DOUBLE INDEMNITY IN LIFE INSURANCE POLICIES

BY

HENRY H. JACKSON

For a very good general knowledge of disability benefits in connection with life insurance policies the student has but to refer to the excellent papers of Mr. Woodward[1] and Mr. Morris.[2] No paper devoted to the other popular adjunct of life insurance coverage generally known as Double Indemnity has been published in the *Proceedings*, although in a more general study by Mr. Laird,[3] published in May 1921, an important paragraph is devoted to the subject:

> "Life insurance companies have introduced a provision that in case of death by accidental means before a limiting age, usually 70, the face of the policy will be doubled. This provision was at first attacked even more vigorously than the permanent total Disability benefit as a function of Life insurance but its popularity with the insuring public has swung company after company into line until now a majority of the Life insurance companies grant some form of Double Indemnity in case of death by accidental means."

The object of the present study is to summarize for students the essential features of the subject, even though these are obtainable elsewhere, with the addition of scattered facts as to present practice not readily accessible.

So completely American is this Double Indemnity benefit that the recent excellent Index of the Transactions of the Faculty of Actuaries contains not one reference to it, while in the Journal of the Institute of Actuaries the report of the one meeting devoted to a discussion of the Disability and Double Indemnity benefits[4]

(1) Joseph H. Woodward. Disability Benefits in Life Insurance Policies. P. C. A. S., VII, 10 (November 1920). Discussion VII, 394.

(2) Edward B. Morris. The Permanent Total Disability Provision in Life Insurance Policies. P. C. A. S., XV, 9 (November 1928).

(3) John M. Laird. Non-Cancellable Accident and Health Insurance Underwriting Problems. P. C. A. S., VII, 302 (May 1921). Discussion VII, 334.

(4) The Inclusion of Disability and Fatal Accident Benefits in Life Assurance Contracts. J. A. I. A., LV, 131 (March 1924—July publication).

flounders inconclusively through the former and manages almost wholly to ignore the latter. The student will find much of interest about Double Indemnity in the following papers:

Note on Double Indemnity Clauses in Life Insurance Contracts, William A. Hutcheson, T. A. S. A., XIX, 79; discussion, 332;

Liability to Death from Accident, H. W. Buttolph, R. A. I. A., VII, 45; discussion, 102;

An Actual Experience of Double Indemnity Benefits, R. M. Webb, R. A. I. A., XI, 77; discussion, 88;

Selection of Risks for Disability and Double Indemnity Benefits, R. G. Hunter, R. A. I. A., IX, 27; discussion, 167;

and the informal general discussions recorded in R.A.I.A., V, 65, VI, 127, and XI (2), 58, while the subject is admirably covered in "The Accidental Death Feature in Life Insurance Policies" by Arthur Hunter, T. A. S. A., XXVI, 37, and the able discussion it elicited.

First, then, for the benefit and its name. Actuarial science suffers from unhappy ambiguity of nomenclature. Many of its terms are employed in two distinct and even contradictory senses—the adjectives *continuous*, *immediate* and *ordinary* are ready examples. In connection with disability benefits the expressions employed have been particularly unfortunate. For years we have been defining the word "permanent" as meaning "temporary" and recent publicity has been given the suggestion that "total" be defined as "partial." (It may be of interest to note that precisely the same suggestion was offered by Mr. Woodward before the Casualty Actuarial Society in closing the discussion of his paper on disability in 1920). But never, I believe, was our nomenclature so entirely unfortunate as in the choice of the expression "Double Indemnity" to designate the special fatal accident benefit attached to life insurance policies. For in the first place (and here it is like the main life contract and decidedly at variance with the disability feature) it is *not* a contract of indemnity at all. In the second place (as will appear later) it does not necessarily provide for a payment of double the face of the original policy. And in the third place such a title gives no faintest inkling of its true significance, since an extra payment for death from tuberculosis or insanity is conceivably

quite as reasonable and is economically decidedly more defensible than one for death which "resulted from bodily injury effected solely by violent, external and accidental means." However, I shall throughout this paper employ the generally accepted name. Besides, the substitute expression now fairly common is longer and itself not quite free from ambiguity. For may not "accidental death benefit" be interpreted as meaning either accidental-death benefit or accidental death-benefit? And the latter implication is certainly deplorable!

The exact coverage extended under Double Indemnity can more conveniently be treated a little later. Accepting for the moment the broad coverage obviously intended by the words quoted from Mr. Laird's paper, and remembering the precise significance of the word *means* as so painstakingly pointed out in Mr. Strong's discussion of the paper by Arthur Hunter (*l. c.*, p. 528) and in a paper by Mr. W. M. Bullitt before the Association of Life Insurance Counsel,[5] we may examine in turn the popularity of the benefit and the experience of companies writing it in the United States and Canada. To assure authoritative information I addressed inquiries direct to the actuaries of every company in North America having admitted assets exceeding $25,000,000 on January 1, 1929. With extraordinary patience and the greatest courtesy, these 56 companies have supplied me not only with the information requested but with much valuable material in addition. Subsequent references in this paper to insurance practice in Canada and the United States, unless obviously drawn from the sources already cited or others specifically mentioned, are to be understood as an interpretation of the data thus generously put at my disposal.

Of the 56 companies questioned, 51 offer Double Indemnity as part of their regular coverage, 2 of the remaining five have separate casualty departments through which accident coverage is exclusively placed, while one has a special arrangement whereby its agents are automatically the agents of an accident company which issues accident coverage applied for on the life application. Thus only two of the 56 do not grant the Double Indemnity protection and doubtless at least some of their agents have private facilities for placing this benefit. A tabulation indicating the

([5]) William Marshall Bullitt. Accidental Means. Address before the Association of Life Insurance Counsel, December 7, 1927.

entrance of the 51 companies into the Double Indemnity field during the 25-year period may be of interest.

Year of Entry	Number Entering	Year of Entry	Number Entering
1904	1	1919	4
1905	1	1920	2
1907	1	1921	5
1909	2	1922	13*
1911	1	1923	3
1914	1	1924	2
1916	1	1926	1
1917	5	1928	2
1918	5	1929	1

The amount of this coverage now in force might be ascertained by going to the complete annual statements of the individual companies. The statements filed with the Vermont Insurance Department were accessible and for the companies doing business in that state and offering the Double Indemnity benefit a tabulation showed total insurance in force exceeding \$69,900,000,000; with corresponding Double Indemnity in force on over \$25,500,000,000, or 36.5% on December 31, 1928. The 23 companies represented in this compilation are almost without exception old eastern companies. Some of these have introduced Double Indemnity very recently and have less than 10% of their business containing this provision. On the other hand, the figures include the two giant industrial companies which late in 1928 conferred upon all industrial policies the special accidental death benefit without any extra premium charge, thus swelling the amount of Double Indemnity coverage by several billions. But one of the huge companies writing no industrial business reported 62% of total business containing Double Indemnity. And probably the companies not operating in Vermont have as a whole stressed Double Indemnity at least as much as have these companies. That Double Indemnity is today in force on about a third of all the ordinary business in North America appears to be reasonably certain.

