistent

Rollforward components

	R	r dw	dr w	dr dw	Total (next R)
2009	93.5%	-7.2%	8.0%	9.6%	103.8%
2010	103.8%	-2.8%	-11.6%	1.6%	91.0%
2011	91.0%	0.4%	-5.4%	1.0%	87.0%
2012	87.0%	0.2%	0.7%	-0.3%	87.5%
2013	87.5%	-0.9%	-5.7%	1.4%	82.4%
2014	82.4%	-2.3%	3.2%	2.4%	85.7%

Upshot - rollforward

- Mix of business problem is known
- One more tool to address it
- Not as simple as we'd hope from the sequential rollforward

2019 ANNUAL MEETING & EXHIBIT

Anomaly detection

SOCIETY OF ACTUARIES®

Anomaly detection

- See where something was weird: **computationally**
- Q: what is the "thing" – the entity?
  - **Study year – for example:** Is it similar to others? If so, to which?
- Ex: get a new study year: did exposure trend or jerk around?
- For now: at least exposures should not be too jumpy –
  - so see how jumpy they are on the following slides
- For another time: check decrements (mortality and / or lapse)
  - Must further anchor in probabilistic framework….
  - Mortality is (hopefully) an anomaly at a granular level

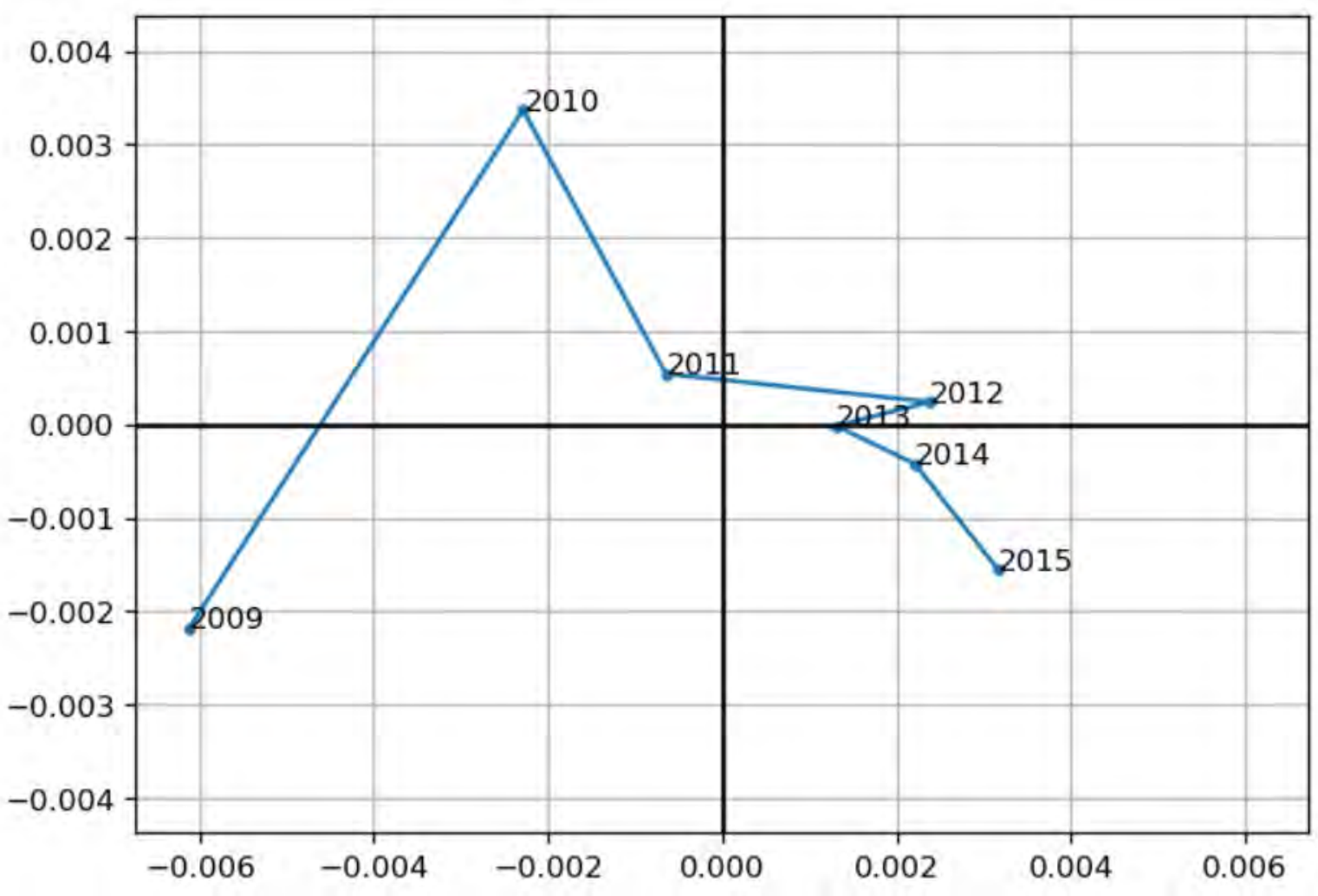
PCA, SVD: for filtering out noise

