Session 115, Data-Driven Explorations in Healthcare Credibility

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What is Credibility?

- For group insurance with relatively small enrollment, observed claim cost may not be predictive of future claim costs due to the inherent random variation in annual medical claims by member

- To best predict future claim costs, the experience data is often blended with a manual rate in a manner that attempts to minimize prediction error

- The weight given to the experience data is referred to as Credibility

- $P = (E * Z) + (M * (1 - Z))$
  - P = Projected Claim Cost
  - E = Experience Rate
  - M = Manual Rate
  - Z = Credibility

- Following the law of large numbers, the Credibility weight (Z) increases as the group size increases since there will be less variability from year to year and therefore less regression to the mean is needed

Approaches to Determine Credibility Curves - Bühlmann

- Bühlmann's Approach: Linear Approximation of Bayesian Credibility
  - Key Resource: *Introduction to Credibility Theory* by Thomas N. Herzog

- $Z = \frac{N}{(N+K)}$
  - Z = Credibility
  - N = Covered Lives
  - K = Constant

- Constant can be calculated as $K = \frac{EPV}{VHM}$
  - EPV = Expected Process Variance (Total Member-Level Variance minus VHM)
  - VHM = Variance of Hypothetical Means (Variance between group-level costs)

- Calculated value of K highly dependent on outliers/truncation levels
  - Data-driven approach suggests K = 150 with claims capped at $75,000 annually
  - Without claim truncation, data suggests K = 300

Approaches to Determine Credibility Curves - Layered

- Layered or Hierarchical Model: Derived from the covariance of claim costs from one time period to another
    - Key Resource: *A Practical Approach to Assigning Credibility for Group Medical Insurance Pricing* by Charles Fuhrer

- $Z = \frac{(K_1+(N-1)*K_2)}{(1+(N-1)*K_3)}$
    - Z = Credibility
    - N = Covered Lives
    - K_1, K_2, K_3 = Constants

- Constant can be estimated from data by running regressions to minimize prediction errors:
    - K_1 = Credibility on 1 member's claim cost to predict same member in future year
    - K_2 = Credibility on 1 member's claim cost to predict rest of group cost in same year
    - K_3 = Credibility on 1 member's claim cost to predict rest of group cost in future year

- Again, calculated value of K is highly dependent on outliers/truncation levels
    - With claims capped at $75,000 annually: K_1 = .358, K_2 = .009, K_3 = .010

Approaches to Determine Credibility Curves - Stochastic

- Stochastically simulating needed credibility levels using a member claim distribution table
    - Key Resource: *Developing Group Health Credibility Factors through Stochastic Modeling* by John A. Albert

- Monte Carlo simulation methods can be used to determine the most accurate credibility levels by group size

- Assumptions need to be made (and can easily be sensitivity tested) for:
    - Correlation in member claim costs from year to year
    - Truncation/pooling of high claims
    - Member turnover within groups from year to year