It seems likely that an even higher proportion of new business than of total business in force contains Double Indemnity. The annual statements of the companies do not directly give this information, but first year Double Indemnity premiums received

*In this year the 9 Canadian companies entered the field together, the statutory taboo having been removed.

are included and form a helpful guide in determining the amount of new business so written. Rough approximations based on the figures available indicate that of the business written in 1928 by the 23 companies studied (industrial business excluded) some 40% included this benefit, with four very large companies attaching it to at least 50% of their business, one of them, indeed, to probably more than 75%. The cases in this group where less than 15% of the new business contains the benefit are extremely rare and are accounted for either by the fact that this field has been entered very recently or that the company has a casualty branch with which it does not wish to compete too actively in its life department. In general it seems a fair conclusion that the attitude of the management of an individual company toward the benefit greatly influences its sale, for there are some who regard it enthusiastically while others view it with a sort of tolerant disdain. Let us examine the basis of these divergent views:

In the second edition of Mr. Maclean's standard work[6] the strictures on Double Indemnity are summarized to this effect:

> "The double indemnity clause seems an unnecessary and undesirable part of a life policy. It is merely a 'side bet' for which the odds offered the insured appear so attractive that he usually decides to take it, but there is probably no good reason for his doing so. . . . Indeed, as death from accident is not preceded by an expensive illness, but may, on the contrary, result in some financial compensation to the representatives of the insured, accidental death might be regarded as the least appropriate reason for a double indemnity provision."

How, then, is one to account for the popularity and success of the venture? There are several answers which it seems necessary to repeat in some detail: First of all, a quotation from Mr. Woodward's valuable paper already referred to makes admirably the main point. The reader has but to substitute the words "Double Indemnity" for "disability" wherever applicable in the following paragraph:

> "The chief economic advantage of having disability insurance written in connection with life insurance is the saving in expense. The life insurance companies in any

(6) Life Insurance, by Joseph B. Maclean. McGraw-Hill Book Company, Inc. New York, 1929. (Second edition.) See pages 321-4.

> event incur such expense as is incidental to securing life insurance. At slight additional expense they can supply protection against the more serious cases of sickness or disability. In addition to the commission paid to the agent, the issue of a life insurance policy involves the expense of a medical examination and of an inspection report. It is clear that if we have a medical examination and an inspection report we can sell disability insurance on the basis of a much more careful selection and gradation of risks than any company attempting to issue such insurance without these advantages could hope to achieve. Furthermore, the effort of selling a limited amount of disability insurance at the same time that life insurance is sold is little, if any, greater than the effort of selling life insurance alone. Indeed, the original motive for incorporating the disability clause in the life insurance contract was to make the sale of that contract easier than would be the sale of the life insurance without it. Further advantages are that when disability insurance is issued in connection with life insurance the acquisition cost is paid only once, the renewal expense is relatively low, and, finally, that the purchase of a substantial amount of life insurance along with the disability benefit is an evidence of good faith and tends to improve the moral hazard."

Again, though disability is the more defensible adjunct from the point of view of the economist, from that of the actuary it is the less so in that Double Indemnity is based on the very event which constitutes the major claim and that, in sharp contrast to disability, both are distinctly not contracts of indemnity. Viewed thus, the life policy, the Double Indemnity and the disability benefit are not unlike a staid old dog, his frisky pup, and a decidedly temperamental cat, all in the same compartment.

Even economically viewed, this accident benefit is not merely meretricious since, as has been well pointed out, sudden death may prevent arrangements of the deceased's estate which he could advantageously provide for from an ordinary deathbed. Moreover, fatal accidents befall with undue frequency under-insured fathers of young families.

A further point suggested in Mr. Maclean's account has not to my knowledge received due emphasis. From the point of view of the individual, all insurance is just plain downright gambling. Possibly insurance men in underscoring the economic and scientific basis of the business as a whole have unduly understressed this phase. Now a bargain is as attractive in gambling as any-

where else. Above all it is fun to bet in your own favor instead of eternally against yourself, and here's a chance. With every life insurance premium you pay you are constantly betting against your own desires. "I bet I die this year . . . . or surely this." Your whole interest is *against* your winning. But Double Indemnity gives you the opposite chance. For who, if he must die, would not willingly escape all the long-drawn-out agony for himself and those dear to him of lingering illness? "I bet (and at what incredibly favorable odds) if I die this year it will be by accidental means, and if I win I win doubly." Thus psychologically the benefit seems sound enough.

And its chief actuarial advantage has yet to be stated: reasonable and adequate rates are not difficult to obtain. Of the 51 companies in this survey only half a dozen had so much as adjusted the Double Indemnity rates first adopted and of these every revision save two had been downward. What a contrast to the history of disability benefits! The two (slight) upward revisions require a digression. It appears to be the general practice today to let commissions on Double Indemnity follow those on the main contract. Some companies when first without much enthusiasm introducing the benefit allowed only renewal commissions on any of these extra premiums. At least one of the adjustments in question was introduced to cover the change from "renewal only" to "first and renewal" commissions on Double Indemnity premiums.

What, then, are regarded today as reasonable and adequate office annual premiums for such Double Indemnity coverage as is customarily offered with life insurance policies? A broad general answer is: $1 to $1.50 per thousand as a flat rate at all ages for continuous premium policies, with limited premiums commuted accordingly. This very broad answer requires nearly as many exceptions as the typical Double Indemnity clause itself, but may be accepted in general. In particular, of the 51 companies 15 report a graded annual premium. These include all 9 of the Canadian companies which here as elsewhere have set their southerly competitors an example by their ability to adopt uniform rates and essentially a standardized clause. Since these rates have been followed more or less closely by several other companies recently entering the field, the student may like to know that the premium is: For ages at entry up to 45

inclusive, $1.25 flat, graded up $.05 yearly thereafter to $1.75 at 55 for a clause automatically cancelled at 60. Only four companies have the flat $1 rate but these are four of the hugest and grant coverage for life. Of the remaining companies ten charge $1.25 and eleven charge $1.50 while the rest are scattered at $1.20, $1.30, $1.35, $1.40 and (1) $2. So vast is the business conducted at the $1 rate, however, that the weighted average continuous premium Double Indemnity charge on this continent is by my best estimate not over $1.20 and I greatly doubt whether the limited premium policies issued bring this up to $1.30. Indeed, on the basis of the business accessible to my individual audit, the average is not increased 5% by limited premium business.

