Gerbils on Espresso

A Better Way to Calculate IBNR Reserves With Low Variance

BY ROBERT G. LYNCH

Cookbook methods for calculating IBNR reserves may have worked in the age of slide rules and adding machines, but lack of mathematical soundness condemns them in the age of computers.

THE MOST COMMON AND PERSISTENT BUGABOO for chief financial officers of managed care and health insurance organizations is the month-to-month variation in calculated reserves for "incurred but not yet paid" (IBNR) claims. While a certain degree of real variation in these reserves is to be expected, it's the duty of the financial actuary to calculate as accurately as possible the amount to be expected.

The achievement of this goal necessitates an understanding of the difference between the process variance, measured by the "standard deviation" of the underlying claim incurral and payment process, and the method variance, or "standard error," which is a characteristic of the measurement method.

Due to the heuristic nature of most of the calculation methods used by actuaries, a certain amount of method variance is to be expected. However, a critical evaluation of the most common methods used by health care actuaries shows that the methods used yield, for the most part, a much higher error due to methodology than is necessary.

ILLUSTRATION BY RICHARD THOMPSON

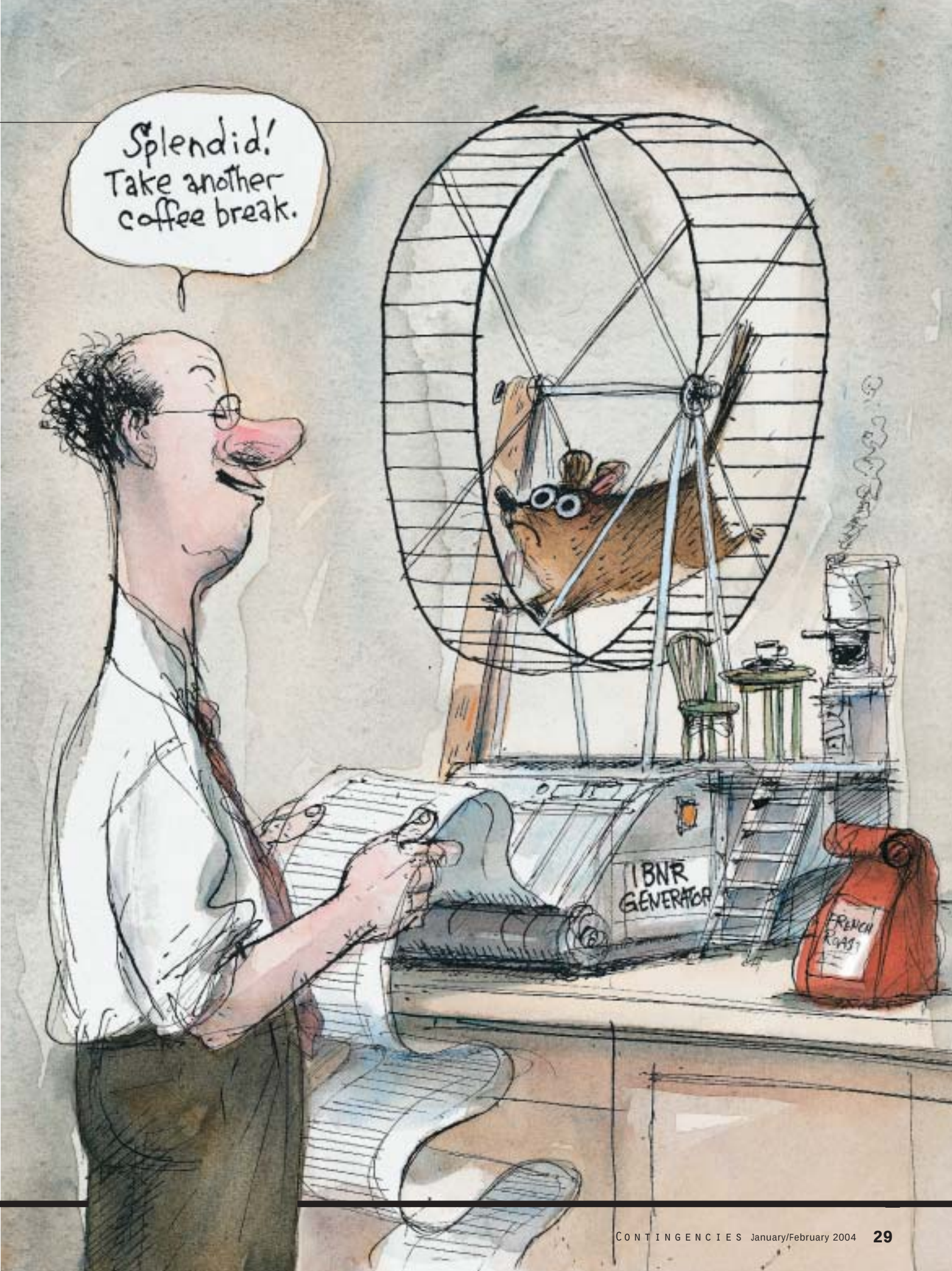
Splendid! Take another coffee break.
IBNR GENERATOR
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TABLE 1. IBNR Estimates for Tightly Held Managed Care Organization or Integrated Health Care Delivery System