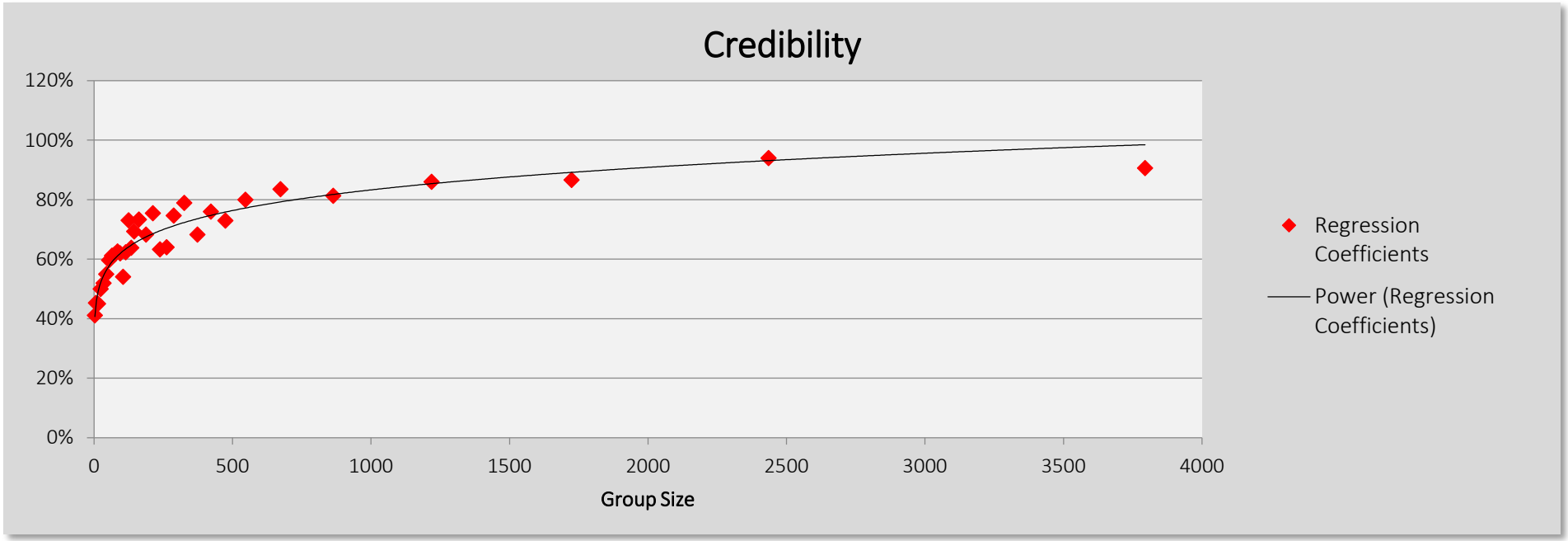
- Could be modeled in a much more sophisticated (and possibly accurate) way with today's technology and data processing capabilities

Data-Driven Regression Approach

- Database with 3 years allowed costs and enrollment data for Small and Large Employers
- Experience and Projected Allowed PMPMs were calculated for each group for various time periods, all with annual claims capped at $75,000 per member
- The total Allowed PMPM for each time period was normalized to the same amount to neutralize any trend or other projection effects
- Groups that had similar enrollment in the experience and projection periods were divided into 35 buckets by group size
- For each bucket a linear regression was performed to determine the weights for the experience/manual rates that minimized the squared prediction error
- Weights by group size were fitted to a smoothed line using a power law curve