While such limited premium extras have been referred to as commuted (on the basis of course of the regular valuation table employed) such commutation varies from exact calculations for each age and kind to very general approximations indeed—with the present tendency apparently toward the use of exactly proportionate individual limited rates.

The question of office rates has been stressed (unduly perhaps) since on a reasonably correct answer depends part of a proposed investigation of the total company experience on Double Indemnity for the years 1920-1927 inclusive. For these years the Spectator Company in the Life Insurance Policyholders Pocket Index has compiled premiums received and losses paid on the Double Indemnity business issued by companies in the United States having over $25,000,000 of insurance in force. The list of such companies offering the benefit has grown from year to year, amounting in 1927 to 131. The totals for the eight years in question are here tabulated:

DOUBLE INDEMNITY PREMIUMS AND LOSSES—AGGREGATE SPECTATOR FIGURES

Calendar Year	Premiums Received	Claims Paid	Ratio of Claims to Premiums
1920	$ 4,865,635	$ 1,677,669	34.5%
1921	9,208,436	4,050,419	44.0
1922	10,533,741	4,441,652	42.2
1923	12,721,213	4,944,230	38.9
1924	15,991,066	6,778,390	42.4
1925	19,117,245	8,431,700	44.1
1926	19,201,531	7,621,057	39.7
1927	21,992,946	9,566,446	43.5
Total.....	$113,631,813	$47,511,563	41.8

If the assumed average weighted premium of $1.30 be accepted as approximately correct and if an increase (disregarding interest increments) of $10,000,000 in reserves from the beginning to the end of the period be conceded, it will be observed that the net death losses in the total experience fall just under $.60 per $1000 annually.

At a meeting of the Actuaries' Club of Toronto last February, the experience of Canadian companies on Double Indemnity was discussed. Mr. Arthur Pedoe has kindly supplied me with an abstract of this discussion from which it appears that on mean exposures for the calendar years 1923-1927 inclusive slightly exceeding $1,500,000,000, the net cost of Double Indemnity claims per $1000 was $.553. The rate represents total Double Indemnity business issued in Canada by Canadian and other companies. This corresponds with astonishing closeness to the reported experiences of the New York Life, Metropolitan and Mutual at $.55, $.52 and $.58, respectively.

It appears then that the aggregate loadings of American companies above the net Double Indemnity rates are ample to care for the various expenses connected with this special branch of the business and to provide a handsome surplus for contingencies. Reference to the annual statements filed with the Vermont Department appears to confirm this fact. It will be remembered that a comparatively new section of the Gain and Loss Exhibit requires a segregation of income and expense by classes of business. In the absence of explicit directions for its construction there is undoubtedly enormous diversity in the methods employed to prepare certain estimated items. Yet the total figures for the companies in question are impressive. A single company for the year 1927 reported a gain exceeding $1,900,000 while actual losses existed rarely even for individual companies in spite of the fact already referred to that several had only small volumes in force with comparatively high individual limits and so might encounter violent fluctuations and possible net losses in unlucky early years.

At this point it is convenient to introduce a brief discussion of the underlying actuarial principles. These are so simple that they have not found their way into formal actuarial literature. Yet one who has read examination papers for several years may be pardoned for believing that at least some candidates may profit by such an exposition.

Let the benefit be not granted before age w, and be discontinued at age y, where y may or may not be as great as ω. And let $w - 1 < x < y$. Denote the yearly probability of accidental death at age x within the terms of the clause q'_x. Assume that q''s have been obtained from existing data. Then from any suitable l_x column may be prepared a d'_x column where $d'_x = l_x\, q'_x$. Assuming contrary to fact but in accordance with the legalized conventions that claims are payable at the end of the policy year, we now have: $A'^{1}_{x:\overline{1|}} = \dfrac{v\, d'_x}{l_x} = v\, q'_x$ and commutation columns may be constructed in the ordinary way of: $C'_x (= v^{x+1}\, d'_x)$ and $M'_x\ (= \Sigma C'_x)$. In actual practice given a suitable table of q' it would doubtless be simpler to develop C' direct from the ordinary D_x functions (from the relation $C'_x = v\, q'_x\, D_x$) without bothering to develop a theoretically correct but otherwise unnecessary d'_x. Such a procedure will obviously give a smoother grade for C'_x, since the theoretic d', being at once integral by definition and small by nature, will produce ragged values similar to those toward the end of a regular mortality table.

Clearly, then, if $q'_y = d'_y = C'_y = M'_y = 0$ we have

$$A'_x = \frac{M'_x}{D_x}$$

$$A'^{1}_{x:\overline{n|}} = \frac{M'_x - M'_{x+n}}{D_x} \quad (n < \overline{y - x})$$

whence annual premiums throughout the entire benefit period or for any shorter period are readily computed by dividing by the appropriate *regular* temporary annuity-due (or life annuity-due if $y = \omega$ with coterminous premiums).

Two comments will occur to the student: If the benefit ceases on the inception of total disability benefits under the policy—as it does in about half the clauses analyzed—should not the C' column be constructed from the l_x^{aa} rather than the l_x table, the D^{aa} column and the corresponding active life annuities being employed in all computations? That is $\dfrac{M'^{aa}_x}{D_x^{aa}} = A'_x$ and $P'^{1}_{x:\overline{n|}} = \dfrac{A'^{1}_{x:\overline{n|}}}{\text{a}^{aa}_{x:\overline{n|}}}$. Again, where the benefit does *not* cease on

disability, should not the benefit be valued from the "mixed life" C' columns and the annual premium from the "active" annuities? Or, what amounts to the same thing, should not the premium-waiver premium include an extra charge when Double Indemnity premiums are to be included in the benefit? For, obviously, a company not discontinuing Double Indemnity on disability will hardly propose to keep on collecting the Double Indemnity premiums while waiving those under the major contract—although the point does not appear to be specifically covered in certain of the policies examined.

The answer to these kindred questions is a third question: Should there not be certain *minima* concerning which the actuary, as well as the law, *non curat*? The ignoring of this trifle introduces the further point as to the proper tables with which to combine your q''s. Must the nuisance of select values be introduced? Again the practical reply should be, I think: Since this special benefit is not materially influenced thereby, *i. e.*, since select q''s need not be developed, an aggregate or ultimate table may be employed for the purpose of deriving C' without essential loss of accuracy.

The usual processes for developing reserves on the basis of premiums thus derived—that is, the prospective, retrospective or accumulative are, it will be observed, readily applicable. For instance, a new k_x' is easily made to match the regular u_x for accumulation; or under the Karup method, a special θ_x' may be developed.