	ZERO RUN-OUT IBNR						1-MONTH RUN-OUT IBNR					
	Average Estimated IBNR			Standard Error of Estimate			Average Estimated IBNR			Standard Error of Estimate		
Method	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims
Actual IBNR	$7,991	100.0	130.8	$ 840	10.5	13.7	$3,563	100.0	58.3	$ 603	16.9	9.9
Completion Factor	$7,621	95.4	124.7	$1,515	19.0	24.8	$3,217	90.3	52.7	$ 790	22.2	12.9
Pure Paid PMPM	$7,745	96.9	126.8	$ 962	12.0	15.7	$3,293	92.4	53.9	$ 759	21.3	12.4
3-Month Paid PMPM	$7,652	95.8	125.2	$ 791	9.9	12.9	$3,142	88.2	51.4	$ 625	17.6	10.2
Pure Incurred PMPM	$8,818	110.3	144.3	$1,111	13.9	18.2	$4,607	129.3	75.4	$1,271	35.7	20.8
3-Month Incurred PMPM	$7,707	96.4	126.1	$1,137	14.2	18.6	$3,348	94.0	54.8	$ 938	26.3	15.3

	2-MONTH RUN-OUT IBNR						3-MONTH RUN-OUT IBNR					
	Average Estimated IBNR			Standard Error of Estimate			Average Estimated IBNR			Standard Error of Estimate		
Method	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims
Actual IBNR	$2,076	100.0	34.0	$ 483	23.3	7.9	$1,339	100.0	21.9	$ 308	23.0	5.0
Completion Factor	$1,809	87.2	29.6	$ 603	29.0	9.9	$1,113	83.2	18.2	$ 398	29.7	6.5
Pure Paid PMPM	$1,808	87.1	29.6	$ 615	29.6	10.1	$1,134	84.7	18.6	$ 408	30.5	6.7
3-Month Paid PMPM	$1,724	83.0	28.2	$ 488	23.5	8.0	$1,064	79.5	17.4	$ 342	25.6	5.6
Pure Incurred PMPM	$3,332	160.5	54.5	$1,420	68.4	23.2	$2,804	209.5	45.9	$1,584	118.3	25.9
3-Month Incurred PMPM	$2,030	97.8	33.2	$ 870	41.9	14.2	$1,462	109.2	23.9	$ 723	54.0	11.8

TABLE 2. IBNR Estimates for Open Indemnity-Type Health Insurance Carrier

	ZERO RUN-OUT IBNR						1-MONTH RUN-OUT IBNR					
	Average Estimated IBNR			Standard Error of Estimate			Average Estimated IBNR			Standard Error of Estimate		
Method	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims
Actual IBNR	$11,084	100.0	181.4	$ 957	8.6	15.7	$5,930	100.0	97.1	$ 800	13.5	13.1
Completion Factor	$10,462	94.4	171.2	$2,910	26.3	47.6	$5,817	98.1	95.2	$1,170	19.7	19.1
Pure Paid PMPM	$11,219	101.2	183.6	$1,005	9.1	16.5	$5,935	100.1	97.1	$ 860	14.5	14.1
3-Month Paid PMPM	$11,137	100.5	182.3	$ 976	8.8	16.0	$5,822	98.2	95.3	$ 801	13.5	13.1
Pure Incurred PMPM	$13,463	121.5	220.3	$3,000	27.1	49.1	$8,612	145.2	141.0	$3,140	53.0	51.4
3-Month Incurred PMPM	$11,232	101.3	183.8	$1,109	10.0	18.2	$6,145	103.6	100.6	$ 991	16.7	16.2