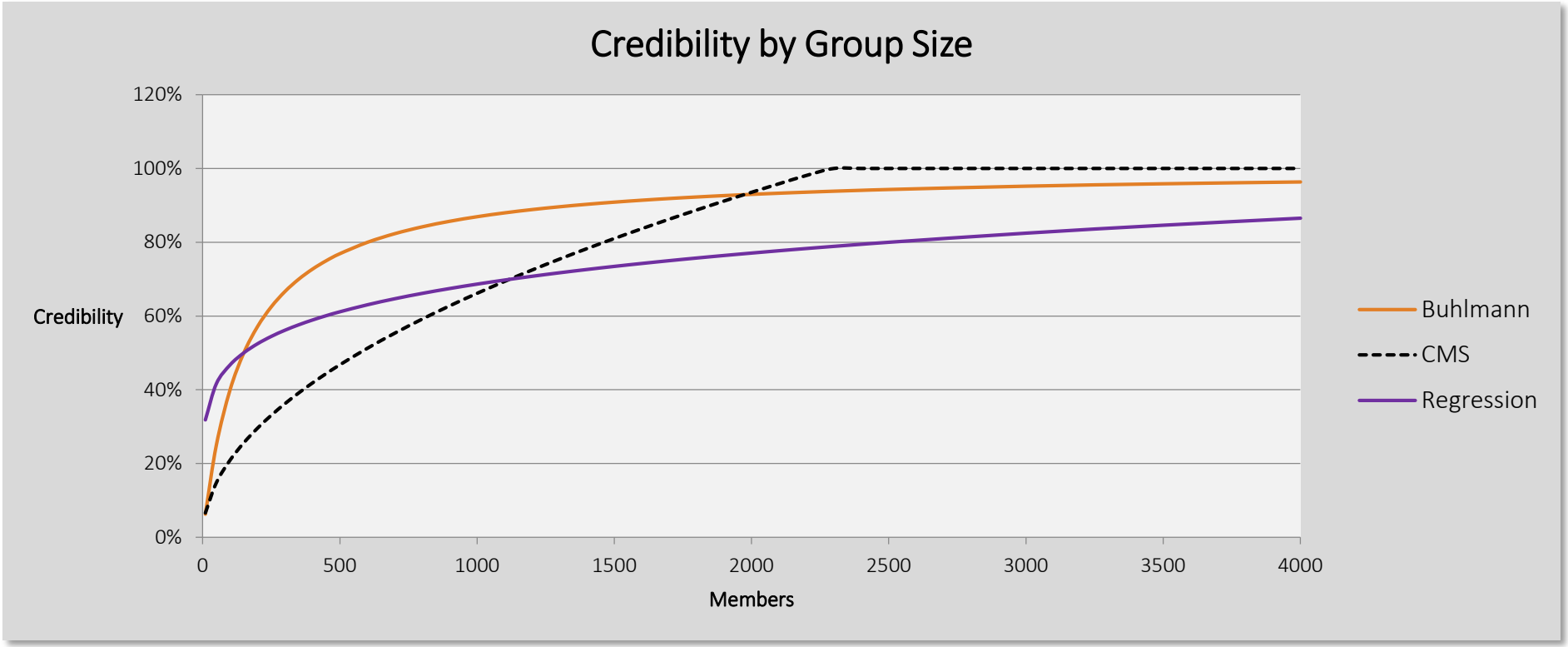
Data-Driven Regression Approach - Example

- Calculate experience and manual rate for all groups in a given group size corridor
- Determine the weight to give the experience rate that minimizes the squared prediction error of actual costs in the projection period by running a simple linear regression
- Repeat for various group sizes
- Fit a credibility curve to the data



Initial Results

- Regression curve (12 month delay with a calibrated manual shown) typically flatter than other approaches
- Even a 1 member group should have 30-40 percent credibility if minimizing prediction error is the only goal



Initial Results – Does This Matter?

- How much does this actually help?