WHAT: reduce dimensions used to measure entities (study years here)
WHY: 1) simplify calculations 2) some are just noise anyway
HOW:

1. Take average distribution across study years
2. Shift the mix from the average categories get best fit to distribution
   - Add in an offset to that average distribution that's scaled for each study year
   - That scaling factor is a new 1st dimension, x coordinate

2. Add 2nd layer of shift to correct for remaining error: is new 2nd dimension
   Could continue adding dimensions, but this is enough for now
3. Plot study years in 2-d
   - Captures major features
   - Shows trends more clearly and simply
   - Facilitates cluster analysis to reduce dimensions
4. Could add further dimensions to capture remaining localized errors

By insurance_plan, smoker_status, face_amount_band, issue_age



This exhibit conveys shift in mix of many different cross-categories at once.

Some are clearly in left field.

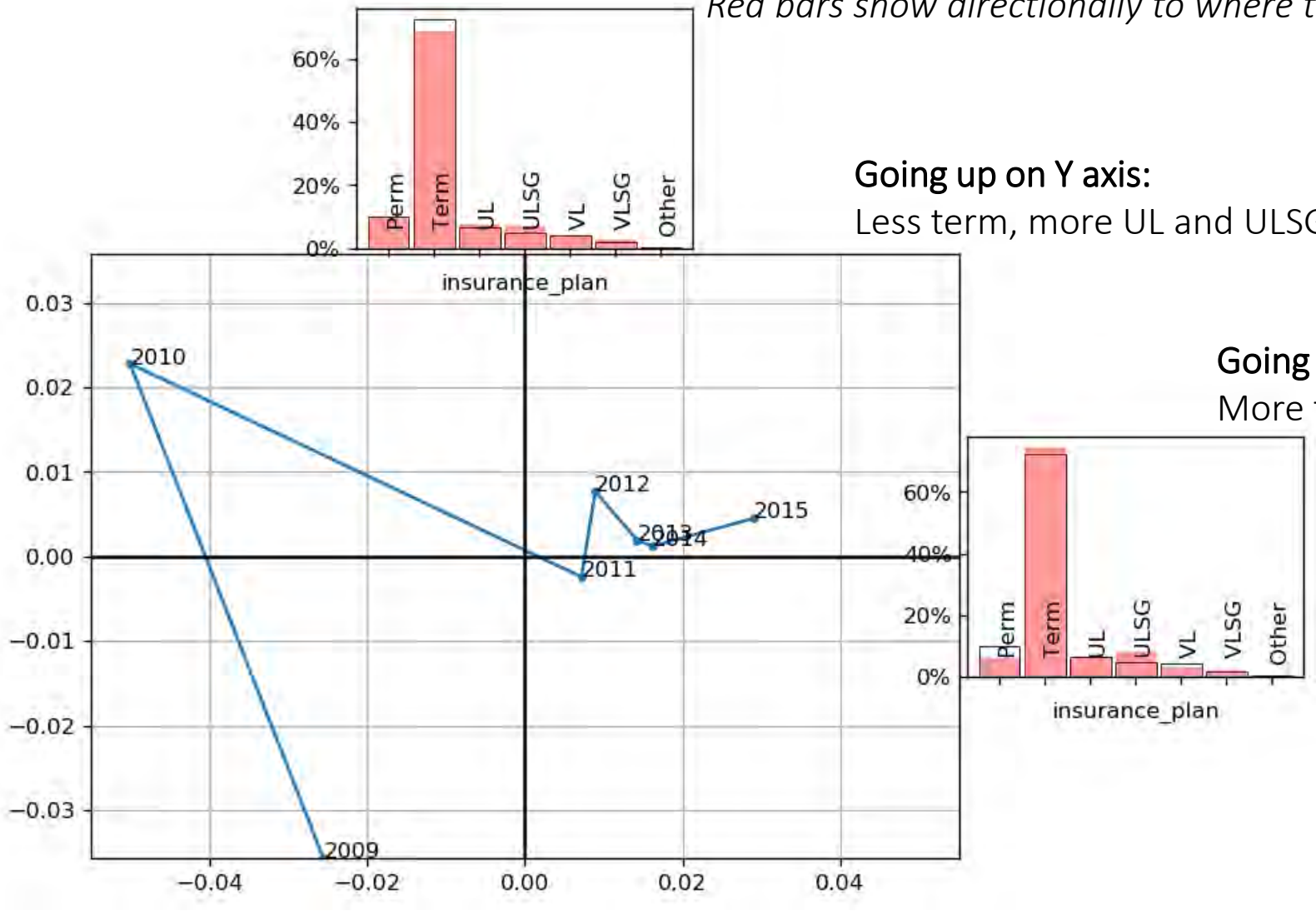
There are too many cross-combinations to show here: so let's look at univariate mixes.