	2-MONTH RUN-OUT IBNR						3-MONTH RUN-OUT IBNR					
	Average Estimated IBNR			Standard Error of Estimate			Average Estimated IBNR			Standard Error of Estimate		
Method	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims
Actual IBNR	$3,728	100.0	63.8	$ 514	13.8	8.8	$2,634	100.0	45.1	$ 402	15.3	6.9
Completion Factor	$3,510	94.1	60.1	$ 692	18.6	11.8	$2,422	91.9	41.5	$ 517	19.6	8.8
Pure Paid PMPM	$3,821	102.5	65.4	$ 580	15.6	9.9	$2,651	100.6	45.4	$ 424	16.1	7.3
3-Month Paid PMPM	$3,525	94.6	60.4	$ 461	12.4	7.9	$2,427	92.1	41.6	$ 359	13.6	6.2
Pure Incurred PMPM	$6,670	178.9	114.2	$3,292	88.3	56.4	$5,785	219.6	99.1	$3,433	130.3	58.8
3-Month Incurred PMPM	$4,087	109.6	70.0	$ 933	25.0	16.0	$3,153	119.7	54.0	$ 997	37.8	17.1

On the face of it, then, the actuary is concerned with dealing with these two largely random events: who gets sick when, and how much does it cost?

A re-examination of one of the basic properties of variance will reveal why some common reserve calculation methods result in a high variance and what will lower that variance. That key property is that variances are additive under additions but increase polynomially under multiplication. That is, the variance of the sum of a collection of random variables is, in general, the sum of the variances of the individual variables, while any multiplication process applied to a random variable increases variance in proportion to the square of the multiplier. (For ease of presentation, I will assume that covariances are negligible here.)

So, to keep the error variance to a minimum, one should seek to use methods that rely on the summation of data, and avoid methods that use or result in multiplicative factors. The best example of this in statistics is the Best Linear Unbiased Estimator (BLUE) of regression, which is based on minimizing the sum of the squared errors.

The textbook method used by most actuaries to calculate IBNR reserves is the Completion Factor method, which is mathematically equivalent to the Chain Ladder method. As anyone who has studied for SOA Exam 5 (or its predecessors) knows, this method is based on the calculation of the historical proportion of claims incurred in a given incurral period (usually the incurral month) and paid in that and any given succeeding period (usually the paid month) to the total incurred claims in the incurral period.

This ratio is the "completion factor." For a recent month, the incurred and paid claims are then multiplied by the reciprocal of the completion factor to give an estimate of the actual incurred claims in the incurral month. The total incurred claims are estimated by simply adding together the amounts calculated for each month up to the valuation date.

Since this process involves multiplying real data by a statistical parameter that's calculated using the subversive operator of multiplication, it's no surprise that the standard error of the result is quite high.

People Get Sick

Many CFOs, frustrated by the wild fluctuations in reserves produced by the Completion Factor method, have sought refuge and stability by turning to a different approach, which I will refer to as the Incurred Claims Per Member Per Month method, or simply the Incurred PMPM method.