Returning now to the less rarefied atmosphere of actual practice, how are net premiums and reserves computed today? As already implied by the gross premiums, the benefit is generally assumed to be a fixed annual value regardless of age, so that $q'_x = (1 + i)k$, for all values of x from w to $y - 1$ inclusive, and $A'_x = k\,a_{y-x}$. For purposes of valuation k is assumed to be .001 by many companies (even those charging but $1 per $1000 for Double Indemnity); or to be .0009 by some charging $1.35, thus giving a 50% net loading.

The student will observe that this simple assumption leads to an initial reserve of k per unit and a final of 0 on all continuous premium benefits, while on the higher premium cases the excess of the net annual premium over k has but to be accumulated with benefit of interest and survivorship to the end of the premium

paying period, whereafter the net single-premium value represents the liability. The point is emphasized here, needlessly, perhaps, since as will appear presently the actual company practice resulting is one whereby limited premium business is segregated, mean reserves on the continuous premium plan (of $k/2$ per unit) are set up on the entire business and the excesses of net limited premiums above the theoretical k are calculated and accumulated by various approximate methods.

The Travelers Insurance Company, from the New York Life and Metropolitan experiences and group experience as arranged by Mr. Beers, supplemented by its own experience, has prepared a valuable table of the probability of death (before age 70) by accidental means as defined in modern policies. The results, as combined with the A.M.[5] Mortality Table with interest at 4%, have been generously put at my disposal by Mr. Morris, and with a companion table prepared by me as an adjunct to the despised but tenacious American Experience Table, both on a 3% and a 3½% basis, will be found in an appendix.

Specimens of q_x' thus developed by The Travelers and of the corresponding premiums and reserves for certain policy types must, however, be introduced at this point. The benefit ceases at age 70.

NET LEVEL ANNUAL PREMIUMS PER $1000

Age at Issue x	$1000\,q'_x$	Life	20 Pay. Life	20 Yr. End.	5 Yr. Term
25	.52	$ .61	$ .86	$ .49	$.48
35	.48	.71	.92	.60	.48
45	.66	.89	.98	.82	.67
55	.89	1.12	1.12	1.12	.91

MEAN RESERVE PER $1000

Age at Issue	Fifth Year			Tenth Year		
	Life	20 Pay. Life	20 Yr. End.	Life	20 Pay. Life	20 Yr. End.
25	$ .94	$2.39	$ .27	$2.04	$5.28	$ .53
35	1.55	2.69	.90	2.71	5.27	1.23
45	1.61	2.13	1.23	2.72	3.92	1.84
55	1.75	1.75	1.75	2.19	2.19	2.19

The first inclination of the actuary on scanning such figures so soundly based is to question the admissibility of flat office rates regardless of age. Yet the simpler assumption has thus far been satisfactory in practice. The rates adopted have been in the

aggregate ample, the great bulk of the business is sought by comparatively young men on continuous premium forms, and the fundamental assumption that all such coverage may be with reasonable propriety regarded as yearly renewable term coverage at a flat premium rate works out with such ease and general fairness that a change to a different assumption in the immediate future is not anticipated.

The Double Indemnity reserves set up by the companies reporting to the Vermont Department are impressive, amounting on December 31, 1928, to over $31,000,000 on the more than $25,000,000,000 in force with this benefit. These figures imply total extra Double Indemnity reserves held by all United States and Canadian companies of well toward $40,000,000. The various processes employed by the companies in calculating so important an item may reasonably and must theoretically be of interest to the student. In this connection it should be remembered that the reserves on this new feature are not ordinarily as yet prescribed by statute. There are exceptions in the Middle West where a definite standard is incorporated in the insurance law but the statement is in general fair that the usage of American companies represents a rational agreement arrived at by the life offices and insurance departments instead of the strait-jacket of legislative enactment. From the detailed information accumulated, a fair statement appears to be:

On continuous premium policies most companies are assuming a generously high rate of fatal accidents constant at all ages covered, and, regarding such insurance as automatically renewable term coverage at flat rates, they set up half the net premium as a mean reserve December 31. The companies operating on a very low extra premium usually set up half the entire premium as the mean reserve. The statutes already referred to require the setting up of half the gross premium. The companies charging the somewhat higher rates and not hampered by statute ordinarily set up $.45 or $.50 per $1000 as the mean reserve.

On limited premium contracts the problem is not quite so simple. An obvious method of handling these cases where $.50 per thousand is set up as the mean reserve on whole life contracts is to accumulate during the premium paying period the excess assumed net premium collected above $1 per thousand annually

with the benefit of interest and survivorship to the valuation date. The student familiar with the tables of forborne annuities to ages 60 and 65 published in 1922 by Mr. Glover[7] will realize that the necessary office calculations in connection with the tabular figures are simple. Beyond the premium paying period the reserve will obviously be merely the single premium for the benefit in question at the age attained, which is immediately available per dollar of original net premium on the life plan by reference to a table of temporary annuities. Throughout this discussion it is assumed that appropriate adjustment will be made for the date of automatic cancellation of the benefit if it is cancelled before the end of the mortality table.

Since, however, the limited premium business is comparatively unimportant, approximate methods of valuation are ordinarily employed for this portion of the business. Perhaps the simplest of these is that which assumes accumulations of net premiums in excess of the net level continuous premium at a rate of interest high enough to cover the basic interest assumption and reasonable benefit of survivorship. Five per cent. has frequently been assumed as such a rate and is ordinarily acceptable to insurance departments. The office processes of arriving at total extra reserves for Double Indemnity with these basic assumptions will be obvious.

On the other hand, a few companies even though they charge flat premiums regardless of age for the benefit compute reserves on the basis of such a table as that in the appendix. Theoretically these reserves could be exactly computed by the various office valuation methods comparable to those employed for ordinary insurance policies. Actually, approximate methods are of quite sufficient accuracy under the circumstances. Indeed, the experiment has been successfully tried of applying a flat mean reserve per thousand factor to the total Double Indemnity insurance in force and making such slight adjustment in this factor every few years as an investigation of the business might indicate.

