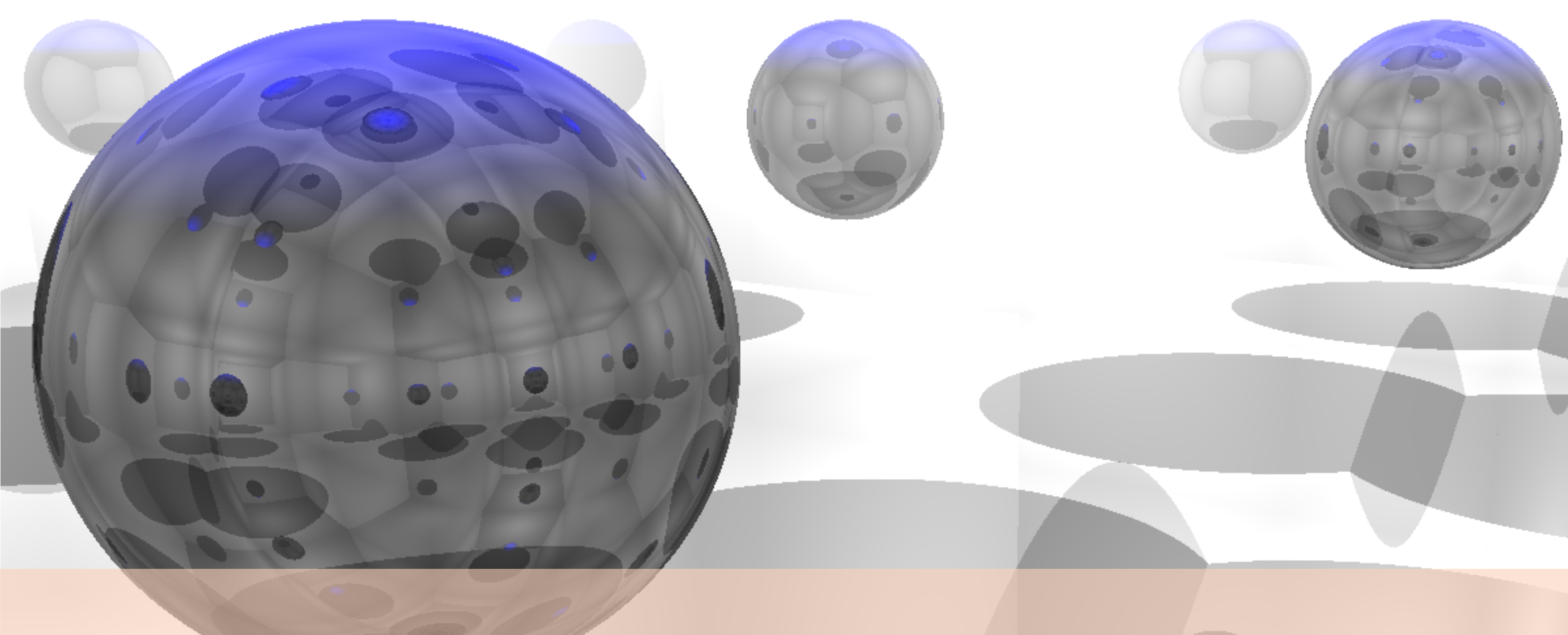

Standard Errors

Our Failing Health Care (Finance) Systems & How To Fix Them

Thomas Cox PhD RN

Row (1)	Operating Characteristic (2)	**Paradigm Insurer** (3)
(1)	Size (N) (1,000s)	**1,000**
(2)	Standard Error (σ_{e_N})	**0.0500**
(3)	Premium Per Policyholder (Annual)	**$4,000**
(4)	Expense Provision Included In Premium	**0.1500**
(5)	Expected Loss Ratio Provision In Premium	**0.7500**
(6)	Profit Margin Provision In Premium	**0.0500**
(7)	Risk Premium Provision In Premium	**0.0500**
(8)	**P[Profit≥10%]**	**0.5000**
(9)	P[Profit≥5%]	**0.8413**
(10)	P[No loss]	**0.9772**
(11)	P[Losses≥5%]	**0.0013**
(12)	P[Losses≥10%]	**0.0000**
(13)	Solvency Preserving Loss Ratio (SPLR)	**0.8663**
(14)	Surplus Needs ($Millions)	**$21**
(15)	Aggregate Surplus ($ Millions)	**$6,783**
(16)	Maximum Sustainable Benefits 5% Profits	**0.7500**
(17)	Maximum Sustainable Benefits 5% Profits $	**$3,000**
(18)	Maximum Sustainable Benefits Avoid Losses	**0.7500**
(19)	Maximum Sustainable Benefits Avoid Losses $	**$3,000**

Table 9.1: Paradigm Insurer Operating Characteristics

help you evaluate different health care (finance) system reform proposals.

9.1 Paradigm Insurer Operating Characteristics

The Paradigm Insurer's future operating results, as all insurers' operating results, depend on the variation in its Population Loss Ratio Estimates ($PLRE_{PI}$s), its loss ratios.

PI's standard error, $\sigma_{e_{PI}} = \sigma/\sqrt{1,000,000}$, tells us how much *PI*'s population loss ratio estimates ($PLRE_{PI}$s) vary from year to year. I assume $\sigma_{e_{PI}}$=0.0500, or 5% of *PI*'s annual premium revenues.

PI's population loss ratio estimate cumulative distribution function is normally distributed, $\Phi_{PI}(\mu=0.7500, \sigma=0.0500)$, because *PI*'s loss ratio is an average of 1,000,000 individual policyholder population loss ratio estimates (See Formula 7.3).

I summarize *PI*'s future operating results in Table 9.1. *PI*'s future operating results include:

- Issues 1,000,000 policies