In this method, the average total incurred claims PMPM from historical (and supposedly complete) data is calculated, and

TABLE 3. IBNR Estimates for Open-Access POS or PPO Type of Health Plan

	ZERO RUN-OUT IBNR						1-MONTH RUN-OUT IBNR					
	Average Estimated IBNR			Standard Error of Estimate			Average Estimated IBNR			Standard Error of Estimate		
Method	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims
Actual IBNR	$ 9,538	100.0	159.6	$ 801	8.4	13.4	$4,746	100.0	79.4	$ 641	13.5	10.7
Completion Factor	$ 9,196	96.4	153.9	$1,727	18.1	28.9	$4,542	95.7	76.0	$ 860	18.1	14.4
Pure Paid PMPM	$ 9,474	99.3	158.6	$ 841	8.8	14.1	$4,612	97.2	77.2	$ 713	15.0	11.9
3-Month Paid PMPM	$ 9,399	98.5	157.3	$ 679	7.1	11.4	$4,486	94.5	75.1	$ 598	12.6	10.0
Pure Incurred PMPM	$10,695	112.1	179.0	$1,787	18.7	29.9	$6,144	129.5	102.8	$1,900	40.0	31.8
3-Month Incurred PMPM	$ 9,468	99.3	158.4	$ 872	9.1	14.6	$4,720	99.4	79.0	$ 779	16.4	13.0

	2-MONTH RUN-OUT IBNR						3-MONTH RUN-OUT IBNR					
	Average Estimated IBNR			Standard Error of Estimate			Average Estimated IBNR			Standard Error of Estimate		
Method	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	Average Total IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNR $ (X 1,000)	Percent of Actual IBNR	% of Avg Monthly Incurred Claims
Actual IBNR	$2,902	100.0	48.6	$ 412	14.2	6.9	$1,987	100.0	33.2	$ 292	14.7	4.9
Completion Factor	$2,678	92.3	44.8	$ 545	18.8	9.1	$1,782	89.7	29.8	$ 388	19.5	6.5
Pure Paid PMPM	$2,806	96.7	47.0	$ 462	15.9	7.7	$1,886	95.0	31.6	$ 319	16.0	5.3
3-Month Paid PMPM	$2,628	90.6	44.0	$ 371	12.8	6.2	$1,749	88.0	29.3	$ 278	14.0	4.7
Pure Incurred PMPM	$4,522	155.8	75.7	$2,021	69.6	33.8	$3,793	190.9	63.5	$2,140	107.7	35.8
3-Month Incurred PMPM	$3,000	103.4	50.2	$ 739	25.5	12.4	$2,239	112.7	37.5	$ 720	36.3	12.1

trend is applied to project those amounts to recent months. Then this projected PMPM amount is multiplied by the number of member-months in the valuation period to yield the total incurred claim costs to be entered in the financials. The IBNR reserve is "backed into" as an afterthought by subtracting the incurred and paid claims amounts from this estimate of the total incurred claims amount.

This method gives a nice, stable projection of total incurred (or accrued) claims expenses, which is great comfort to CFOs, most of whom crave stability. However, for estimating incurred claims, it totally ignores data on claims incurred and paid in recent months. Moreover, it inherently assumes a negative correlation between claims incurred and paid and claims incurred and not yet paid. It's worthwhile scrutinizing the sources of variability in the process of claims incurral and payment to better understand what we're attempting to measure.

People get sick, more or less at random. If they judge themselves to be sufficiently sick, they seek out medical care by going to their doctor or, in some cases, the hospital emergency room. At that point they enter the complex world of the health care system, which provides them a selection of services or products that, it's hoped, gets them well and back into their normal, healthy routine again. The amount and cost of this health care treatment can vary hugely in each case, depending on the presenting condition.

On the face of it, then, the actuary is concerned with dealing with these two largely random events: who gets sick when, and how much does it cost?

However, between the point when the person (now a patient) enters the health care system and the time when the paying party (the health insurer or HMO) actually cuts a check to reimburse the providers in the system, a lot of things happen. And those things (let's call them "claims reporting and processing") usually take time (the "claim lag").

The duration of the claim-lag period varies not only somewhat at random but also in relation to the source or size of the individual claims. During the claim-lag period, the value of those health care services (or at least the part for which the payer is liable) floats in the limbo of IBNR.

The problem from the actuary's point of view is that the amount of time involved in claims reporting and processing can vary a lot, and may or may not relate to how many claims are floating around in the IBNR limbo, or how big they are.