All the companies combined reporting to the Vermont Department showed reserves on Double Indemnity reinsured with other companies amounting to only $10,425, of which approximately

(7) Double, Triple and Multiple Indemnity, Extra Net Premiums and Reserves, by James W. Glover. Edwards Brothers. Ann Arbor, Mich., 1922.

half was reported by a single company which recently entered the Double Indemnity field with a maximum Double Indemnity limit of $25,000 and a retention limit of $5,000. This means that the larger eastern companies reinsure practically none of this business. One of these has a retention limit of $100,000, several others of $50,000, and still more of $25,000. Yet the general practice of the 51 companies included in the questionnaire is very different. Most of these, excluding the older eastern companies, have important Double Indemnity reinsurance facilities, the larger companies frequently offering a maximum of $50,000 with a retention of $25,000, while others reinsure several times the amount retained. Reinsurance facilities for the business are readily available and until quite recently several reinsurers were willing, I am told, to assume the entire risk on Double Indemnity. The present feeling of the reinsurers, however, is well summed up in this clear statement by one of them: "We prefer to have the original company retain part of the Double Indemnity in order that it may have an interest in the selection and in the claim settlement. If, however, the original company grants Double Indemnity up to $25,000 and retains $5,000, we sometimes reinsure the remaining $20,000. Sometimes it comes to us on what they call the semi-automatic basis. That is, we have a right to refuse if we are already loaded but we accept the other company's judgment as to insurability."

In this connection it is convenient to refer to various miscellaneous office practices connected with the business. As will appear in more detail later, the coverage may be discontinued at age 60, 65 or 70, or may extend throughout life. One company discontinues the benefit after 20 years from date of issue while several companies on limited payment contracts simplify their rates and reserves by discontinuing the special coverage when the policy becomes paid up by limitation. In the limiting age of issuance, however, there is considerable uniformity, the upper age limit being 55 years in about three-quarters of the companies. One does not issue it above age 50 while the rest cease to write at 59 or 60 except only two which go to 65. Both of these discontinue the benefit at 70 and employ fairly stiff graded premiums at the higher ages. Concerning the lower limits, there is rather more diversity, some not choosing to issue the benefit before majority and several not quoting below age 20 or 18. By actual count 15

is decidedly the most popular lower limit while two companies report rates at age 10.

The benefit is granted to women by most companies that insure women at all, since the fatal accident rate is much lower among women than among men. Ordinarily the age limits are the same as for men but the maximum amounts are frequently reduced. A few companies do not sell Double Indemnity to women at all and certain others restrict its sale to self-supporting spinsters.

The attachment of the benefit to term contracts also reveals varying practices. In recent years there has been apparent in American life insurance a trend toward lower premium forms, stimulated perhaps by many very large policies of corporation insurance, frequently on the term plan. It is a trifle difficult to tell whether the volume of term insurance has increased because of the special benefits of disability and Double Indemnity which have been lately attached to it by a good many companies or whether companies have granted these benefits because of the increased popularity of their term forms. In any event, I was interested to find that most of the companies are now attaching Double Indemnity to term policies on about the same basis as to standard forms. The limits in some cases are reduced in connection with term contracts and the benefit is not ordinarily granted at very early ages and sometimes not to women on this plan.

The problems of medical selection have not been seriously increased by the inclusion of Double Indemnity as they have been by the inclusion of disability benefits. The accidental death rate, so far as company investigations indicate, is little or not at all influenced by medical selection. Obviously, there may be physical defects, as for example the loss of an eye, which might be deemed cause for denying Double Indemnity at standard rates where standard life insurance could be issued. But it is a fair general statement that Double Indemnity can be allowed at standard rates in connection with standard policies issued within a company's prescribed limits. Occupational hazards offer an exception. In such instances the practice of the companies varies. A number simply decline the accident risk. Others have exceedingly simple extra rates applicable to such cases, as for example 1½ or 2 times the standard rate. A few appear to have an accident rating as high as 3 times the standard, even on risks

not rated substandard for life insurance. Most companies doing substandard business offer the Double Indemnity in connection with reasonably favorable cases, again under a very simple rating system where necessary.

The practice regarding the attachment of the rider to old policies is naturally suggested by the question of selection. Through the courtesy of its actuary, I learn that a well-established Middle Western company as early as 1908 on entering this field tried the experiment of offering Double Indemnity coverage to all its old policyholders within its specified age limits regardless of present occupation or health and that the whole experience of this company has yielded a net Double Indemnity cost of approximately $.72 per $1,000. Generally, however, some evidence of insurability, frequently including a medical examination, possibly of a rather informal nature, at the expense of the insured is required. This is not only a safeguard against adverse selection but also an incentive to the applicant to buy new insurance at the same time and thus save the cost of the examination.

It is generally felt that the moral hazard in connection with Double Indemnity itself need not be feared in a case deemed eligible for life insurance. It is of some interest to remember that such was originally the feeling concerning disability. Thus Mr. Dawson remarked (R. A. I. A., VIII, 112): "That element [*i. e.*, of moral hazard] is scarcely traceable at all when temporary disability insurance is combined with life insurance. You can see how that could be true by reason of the large premium payable in consequence of which the man could not well load himself up with an extravagant amount of that protection; but it is not only on account of that large premium, but also on account of your medical examination and your inspections." Unfortunately, the disability experience of the companies has not borne out these earlier hopes. While obviously the possibility of similar adverse selection in connection with Double Indemnity is greatly reduced, it seemed to be worth inquiring whether companies as part of selection routine were investigating the amount of Double Indemnity already carried by applicants. This question revealed the fact that 24 of the 51 companies do request this information while others are considering its inclusion. Although it appears that only rarely has the information thus elicited led to declining an applicant for Double Indemnity, it may

in future serve a valuable purpose in calling attention to the possibility of a speculative hazard, and indicate the advisability of declining any form of insurance whatever on a particular applicant.

A study of the contract forms offered by the different companies is instructive as revealing the rather general uniformity now established. My first thought was that a comparison of early and recent clauses within the companies would afford valuable material for comment. Yet many actuaries in responding to my request wrote in effect: "The company first adopted the Double Indemnity feature six or more years ago (indeed, 12 years in one instance), and still continues the original clause and the original rates without change." Few of us could truthfully make a similar statement regarding disability! The fact is that after the pioneering stage comparative standardization was early reached and experimental frills have for the most part not been added. The recent changes made were for the purpose, so far as I could detect, of avoiding some particular risk which was proving to be more troublesome than anticipated, of clarifying the clause previously adopted in some minor detail, or of attempting to meet in future some outrageously unjust court decision bearing on a particular wording.

An analysis of the 51 current contracts will prove but dull reading for the student, who is advised to skip the following pages except in so far as any particular entry may engage his special interest. As a general introduction, however, to these particular details a few remarks may be appropriate.