Insurance plan

What this is: principal component analysis of mix of exposure (amount) *from* matrix of study year, plan: share of that study year's total exposure

Black bars are average distribution across years.

Red bars show directionally to where the mix shifts going up the axis



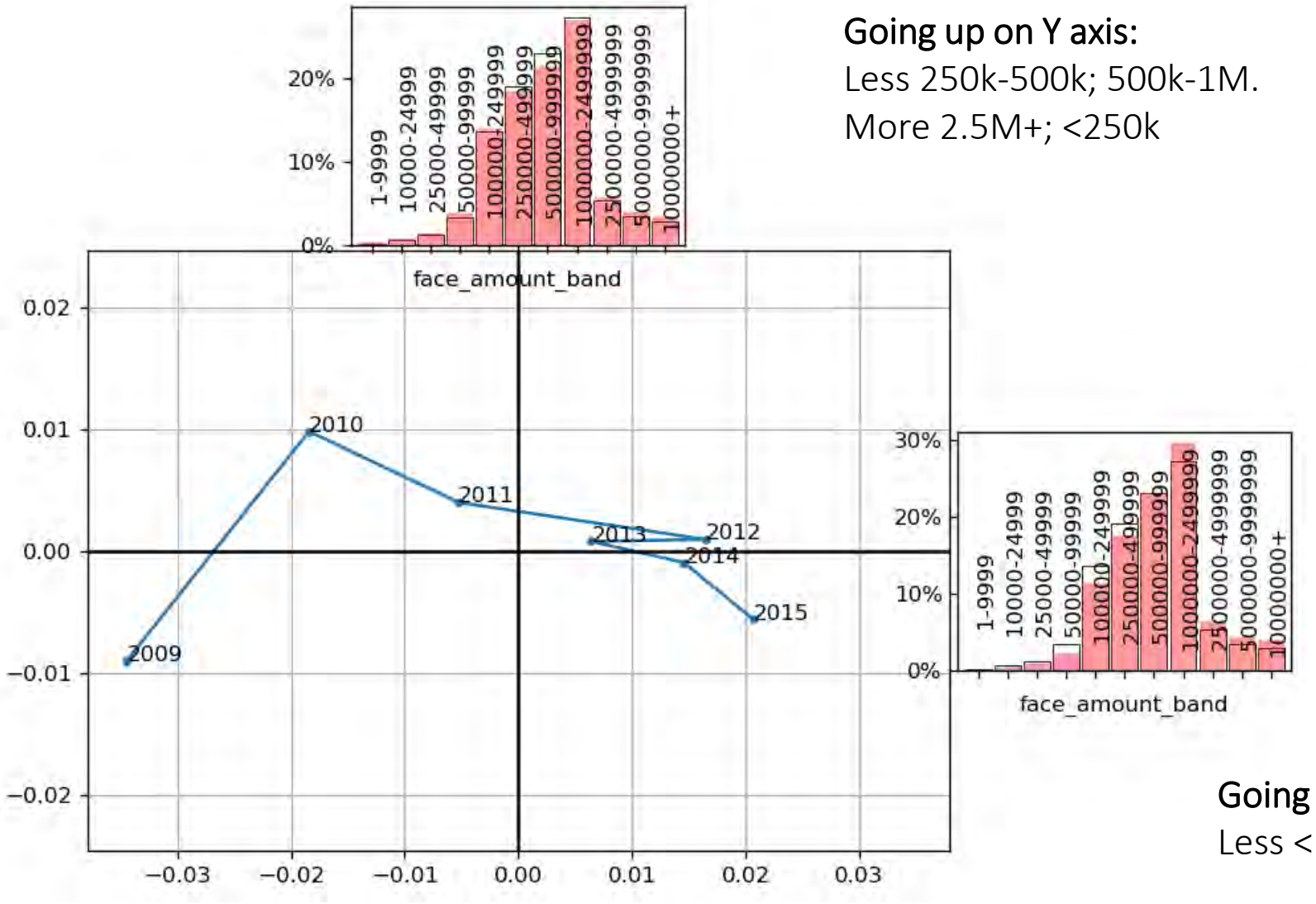
Going up on Y axis:

