WHY N.C.D.?

by

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INTRODUCTORY NOTE

This paper was originally written as a Note for the Institute of
Actuaries Students’ Society on ‘N.C.D. Systems in Motor Insurance’.
This topic was one of nineteen non-life topics on which Notes were
requested by the Students’ Society in 1973, a different member of
the Society being responsible for each topic. The Notes were not
expected to give the results of research work along previously
unexplored lines. Rather, they were intended as a survey of existing
knowledge in each subject—including references to any useful
literature—which could be understood by and be of general interest
to members of the profession who had little or no experience of non-
life work.

Following a request from the Manchester Actuarial Society, it
was decided to revise and expand the original Note to make a paper
more suited for discussion. No Claim Discount (N.C.D.) is one of
the more controversial areas of motor insurance, being a topic on
which the motorist is liable to hold strong and emotive views from
time to time. As now written the paper takes a critical look at N.C.D.
systems, as well as outlining their basic features. The paper considers
briefly other forms of rating according to the claims experience of
individual policies, and why any form of experience rating is needed.

1. BACKGROUND

The idea of giving a discount to a policyholder who has not made
a claim is almost as old as motor insurance itself. Up to about 1928
the discount was quite small, perhaps 10% if no claim had been made
in the previous year. It appears to have been intended as an induc-
ment to a policyholder to renew his policy with the same company,
but the custom of offering discount to a transferring policyholder quickly developed and so nullified any advantage in discount to policyholders who stayed with the same company. For a long time the discount was termed a bonus even though it was not an appropriation of profits; the term 'no claim discount' (N.C.D.) became established in the 1960's. 'No claim discount' is a rather anomalous expression, for as the paper explains later both 'no claim' and 'discount' are not always strictly appropriate.

2. EXPERIENCE RATING IN THE U.K.

2.1. An experience rating system is a system by which the premium for an individual risk takes into account the claims experience of that individual risk. N.C.D. systems constitute a form of experience rating used in private motor insurance in the U.K.; the practice is to consider the number of years since the last claim, subject to some important qualifications which are considered later. Most U.K. private motor policies are subject to N.C.D. Those which are not are mainly fleet risks and special policies for the mature policyholder with a good insurance record at the time his policy was taken out.

2.2. Claims

One of the conditions of most motor insurance policies is that the insurer must be notified within a specified period of time 'upon the happening of any accident or the occurrence of any loss or damage'. Using a strict legal interpretation this condition implies that every incident, no matter how trivial, must be reported to the insurer. In practice many policyholders do not bother to report minor incidents. However, even if a policyholder does report an incident he will not lose any of his entitlement to N.C.D. if he elects to bear any liability himself. If the policyholder does not elect to bear any liability himself, the insurer will treat the report as a claim, and as a general rule this will result in loss of discount.

There are important exceptions to this general rule:

(1) Many policies contain a provision whereby payments of Emergency Treatment Fees and claims for damage to a windshield only (with an upper limit of cost) are not taken into account, and if no other payments are involved no discount will usually be lost.
(2) If the insurer is able to recover the whole of his outlay, or would have been able to recover the whole of his outlay but for the operation of a knock-for-knock agreement between the insurers concerned, no discount will usually be lost.

Certain payments under knock-for-knock agreements are not taken into account in deciding whether N.C.D. is to be allowed or not. A knock-for-knock agreement is a form of claim-sharing agreement under which each insurer pays for the damage to his policyholder's own vehicle. It is a private arrangement between the insurers concerned, and does not operate to affect the rights or liabilities of the policyholder himself. Thus, a payment made under a knock-for-knock agreement that would otherwise have been recovered from another insurer is not treated as affecting entitlement to N.C.D. Conversely, the absence of a payment where one would have been made had there been no agreement will not prevent loss of discount by the policyholder.

It is customary to talk of 'allowed' claims and 'disallowed' claims according to whether they are ignored or counted in assessing N.C.D. The experience of one company is that the proportion of 'allowed' claims varies from about 30% for high risk policies (e.g. young policyholders insuring sports cars) to well over 50% for low risk policies. However, these percentages can be expected to vary from company to company, not only because of differing practices in allowing N.C.D. following a claim but also because of variations in the types of incident which are recorded as claims.

Whether or not N.C.D. is allowed depends on considerations of recovery of outlay, not of who was to blame. It cannot be safely assumed that the discount will automatically be allowed even if a car was, for example, run into from the rear or hit whilst parked in a sensible place.

The practice of different insurers in allowing N.C.D. after claims varies considerably. Some insurers have an 'instant allowed' scheme whereby claims of particular kinds are 'allowed' without delay provided certain conditions are satisfied. Such a scheme can produce considerable administrative savings which may more than compensate for the comparatively generous treatment it affords to some policyholders.

The question could be asked, 'Why have allowed claims at all?'. (After all, it is supposed to be a no claim, not a no blame, system
which is being operated.) It could be argued that the number of claims (allowed and disallowed) incurred under a policy over a period of years is related to the extent to which a vehicle is exposed on the road during that time. If this reasoning were accepted, then disallowing all claims would appear to offer more scope than at present for distinguishing the high risks from the low risks. On the other hand it would seem to the policyholder so obviously unfair if he were to be penalized even after a claim in which the insurer had recovered his outlay that it scarcely seems practicable to operate a system in which N.C.D. entitlement is lost after every claim.