- Charges each policyholder a $4,000 "market premium" collecting $4,000,000,000 (1,000,000 * $4,000) in premium revenues
- Bears "risk" because $PLRE_{PI}$ is unknown until policies expire and accounting is complete
- Operating results are linear functions of $PLRE_{PI}$
- Operating result *probabilities* are non-linear functions of $PLRE_{PI}$
- Expected Loss Ratio=Population Loss Ratio = 0.7500 /dollar ($3,000,000,000)
- Operating Expenses = $0.15/dollar ($600,000,000)

- Market based "Profit Margin" = 5% ($200,000,000)
- Market based "Risk Premium" = 5% ($200,000,000)
- Pays Claims Costs of $3,000,000,000 or less ($PLRE_{PI} \leq 0.7500$) from current revenues, earning profits of at least 10%, with probability 0.5000
- Pays Claims Costs of $3,200,000,000 or less ($PLRE_{PI} \leq 0.8000$) from current revenues, earning profits of at least 5%, with probability 0.8413
- Pays Claims Costs of $3,400,000,000 or less ($PLRE_{PI} \leq 0.8500$) from current revenues, and avoids net operating losses, with probability 0.9772
- Has beginning Surplus reserves of $65,200,000 protecting it from Claims Costs up to $3,465,200,000 ($PLRE_{PI} \leq 0.8663$), with probability 0.99
- Becomes insolvent, with probability = 0.0100, when total Claims Costs exceed $3,465,200,000

I assume that *PI*, all insurers, and all health care providers operate as efficiently as possible with their current resources. I will show that small insurers must make deep cuts in *PI*'s standard setting claims settlement policies and procedures for medically necessary and appropriate care.

I will show that under reasonable, market-based assumptions, more smaller, competing insurers cannot move our health care finance system toward greater efficiency because more smaller insurers do not manage risk as efficiently as large insurers. Small insurers' inefficiencies as financial risk managers force them to make cuts in *PI*'s standard setting claims settlement policies and procedures for medically necessary and appropriate care or risk missing their profit, loss avoidance, and solvency preservation goals.