Less term, more UL and ULSG, bit more VLSG

Going right on X axis:

More term, ULSG; less perm, VL

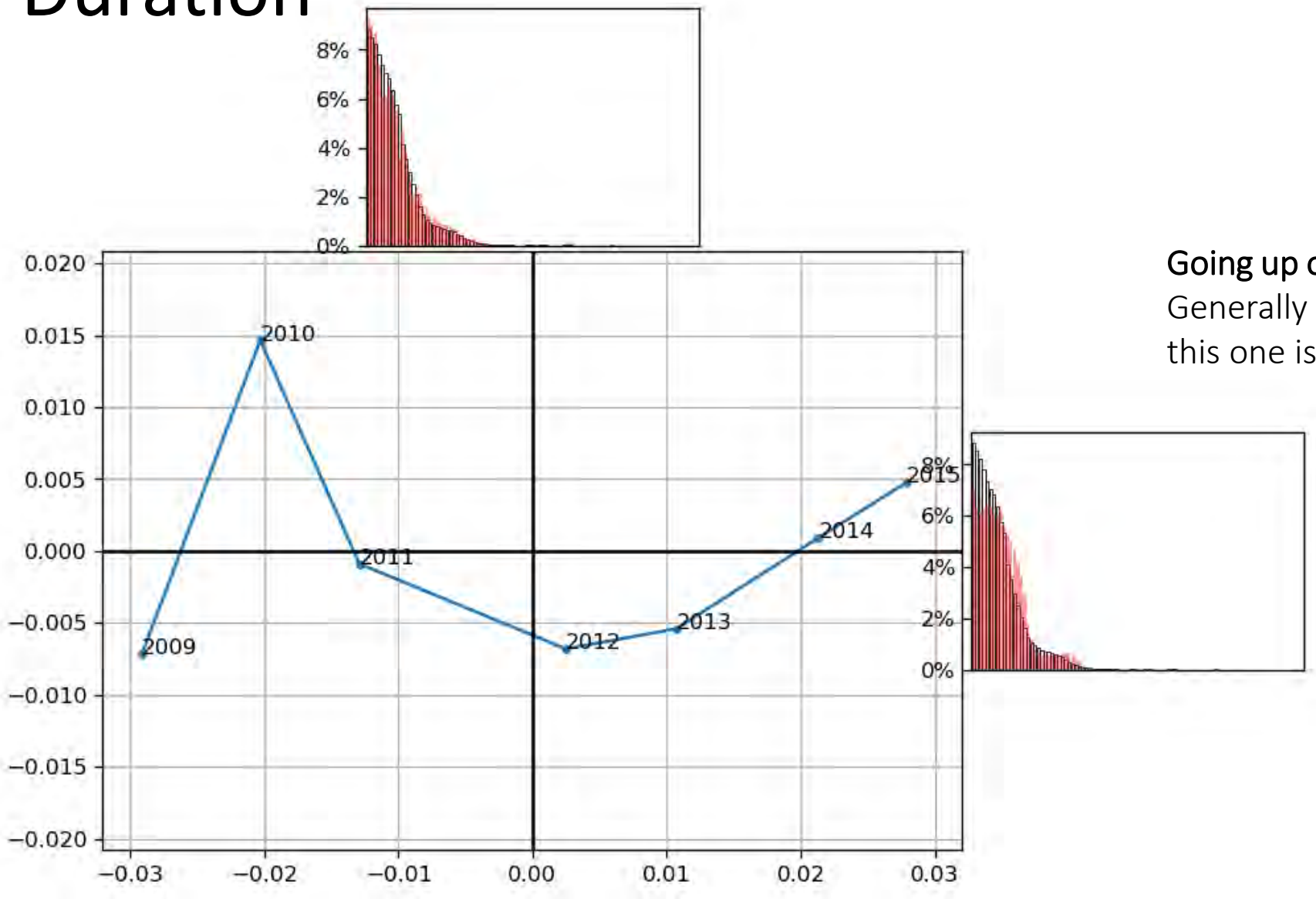
Face amount band