2.3. N.C.D. is expressed as a percentage of ‘basic premium’. The basic premium is an amount which is dependent on the cover provided by the policy and on certain facts about the vehicle, the policyholder and the persons entitled to drive. Among the factors used in rating are the type and age of the car, where it is kept, the age of the policyholder, and whether a voluntary excess is required (whereby the insurer is not liable for the first £X of every claim for damage to the policyholder’s own vehicle). When basic premiums are set, an allowance needs to be made for the effect of N.C.D. in each group, since, for example, young policyholders will have earned on average less discount than older policyholders. Few policyholders will pay as much as the basic premium, perhaps not more than 5%-15% in most N.C.D. scales.

2.4. Until 1966 it was normal to lose all entitlement to discount on making one claim and to have to work one’s way back to the top of the scale. In 1966 most U.K. insurers increased their maximum rate of N.C.D. from 40% to 60% and consequently if the old rules had been retained the loss of discount for making a single claim could have been very severe. The practice was therefore introduced of providing that on making one, or perhaps even two, (disallowed) claims in one policy year the policyholder did not necessarily lose all his entitlement to N.C.D., but merely moved to a lower level on the N.C.D. scale. (Later in the paper, moves to a lower (intermediate) level of N.C.D. are referred to as fallback.) This shows why it is, strictly, inappropriate to regard each level of discount as representing a specific number of claim-free years.

There are many N.C.D. scales in operation in the U.K., differing from each other in the number of steps in the scale, the rates of discount and the rules for moving up and down the scale. A survey in Money Which? (16) in December 1969 described 54 such scales, but
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a subsequent survey in September 1972 showed that the number of scales had been greatly reduced.

2.5. In order to provide quotations it is necessary for offices either to tabulate all the levels of net premium for each basic premium or to calculate each premium net of discount as and when required. The latter method is virtually unavoidable if the manual of basic premiums is very extensive. The former method is most convenient where a points rating system is in operation.

A points rating system is a simple means of calculating basic premiums. Points are allocated for each value of each rating factor. For a particular policy the appropriate values of the rating factors are selected, and the corresponding points are added together. The total number of points obtained is looked up in a table giving, for each total points, the basic premium and the premiums net of each rate of N.C.D. Usually the scale of premiums is multiplicative, i.e. the premium for T + 1 total points is \((1 + k)\) times the premium for T total points.

An even simpler method of obtaining net premiums when using a points system can be introduced if it is considered acceptable to approximate to the rates of discount previously allowed. Consider, for example, points scales in which an increase of 1 in the number of points corresponds to an increase in premium of 2\% and 6\% respectively. Some values of \(v^n\) are:

<table>
<thead>
<tr>
<th>(n)</th>
<th>(2%) ((47-n))</th>
<th>(v^n)</th>
<th>(6%) ((18-n))</th>
<th>(v^n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>47</td>
<td>0.00000</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>37</td>
<td>0.80051</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>13</td>
<td>34</td>
<td>-0.74882</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>16</td>
<td>31</td>
<td>-0.70047</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>-0.59944</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>31</td>
<td>16</td>
<td>-0.50169</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>41</td>
<td>6</td>
<td>-0.40161</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>47</td>
<td>0</td>
<td>-0.35142</td>
<td>18</td>
<td>0</td>
</tr>
</tbody>
</table>

The above table shows values of \(n\) for which, at the given rates of interest, 100 \((1-v^n)\) approximates to rates of N.C.D. of 0, 20, 25, 30, 40, 50, 60 and 65\%. Thus, it will be seen that if the basic premium is given by \(T\) points the premium net of N.C.D. may be given by \((T-n)\) points. However, it is preferable for the premium calculation to involve additions only. For example, assuming 65\% to be the maximum rate of N.C.D., we can add \((47-n)\) in the first scale to the total number of points already obtained for the other rating factors,
or add \((18-n)\) in the second scale, to give the premium net of N.C.D.

This method has the advantage that only a single premium is tabulated for each total number of points. In practice nominal rates of discount would probably continue to be quoted, and this would entail the actual rate of discount being not less than the nominal rate. From this point of view, the 2½% scale is not as convenient as it might appear at first glance. For example, using a 2½% scale, a discount of 30% would not quite be achieved by adding 31 points, and it would be necessary to add only 30 points in this case, corresponding to an actual discount of approximately 31.5%. The choice of scale is influenced also by factors other than the rates of N.C.D.

3. REASONS FOR AN N.C.D. SYSTEM

3.1. To reduce heterogeneity within each rating category

The categories used in group rating are not sufficient to eliminate all heterogeneity, since it is not possible to identify and measure all factors which may influence the risk. The operation of an N.C.D. system is a means of reducing the residual heterogeneity within each group of policies.

