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TREND AND LOSS DEVELOPMENT FACTORS

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"The mere fact that something has happened a certain number of times causes animals and men to expect that it will happen again."

— Bertrand Russell

During the past year or two it has become apparent that there exist widespread misconceptions about trend and loss development factors. Rather than surface misunderstandings, they appear to result from fundamental confusion between the data base from which the factors are derived and the purpose which they serve. These are essentially laymen's errors, of the kind one might expect to fade away after brief consideration, but they have been surprisingly persistent. Indeed, I have found in private conversations that the overlap fallacy has been uncritically accepted even by many actuaries. The problem may be due to a lack of serious consideration of these difficult concepts outside of the adversary proceedings of disputed rate filings; there has been surprisingly limited treatment of them in the *Proceedings*. The purpose of this paper is to try to clarify a few of the problem areas, and if possible to refute some errors. The crucial importance of avoiding unsound concepts of trend was well illustrated two years before this Society was founded:

"The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken."

— Bertrand Russell, On Induction (1912)

In order to treat the problems in the use of these factors, it is necessary first to define them. The definitions are general, but for simplicity, we will

limit the discussion mainly to automobile — it is the line with the most controversial and best developed practices in this area.

Definitions

There exist in our society dynamic forces — economic and demographic among others — which produce measurable changes in insurance experience as time passes. We call these changes trends. In automobile insurance the three trends most generally considered are those of average claim cost, claim frequency, and classification drift (Physical Damage Age & Symbol Groups). A *trend factor is any index which measures changes over time.* Please note that the changing value itself need not be used; any index which will measure it is acceptable.

The first complete report of an accident year is often compiled as early as three months after the close of the year. For many lines of business, especially the "Schedule P" lines — auto B.I., other liability B.I., and workmen's compensation — claim settlements are often long delayed; even at reports substantially later than three months after the close of the accident year (or policy year or calendar year) the estimated cost of many claims may still be very inaccurate and subject to substantial subsequent revisions. For individual claims (by which loss reports for virtually all lines of insurance are submitted to bureaus) subsequent changes cannot be predicted, but in the aggregate there is a pattern of change from report to report, as more claims are paid and estimates of others are improved. The process of change as an accident year matures is called development. *A calculated past ratio of mature to immature data is called a loss development factor.* This type of factor measures phenomena intrinsic to a specific type of claim, and can only be measured by data completely identical except for age.

The Overlap Fallacy

This idea is probably so persistent because it is so well presented by its proponents. Their arguments are generally logical, well-thought-out, and very attractive. The best summary I have seen is by Commissioner Newton I. Steers, Jr. of Maryland.[1] "I find that inflationary forces in our economy do operate during the period of time between the original estimate of loss

[1] Steers, Newton I. Jr., September 30, 1969 disapproval letter to Mr. Bernard I. Farrell, Manager, Insurance Rating Board Central Atlantic Office: second paragraph, page two.

and the final determination or payment of trial loss. Thus the loss development factor already reflects the trend (inflationary) factor. Since the filing applied these duplicative factors successively and thus compounds them, I find that the IRB has not shown that the combined rates thus derived will not be excessive."

Commissioner Steers has correctly noted that in addition to such obviously proper items as IBNR losses, the loss development factor also includes inflationary effects. Because this inflation appears to take place over approximately the same time period as that which underlies the trend factors, it is deceptively apparent that inflation is counted twice — the two factors "overlap." Q.E.D.

This argument itself is clear and logical, but it is based on a fundamental misunderstanding. *What are rates supposed to do?* Are they intended to provide adequate funds to cover the loss costs which apply at the instant accidents occur? Or are they intended to provide adequate funds to *settle* the claims which result from accidents? If you will accept the latter intent as self-evident, then it immediately follows that an adequate rate must include a provision for any inflation which may occur between the date an accident occurs and the date it is settled. Trend factors, however, are only projected to the average expected accident date. Part of this deficiency is taken care of by evaluating claims three months after the close of the experience period. This is nine months after the average accident, and therefore can include a reasonable estimate of future cost increases. The remaining *unanticipated* inflation will tend to be *precisely* the amount included in a loss development factor.