Going up on Y axis:
Less 250k-500k; 500k-1M.
More 2.5M+; <250k

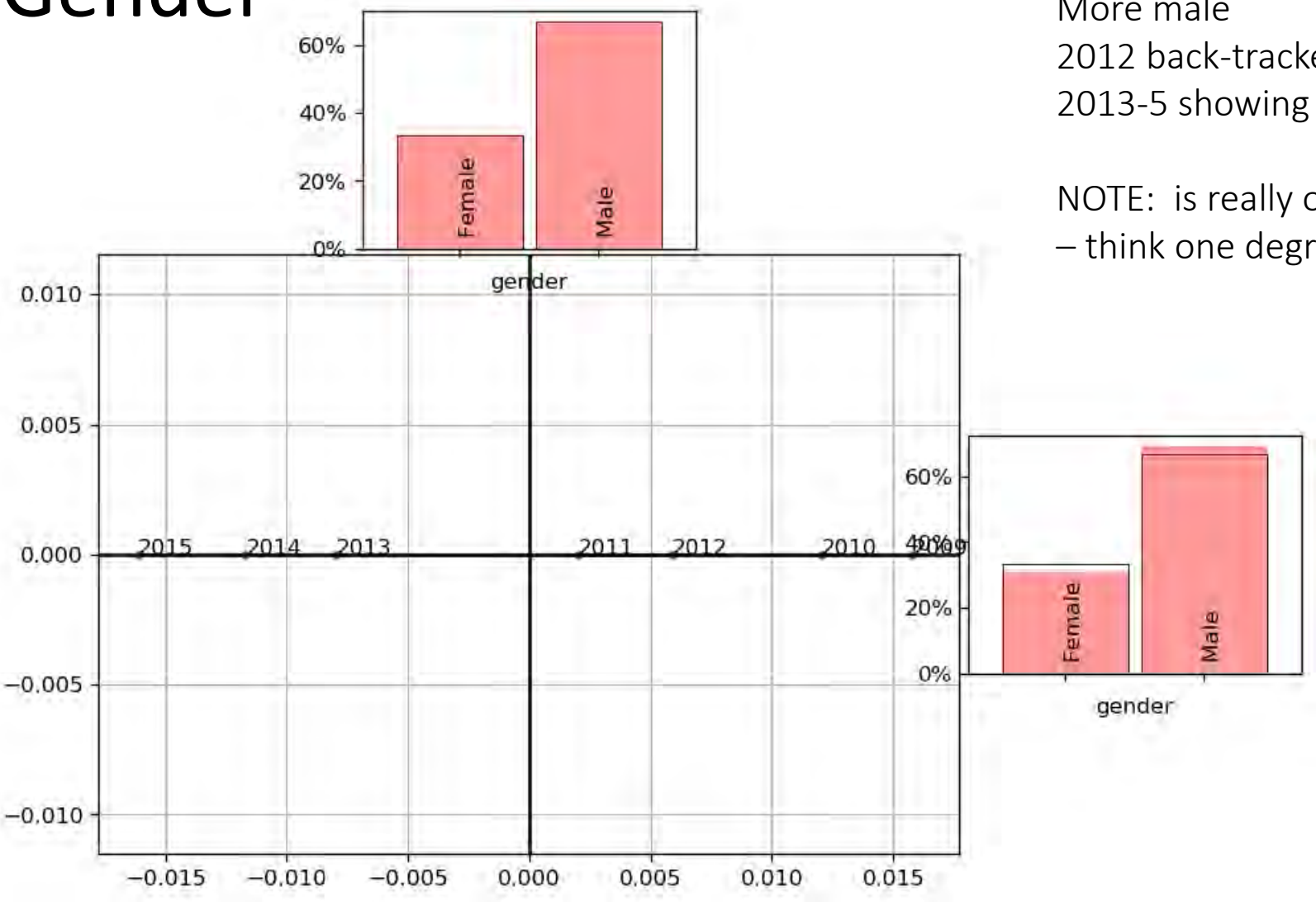
Going right on X axis:
Less < 500k; more in each band 1M+