Johnson and Hey (9) described the use of a simple mathematical model to study the influence of a single risk factor after largely eliminating the effects of other risk factors represented in the model. This can be done for N.C.D. If the portfolio is grouped according to N.C.D. category we can calculate for each group the claim cost per vehicle year, having largely eliminated the effects of the rating factors, other than N.C.D., which are used as a basis for the model. We should also try to eliminate the effect of knock-for-knock, since this will vary from one N.C.D. category to another, but only guesswork can be employed here. The above exercise will show, for a given scale of fallback and after making an appropriate allowance for expenses, the discounts which should theoretically be allowed for each N.C.D. category. This will indicate whether the discounts actually allowed are reasonably equitable among the different N.C.D. categories. It should be borne in mind that any N.C.D. scale will probably be applied to all private car policyholders and all types of cover. It could be expected that different N.C.D. scales would be appropriate for different groups of policyholders.
and types of cover, but a number of factors encourage the use of a uniform scale, as will be shown in Section 6.

**Numerical Example**

Statistics from the experience of one large U.K. insurance office over several years give frequencies and average costs (roughly in terms of 1972 money) of claims as follows:

<table>
<thead>
<tr>
<th>N.C.D. category*</th>
<th>Frequency per 1000 vehicle years</th>
<th>Average amount of claim £</th>
<th>Approx. claim cost per vehicle year £</th>
<th>Guess of what the claim cost might be if the effect of ( K/K ) were eliminated £</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>210</td>
<td>132</td>
<td>27.5</td>
<td>30.0</td>
</tr>
<tr>
<td>1</td>
<td>180</td>
<td>128</td>
<td>23.0</td>
<td>25.0</td>
</tr>
<tr>
<td>2</td>
<td>160</td>
<td>125</td>
<td>20.0</td>
<td>21.0</td>
</tr>
<tr>
<td>3</td>
<td>150</td>
<td>123</td>
<td>18.5</td>
<td>18.5</td>
</tr>
<tr>
<td>4</td>
<td>140</td>
<td>119</td>
<td>16.5</td>
<td>16.5</td>
</tr>
<tr>
<td>5</td>
<td>135</td>
<td>116</td>
<td>15.5</td>
<td>15.5</td>
</tr>
<tr>
<td>6</td>
<td>132</td>
<td>115</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>7</td>
<td>127</td>
<td>115</td>
<td>14.5</td>
<td>14.0</td>
</tr>
<tr>
<td>8</td>
<td>120</td>
<td>115</td>
<td>14.0</td>
<td>13.0</td>
</tr>
<tr>
<td>9</td>
<td>110</td>
<td>115</td>
<td>12.5</td>
<td>11.5</td>
</tr>
<tr>
<td>Combined 4-9</td>
<td>125</td>
<td>116</td>
<td>14.5</td>
<td>14.0</td>
</tr>
</tbody>
</table>

* Subject to the earlier qualification, this can be regarded as 'claim-free years', category 9 comprising 9 years and over.

*Note:* The figures have been adjusted in respect of other factors so as to represent the effect of N.C.D. category only, unaffected by any other factor (for example age of policyholder) which is associated with N.C.D.

The average amounts of claim are not yet established with great accuracy and thus the last two columns have been rounded to the nearest £0.5. The effect of knock-for-knock agreements is a net transfer of claim cost from the high-risk categories to the low and on a true assessment of liability the range of claim cost might be from £30.0 to £11.5 with a mean for the 4–9 category of about £14.0. It follows that if the 0 group pays basic premiums, then 60% discount does not seem to be earned until one approaches category 9. After eliminating the effect of knock-for-knock, a discount scale giving net premiums in proportion to claim cost might be roughly as follows:

<table>
<thead>
<tr>
<th>N.C.D. category</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount (%)</td>
<td>0</td>
<td>17</td>
<td>30</td>
<td>38</td>
<td>45</td>
<td>48</td>
<td>50</td>
<td>53</td>
<td>57</td>
<td>62</td>
</tr>
</tbody>
</table>
although if allowance were made for expenses not proportional to
the net premium a somewhat shallower scale would be justified.

It is interesting to note that if a points scale were used it would not
be satisfactory to have the same number of points difference be-
tween successive positions on the scale. For example, using the 6%
points scale referred to in Section 2.5, the above rates of discount
could be approximately reproduced by the following points values
for N.C.D.:

<table>
<thead>
<tr>
<th>N.C.D. category</th>
<th>Points</th>
<th>Discount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>44</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>53</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>53</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>56</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>58</td>
</tr>
</tbody>
</table>

Offices do not in practice use discount scales with so many
steps, one reason perhaps being the difficulty of establishing entitle-
ment to N.C.D. on transfer from another insurer. The office re-
ferred to above uses a scale in which 25% discount corresponds
roughly to 0% in most other scales, and in which the highest rate of
discount is 65%; adjusting the office’s discounts to be consistent
with 0% N.C.D. for the basic category, the rates of discount actually
allowed are:

<table>
<thead>
<tr>
<th>N.C.D. category</th>
<th>Discount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>47</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
</tr>
<tr>
<td>6</td>
<td>53</td>
</tr>
<tr>
<td>7</td>
<td>53</td>
</tr>
<tr>
<td>8</td>
<td>53</td>
</tr>
<tr>
<td>9</td>
<td>53</td>
</tr>
</tbody>
</table>