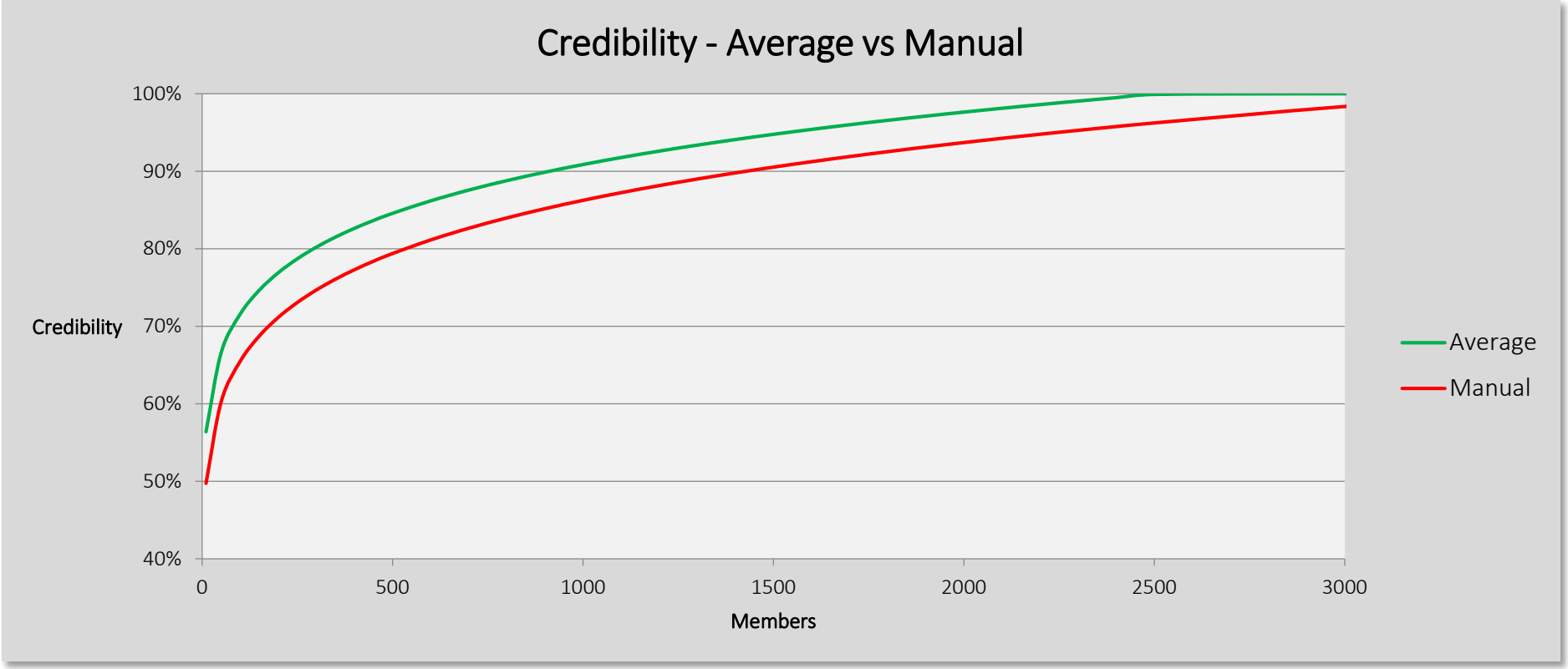
~1000 Large Groups grouped into ten projection buckets

Group	Actual	Proj Buhlmann	Proj Regression	Proj Diff PMPM
1	266.05	265.39	256.87	-8.52
2	294.05	307.25	300.70	-6.55
3	323.29	331.16	326.87	-4.29
4	350.01	349.89	347.52	-2.37
5	366.60	368.43	366.51	-1.92
6	384.28	386.92	386.54	-0.38
7	406.01	407.20	407.08	-0.12
8	431.78	430.67	432.03	1.35
9	463.22	462.24	465.53	3.28
10	545.39	540.21	548.30	8.09
	Correlation:	0.22	0.22	
	MAPE:	80.86	80.13	

- Since credibility curves cross, results in similar prediction accuracy and only slightly different answers