The earliest clause reported by any of the 51 companies enumerated was issued by the Fidelity Mutual in 1904 and reads as follows: "In the case of death being caused by bodily injury of the insured effected exclusively by external, violent and accidental means, and occurring within 90 days of the event causing the injury, double the sum of insurance will be paid." The corresponding rates were graduated by age, varying from $2.96 per $1000 at 21 to $3.44 per $1000 at 60. It should be remembered that the first clauses of some of the companies consisted solely of what was formerly referred to as the Travel Accident Clause in contrast to what was called in distinction the General Accident Clause. The former, requiring a very low premium—frequently $.10 annually per $1000—provided Double Indemnity only in the

event of death by accidental means to a passenger in a common carrier. This travel clause is no longer issued by any of the companies under review. With few exceptions the companies now issue Double Indemnity as a rider instead of incorporating it in the body of the original contract. The exigencies of doing business in conformity with diversified statutes require most companies to have a supply of three or four different riders, all attempting to grant precisely the same coverage so far as the laws of particular states and the rulings of particular commissioners will permit. Very frequently the extremely slight changes thus necessitated would appear utterly puerile to an outsider and some of them surely must so appear even to the commissioners whose unfortunate duty it is to disapprove clauses not precisely adapted to their own Procrustean system. In the following analysis trivial details relating to the requirements of different states are completely ignored.

The portions of the rider which are peculiar to the Double Indemnity benefit may be considered in three groups: The general accidental death coverage, special forms of accidental death excluded from this coverage, and special provisions for termination of the rider. The first of these is the simplest and, if claims were to be adjusted according to common sense instead of judicial procedure, might be worded as follows: "If while the original policy is in full force it becomes a claim by death, the amount of such death claim will be increased by $...... on submission of due proof that death resulted directly from accidental means, as those words are generally understood and accepted, unless such death is specifically excluded in the exceptions hereunder."

Note: The inclusion in this clause of the amount in dollars of extra accident coverage instead of "double the face of the original policy" has become popular of late, 28 of the 51 companies employing it. Undoubtedly some mean precisely the same thing by the two expressions and one actually employs both. Yet the device permits the writing in one contract of life insurance for a given amount and of the accident benefit for a different and smaller amount wherever that course is desirable because of the company's limit or otherwise. It also permits the avoidance of any reference to the exclusion of dividend additions for example, which under the other phraseology some companies deem it

necessary to exclude. Not one of the companies questioned is now issuing Double Indemnity for an amount in excess of the face of the original policy—that is, triple indemnity and the like have been definitely discontinued in American practice. However, one company at an increase of about one-third over its usual Double Indemnity premium covers not only accidental death but also gives a benefit of like amount to the insured himself in case of "dismemberment or loss of sight through accidental means."

Arrangement is ordinarily included to pay the accident claim "in the same manner and to the same payee or payees" as the other proceeds of the policy. Several companies at this point include the expression "unless otherwise provided," thus implying that office practice permits an occasional special arrangement for payment of the Double Indemnity claims. Where the rider is attached to a continuous monthly income policy care is exercised to limit the accident payments to the guaranteed period. Four companies have in the general provision a clause to this effect: "In case claim is made for accidental death benefits under this Provision and such claim is denied by the Company, it may, upon receipt of satisfactory proof of death, pay the proceeds of the policy, exclusive of any benefits herein provided, without prejudice to the claim for such accidental death benefit or to the defense thereto."

In every instance the Double Indemnity premium appears to be non-participating and with a single exception is without cash or other non-forfeiture value. In this one instance the excess of Double Indemnity premiums on a limited payment plan over the corresponding continuous premium plan is accumulated without interest to increase the cash value of the original policy or to increase correspondingly its other non-forfeiture options.

Exceptions

The list of exceptions is very numerous and varies markedly with the companies. Exceptions marked with an asterisk have already been excluded in the general clauses. This redundancy in company clauses is merely another instance of the intricacies to which life is exposed by legal phraseology and fear of judicial obtuseness.

1. If a period of more than....days intervenes between the accident and death resulting therefrom.

NOTE: Such a clause is universally adopted. The popular period is 90 days, (preferred by 43 companies). 7 employ 60, 1 uses 100 days.

2. If death occurs after the policy anniversary nearest the ...... birthday of the insured.

NOTE: One company discontinues the benefit after 20 years from date of issue. The most popular limiting date is the anniversary nearest the 60th birthday, (in 24 companies). 8 companies extend it to the 65th, 9 to the 70th, while 9 companies set no age limit.

Actually this clause is less simple than my wording would indicate. One company appreciates the fact that two anniversaries may be equally near the birthday unless a February 29 has been providentially interposed and therefore inserts the expression "The first premium due date nearest the 60th birthday." A few companies ignore policy anniversaries entirely and fix their attention on the actual birthday of the insured. One employs the anniversary following the 70th birthday, instead of the nearest anniversary.

3. *Death by disease.

NOTE: An inclusive expression frequently employed covers "any physical or mental disease or infirmity." 48 companies feel the necessity of introducing such an exceptionable exception, which is in itself sufficient commentary.

4. Death by suicide.

NOTE: Practically without exception this is included with the elaboration "whether sane or insane." A recent case in which a lower court is reported to have approved a claim for Double Indemnity, although the insured was shown to have inhaled voluntarily carbon monoxide, to have been carried to bed, to have recovered sufficiently to get up and obtain his revolver and then deliberately to have shot himself, on the ground that his mind having been deranged by the carbon monoxide he shot himself by the merest accident, indicates the difficulty of excluding all payments on such claims.

5. Death by poison.

NOTE: 27 companies exclude poison whether taken voluntarily or otherwise.

6. Death by inhaling gas.

NOTE: Since speedy death by the carbon monoxide route has become so prevalent, several companies have adopted this clause. 13 are now using it. The student interested will find an illuminating paper on the subject in the 1928 Proceedings of the International Claim Association.[8]

7. Death by violation of law by the insured.

NOTE: The intent of this exception (included by 42 companies) is perfectly clear and no reputable company would dream of a harsh interpretation. That the policyholder may understand this, the wording preferred by some companies is: "Death resulting from committing an assault or felony." One company to take no chances expresses the exception as "Assault, felony or any other violation of law by the insured."

8. Death as a result of riot or insurgency.

NOTE: Included by 33 companies.

9. Death as a result of war.

NOTE: Included by 30 companies. A typical wording of this exception is "from war or any act incident thereto." Red Cross or other relief service is occasionally included in this connection and in a few instances travel in wartime outside the continental limits of United States and Canada is excepted from the Double Indemnity coverage.

10. Death as the result of aviation.

NOTE: All 51 companies exclude the aviation hazard except that two of the companies recognize Double Indemnity where accidental death befalls a fare-paying passenger.

11. Death as the result of submarine operations.

NOTE: Included by 45 companies.

12. Death as the result of military or naval service in time of war.

NOTE: Nearly every company excludes this hazard, many of them not even including the phrase "in time of war." 19 of the companies provide for termination of the Double Indemnity benefit entirely in case of military or naval service in time of war.