3.2. To discourage small claims

One reason for having N.C.D. is to discourage the making of small
claims and so keep claim costs and management expenses at a lower
level than they would otherwise be. A policyholder contemplating
whether to make a claim will usually recognize that claiming may
well result in a penalty through loss of future discount. The total
penalty is often somewhat arbitrary; it depends on the features of the
particular N.C.D. system and the current position of the policy-
holder on the discount scale. A loss of £50 to £100 over a period of
three to five years is by no means unusual, so that making a claim
of say £20 to £50 might well result in a greater total net cost to the
policyholder than if he had not claimed at all. Penalties are con-
sidered in detail in Section 5.

Incidentally, many comprehensive policies now provide cover for
the contents of vehicles (personal belongings, rugs, etc.) up to a
fixed amount. This extension of cover is of much less value than might
be apparent, since contents claims will usually be less than the result-
ing loss of discount.
3.3. To charge premiums more closely reflecting the individual risks

If one postulates a policyholder with a true disallowed claim frequency $p$ (assumed constant) it is simple to calculate for a given N.C.D. scale the expected premium he will pay over a period. For more detail the reader should refer to the papers by Beard (1) and (2) and Johnson and Hey (9). The Johnson and Hey paper showed that a much higher than average risk produced, over a period of years, an expected net premium which was little above the average for all policyholders. This was for a particular N.C.D. scale, although other scales are likely to produce similar results.

It would appear then that in U.K. conditions the claims history of an individual policy will not enable us to go very far towards correcting the premium for a policyholder for whom the risk differs materially from the average for the group in which he has been placed. Whilst this seems unsatisfactory, it may be regarded as inevitable in conditions in which there are only about 90 disallowed claims per 1000 vehicle years. With this in mind one can readily understand why members of the motoring public may claim that an N.C.D. system penalizes unlucky motorists rather more than reckless or careless ones.

3.4. To induce safer driving

It could be argued that the existence of a financial penalty on claiming may induce safer driving but there can be no evidence to support this and it seems unlikely that the amount of potential penalty could have any significant effect.

4. Determining the rules for moving up and down

Consideration should be given to calculating appropriate rules both for moving up and for moving down an N.C.D. scale. Let us take a new entrant with no previous claims experience. We can classify the risk according to the available information (rating area, car group, etc.) and charge what seems an appropriate initial premium. At the end of the first year we have more information, since we know what the claims experience has been. We can use this information to modify the original premium since claimants can be expected, as a result of heterogeneity, to be on average higher risks than non-claimants. It is the extent of the heterogeneity which we should wish to determine.
Delaporte (3) and (4) approached this problem by using observations of numbers of vehicles having 0, 1, 2, ..., accidents in a given period. He found that these observations corresponded closely to a negative binomial distribution, and hence derived the parameters of a Pearson Type III distribution for the underlying risks. He showed how this distribution could be used to produce a table of premium adjustments related to the number of claims made on an individual policy. He appeared to visualize that the premium adjustment table would vary from one rating category to another.

The concept underlying Delaporte's approach seems quite attractive but its practical application appears to have significant drawbacks:

(i) In order to obtain initial distributions, large numbers of policies are required.
(ii) Observations based on policies exposed for a period of several years relate to a select group because of movements into and out of the group of policies being studied.
(iii) Over a period of several years the underlying risk distribution may change and thus invalidate the original published tables.
(iv) Finally, the introduction of a scale of experience rating where none has existed before may be expected, because of the deterrent effect, to alter the pattern of claims for the future.

There are clearly severe limits on the extent to which the underlying risks can be assessed on the basis of the information which we are likely to have at our disposal. An approach which is less ambitious than that described by Delaporte would be to examine the claims experience according to the number of claim-free years (ignoring allowed claims) at the previous renewal and whether or not a (disallowed) claim arose in that year. In practice we should probably have to use N.C.D. category rather than the number of claim-free years for the lower categories. Also, we should wish largely to eliminate the effects of rating factors other than N.C.D.

This process would give a good guide to the increase or decrease in premiums required according to whether a claim has or has not arisen in the year. It would still have to be borne in mind, however, that a change in the levels of discount and fallback arrangements could affect penalties and hence affect the subsequent pattern of claiming. Although in principle the increases and decreases could vary from one rating category to another, it seems likely that in
practice one would seek to adopt a system of uniform percentage adjustments in premium.

5. THE PENALTY ON CLAIMING

The first effect of making a disallowed claim is that the next year's premium is higher than it would otherwise have been—often much higher. For example the loss of all discount when 60% was expected would result in the premium being 2½ times that anticipated. With basic premiums commonly of the order of £80–£100 these penalties could be as much as £60. However, a penalty will also be incurred in each subsequent year until the policyholder reaches his maximum entitlement. It will be seen that in general the longer the period to maximum entitlement, the larger the penalty in total for a given initial penalty.