Gerbils on Espresso

Enter the IBNR calculation. The health care actuary applies the textbook Completion Factor method, because that's what he's learned, and using it saves the effort of having to think too much. ("If it's good enough for everybody else, then it's good enough for me!") Unfortunately, the Completion Factor method has an implicit, hidden assumption in it. That assumption is this: *The only source of variability in actual claims incurral is in the frequency and intensity of health care services (morbidity), and there is no variability in the rate of claims reporting and processing.*

The actuary dutifully sends off his IBNR reserve report to the CFO every month, on the same day. The CFO, however, is

TABLE 4. Important Characteristics of the Completion Factor, Incurred Claims PMPM, and Paid Claims PMPM Estimators of IBNR and Incurred Claims

Characteristics of IBNR Reserve/Incurred Claims Estimation Method	IBNR RESERVE/INCURRED CLAIMS ESTIMATION METHOD		
	Completion Factor/ Chain Ladder	Incurred Claims PMPM	Paid Claims PMPM
Assumptions that are implicit to the respective methods	Variations in paid claim amounts are dependent only on variations in morbidity and total incurred claims costs. Conversely, total incurred claims costs are dependent only on claim amounts incurred and already paid. Rates of claims reporting and processing are stable and constant	Morbidity and total incurred claims costs are fully predictable solely from past claim costs adjusted for trend, etc. Total incurred claims amounts for recent months are independent of claims incurred for the same period and already paid (except when the latter is the greater)	Claim dollar amounts incurred but not yet paid are equal to past average PMPM paid amounts with similar lags, adjusted for trend, etc. Claim amounts incurred but not yet paid are independent of claim amounts incurred and already paid
Error variance of IBNR estimate associated with respective methods	Very high	Moderate	Very low
Error variance of incurred claims estimate associated with respective methods	Very high	Very low	Low
Bias of IBNR and incurred claims estimator	Unbiased	Produces estimates biased toward the high side relative bias increases with longer claims run-out	Unbiased
Correlation between IBNR amounts and claim amounts incurred and paid	Strongly positive correlation	Strongly negative correlation	Not related 0% correlation
Correlation between total incurrred claim amounts and claim amounts incurred and already paid	100% positive correlation by ratio	No correlation (except when Incurred and paid are greater than average total incurred)	Strong positive "additive" correlation
Sensitivity of IBNR estimator to seasonality of morbidity (claims incurral)	Not sensitive; seasonality is implicitly accounted for in method.	Very sensitive, but inversely. Without adjustment, any seasonality may contribute significant error to IBNR estimates.	Not sensitive, adjustments may be made for known seasonal variations in morbidity
Sensitivity of IBNR estimator ro calendar seasonality (e.g., number of days in month)	Not sensitive; seasonality is implicitly accounted for in method.	Very sensitive; adjustments necessary	Somewhat sensitive; adjustments necessary.
Sensitivity of IBNR estimator to benefit design seasonality (e.g., calendar-year deductibles, benefit limits)	May be slightly sensitive, depending on benefit design; adjustments may be necessary	Very sensitive; adjustments necessary	May be sensitive; adjustments necessary depending on benefit design
Sensitivity to trend effects	Not sensitive to trend	Sensitive to trend, inaccuracy of trend assumptions may lead to significant error in IBNR estimates	Slightly sensitive to trend, but potential for error significantly less than incurred PMPM method
Sensitivity of IBNR to changes in morbidity or utilization patterns of covered population	Very sensitive, but due to high variance of results, it may be difficult to identify changes immediately	Very sensitive, changes in paid claim amounts are implicitly assumed to result from claim payment process, not changes in incurred amounts	Not sensitive, method inherently assumes that remaining IBNR is constant after other adjustments
Sensitivity of incurred claims estimates to changes in morbidity or utilization patterns of covered population	Very sensitive, but due to high variance of results, it may be difficult to identify changes immediately	Not sensitive, method inherently assumes that morbidity does not change	Somewhat sensitive, more sensitive in situations with rapid claims reporting and processing, less sensitive in slow or inefficient systems
Sensitivity of IBNR estimates to variation in rate of claims reporting and processing	Very sensitive; any variation may result in significant error of IBNR estimate.	Very sensitive; any variation may result in significant error of IBNR estimate.	Somewhat sensitive, speeding up process causes over-estimation of IBNR, and vice versa
Sensitivity of incurred claims estimates to variation in rate of claims reporting and processing	Very sensitive; any variation may result in significant error of Incurred claims estimates	Not sensitive	Somewhat sensitive, similar to IBNR estimator

incredulous. The reported reserves bounce around like a gerbil snacking on espresso beans. She knows this can't be right. She also knows that if her financial reports to the CEO and the board of directors don't resemble something close to reality, she'll be out on the street selling pencils pretty quick.