It may clarify the point to build a model, and consider specific dates in a hypothetical rate review. Let us use accident year 1969 experience, for a revision to be effective January 1, 1971. The average date of accident in the experience period would then be July 1, 1969; the average policy effective date under the revised rates will be July 1, 1971 (assuming annual rate revisions); and the average date of accidents covered by these policies will be January 1, 1972 (assuming one-year policy terms). Thus the total average period of time which will elapse between the actual past accidents on which our rates were based, and the future accidents for which the rates must pay, is 30 months. It is clear that in order to be appropriate to the accidents for which they will pay, the rates must be based on accident year 1969 experience projected forward 30 months by trend factors.

Because the latest available report for accident year 1969 will be as of March 31, 1970, it is also clear that losses will be immature and require development to their estimated ultimate disposition level. One part of the factor used to develop these losses will reflect *unanticipated* increases in cost level between the evaluation date and the ultimate settlement date. To simplify the model, assume that *no* future cost increase is considered at the time reserves are set, and that the average settlement will take three years, to an average date of July 1, 1972. Under these assumptions there should be included in the loss development factor a sizable amount to take care of increasing cost level for the 27-month period from March 31, 1970 to July 1, 1972.

The overlap theory (as I understand it) would suggest that the claim cost trend factor reflects inflationary changes for the 30 months from July 1, 1969 to January 1, 1972, and that the loss development factor reflects inflationary changes for the 27 months from March 31, 1970 to July 1, 1972. There is therefore an *overlap* of 21 months, from March 31, 1970 to January 1, 1972, in which the two factors are at least to some extent reflecting the same inflationary changes.

The error here is in treating dates as if they were *absolutes*, when in fact they are only measuring an *interval of time*. Our model has been set up so that the actual absolute dates can be determined.

Consider three time periods:

A. 7/1/69 to 1/1/72; average experience period accident date to average effective period accident date — inflation is measured by the trend factor.

B. 1/1/72 to 10/1/72; first nine months after average effective period accident date — inflation is measured by a part of the changes in cost estimates during the comparable period (from 7/1/69 to 3/31/70) between the average experience accident date and the accident year evaluation date.

C. 10/1/72 to 1/1/75; remaining 27 months after average effective period accident date, up to the average effective period settlement date (which by our assumptions is three years after the average accident date) — inflation is measured by the loss development factor which is based on a comparable 27-month period, running from 9 to 36 months after an earlier group of accidents.

It can be seen in our example that not two but three measures of inflation are applied successively. However, the actual cost changes we are predicting in ratemaking will also occur successively. The final result is exactly correct; we arrive at the precise cost level needed to *settle* claims arising out of accidents covered by policies written during the effective period of our rates. There is no overlap.

In the real world, of course, claim costs do not generally receive the full impact of inflation after the accident date, because many costs are incurred prior to settlement; neither are reserves established without any consideration of future cost increases. But loss development factors, because they are based on comparable prior developments, tend to measure exactly the things that will probably occur after future accidents. Like any estimate, they are subject to random and/or cyclical errors, but if the factors are based on a period long enough to really approach ultimate cost, they are *valid and unbiased;* on the average over a long period, they are equally likely to be too low or too high.

As a final comment on this subject, it should be conceded that a "real" overlap between trend factors and loss development factors could exist. In an Actuaries' Report on automobile ratemaking procedures, commissioned by the Commonwealth of Virginia, Roberts[2] stated: "Actually, however, [capital gains] are already reflected in that the bureaus do not project loss costs to the anticipated average date of payment. In a generally rising stock market, notwithstanding occasional reversals, capital gains have provided a hedge against the effects of inflation in driving claim costs upward between dates of accident and dates of settlement. It may be in recognition of this factor that the industry has not come forward with arguments for corresponding projection of loss costs."