If the rules for an N.C.D. scale have been determined using an approach described in Section 4, the penalties on making a claim will already have been fixed. Often, though, the rules for an N.C.D. scale are determined on a somewhat arbitrary basis, and this can lead to an inappropriate range of penalties.

It is a widely held view that it is desirable to make the total penalty much smaller for the policyholder who has reached maximum discount than for the new or inexperienced policyholder. It is difficult to see why this should necessarily be so. In the absence of statistical evidence to the contrary it would seem to the author to be preferable to make the penalty roughly the same for policyholders in all N.C.D. categories.

Examples of Total Penalties
(expressed as percentages of basic premium)

It is an interesting exercise to experiment with different scales and fallback arrangements, taking care to compare what will be paid with what would have been paid had there been no claim. In the following examples, penalties in future years have not been discounted to the present, and no allowance has been made for future increases in premium rates or the possibility of more than one claim.

Example A: (A typical N.C.D. scale.) Discounts of 30%, 40%, 50% and 60% after 1, 2, 3 and 4 claim-free years, with two-year maximum fallback following a claim.
Comparisons of penalties for policyholders now on 40% and 50% N.C.D. are given below.

<table>
<thead>
<tr>
<th>Year after claim</th>
<th>Current rate 40%</th>
<th>Current rate 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discount after claim</td>
<td>Discount if no claim</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Total loss</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

It will be seen that the total penalty at 40% is almost double that at 50%, a feature which can hardly be defended. The penalty to a policyholder without discount is the same as at 50%, but is made up of $30 + 10 + 10 + 10 = 60\%$. The penalty to a policyholder on 60% N.C.D. is only 30%, made up of $20 + 10 = 30\%$.

Example B: (A scale operated by one U.K. office.) Discount of 25% for new entrants and 35%, 45%, 55%, 60% and 65% N.C.D. after 1, 2, 3, 4 and 5 claim-free years. Fallback arrangements are set out on page 99.

Penalties for policyholders now on 35% and 60% or 65% N.C.D. are made up as shown below.

<table>
<thead>
<tr>
<th>Year after claim</th>
<th>Current rate 35%</th>
<th>Current rate 60% or 65%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discount after claim</td>
<td>Discount if no claim</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>55</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Total loss</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

It is interesting to note that one need not drop down a scale to incur a penalty. In this example, if 25% discount remained at 25% in the year following a claim, it is easy to see that there would be a penalty of 40; this compares with a penalty of 105 on returning to 0% from 25%.

Since the 25% discount level should be regarded as the basic premium, the losses should strictly be expressed as percentages of the
WHY N.C.D.?

Review by under-writers

NIL

New business usually starts here.

25%

35%

45%

55%

60%

65%

Arrows indicate path followed by a policy with claims in policy year as follows:

- 0 claims
- 1 claim
- 2 claims

Not shown: Three claims result in a return to NIL.
Two claims when on 55% or less result in a return to NIL.
premium with 25% discount. Making these adjustments, the total losses of 70 and 35 in the above table become 93 and 47.

Example C: (A scale operated by a Lloyd’s syndicate.) New entrants normally start at 100% of basic premium and move up or down 20% on making one claim or no claims. The minimum premium is 40% of the basic premium.

Two examples of penalties produced are given below, taking the basic premium as £100.

<table>
<thead>
<tr>
<th>Year after claim</th>
<th>Current premium £160</th>
<th>Current premium £40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Premium if no claim</td>
<td>Premium if no claim</td>
</tr>
<tr>
<td></td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>1</td>
<td>180  140</td>
<td>60  40</td>
</tr>
<tr>
<td>2</td>
<td>160  120</td>
<td>40  40</td>
</tr>
<tr>
<td>3</td>
<td>140  100</td>
<td>40  40</td>
</tr>
<tr>
<td>4</td>
<td>120  80</td>
<td>40  40</td>
</tr>
<tr>
<td>5</td>
<td>100  60</td>
<td>40  40</td>
</tr>
<tr>
<td>6</td>
<td>80   40</td>
<td>40  40</td>
</tr>
<tr>
<td>7</td>
<td>60   40</td>
<td>40  40</td>
</tr>
<tr>
<td>8</td>
<td>40   40</td>
<td>40  40</td>
</tr>
</tbody>
</table>

Total loss: 260  20

The table shows that this scale can produce extremely large, and very small, penalties. In the case of the policyholder with a current premium of £160 it is arguable whether he can be regarded as being adequately insured, since it will not be economic in the long run for him to make any claim for an amount as high as 2½ times the basic premium, even though the sudden liability of paying for the claim himself will be avoided.

6. REASONS FOR A UNIFORM N.C.D. SCALE

For private cars it is easier to earn discount with non-comprehensive cover than it is with comprehensive cover since the disallowed claim frequency is perhaps only half that for comprehensive cover. It might be thought that discounts should consequently be less.

All premiums should include an element of expenses unrelated to the size of net premium, as well as expenses proportional to the size of the premium. The element of expenses unrelated to the size of net premium is more significant for non-comprehensive policies than
comprehensive policies, since the average premium per policy is much less in the former case. Discounts are applied to the total premium, not the premium net of ‘per policy’ expenses; this is another reason for expecting somewhat lower discounts to apply to non-comprehensive policies.