13. Death by contusionless injury.

NOTE. In this connection or elsewhere the Double Indemnity clause provides for the company the right to examine the body

(8) Charles Rathbun. Carbon Monoxide Poisoning. Particularly from Automobiles. Proceedings of the Nineteenth Annual Convention of the International Claim Association (September 1928). Page 56.

and to perform an autopsy unless forbidden by law. Most of the companies require that the particular accidental means in question shall be evidenced by a mark discoverable on such autopsy. In this connection, however, it is necessary to except accidental drowning which is invariably included in the coverage and which may well fail to reveal such contusion. The interesting methods employed by those drafting the clauses in inserting this exception to an exception are instructive rather to the student of English than to the student of Double Indemnity as such.

14. Death as a result of police duty.

NOTE. 18 companies insist on this exception.

15. *Death as the result of infection.

NOTE. The inclusion of this exception is hedged about by many explanations to show that pyogenic infection as the direct result of the accident and the immediate cause of death is not excluded. When a court can solemnly aver that death by typhoid fever may be death by accidental means if the introduction of the typhoid germ to the mouth can be ingeniously explained as possibly having resulted from the break in a water main, one can hardly wonder at this apparently redundant exception, included by 27 companies.

16. Death by murder.

NOTE. A softer phrase is "intentionally inflicted injuries." One company accepts the risk of death by murder after the first year. 7 do not accept it at all. Though by definition murder cannot be accidental, companies and courts alike recognize it as accidental so far as the victim is concerned.

17. Isolated examples of the following exceptions may be lumped together without comment:

> One company adds revolution to riot or insurrection, one company excludes sunstroke, and one company very properly requests but does not quite insist upon notice to the company within 30 days of any accident likely to prove fatal.

DISCONTINUANCE

Provision for discontinuance of the benefit under the following contingencies has been noted:

(1) On discontinuance of the extra premium to provide the special benefit.

(2) On surrender of the original policy.

(3) On transfer of the original policy automatically or otherwise into continued term insurance or into a reduced amount of paid up insurance.

(4) On attainment of the age limit specified in the coverage.

NOTE. One company has asked itself the interesting question: "What would happen if the extra premium is through error collected beyond this period of limitation?" and has answered it by providing for the return of premiums with interest should such an error occur. A nice question in logic is presented where no such foresighted provision has been included. Would a court rule that the rider was inoperative because the period of limitation had been passed or would it rule that pay for the coverage having been collected the coverage must be granted?

(5) On written request of the insured.

NOTE. Such discontinuance is frequently limited to anniversaries, although many companies do not specify. The policy is ordinarily required to be submitted for endorsement with the written request. In several instances where such cancellation is not limited to a premium due date the provision does not specifically include the refund of a fractional premium to that date. Doubtless an adjustment would be made, however.

(6) On receipt by the insured of any total disability benefit in connection with the policy.

NOTE. 25 of the clauses provide for such discontinuance. Few indeed of the other 26 state specifically in the Double Indemnity clause that the extra premium therefor will be waived in case of disability. Very likely such waiver is covered in these instances by the disability clause itself.

(7) Isolated clauses of termination are the following:

It has already been pointed out that frequently military or naval service in time of war automatically terminates the Double Indemnity contract. In one instance engaging in aviation has the same effect. In 5 cases on limited premium policies termination automatically becomes effective when the contract becomes paid up by limitation. In one instance termination is effective "if the insured makes his residence or travels outside the continental limits of the United States or the Dominion of Canada," while Red Cross service or other relief work in connection with actual warfare is cause for termination in another. Some companies think it prudent to assert that coverage ceases on conversion to

another form of insurance unless arrangements at an adjusted rate for continuance of the benefit are made, or on maturity of the contract as an endowment.

The close connection between modern transportation and accident insurance should not escape the student's attention. To the hazards introduced by the invention of railroads we owe the invention in England of personal accident insurance:

> "Eleven companies formed in England between 1845 and 1848 to write accident insurance against railway injury, £1 for £1000 being the usual rate. One survived, the Railway Passengers Assurance Company. It was but a step to assume liability for accident of any nature, and this the Accidental Death Insurance Company did in 1850. As is true in all branches of insurance, rates had to be dictated by judgment until experience became available."[9]

One suspects that much of the need and popularity of Double Indemnity today may properly be attributed to the automobile. In the statistics of the New York Life published five years ago by Mr. Hunter, this was the direct source of over 35% of the Double Indemnity claims, without counting carbon monoxide poisonings. A Department of Commerce bulletin of October 17, covering data from 78 large American cities, reports an annual death rate from automobile accidents per 100,000 population of 24.9 for the 52 weeks ending October 5. The rate of increase from year to year in this type of fatal accidents has been alarming. Just as an increasingly important function of life insurance companies lies in educating the insured public through campaigns to promote better health, it may well be that the life companies offering Double Indemnity benefits will take a more and more commanding part through education and the arousing of the public conscience to reduce automobile fatalities. The record of Double Indemnity in this country for the first 25 years must impress the impartial historian as being on the whole very favorable indeed. If during the next quarter-century the companies can cooperate successfully toward the material reduction of the fatal accident risks against which they insure, the history of Double Indemnity for that period will be fairer still.

---

(9) Insurability, Prognosis and Selection, by H. W. Dingman. The Spectator Company. New York, 1927. Page 13.