This lengthened period of trend was not seriously suggested by Roberts for actual use in ratemaking — in fact it appeared in his chapter on investment income — but some profit-starved readers must have been tempted to lift it out of its proper context and apply it in their ratemaking process. Fortunately they did not, for if this were done it would be a perfect example of "true" overlap. One part of this cost trend after the accident would be picked up by foresighted reserving, and the entire remainder by the loss

[2] Roberts, Lewis H. *Actuaries' Report to the State Corporation Commission of Virginia.* Published by Woodward & Fondiller. Distributed by the Virginia Bureau of Insurance (August 17, 1966), page 50.

development process. Thus the *entire* trend beyond the average effective period accident date, up to the settlement date, would be redundant.

Loss Development Factors and Inaccurate Reserves

The most frequent misunderstanding about loss development factors is that they *ought to be* 1.00 or less, because companies are legally required to carry reserves adequate to pay all of their outstanding losses. This incorrect inference results from an invalid analogy between reserves reported to bureaus and reserves shown in the annual statement. They are not generally the same. Most bureau statistical plans require unit loss reserves — individual reserves allocated to specific known cases. A company's annual statement loss reserves, however, are required to be adequate in the aggregate, for all cases whether or not known, and need have no relevance to specific cases. If they are produced on a formula basis which does not utilize the data submitted to the bureaus, occasional substantial differences can obviously be expected; even if the annual statement reserves are built from the same data, however, the minimum difference we can expect is the reserve for incurred-but-not-reported cases, and there may in some instances be other similar differences, such as a reopened case reserve or a special reserve to satisfy the 60% loss ratio minimum reserve requirement from Schedule P.

In many cases these reserves can be the difference between adequacy in the annual statement and inadequacy in bureau data. The problem would be much greater if bureau accident year reserves were reported as of December 31. Fortunately, reserves for the casualty lines (where loss development is most severe) are reported as of March 31, allowing three months for late reported claims and unreserved small claims to "develop" within the company. This is not, however, a sufficient time to eliminate IBNR as a problem. For the General Accident Group, some percentages of accident year 1968 losses which were first reported during the period between March 31, 1969 and September 30, 1969 (the latest report available) were:

Automobile B.I.	4.4%
Automobile P.D.	2.1%
Other liability B.I.	12.5%
Other liability P.D.	6.6%
Workmen's compensation	3.2%

While these amounts *by themselves* do not account for the size of recent loss development factors, they are large enough to show that exactly accurate reserves will still develop upward from a first bureau report.

One could argue that these reserves should be spread over specific claims by a factor, and thus included in bureau reports. Besides the fact that this would in practice simply replace bureau-level loss development factors with individual company loss development factors (derived from smaller statistical bases), there are at least four counter-arguments:

1. It might be considered unsound in principle to slightly over-reserve 90% of the cases to compensate for the 10% which will increase sharply.
2. A blanket distribution may not properly reflect individual state differences, and an individual company may not have sufficient stability for state-by-state allocation.
3. There are some theorists who believe that "loading" individual case reserves encourages higher claim costs, by often permitting adjusters to make over-generous settlements "within the reserve."
4. Sudden changes in reporting practice could result in excessive loss development factors during the changeover period.

Loss Development Factors Compound Reserving Errors

In an earlier section of this paper, it was stated that loss development factors, although valid and unbiased in the long run, "are subject to random and/or cyclical errors." It is the purpose of this section to show that these errors can be most severe and to suggest possible improvements. By now the reader is certainly aware that the author has no reservations about the concept of applying loss development factors. However, the method of calculating and applying the factors is open to criticism.

Loss development factors are generally calculated from the actual development, during the past two-year period, of earlier reports of incurred losses. For purposes of analysis, let us consider a simplified model in which losses reach their ultimate level at 27 months, and a single prior year's development from 15 to 27 months is used as the loss development factor for the current year's 15-month report. This model will have twice as much variance (or 1.4 times as much standard deviation) as the real world, due to random errors, and will have a much shorter period for cyclical errors.

For our model, let the actual losses for each year be $1,100,000. In Case I, reported losses at 15 months are consistently $100,000 less than ultimate. In Case II, the reported losses for two of the years are $50,000 less, and then return to their normal level.