It is not always the case that the higher the claim frequency the higher the rates of discount which are appropriate. For instance, young policyholders have a much higher disallowed claim frequency than older policyholders, but it would certainly not be valid to claim that the discounts to be allowed for young policyholders should be higher than those allowed for others. Rather the reverse is the case: there is evidence (using the method of Section 3.1) that young policyholders under a uniform N.C.D. scale are receiving more discount than their likely future experience will justify.

Many companies, whilst apparently allowing normal rates of N.C.D., do in effect give higher rates of N.C.D. for young policyholders by imposing lower age loadings for those who have attained the higher rates of N.C.D. This is the opposite effect to the one for which statistics suggest the companies should be aiming.

There are several reasons why the same basic N.C.D. scale normally applies to all types of cover and also to the high risk as well as the low risk cases:

(1) Having two or more scales would introduce more complexities both in administration and in communicating with the public. Imagine trying to explain in simple terms to a young policyholder why he was entitled to less discount than his older counterpart!

(2) A sharp jump in premium may occur when a policyholder transferred from one N.C.D. scale to another, unless special transitional arrangements were devised.

(3) It would be difficult to construct two or more different scales each giving sensible penalties, in relation to those of the other scales, for those who make claims.

(4) Most non-comprehensive policyholders are entitled to low discount only. This may seem surprising in view of the lower claim frequency. The reason is that once a policyholder achieves three or more claim-free years he is very likely to convert to full comprehensive cover.
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(5) There is a shortage of reliable information on the variation of claims experience by N.C.D. category for non-comprehensive cover. The number of claims for older, non-comprehensively insured policyholders with low rates of N.C.D., even for the whole U.K. insurance market, is less than the number needed for proper statistical analysis.

7. EFFECT ON PREMIUM INCOME OF A CHANGE IN N.C.D. RULES

Before introducing a new N.C.D. scale, whether by changing the rules for moving up and down or by changing the rates of N.C.D. or both, it is important to estimate both the short-term and the long-term effects that the change will have on the premium income for the portfolio.

In order to see what this entails we can begin by assuming a certain frequency of claims for which N.C.D. is disallowed, and corresponding to this we can assume probabilities of having 0, 1, 2, ..., such claims in a year. For this purpose it seems reasonable to assume a Poisson distribution. For any given N.C.D. scale, it is then a simple exercise to start with a group of new entrants and work out, from the rules for moving up and down and assuming that there are no exits, what proportion of them will be in each N.C.D. category in each subsequent year, and hence what the average rate of N.C.D. will be in each year. The ultimate position can be calculated directly by solving the equations which express the conditions that the group is in a stationary state.

The process can be illustrated by a numerical example, using the scale described in Example A on page 97. It is convenient to set out in matrix form the probabilities of moving from one category to another:

\[
\begin{pmatrix}
1-p_o & p_o & 0 & 0 & 0 \\
1-p_o & 0 & p_o & 0 & 0 \\
1-p_o & 0 & 0 & p_o & 0 \\
1-p_o - p_1 & p_1 & 0 & 0 & p_o \\
1-p_o - p_1 & 0 & p_1 & 0 & p_o
\end{pmatrix}
\]

where \( p_i \) is the probability of \( i \) claims.

We shall assume an overall disallowed claim frequency of \( \cdot1 \), giving \( p_o = \cdot9484 \) and \( p_1 = \cdot09048 \). Applying these values to 10,000 entrants in category 0 in the first year, we obtain the following numbers in the five N.C.D. categories:
WHY N.C.D.?

It would probably have been more realistic to allow for heterogeneity in the portfolio by assuming that some policyholders had a higher claim frequency than the remainder, but applying the average frequency to the whole portfolio is satisfactory as an illustration.

With the rates of discount allowed in the scale in Example A on page 97, it follows that the average rate of N.C.D. in each year is:

<table>
<thead>
<tr>
<th>Year</th>
<th>Average N.C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>27.1</td>
</tr>
<tr>
<td>2</td>
<td>35.3</td>
</tr>
<tr>
<td>3</td>
<td>42.7</td>
</tr>
<tr>
<td>4</td>
<td>51.5</td>
</tr>
<tr>
<td>5</td>
<td>52.7</td>
</tr>
<tr>
<td>6</td>
<td>53.8</td>
</tr>
<tr>
<td>7</td>
<td>55.1</td>
</tr>
<tr>
<td>8</td>
<td>55.2</td>
</tr>
<tr>
<td>9</td>
<td>55.4</td>
</tr>
<tr>
<td>10</td>
<td>55.7</td>
</tr>
<tr>
<td>Ultimate</td>
<td>55.7</td>
</tr>
</tbody>
</table>

The situation in practice is complicated by movements in and out of the portfolio, and by variations in the mix of business and in the frequencies of disallowed claims. The proportions in the various N.C.D. categories will not usually be those corresponding to the ultimate position: because of the flow of new entrants to insurance, the proportions on the lower rates of N.C.D. will usually be appreciably higher than those in the ultimate state. Nevertheless, calculations on these lines can give a useful guide to the effect of a change in the N.C.D. scale.