Let me repeat this idea for clarity. If small insurers could cut premiums and increase policyholder benefits, small insurers should be able to match, or exceed, *PI*'s probabilities of: Earning modest profits (See Chapter 11 page 59); Avoiding operating losses (See Chapter 12 page 67); and Avoiding insolvency (See Chapter 13 page 73) while matching, or exceeding *PI*'s policyholder benefits (See Chapter 14 page 83). These smaller insurers would also need to have lower aggregate surplus needs than *PI* ($65,200,000) in order to insure 1,000,000 policyholders (See Section 13.3 page 79).

I will show that small insurers cannot match *PI*'s operating performance standards in any efficient health care (finance) system, but that larger insurers can meet, and even exceed, *PI*'s operating performance standards.

Table 11.1: Portfolio Adjusted Insurer Profitability Probabilities

Portfolio Size Adjusted Insurer Profitability Probabilities

	Characteristic	NHI	B	**PI**	D	E
Row	(1)	(2)	(3)	**(4)**	(5)	(6)
(1)	Size (1,000s)	323,000	10,000	**1,000**	100	10
(2)	σ_{e_N}	0.00278	0.01581	**0.05000**	0.15811	0.50000
(3)	**P[Profit≥10%]**	**0.5000**	**0.5000**	**0.5000**	**0.5000**	**0.5000**
(4)	P[Profit≥5%]	1.0000	0.9992	**0.8413**	0.6241	0.5398
(5)	P[No loss]	1.0000	1.0000	**0.9772**	0.7365	0.5793
(6)	P[Profit≥8.89%]	1.0000	0.7587	**0.5878**	0.5280	0.5089

more competition between increasing numbers of small insurers, would be asking health care providers to become their patients' health insurers. But that is a different book. In this book my focus is restricted to the impact of insurer portfolio size on insurer operating results.

The problems small insurers face are a much worse than low probabilities of earning profits. But before we move to analyzing the probabilities of insurer operating losses, we need to go back and take a second look at *NHI* and Insurer *B*. We have not been careful enough in assessing their profitability probabilities.

11.4 Probabilities Of Profits > 8.89%

Our analysis in Section 11.2 revealed that $\Phi_{NHI}(0.7500, \sigma_{e_{NHI}})(0.8000)) = 1.0000$. So it seems that *NHI* is virtually guaranteed profits of at least 5% of its premium revenues every year. But evaluating the probability that these insurers earn profits greater than 5% of their premium revenues was a completely arbitrary choice. It is also very misleading.

If we look at the x-axes for *NHI*, on Figure 11.1 (See page 60) and Figure 11.2 (See page 62), we see that they represent a far narrower loss ratio range than the x-axes for any of the other insurers. *NHI*'s normal probability density curve falls very sharply, immediately to the left, and immediately to the right, of the mean value, $PLR = 0.7500$, because *NHI* has the smallest standard error, $\sigma_{e_N HI} = 0.00278$, of all five insurers.

I can better highlight the advantage of large insurer portfolio size if I compare *NHI*'s probability of incurring loss ratios that are no higher than four of *NHI*'s standard errors above the *PLR*, 0.7611 (0.7500 + 4 * 0.00278), with the probability that other health insurers will incur loss ratios this low, or lower. I have chosen this distance from the mean value for a good reason. The probability that *NHI*'s loss ratio falls below four standard errors above its mean value is 0.9999683, or effectively, 1.00000. With a 15% expense ratio, *NHI* can cover a loss ratio of 0.7611 and earn profits greater than 8.89% every year.

Now that we know the highest loss ratio that guarantees profits of 8.89% of premium revenues for *NHI*, we can make a far more meaningful comparison of these five insurers probabilities of earning profits this high. We now evaluate the probabilities that all our insurers earn profits of at least 8.89%, at loss ratios below 0.7611. We will see a severe problem for small health insurers. A