Duration



Going up on X axis:
Generally aging: makes some sense that this one is smoother

Gender



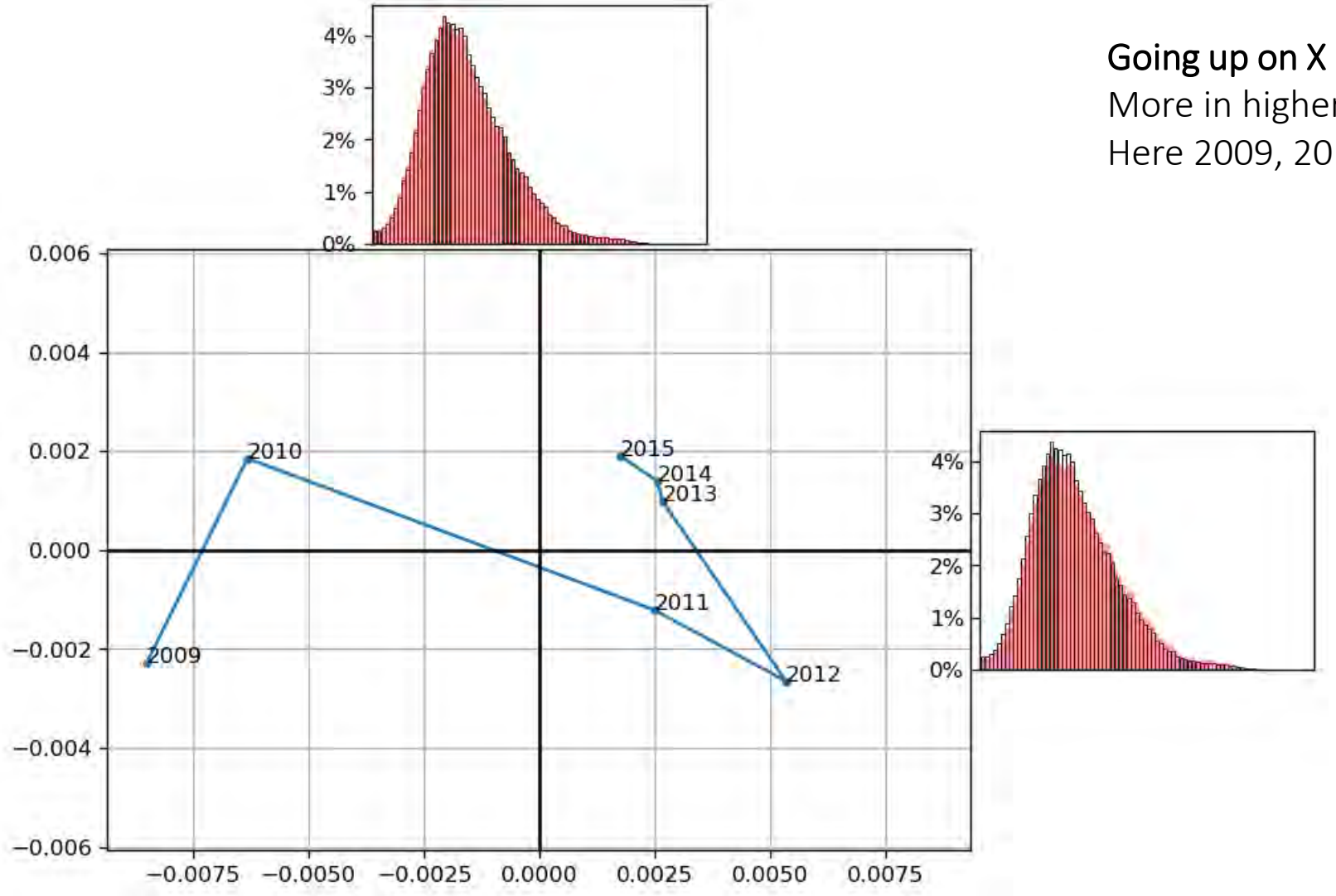
Going up on X axis:
More male
2012 back-tracked.
2013-5 showing even trend.