Suppose, for example, that we are contemplating merely a change in the rates of N.C.D., with no change in the rules for moving up and down. Given the proportions in the portfolio at present, we can calculate the immediate effect of the change fairly readily. It should be noted, however, that the proportions used should not be those at the next renewal for the policies falling due for renewal, since these are a select group: the new entrants, even allowing for transfers from other companies, will tend to be on lower rates of N.C.D. than the existing policies falling due for renewal. It is therefore necessary either to assume a certain volume of new business in each category, for combining with the existing business (with perhaps an
adjustment for selective lapses from the renewal date) or to use the proportions in the various N.C.D. categories at the last renewal (or entry) date, for all renewal months combined.

Having calculated the immediate effect of the changes in N.C.D. rates, it is still advisable to make comparisons, for subsequent years, between the old and the new scales. If, for example, the choice lay between continuing the existing scale and introducing the new scale, with the basic premiums suitably adjusted to produce the same premium income in the first year, in either case, for the portfolio as a whole, it would be worth while knowing which scale would produce the greater premium income the following year, for a similar portfolio. The point is perhaps especially relevant at a time of statutory supervision of increases in premium rates.

Similar considerations apply if a change in the N.C.D. movement rules is contemplated. Here it is necessary to calculate the effect of the new scale by using the matrix corresponding to that scale.

When any N.C.D. changes are introduced, it is of course possible that the changes will themselves affect the probabilities of claiming, and it may therefore be necessary to test the effect of varying the assumptions as to the pattern of claiming.

8. OTHER CLASSES OF BUSINESS

8.1. Motor cycles

Claim frequencies for motor cycles are generally much lower than for private cars. For example, the smaller motor cycles ridden by older men may give rise to only one claim in 100 vehicle years, and this is quite inadequate to form the basis of experience rating. As a result, some companies give no discount, or very little, to motor cyclists. However, experience shows that the motor cyclist in the 16–18 age group gives rise to a claim cost up to ten times that of the adult, experienced rider. There are two methods of allowing for this.

Method A: A very high loading (say 800%) may be charged at the lowest ages, the loading reducing rapidly, but with no discounts, as the age increases to about 25.

Method B: Alternatively, much lower age loadings (of the order of 200%) may be charged, but with discounts up to about 65%, and a basic premium of around three times that in method A.
The net result to policyholders can be made much the same using either method, but method B would probably be more acceptable to most policyholders.

8.2. Commercial vehicles
For commercial vehicles claim rates may be very high: up to one claim, or even more, per vehicle year, and this would appear to provide plenty of scope for experience rating. However, the bulk of this type of risk is likely to be in fleets, which are not subject to N.C.D. A fleet (of either commercial vehicles or private cars) is rated on the collective experience of that fleet, using a form of experience rating which is based on total claim cost rather than on the numbers of disallowed claims.

9. OTHER FORMS OF EXPERIENCE RATING
With any form of experience rating it is necessary to decide the period of time over which the claims experience will affect the discount. Having too short a period would provide insufficient claims for a proper analysis of the experience, whereas having too long a period would give weight to claims in policy years since when the underlying risk may well have changed. Bearing in mind the extra administrative difficulties of too long a time scale, five or six years would appear reasonable.

We next need to determine which incidents should count towards an assessment of the claims experience. In some countries, notably the U.S.A., incidents other than claims may count. Such incidents may include traffic violations or the issue of tickets by the police. For convenience, we shall refer to all such incidents as ‘claims’.

It may be noted here that it is practicable to base experience rating on numbers of claims only, not on amounts of claims, if only because the amount of a claim may not be known until several years after the date on which the claim arose.

Earlier in the paper we have been concerned with N.C.D., the form of experience rating in which the main factor is the number of years since the last claim. Other methods of experience rating are possible. For example, the system could be related to the number of claims in a given period or the number of claim-free years in a given period. In either of these examples, a single claim in the last (say) five years would lead to the same premium whether or not the claim occurred one year ago or nearly five years ago.
In the first example (using the number of claims in a given period), if it were desired to give more weight to the most recent claims, a different number of ‘claim points’ could be allotted for claims in each of the five years, the most recent claims having the most claim points. Let the number of claims in year \( n+i \) be \( c_i \), \( i = 0 \) to 4, and let each claim in year \( n+i \) be allotted \( p_i \) points. Then, in policy year \( n+5 \), the total number of claim points would be given by

\[
\sum_{i=0}^{4} c_i p_i
\]

and the premium would be determined by reference to this total. The formula could be modified to include (say) \( p_i/2 \) claim points for each claim currently classified as ‘allowed’. New entrants could be dealt with by including notional claim points dependent on their previous insurance history (if any).

With a little imagination it is possible to devise other elaborate experience rating systems. How such systems, assuming they could be implemented, would work out in practice is difficult to predict. In particular, there is always the problem that those policyholders who could obtain cheaper rates elsewhere may lapse their policies. In the U.K. there is a very strong incentive for companies to maintain an N.C.D. system on conventional lines, in order to keep in line with the rest of the market.