APPENDIX I
COMMUTATION COLUMNS
Double Indemnity to Age 70

The Travelers q'_x combined with $A\ M^{(5)}$ 4%

Age	q'_x	C'_x	M'_x	1000 A'_x	a_{70-x}
20	.00059	25.546	536.223	11.96	20.21
21	.00057	23.608	510.677	11.90	20.06
22	.00055	21.787	487.069	11.85	19.90
23	.00054	20.469	465.282	11.82	19.74
24	.00053	19.223	444.813	11.80	19.57
25	.00052	18.044	425.590	11.79	19.40
26	.00051	16.929	407.546	11.80	19.22
27	.00050	15.877	390.617	11.81	19.03
28	.00049	14.882	374.740	11.83	18.83
29	.00048	13.944	359.858	11.87	18.63
30	.00047	13.058	345.914	11.92	18.42
31	.00046	12.222	332.856	11.98	18.19
32	.00045	11.433	320.634	12.06	17.96
33	.00046	11.199	309.201	12.15	17.72
34	.00047	10.962	298.002	12.23	17.47
35	.00048	10.724	287.040	12.31	17.21
36	.00049	10.486	276.316	12.39	16.94
37	.00050	10.246	265.830	12.45	16.66
38	.00052	10.210	255.584	12.52	16.37
39	.00054	10.155	245.374	12.56	16.07
40	.00056	10.084	235.219	12.60	15.76
41	.00058	9.997	225.135	12.61	15.44
42	.00060	9.894	215.138	12.61	15.11
43	.00062	9.777	205.244	12.60	14.77
44	.00064	9.647	195.467	12.56	14.42
45	.00066	9.356	185.820	12.51	14.06
46	.00068	9.208	176.464	12.46	13.69
47	.00070	9.048	167.256	12.39	13.31
48	.00072	8.878	158.208	12.30	12.92
49	.00074	8.697	149.330	12.19	12.53
50	.00076	8.506	140.633	12.07	12.12
51	.00078	8.306	132.127	11.93	11.70
52	.00080	8.096	123.821	11.78	11.27
53	.00083	7.978	115.725	11.60	10.82
54	.00086	7.841	107.747	11.41	10.37
55	.00089	7.687	99.906	11.18	9.90
56	.00092	7.431	92.219	10.92	9.42
57	.00095	7.248	84.788	10.65	8.93
58	.00099	7.125	77.540	10.34	8.42
59	.00103	6.979	70.415	9.99	7.90
60	.00108	6.877	63.436	9.59	7.35
61	.00114	6.807	56.559	9.14	6.79
62	.00120	6.644	49.752	8.61	6.20
63	.00126	6.509	43.108	8.01	5.58
64	.00133	6.394	36.599	7.33	4.94
65	.00141	6.288	30.205	6.53	4.25
66	.00150	6.141	23.917	5.61	3.53
67	.00160	6.036	17.776	4.55	2.75
68	.00172	5.920	11.740	3.27	1.91
69	.00185	5.820	5.820	1.78	1.00

APPENDIX II

COMMUTATION COLUMNS

Double Indemnity to Age 70

The Travelers q'_x combined with American Experience 3%

Age	C'_x	M'_x	1000 A'_x	a_{70-x}
20	29.236	699.705	13.64	22.24
21	27.175	670.469	13.57	22.05
22	25.224	643.294	13.52	21.86
23	23.837	618.070	13.48	21.65
24	22.517	594.233	13.46	21.44
25	21.261	571.716	13.45	21.23
26	20.475	550.455	13.44	21.00
27	19.323	529.980	13.44	20.77
28	18.227	510.657	13.45	20.53
29	17.184	492.430	13.47	20.29
30	16.192	475.246	13.50	20.03
31	15.249	459.054	13.55	19.77
32	14.353	443.805	13.61	19.50
33	14.129	429.452	13.68	19.22
34	13.900	415.323	13.74	18.93
35	13.667	401.423	13.80	18.63
36	13.430	387.756	13.86	18.33
37	13.189	374.326	13.91	18.01
38	12.946	361.137	13.95	17.68
39	12.949	348.191	13.98	17.35
40	12.930	335.242	14.00	17.00
41	12.891	322.312	14.00	16.64
42	12.832	309.421	13.99	16.28
43	12.756	296.589	13.95	15.90
44	12.663	283.833	13.90	15.51
45	12.553	271.170	13.83	15.11
46	12.428	258.617	13.73	14.69
47	12.288	246.189	13.62	14.27
48	12.134	233.901	13.49	13.83
49	11.965	221.767	13.34	13.38
50	11.783	209.802	13.18	12.93
51	11.587	198.019	12.99	12.46
52	11.364	186.432	12.80	11.97
53	11.295	175.068	12.56	11.48
54	11.053	163.773	12.30	10.97
55	10.925	152.720	12.02	10.45
56	10.773	141.795	11.71	9.92
57	10.597	131.022	11.37	9.38
58	10.507	120.425	11.00	8.81
59	10.382	109.918	10.59	8.24
60	10.322	99.536	10.13	7.64
61	10.311	89.214	9.60	7.03
62	10.247	78.903	9.01	6.40
63	10.049	68.656	8.33	5.74
64	9.966	58.607	7.59	5.05
65	9.897	48.641	6.73	4.33
66	9.829	38.744	5.75	3.58
67	9.688	28.915	4.63	2.78
68	9.652	19.227	3.33	1.92
69	9.575	9.575	1.80	1.00

APPENDIX III

COMMUTATION COLUMNS

Double Indemnity to Age 70

The Travelers q'_x combined with American Experience 3½%

Age	C'_x	M'_x	1000 A'_x	a_{70-x}
20	26.537	572.751	12.30	20.59
21	24.547	546.214	12.24	20.43
22	22.675	521.667	12.19	20.27
23	21.325	498.992	12.17	20.10
24	20.047	477.667	12.15	19.93
25	18.837	457.620	12.15	19.75
26	17.692	438.783	12.15	19.57
27	16.609	421.091	12.17	19.37
28	15.584	404.482	12.20	19.17
29	14.615	388.898	12.24	18.97
30	13.698	374.283	12.30	18.75
31	12.832	360.585	12.36	18.53
32	12.013	347.753	12.45	18.30
33	11.775	335.740	12.55	18.06
34	11.534	323.965	12.64	17.81
35	11.291	312.431	12.73	17.56
36	11.046	301.140	12.81	17.29
37	10.801	290.094	12.89	17.01
38	10.770	279.293	12.97	16.73
39	10.720	268.523	13.03	16.44
40	10.653	257.803	13.07	16.13
41	10.569	247.150	13.10	15.81
42	10.471	236.581	13.10	15.49
43	10.358	226.110	13.10	15.15
44	10.233	215.752	13.07	14.80
45	10.095	205.519	13.03	14.44
46	9.946	195.424	12.97	14.07
47	9.787	185.478	12.89	13.68
48	9.617	175.691	12.79	13.29
49	9.307	166.074	12.67	12.88
50	9.124	156.767	12.54	12.46
51	8.932	147.643	12.40	12.02
52	8.731	138.711	12.23	11.58
53	8.630	129.980	12.05	11.12
54	8.509	121.350	11.84	10.65
55	8.371	112.841	11.59	10.16
56	8.214	104.470	11.32	9.66
57	8.041	96.256	11.01	9.15
58	7.934	88.215	10.67	8.62
59	7.802	80.281	10.29	8.07
60	7.646	72.479	9.86	7.50
61	7.605	64.833	9.38	6.91
62	7.525	57.228	8.82	6.30
63	7.407	49.703	8.19	5.66
64	7.310	42.296	7.46	5.00
65	7.172	34.986	6.63	4.29
66	7.091	27.814	5.69	3.55
67	7.004	20.723	4.59	2.76
68	6.902	13.719	3.30	1.92
69	6.817	6.817	1.79	1.00