NOTE: is really one-dimensional
– think one degree of freedom

ALSO NOTE: these distributions should ideally be transformed out of the simplex into a real space.. But this is close enough to illustrate

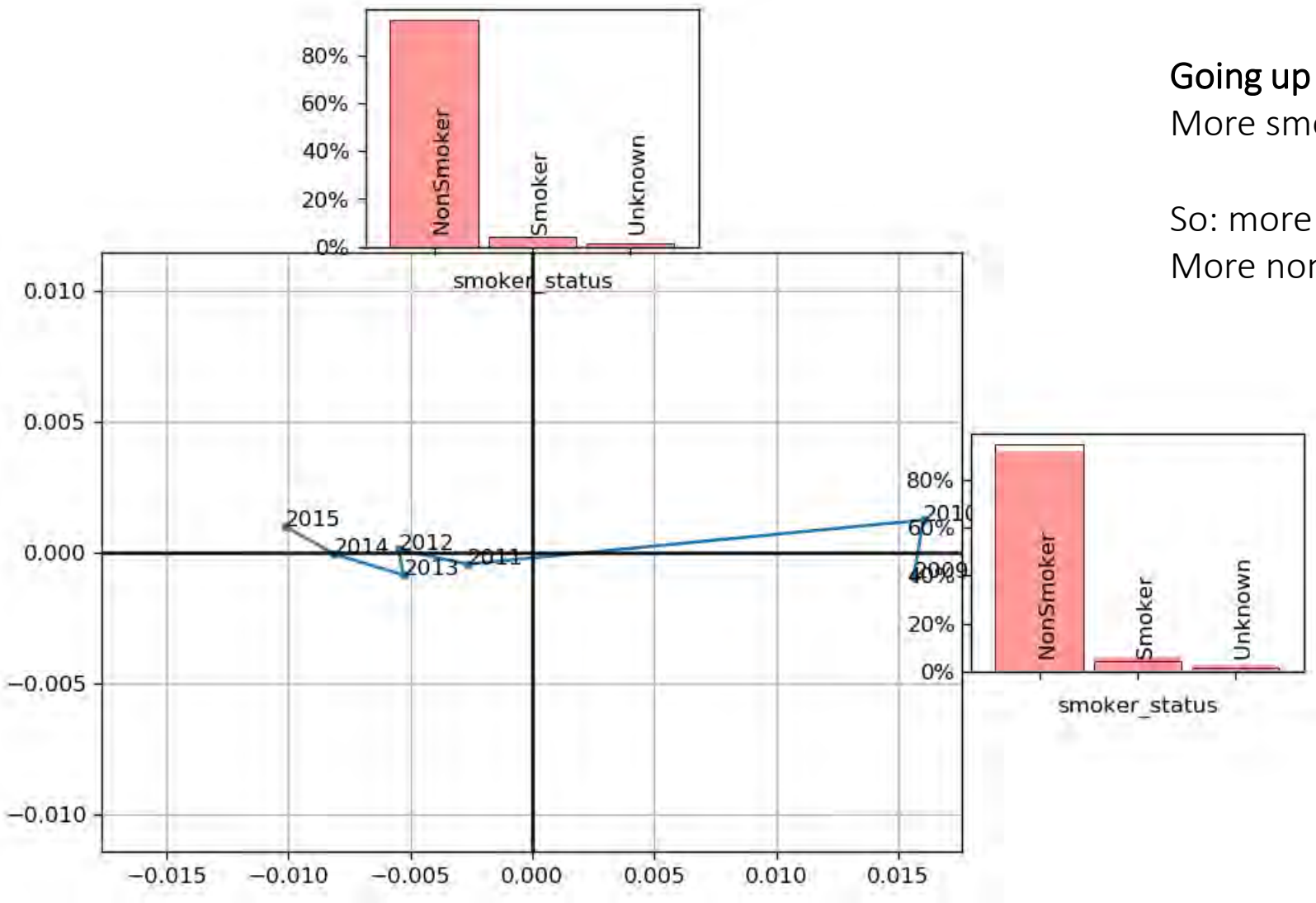
Issue age

Going up on Y axis:
Is younger issues (L of peak)



Going up on X axis:
More in higher ages.
Here 2009, 2010, 2012 also weird.

Smoker status



Going up on X axis:
More smoker.

So: more recent years have less smoker exposure,
More nonsmoker.