So she thinks, "The health plan has a lot of members, and they don't all get sick at once. I'll just project forward our past incurred PMPM claims using the trend rate I got from the actuarial department (maybe they got *that* right, at least!) and book the difference as the IBNR reserve."

Unfortunately, the incurred PMPM method also has an implicit, hidden assumption in it. That assumption is this: *The only source of variability in how much is paid in claims each month is due to the claims reporting and processing, and there is no variability in actual member morbidity*.

So which one is using the best estimator? The answer is neither!

The score is now actuaries *minus* 1, accountants *minus* 1.

The actuary can derive a much better estimator by reviewing and using the information from his first actuarial exam (the one on math and statistics). Rather than calculating a factor by which to multiply monthly incurred and paid claims, project a collection of several values that can be summed together to give an unbiased estimator of the IBNR reserves, with a low variance.

Enter the "Paid Claims PMPM" method. It goes something like this: For each incurral month *i* with *j* months of lag, project from historical data the average dollar amount per member incurred in month *i*, but not paid until month *j*. After adjusting those amounts for trend, add them all together for the corresponding *i*s and *j*s in the IBNR limbo, and add all those together for every member *m* in every month *i* (or maybe just multiply by M_i, the number of members covered in month *i*, and then add all the M_is together).

In order to illustrate the differences in results among these three methods, I've prepared a comparison of IBNR estimates calculated using each, together with realized "look-back" IBNR amounts. These calculations are made on real data, which has been transformed to preserve confidentiality. The data has also been adjusted in volume to represent a constant exposure of 100,000 members.

The data is divided into three sets. One set of data represents claims incurred and paid under coverage of a closed-panel, integrated health care delivery system (IDS) or managed care organization (MCO). The second data set represents claims for health care services from providers in a nonnetwork setting, who have no connection to the payer organization, as would be the case with an indemnity or fee-for-service (FFS) health insurance plan. The third data set represents an open, loosely held health plan, such as a point-of-service (POS) or preferred provider organization (PPO).

I show the calculated results for estimates of IBNR amounts for periods with zero claims payment run-out, one month, two

FIGURE 1. Error in Total IBNR Estimates—Zero Run-Out, Closed-Panel Integrated Delivery System or HMO

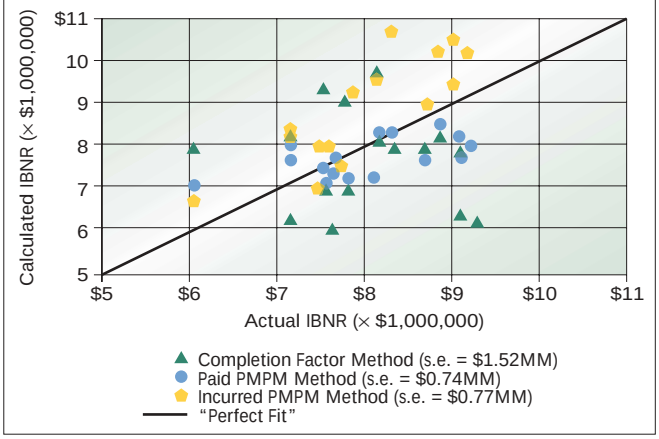


FIGURE 2. Error in Total IBNR Estimates—Zero Run-Out, Open-Access Indemnity Health Plan

