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INDIVIDUAL DISABILITY INCOME

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This session will be devoted to presentations describing the progress, current thinking, and plans of the Committee to Recommend New Disability Tables for Valuation.

MR. WILLIAM J. TAYLOR: Our session this afternoon is, in effect, an informal report of the Committee to Recommend New Disability Tables for Valuation. Our final output will presumably be used for group LTD claims as well. Some of the discussion of experience studies will also be of more general interest. We still have a lot of work to do before we can write our report, but we are hoping to have an exposure draft distributed next spring. In addition to answering any questions you may have about our committee's activities, we hope to also get some feedback from you that will be helpful to us in shaping our final recommendations. To start the session off, I'm going to give you an overview of the committee's history and plans for the future.

Our committee had an unusual beginning. The Society received a request to update the 1964 CDT from what was then a task force of the NAIC chaired by John Montgomery and is now a committee chaired by Ted Becker. The request made specific reference to the need for tables differentiated by sex. Realizing that it takes a considerable period of time to produce complete tables sanctioned by the Society and also that the major deterioration in morbidity was in disability termination rates, John Miller undertook a personal project to develop updated termination rates. After collecting, editing, correcting, compiling and making some preliminary analyses of the data, John organized a meeting of actuaries from the contributing companies to present his results and propose a family of tables to be developed. During that meeting, we learned that he did not have computer resources that were adequate for the task. A small group of the Hartford and Springfield based contributors volunteered to fill this need. Subsequently, the Society asked John to serve as a consultant to the Committee to Recommend New Disability Tables for Valuation which would carry forward the study already underway. John agreed and I was asked to chair the committee. We continued work with the local group while we formed the committee. We structured the committee to consist of a New England "working group" plus broader representation from the rest of the country and Canada. Some of the members outside of New England subsequently became quite active and they are here today.

We viewed the entire job of developing valuation tables as consisting of the following phases:

1. Collecting, editing and correcting data.

2. Developing experience tables.

3. Testing the sensitivity of reserves to each of our variables.

4. Determining the format of the valuation tables to be developed.

5. Developing margins to be added to the experience tables.

6. Testing the final result and describing the resulting changes.

We have good news and bad news. The bad news is that we are still working on phase two. The good news is that we have accomplished a great deal which has value beyond simply producing valuation tables. The experience tables, when completed, should be useful to our membership and the techniques which we are learning and developing should be useful in future experience studies in general.

Our first panelist, Jim Olsen was the architect of the 64 CDT and will give us some historical perspectives this afternoon.

If you've ever been involved in a large intercompany experience study, you know that the collection and correction of data is a source of great frustration. In our project, we had an even greater frustration. Disability Income Morbidity is affected by a large number of variables. If we are going to produce tables by sex, we wanted to be as confident as possible about two things:

(1) The differences we attribute to sex are not in fact caused by some other variable, and

(2) We don't include sex as a variable and exclude any variable that is more significant.

This led us to a dilemma. If we didn't summarize over any variables, we didn't have appropriate tools to analyse the resulting multidimensional array and that data was so thin that it wasn't credible anyway. When we did summarize over some of the variables, we produced distortion. To look at all of the variables you have to produce a number of summarizations, each of which produces a different distortion. We finally concluded that the log-linear model was the best multidimensional tool to use and have had to devise a number of devices to deal with the paucity of data. Ed Seligman will be our second panelist and will describe the log-linear model in fairly simple terms. He will be followed by Frank Knorr who will tell you of some of the results of applying it to termination rates in the second month of disability.

Our data on termination rates thins very rapidly with advancing duration of disability. John Miller, using a variety of sources and a great deal of ingenuity, has put together tables of male termination rates for the latter durations. After John, Ed Seligman will give a presentation on disability incidence rates. Finally, I will try to summarize how we will pull the pieces together into an experience table and describe what we now see as our possible options.

MR. JAMES OLSEN: The Conference Modification of the Class III Disability Table was published in 1939 and adopted by the NAIC in 1941 as the minimum reserve basis for non-cancellable disability policies. A one-year preliminary term valuation method was permitted. Active life reserves were determined solely by the length of the sickness benefit. Initially no recommendations were made regarding reserves for disabled lives, but subsequently the table was also made applicable to disabled lives.