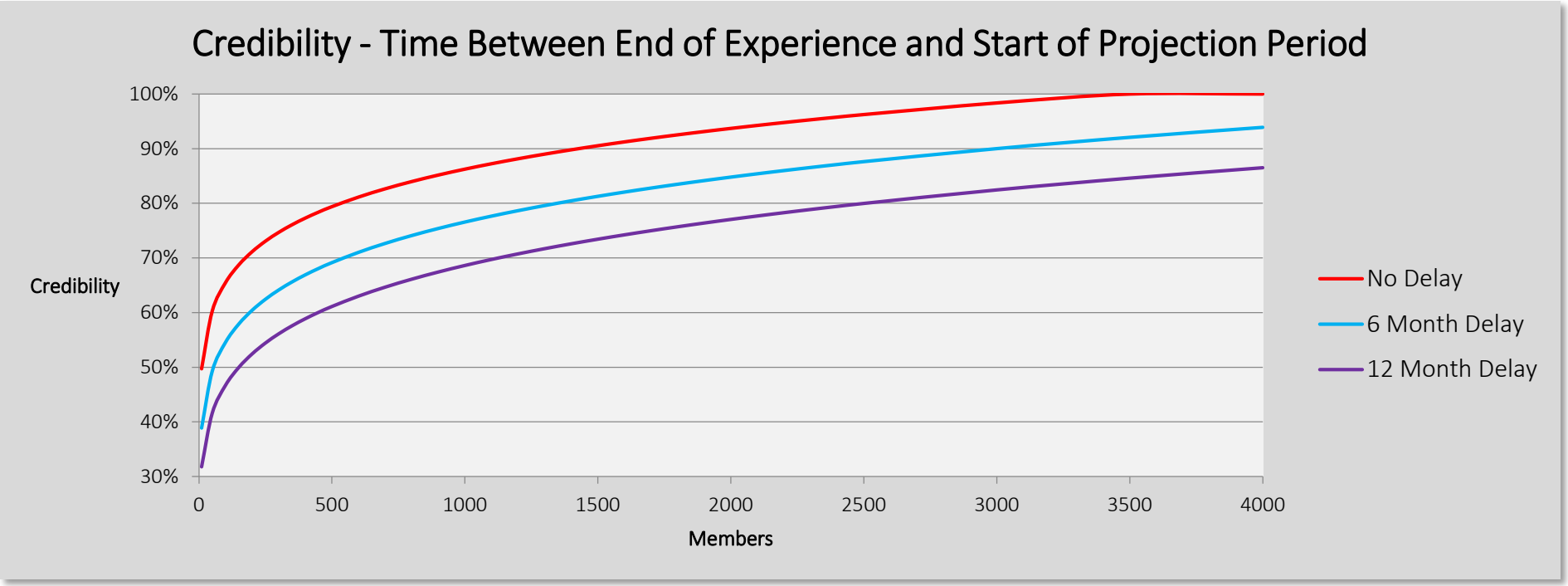
Other Considerations – How Calibrated Is the Manual?

- How well does the manual rate represent the demographics/risk level of the experience?
- A manual rate that is adjusted to the area and age/sex mix of experience results in 4% to 7% less experience credibility needed than a manual rate set to the unadjusted block average



Other Considerations – Time Between Experience and Projection Periods?

- How many months elapse between the experience and projection periods?
- Each additional 6 months in lag time requires 7% to 11% less credibility than if the projection period immediately follows the experience period
- 12 months lag time often used for Rate Filings, Medicare Bids, and some Large Employers



Lag Time Between Experience and Projection Time Periods – Does This Matter?

- How much does this actually help?

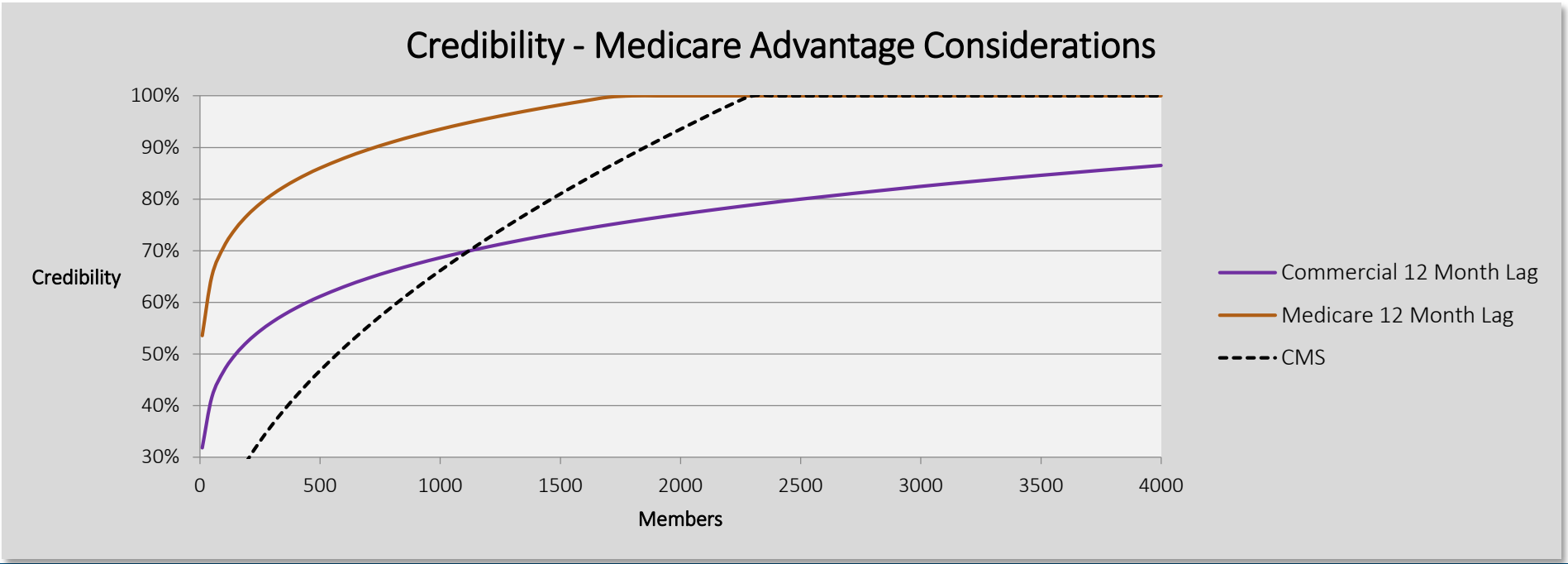
~1000 Large Groups grouped into ten projection buckets