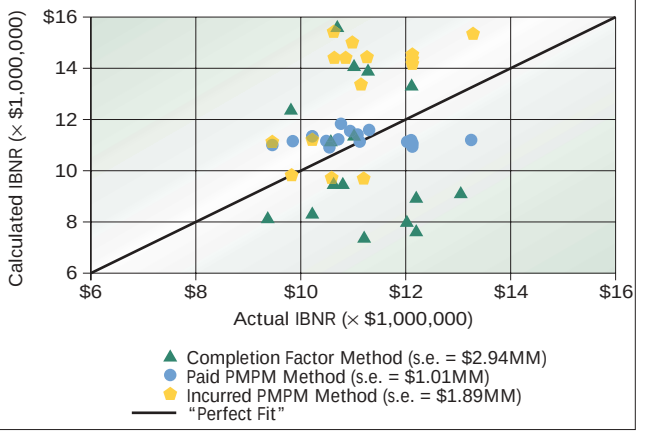
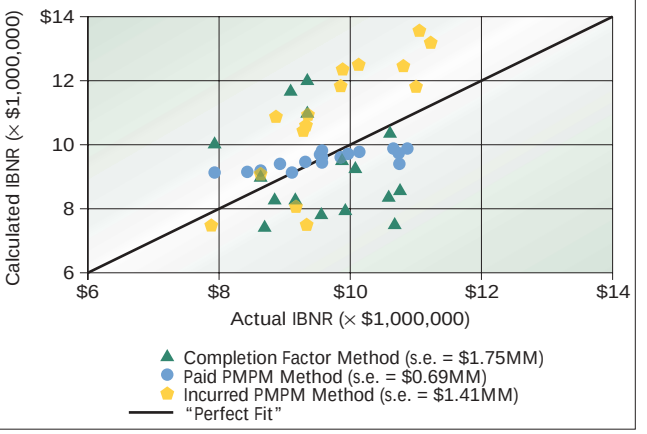


FIGURE 3. Error in Total IBNR Estimates—Zero Run-Out, Open Access POS or PPO Managed-Care Health Plan



months, and three months of run-out, respectively. Table 1 shows the results for the IDS/MCO model, Table 2 shows results for the FFS-type coverage, and Table 3 the results for the POS/PPO payer organization. Scattergram plots of estimated IBNR values versus actual IBNR values are shown in Figs. 1, 2, 3, and 4.

One item that becomes immediately apparent in the estimated values of IBNR amounts using the Incurred PMPM method is that it's biased toward overstating the actual IBNR. This tendency is most noticeable in the examples with some period of claims payment run-out. This estimator bias results from the fact that negative values of IBNR aren't allowed for individual months. As a result, when incurred and paid claim amounts exceed the expected incurred claims, the IBNR is truncated. Since this truncation doesn't occur when incurred claims are less than the projected estimate, the method results in a biased estimator.

Figs. 5 and 6 present a comparison of the standard error of estimation for each of the three methods, together with the sample standard deviation of the actual IBNR. It's apparent from these figures that the Paid PMPM method yields substantially lower error with no run-out of claims payment. As the claims payment run-out period gets longer, the standard errors of estimate for the two methods converge, although the Paid PMPM

FIGURE 4. **Standard Error of IBNR Estimates, Tightly-Held HMO or IDS: by Length of Claims Run-out Period**

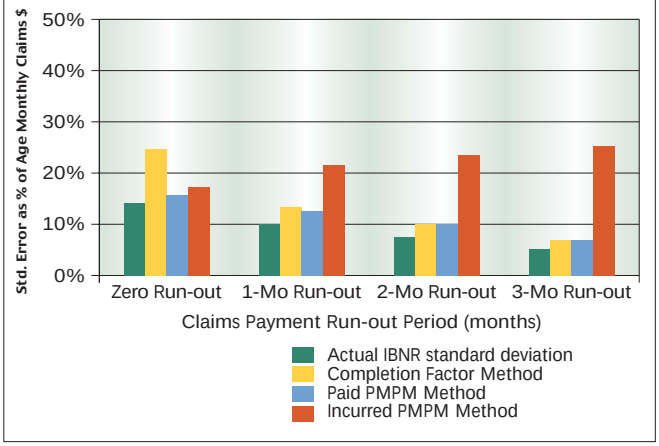


FIGURE 5. **Standard Error of IBNR Estimates, Open Indemnity/FFS Plan: by Length of Claims Run-out Period**