The suitability of any system depends partly on the features of the claims experience in the country in which the system is to operate; for example much higher claim frequencies are experienced in most continental countries than in the U.K., even though the cover provided under private car policies is generally less than in the U.K.

The enthusiastic reader may like to refer to the experience rating system of Delaporte (3) and (4) and to the description of bonus systems in some European countries by Vepsäläinen (14). The latter gives examples of some mathematical properties of bonus systems which were described by Loimaranta (10).

10. WHY HAVE EXPERIENCE RATING AT ALL?

‘The controversial “no-claims” discount, which reduces costs (for some) may one day end. On to-day’s crowded roads, freedom from accidents is usually a matter of luck not virtue. The man who need make no claim has thus merely been fortunate in the discount lottery—but at the expense of those who, through no fault of their own, have to make claims and thus bear an undue share of the ever-rising premiums.’

10.1. It is possible to advance a number of arguments against operating any form of experience rating system.

(i) Section 5 of the paper examined the penalty on claiming. But why should there be any penalty on making the occasional claim? Any experience rating system which provides a substantial penalty as a result of making a single claim can be considered to contravene a fundamental principle of insurance: that the policyholder who nominally has full cover should be in the same financial position after the claim is settled as before the incident which gave rise to the claim.

(ii) Section 3.3 has explained that an N.C.D. system is not able to charge the high risk policies enough in relation to the portfolio as a whole, and this is an unsatisfactory feature. In view of the low level of claim frequencies in the U.K., other forms of experience rating are likely to be similar to N.C.D. in this respect. Experience rating does penalize the unlucky.

(iii) An experience rating system results in premiums which are subject to large and unexpected increases (other than those arising from inflation!). This can cause the policyholder great budgeting problems. He cannot insure against the possibility of losing discount before the next renewal date.

(iv) Experience rating gives rise to a lot of extra administrative work for the office, and much ill-will can be created when claims are disallowed. The case for experience rating must be strong in order to justify all the expense and trouble which are caused.

10.2. If experience rating were ended, risks would be rated merely according to the factors used in group rating. A further group rating factor could be introduced: number of years (if any) since passing a driving test—to provide a loading for inexperienced drivers.

Claim costs would then be shared among all policyholders with the same group rating classification, and no penalty would be incurred as a result of making the occasional claim.

10.3. The obvious drawback to such a scheme is that it could lead to selection against the office. In spite of the administrative costs which could be saved if experience rating were ended, the policyholder with a good claims experience may still be able to obtain a cheaper premium rate elsewhere, and if so there would be a tendency to transfer, the office being left with the less profitable business.
Whether it would be possible to obtain cheaper rates elsewhere would be determined largely by whether other offices were prepared to accept a signed statement from the policyholder regarding his claims history, since the office would have ceased to print the entitlement to discount on the renewal notice. If other offices were not prepared to accept such a signed statement, this might appear substantially to limit the selection against the office. However, there would always be selection in respect of new policyholders, and this could be very onerous for the office.

Only if the whole U.K. insurance market were prepared to ignore experience rating would such schemes be likely to be successful. Even in that unlikely event it would probably be necessary to single out a very small proportion of motorists who had demonstrated by driving convictions and repeated claims that they were almost certainly bad risks; they would be charged an underwriter’s loading. One could remark that applying this loading was a form of experience rating, but it is no more so than is necessary for high risks at present in non-life business other than motor.

10.4. There are at present available in the U.K. a number of private motor insurance schemes which are free of N.C.D. These schemes are for the ‘good’ motorist, and generally specify a compulsory excess in respect of damage to the policyholder’s own vehicle. To join such a scheme one generally needs to have a good insurance record, be over a specified age and own a particular type of car. It is possible to lose entitlement to remain in the scheme, but only after a particularly heavy claims experience.

This type of scheme must also be subject to a certain amount of selection, although this may be limited somewhat by a policyholder’s wish to remain in the scheme because of the extra security it affords in the event of a claim. However, it would be interesting to know how profitable—or unprofitable—such schemes have been in relation to other motor insurance. It can never be assumed that the low risks are necessarily the most profitable risks.

10.5. Recent articles in The Times and the Financial Times have suggested that the introduction of ‘no fault’ insurance would mean the end of N.C.D. The author believes this not to be the case.

‘No fault’ is a principle of legal liability and has no direct connection with insurance. The term ‘no fault insurance’ should therefore be taken to mean insurance in conditions in which the law provides that compensation is payable regardless of fault. Insurance
in such conditions could perfectly well operate with an N.C.D. or other experience rating system, although—especially if fewer recoveries were made—some minor changes might be needed in the rules for allowing claims for N.C.D. purposes.

11. CONCLUSION

If—as in private car insurance in the U.K.—there is evidence that policyholders' future claims experience varies appreciably within the rating groups according to whether or not they have previously made claims, then in a freely competitive market insurers must take this into account in the premiums they charge. Thus, unless some further group rating factor can be found which will account for most of this variation within the existing rating groups—and this seems rather unlikely—some form of experience rating such as N.C.D. is inevitable. This, fundamentally, is the answer to the question 'Why N.C.D.?'

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