Group	Actual (12 Mo. Delay)	Proj No Delay	Proj 12 Month Delay	Proj Diff PMPM
1	264.90	229.60	256.34	26.74
2	296.48	284.32	300.60	16.28
3	321.36	315.89	326.95	11.06
4	350.44	340.81	347.45	6.64
5	366.49	362.87	366.57	3.71
6	385.91	387.03	386.47	-0.56
7	404.63	411.73	407.16	-4.57
8	432.67	441.14	431.96	-9.18
9	461.07	481.17	465.43	-15.74
10	546.74	583.16	549.02	-34.14
	Correlation:	0.21	0.22	
	MAPE:	82.12	80.13	

- Since “No Delay” Curve consistently uses credibility that is too high, can lead to over-projecting high-cost groups and under-projecting low-cost groups

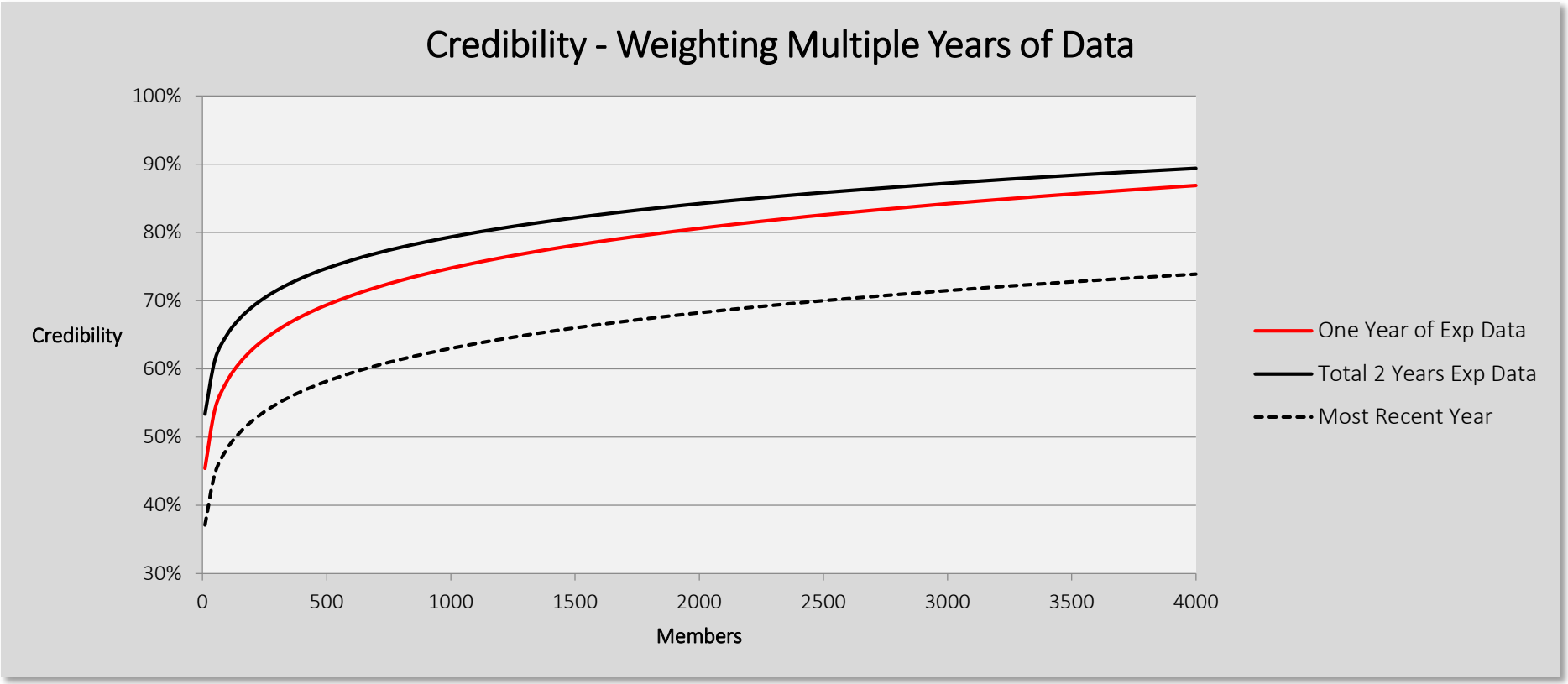
Medicare Advantage Approach

- Available data is more sparse for Medicare Advantage
- Typically a 12-month delay between the experience and projection time periods where a similar, fully-credible demographic group is chosen as manual and adjusted for differences in risk score
- Important to know how well the manual data represents the experience (the less credible/confident you are that your manual represents the true mean, the more experience credibility to use)



Other Considerations - Multiple Years Experience

- General rule of thumb – manual gets 3% to 8% less weight with additional year of data
- Older data carries higher percentage of experience weight at smaller group sizes



Other Considerations - Multiple Years Experience

- How much does this actually help?

~1000 Large Groups grouped into ten projection buckets

Group	Actual	Proj 1 Year	Proj 2 Year	Proj Diff PMPM
1	242.76	228.38	227.39	-0.99
2	284.21	285.54	283.59	-1.95
3	311.95	316.59	314.39	-2.19
4	336.15	340.50	339.84	-0.65
5	360.46	362.52	361.76	-0.76
6	381.50	384.49	384.46	-0.03