Case I:

Year	*Losses Reported at 15 months*	*Actual Ultimate Losses*	*L.D. Factor (based on Prior Year)*	*Estimated Ultimate Losses*
1	$1,000,000	$1,100,000	—	—
2	1,000,000	1,100,000	1.1000	$1,100,000
3	1,000,000	1,100,000	1.1000	1,100,000
4	1,000,000	1,100,000	1.1000	1,100,000
5	1,000,000	1,100,000	1.1000	1,100,000
Average of years 2 - 5		$1,100,000		$1,100,000

Case II:

1	$1,000,000	$1,100,000	—	—
2	950,000	1,100,000	1.100	$1,045,000
3	950,000	1,100,000	1.158	1,100,100
4	1,000,000	1,100,000	1.158	1,158,000
5	1,000,000	1,100,000	1.100	1,100,000
Average of years 2 - 5		$1,100,000		$1,100,775

On the average, as we had expected, the estimated ultimate losses are very close to the actual ultimate losses. It can also be noted that in years 3 and 5, where the actual development follows the same pattern as the previous year (on which the factor is based), the estimated ultimate losses are accurate. However, in years 2 and 4, when there is a change in pattern, the factors are out of phase and miss badly. Furthermore, the error cannot be detected in advance, because when the lower (or higher) first report for year 2 (or 4) first came in, we could not have known whether the ultimate loss level was changing, or only the adequacy level of the first reports.

The pattern of this model does apply, although smoothed a bit, to the real world. By their nature, the loss development factors we calculate are always the ones that *would have been* right in the past, and they are there-

fore an accurate measure of the future development of present losses *only* if the present outstanding cases have the same degree of reserve adequacy as did the past ones on which the factors are based.

Furthermore, a significant upward change in loss development factors is likely to indicate an inadequacy of company loss reserves, because the other factors (IBNR, etc.) in loss development should tend to be fairly stable over time. If this is so, company reserve tests will deteriorate and bring about individual company corrective action. From these arguments we can put forward two tentative conclusions which will apply if loss development factors increase sharply:

1. That estimated ultimate incurred losses, *and therefore rates,* were inadequate in the recent past because of inadequate loss development factors.
2. That adequacy of reserves will return to approximately its former level, rendering loss development factors, and therefore estimated ultimate incurred losses, *and therefore rates,* excessive.

This excessiveness will approximately equal the former inadequacy and will thus not *in the long run* unjustly enrich the companies, but it is a form of automatic recoupment of past underwriting losses, which is contrary to traditional ratemaking policy.

If it is agreed that this is an undesirable condition, but it is also agreed that loss development factors are a necessary feature for proper ratemaking, what should be done? I am aware of only one discussion in the literature, set forth by Roberts in the work previously cited.[3] In brief, his proposal was to *test* loss development factors by using *paid* accident year losses, developed to ultimate incurred level on a formula basis. These paid loss development factors would be very large for some lines, of course, but if they were adequate they would produce adequate estimates of ultimate incurred losses. A similar but less sophisticated approach is now used in automobile physical damage, where calendar year paid losses are developed to incurred level by a flat historical factor. The advantage of an approach based on the Roberts test formula would be that the loss development factors could be expected to be more stable, even though very large, because judgment estimates of losses would be eliminated except for a final estimate of cases still open after five or more years. There are two apparent disadvantages:

[3] Roberts, Lewis H. *op. cit.*, pages 40 to 47.

1. Although probably smaller than the random errors in reserves, there will still be random variations in rates of payment. Because the experience base will be small and the factors large, each dollar of random variation in the experience will have a substantially greater effect on rate level. An obvious example of this problem would be unusually poor fourth-quarter experience, which would be reflected only slightly in paid losses through March.
2. In the case of a non-random trend in average speed of payment, the method will be far less responsive than the present approach. The most important example of this would be increasing congestion and delays in courts of law.

The first of these objections, as well as the actual magnitude of the basic advantage of stability, could be objectively analyzed by careful research of proper data. It would be a major project, but just might be very rewarding, and should be encouraged. It is doubtful that this approach could safely be used by itself, but it would provide an *objective* check on reserves, *independent* of company reserving practices, as a supplement to the usual calculation of loss development factors.