Insurer Operating Loss Percent	Insurer Loss Ratio	NHI's Loss Probability	Insurer B's Loss Probability	Paradigm Insurer's Loss Probabilities	Insurer D's Loss Probability	Insurer E's Loss Probability
0	0.85000	0.00000	0.00000	0.02275	0.26354	0.42074
1	0.86000	0.00000	0.00000	0.01390	0.24330	0.41294
2	0.87000	0.00000	0.00000	0.00820	0.22394	0.40517
3	0.88000	0.00000	0.00000	0.00466	0.20548	0.39743
4	0.89000	0.00000	0.00000	0.00256	0.18795	0.38974
5	0.90000	0.00000	0.00000	0.00135	0.17138	0.38209
10	0.95000	0.00000	0.00000	0.00003	0.10295	0.34458
15	1.00000	0.00000	0.00000	0.00000	0.05692	0.30854
20	1.05000	0.00000	0.00000	0.00000	0.02889	0.27425
25	1.10000	0.00000	0.00000	0.00000	0.01343	0.24196
50	1.35000	0.00000	0.00000	0.00000	0.00007	0.11507
100	1.85000	0.00000	0.00000	0.00000	0.00000	0.01390

Table 12.2: Insurer Loss Probabilities 0 - 100 Percent By Portfolio Size

But of greater concern, among each group of 100 insurers with 10,000 policyholders, insurers the size of Insurer E, operating within the same year, we should expect about 24 catastrophic losses and ensuing bankruptcies during the year.

12.3 Probabilities Of Operating Losses > 50%

Operating losses exceeding 50% of premium revenues are catastrophic events for most insurers. Figure 12.3 (See page 72) compares probabilities of losses exceeding 50% of premium revenues, at loss ratios greater than 1.3500.

It should be clear by now, that NHI, Insurer B and PI have no risk of such catastrophic loses when randomly selecting policyholders at random from population $\mathscr{P}$ and using PIU's claims settlement policies and procedures. Because Insurer D is ten times larger than Insurer E, it has almost no risk of losses this high (i.e. Probability=0.0001). Insurer D incurs such catastrophic losses slightly less frequently than seven 1 in 10,000 years.

However, because Insurer E is so small, insuring only 10,000 policyholders, it incurs losses higher than 50% of premium revenues, at loss ratios exceeding 1.3500, almost 12 years in 100 $(CCDF_N(PLR, \sigma_{e_N})(1.3500) = 0.1151)$.

Table 12.3 (See page 70) summarizes these results, including probabilities that each insurer incurs operating losses from 1% - to 100% of premium revenues.

Table 13.1: Portfolio Adjusted SPLRs, Surplus, and Aggregate Surplus
Portfolio Size Adjusted Insurer Solvency Preserving Loss Ratios, Surplus Requirements, and Aggregate Surplus Requirements To Insure 323,000,000 Americans

Characteristic	NHI	B	**PI**	D	E
(1)	(2)	(3)	**(4)**	(4)	(6)
Size (1,000s)	323,000	10,000	**1,000**	100	10
σ_{e_N}	0.00278	0.01581	**0.05000**	0.15811	0.50000
SPLR	0.7565	0.7868	0.8663	1.1178	1.9132
Surplus ($Millions)	$0	$0	**$65**	$107	$43
Aggregate Surplus $Billions	$0	$0	**$21**	$346	$1,389

risk of large losses they should set aside far more money, as surplus, to protect from these extreme operating losses.

When insurers fail, insurance regulators encourage solvent insurers, especially larger, more profitable insurers, to cover the failed insurer's obligations. Covering the losses and continuing the insurance coverage, for policyholders of failed insurers, maintains consumer confidence in insurance companies and insurance markets.

NHI, with certain profits of 8.89% ($114,858,800,000) and Insurer *B*, with certain profits of 3.68% ($3,680,000,000) each year, can cover many small, failed insurers' policies and policyholders, without substantially reducing their profitability.

But covering the losses of insurers with high probabilities of failing decreases the efficiency with which large insurers convert premiums to profits and they also reduce the efficiency of insurance markets at converting premiums to policyholder benefits. Consumers pay for insurer failures through the higher premiums needed to offset the losses of failed insurers that more successful insurers pay.

Small, inefficient insurers decrease the efficiency of our entire insurance system, taking excessive profits in good years and socializing losses to other insurers, policyholders, claimants and taxpayers in bad years.