7	406.84	408.40	408.12	-0.27
8	435.67	435.25	436.45	1.20
9	467.82	473.91	475.06	1.15
10	571.86	569.16	573.00	3.84
	Correlation:	0.24	0.24	
	MAPE:	75.24	74.07	

- Other ways to incorporate older data:
  - Using prior year premium as a proxy for historical claims
  - Adjusting trend assumptions

Other Considerations When Setting Credibility Curves

- Service Category and Disease Prevalence Mix
  - Certain disease states and other health status indicators are better predictors of future claim cost than others
- For risk-adjusted lines of business, is the revenue received correlated with claim cost?
  - Projecting claim cost may not matter as much as projecting loss ratios for some lines of business
- Changes in coverage or regulation from Base Period to Projection Period
- Competitive Marketplace Pressures
  - Credibility curves have decreased in practice over time due to marketing pressures to give full credibility to groups with healthier than average experience
  - Long-term focus needs to be on pricing the groups correctly, but health plans may need to consider the prices competitors are offering
- Fairness/Transparency
  - Damages due to mistrust may outweigh benefits of actuarially sound approaches if groups do not believe they are being treated fairly or given credit for their “good” experience

Summary of Considerations

- Truncation, Member Turnover
- Block Average vs Calibrated Manual Rate
- How representative of the population is the manual rate?
- How much lag time between experience period and projection period?
- How many years of data?
- Transparency and Competitive Marketplace Pressures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