There is a second approach to stabilizing loss development, which could be applied either by itself or on top of the paid loss approach. Rather than requiring research, it requires changing a basic axiom of ratemaking. This proposal is simply to stop using data as of 15 months. More mature data, at 21 or 27 months, would be less subject to random error and would require much smaller loss development factors. In the paid loss approach, it would significantly increase the volume of the base. Responsiveness would be reduced, but this does not necessarily lead to inadequate rates, because trend factors would be applied for a longer period to compensate for the older experience. A limited form of this approach would be to go back to the previous year only if the latest year would require a very large loss development factor (e.g. greater than 1.20), but this practice would be biased against the companies, because abnormally low loss development factors would be applied while abnormally large ones would not.

Every decision about ratemaking policy ultimately must wrestle with the dilemma of responsiveness versus stability. Both of these proposals would gain stability at the cost of reduced responsiveness, and it is on this question that they should be considered further or rejected. In making this decision, however, one should avoid a habitual reaction in favor of responsiveness at

all costs. Our attitudes in this area are largely based on an earlier day, when responsiveness and adequacy were synonymous. Now that both cost and frequency trend factors are generally applied for the full period from average experience date to average insured event date, this relationship no longer has any necessary validity.

Paid Claim Cost Trend Factors Applied to Incurred Losses

This section is intended to lay to rest another widespread fallacy. Briefly stated, it is the idea that a trend factor based on average paid claim costs can only be properly applied to the paid loss portion of incurred losses, but *not* to the outstanding loss portion. Only a few actuaries have been tempted by this concept, but it is "logical" under casual review and very tempting to laymen. There are several major states where it has recently been the required method of applying trend in automobile liability insurance. Let us consider the apparent alternatives to the application of paid claim cost trend to outstanding losses.

Case I: Average *outstanding* claim cost trend factors should be applied to outstanding losses. The most likely source of error in the ratemaking process as a whole is in setting reserves on outstanding claims. This approach compounds such errors. If we over-reserve, the trend factor will also increase, and we will apply a higher factor to already excessive reserves. Conversely, if we under-reserve, it will result in a lower outstanding claim cost trend factor to be applied to already inadequate reserves. This approach is only accurate to the extent that reserve adequacy does not change. This is parallel to the loss development situation described in the previous section, so it is not necessary to further analyze it here. Suffice to say that outstanding claim cost trend, loss development factors, and the basic incurred loss data will all tend to move together, and thus compound any error three times. Reserving is a major problem in itself; loss development makes it worse. Outstanding claim cost trend factors are a third burden we really do not need, especially when a satisfactory alternative index (average paid claim costs) exists to measure inflation. The situation with regard to loss ratio, average incurred claim cost, or pure premium trend factors is essentially the same.

Case II: No trend factor should be applied to outstanding losses. Some thoughtful consideration will be sufficient for the reader to see that validity for this approach must necessarily imply one of three things:

a. Unpaid claims from *last* year's accidents are valued at the same cost

level as that which will ultimately apply to payments made on the accidents which will occur *in the future* and for which we are trying to make rates. This is nonsensical.

b. Loss development factors eliminate the need for trend on outstanding cases; we have previously shown this to be false. No matter how long last year's accidents are developed, no matter how well the reserved anticipated cost increases, next year's claims will still *start out* an average of 30 months later and will probably take just as long to settle, so we will still need to *add trend* for 30 months.

c. Claims incurred next year that are unpaid as of 3 months after the close of the year will finally be settled at last year's cost level; if this were true, none of us would settle claims promptly.

Clearly we can reject the alternatives offered above, but we must still consider the question of whether trend factors based on paid claim costs are valid. Let us again go back to first principles, and be sure that loss development and trend are properly distinguished. A trend factor is not intended to develop *any particular set* of losses to a later date. It is rather an *index* of the rate of inflation of accident costs (or in claim frequency trend, an index of the rate of change of accident frequencies). If there were a proper government index or indexes of such costs, as explored by Masterson,[4] we could use that index just as well. The primary reason to use paid rather than incurred losses is to be objective and avoid the possibility of errors of judgment. Our goal is to predict the level of future costs, based on the assumption that the past rate of cost change will continue. Obviously we must project the entire incurred losses, and anything that measures the past variation is valid for that projection. The problem is to pick the *best* measure. Except for random variations, all valid measures should produce essentially the same result. Our criteria should then be that *subject to the requirement that it measure past claim costs, the best trend index is that index which is most stable.* Average paid claim costs clearly satisfy the first requirement, and *at the present state of the art* it is the most stable index available.