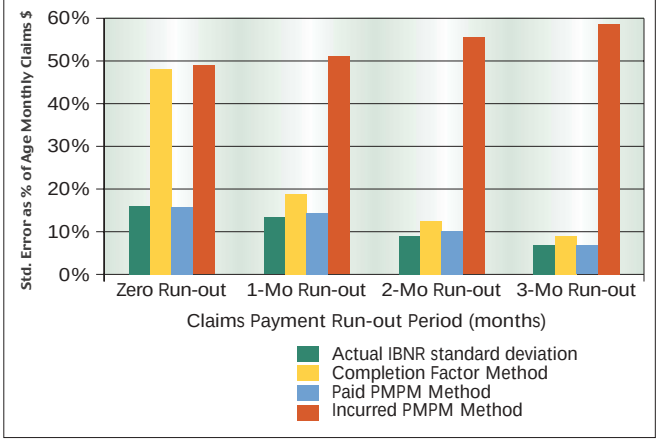
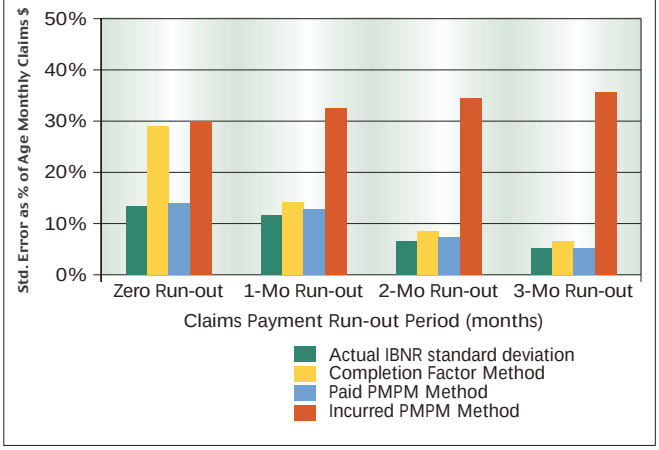


FIGURE 6. **Standard Error of IBNR Estimates, Open Access POS or PPO Plan: by Length of Claims Run-out Period**



It's clearly time to discard the Completion Factor Method for estimating IBNR reserves as the mathematical atrocity it is.

method continues to have a smaller standard error at all lengths of claims run-out.

This result is slightly misleading in that there is actually no correlation between the two estimators. The Completion Factor method tends to exaggerate IBNR in high claims incurral months, while the Paid PMPM method yields IBNR estimators that are independent of actual incurred claims amounts in the months estimated.

I summarize the characteristics of each of these three methods in Table 4.

Hybrids, Not Cookbooks

A logical next step might be to ask if a hybrid of these three methods might yield better results by moderating the inaccuracies of the assumptions implicit to each. I applied such mixed methods to the sample data, using the Paid PMPM and Incurred PMPM methods, respectively, for the final three months of claims incurral leading up to the valuation date. I used the Completion Factor method for periods more than three months before the valuation date. The results are summarized in Tables 1, 2, and 3, and are listed immediately below the results for the "pure" Paid PMPM and Incurred PMPM methods, respectively.

In this example, the hybrid methods appear to generally give improved results over any of the three pure method estimators. In particular, the hybrid three-month Paid Claims PMPM method appears to consistently yield better results than any other estimation method. This is somewhat surprising in light of the fact that, even with three months of claims run-out, the pure Paid Claims PMPM method appears to outperform the Completion Factor method.

Rather than speculate here on the reasons for this apparent paradox (see my earlier disclaimer on covariance), I invite anyone who cares to repeat this analysis on separate data to check for the reproducibility of this result.

In conclusion, it's clearly time to discard the Completion Factor method for estimating IBNR reserves as the mathematical atrocity it is. While an approach such as the Completion Factor method may have been a practical necessity in the age of slide rules and adding machines, its lack of mathematical soundness condemns it in the age of computers.

It's not sufficient to resolutely memorize cookbook methods in much the same manner as 16th-century scholars clung to Aristotle and Galen as Holy Writ. We must critically revisit and reexamine our basic methods for sound thought and reasoning, discarding outdated and unsound methods when necessary, and replacing them with newer, well-founded analyses. There's always a better way; it's up to us to find it.

Note: No gerbils were actually harmed in the preparation of this paper. ●

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