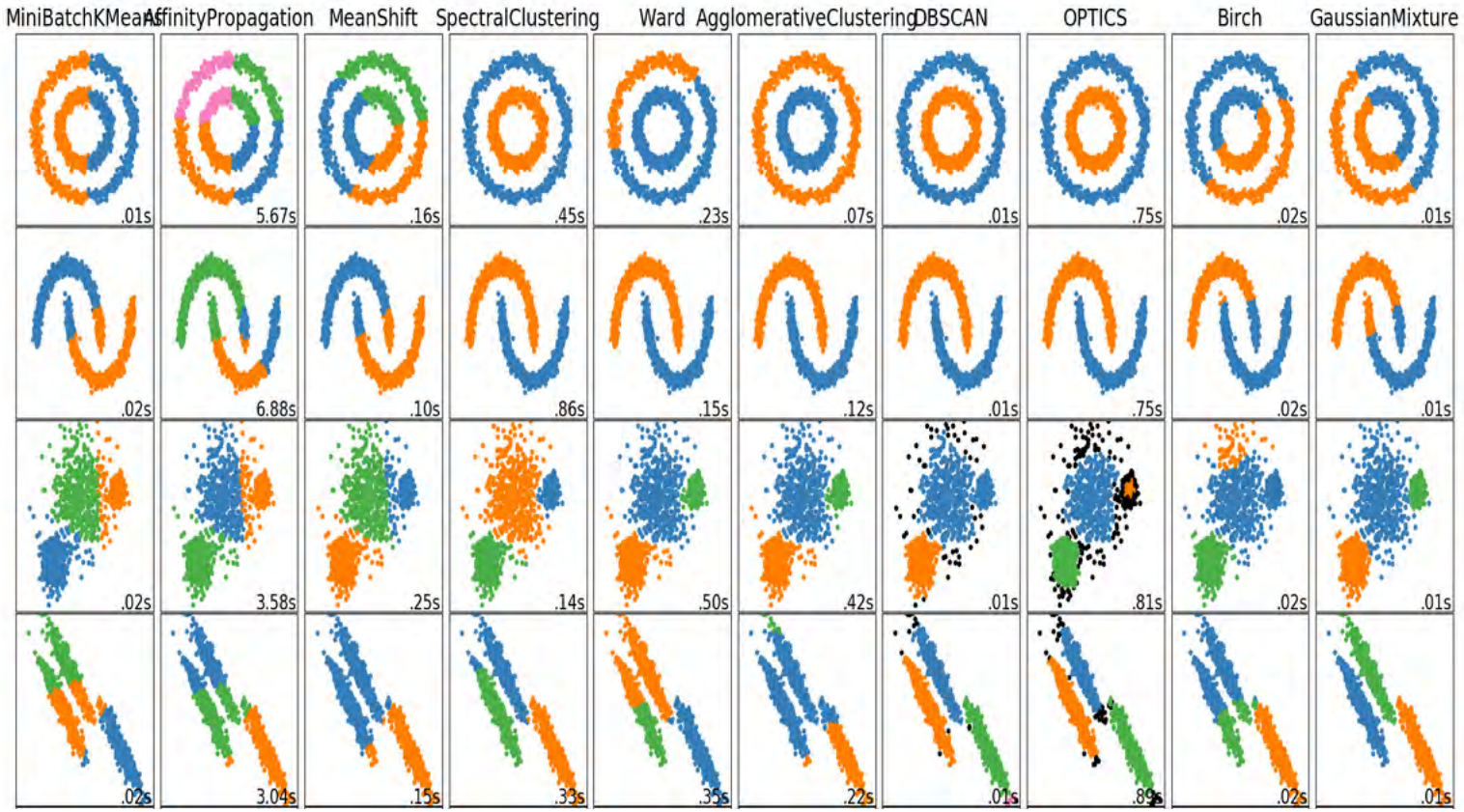
Clustering algorithms

- Purpose: **calculate** the groups
- **Assign individuals** to groups
  - Individual years – other subsets
- **Ex:** is the most recent year pretty similar to prior years
  – or did it zig instead of zag?
- With few observations (like years) it makes less sense
  - But the intuition is there: quantitatively address which one is an oddball
- SVD reduces the number of dimensions of an entity to facilitate computation for large groups

Clustering examples: Python scikit-learn package

https://scikit-learn.org/stable/modules/clustering.html

2.3.1. Overview of clustering methods ¶



Different methods,
different types of situations

Recap – why this?

- See where something was weird: **computationally**
- Say whether new year – or other entity – is similar to others and if so to which: **also computationally**
- Ex: new stat agent collecting data – hopefully no impact
- More advanced: decrements (mortality and / or lapse)
  - for later! Is even noisier
- For now: at least exposures should not be too jumpy –
  - But with increase in study size there were still movements

2019 ANNUAL MEETING & EXHIBIT

Many thanks for your attention!

Brian D. Holland, FSA, MAAA

SOCIETY OF ACTUARIES®