[4] Masterson, Norton E., "Economic Factors in Liability and Property Insurance Claims Costs 1935-1967," *PCAS* Vol. LV, page 61.

Trend and Loss Development Factors for Calendar Year Experience

"How can I tell the signals and the signs?"

—H. W. Longfellow

A loss development factor in the accident year or policy year sense is not calculable for calendar year data. It is appropriate to apply a factor to the raw data in order to reflect the *change* in IBNR and other formula reserves, if they are excluded in the basis data. This serves a purpose similar to that of loss development factors, but a calendar year is not clearly enough defined to permit testing or development in the pure sense. If the reserves, including formula additions, are fully adequate at the beginning and end of the year, calendar year results are adequate and the lack of loss development does no harm. Similarly, if both the beginning and ending loss reserves are *equally* inadequate, *and* there is no growth, the incurred losses are adequate for ratemaking. If, however, there is a change in the adequacy of reserves during the year, or there are consistently inadequate reserves *and* a growth in volume, the calendar year incurred losses are not good enough for ratemaking. Under these conditions a formula additional reserve, which will bring total reserves to an adequate level, must be applied to both the beginning and the ending reserves. If such a factor were only applied to the ending reserve, we would have excessive incurred losses, because a fully adequate ending reserve plus paid losses will then include all incurred losses for the coextensive accident year, *plus* the correction of the previous reserve's inadequacy.

Trend factors are applied to calendar year losses similarly to accident year losses, with one difference: the average date of accident in an accident year can be assumed to be the midpoint of the year, but the average date of accident for calendar year losses is not easily determined. If inadequate reserves exist at the beginning of the calendar year, their development relates to earlier years' accidents. This tends to make the average date of accident earlier, and thus the necessary trend period longer, but the amount of this shift is not readily measurable. The simplest solution to this problem is the formula reserve adjustment referred to in the previous paragraph. After all reserves are raised to the level which the ratemaker believes to be adequate, the following analysis holds:

$$\begin{aligned}\text{Incurred losses} = &- \text{Beginning reserve} \\ &+ \text{Paid losses} \\ &+ \text{Ending reserve}\end{aligned}$$

The right side of this equation can then be subdivided, so that

Incurred losses = − Beginning reserve
+ Paid losses (prior years accidents)
+ Ending reserve (prior years accidents)
+ Paid losses (current year accidents)
+ Ending reserve (current year accidents)

But if the beginning reserve is adequate, then by definition the first three terms exactly cancel, so

Incurred losses = Paid losses (current year accidents)
+ Ending reserve (current year accidents)

This final result is exactly equal to the current accident year incurred losses. Therefore, the midpoint of the year is the appropriate average accident date for a calendar year with fully adequate reserves.

Conclusion

> *"It cannot be that axioms established by argumentation can suffice for the discovery of new works, since the subtlety of nature is greater many times over than the subtlety of argument."*
>
> — Francis Bacon

Loss development and trend factors have tended to increase in recent years, to the point where they account for more than 100% of some rate increases. Despite their magnitude and importance, they have not received adequate treatment in the *Proceedings*. They are not easy concepts to grasp, and their definitions vary, when definitions are given at all. As a result, inadequate knowledge in this area is the typical estate of both laymen and students, and to a lesser degree of many Fellows of this Society. I have expressed a set of positions and opinions in this paper, with which many readers may disagree. Those who can clarify, add to, refute, or support these comments are eagerly invited to join debate. I believe we can all learn quite a bit more about loss development and trend factors, to our mutual benefit.

> *"The history of mankind is an immense sea of errors in which a few obscure truths may here and there be found."*
>
> C. de Beccaria