13.2 Surplus Requirements by Portfolio Size

Insurers' surplus requirements are the dollar amounts of highly liquid assets, they should set aside, before issuing policies, to cover the layer of losses between 0.8500 and their solvency preserving loss ratios.

Surplus cannot be negative, so no insurer should have less than zero ($0.00) even if Formula 13.1 produces a negative number as it does for *NHI* and Insurer *B*:

$$\text{Surplus}_N = (SPLR_N - 0.8500) * \text{Premium Revenues} \quad (13.1)$$

We can correct Equation 13.1, forcing the value to be at least zero, by using the mathematical function, "Maximum" that is available in all programming languages and spreadsheets, as shown in Equation 13.2.

$$\text{Surplus}_N = \text{Maximum}(0, (SPLR_N - 0.8500) * \text{Premium Revenues}) \quad (13.2)$$

Profit %	Maximum Loss Ratio	Insurer Profit Probability	Maximum Sustainable Benefit NHI	B	**PI**	D	E
σ_{e_N}			0.00278	0.01581	**0.05000**	0.15811	0.5000
10	**0.7500**	**0.50000**	**0.7500**	**0.7500**	**0.7500**	**0.7500**	**0.7500**
9	0.7600	0.57926	0.7594	0.7568	**0.7500**	0.7284	0.6600
8	0.7700	0.65542	0.7689	0.7637	**0.7500**	0.7068	0.5700
7	0.7800	0.72575	0.7783	0.7705	**0.7500**	0.6851	0.4800
6	0.7900	0.78814	0.7878	0.7774	**0.7500**	0.6635	0.3900
5	**0.8000**	**0.84134**	**0.7972**	**0.7842**	**0.7500**	**0.6419**	**0.3000**
4	0.8100	0.88493	0.8067	0.7910	**0.7500**	0.6203	0.2100
3	0.8200	0.91924	0.8161	0.7979	**0.7500**	0.5986	0.1200
2	0.8300	0.94520	0.8255	0.8047	**0.7500**	0.5770	0.0300
1	0.8400	0.96407	0.8350	0.8115	**0.7500**	0.5554	0.0000
0	**0.8500**	**0.97725**	**0.8444**	**0.8184**	**0.7500**	**0.5338**	**0.0000**

Table 14.1: Maximum Sustainable Benefits To Match PI's Profitability Probability

14.3 Insurer's Maximum Sustainable Benefits

To have the same probabilities, of earning profits greater than 0%, 5% or 10%, of their premium revenues as *PI*, the other four insurers must set their planned benefit levels the same number of standard errors below the highest loss ratios consistent with these profit levels (i.e. 0.7500, 0.8000 or 0.8500), as *PI*.

We will not try to specify how these insurers will alter their claims settlement policies and procedures. Instead, we calculate the maximum "average benefit" these insurers can plan to provide if they want to match *PI*'s profitability probabilities.

Each insurer could simply deny coverage for a few of their highest cost policyholders. If insurers deny benefits for high cost policyholders they shift both the mean, and the standard error, of their population loss ratio estimate distribution functions. Some insurers do this some of the time. Managed care organizations and health maintenance organizations do this quite frequently.

But if all insurers, all managed care organizations, and all health maintenance organizations did this all the time, consumers would soon realize that their health benefits would not be available when they needed them most, when they were gravely ill or injured.

When consumers feel that their health benefits will not be available they stop buying health insurance and health benefit plans. Consistent refusal to honor high cost claims erodes consumer confidence and compromises the social value of insurance as a risk management mechanism. This is why insurance regulators frequently ask larger, more profitable, insurers to cover the costs of insolvent insurers as we discussed in Chapter 13 (See page 73).

14.4 Benefit Adjustments For Profits Greater Than 5 Percent

For profits of at least 5%, at a loss ratio no higher than 0.8000, *PI*'s offset is one *PI* standard error unit, $\sigma_{e_{PI}} = 0.0500$, below 0.8000, producing *PI*'s maximum sustainable benefit of 0.7500 and probability of achieving this level, 0.8413.