An Industry Committee referred to as Task Force 4 was established to study the problem of reserves for accident and health policies and they issued a report in 1956 which was adopted by the NAIC at their 1956 meeting which resulted in minimum reserve requirements for Hospital and Surgical Expense benefits. Recommendations were made involving disability income policies including the requirement that guaranteed renewable policies and policies where the insurer did not reserve the right to cancel or decline renewal solely because of deterioration of health after issue, had to use the same reserve standards as were applicable to non-cancellable policies. The Task Force recommended the 2 year preliminary term method of valuation as the minimum reserve basis. The Task Force also indicated that sufficient data were not available to construct a new disability table but that companies should determine whether reserves for disability benefits should be higher than the required minimum.

The Society's Committee on Experience Under Individual Accident and Sickness Insurance was formed in 1954 to develop and conduct intercompany studies of morbidity experience under individual accident and sickness policies. The Committee's first study was published in the 1959 Reports Number. Since then a study of disability experience has been published every other year. The experience under the second year of the benefit period was first published in the 1965 Reports Number based on claims incurred during the calendar year 1962.

We now come to the present disability table, the 1964 CDT. The NAIC in December 1964 adopted a report of the Industry Advisory Committee recommending that the 1964 CDT be used as a minimum reserve standard for loss of time benefits. This table is based on the data for the first year of total disability for claims incurred in the years 1958 - 1961, contributed by 17 companies to the Society of Actuaries Committee on Experience under Individual Health Insurance. The termination rates after one year from date of disablement are the same as the 1930 - 1950 disabled life termination rates for Benefits 2 and 3 combined in the 1952 Disability Study of the Society of Actuaries. The new table required higher minimum active life reserves than the previous table, ranging from about 35% for short indemnity limits to about 100% for long indemnity limits. For disabled lives, the new table produced in the aggregate, slightly larger reserves than for the previous table. The 1964 CDT does not vary by sex and occupational class. Based on the poor morbidity experience, since about 1968, it became evident that the 1964 CDT did not produce adequate reserves. Some companies are holding active life reserves as high as 150% of the 1964 CDT and 110% for disabled life reserves. There are other factors which should be considered, such as low interest rates used for reserve factors which may tend to lessen the need for higher reserves.

In 1977 John Miller initiated a study of disability termination rates. Claim data were submitted by companies in the same format used by the Society's Morbidity Committee, with some variations. The Society's Morbidity Committee requested data which only shows a 2-way breakdown by occupational class, but for the new study, the companies were requested to contribute their 4 or 5 occupational class breakdowns in order for the committee to arrive at a 4-way occupational class split. Also the Society's morbidity studies involved only the first 2 years of the benefit period; whereas, the new study included all of the benefit period.

MR. EDWARD J. SELIGMAN: My talk is about the application of multi-dimensional contingency table analysis, specifically the log-linear method, to the selection of those variables which are most important in their effect on incidence and termination.

Let's begin by defining a contingency table. It's a count of occurrences classified in at least two ways such that the categories within each classification satisfy two conditions. First, the categories must be exhaustive; that is, an occurrence must fall within some category of the classification. Second, the categories must be mutually exclusive; that is, an occurrence may not fall within more than one category of the classification. In mathematical language, each occurrence must fall into one and only one category of each classification.

Now the definition is rather abstract, so let's look at a numerical example of the simplest kind of contingency table.

Claim Experience After One Month Duration
All Loss Years

	Off Claim	On Claim
Male	43304	76596
Female	13862	21415

This is a 2x2 table (2 rows and 2 columns), and is called a 2 dimensional table since there are 2 classifications, sex and claim status (the numerical data on this and other slides represents both actual experience and hypothetical data). Let's look at this simple contingency table and see how it obeys the definition of a contingency table. The classification of sex has two categories, male and female, and each claimant must fall into one and only one of these categories. The classification of claim status has two categories, off claim and on claim after one month's duration, and each claimant must fall into one and only one of these categories.

The table below is a 3 dimensional contingency table with the classifications of sex (categories male, female), claim status (categories on claim, off claim), and geographical region (categories California, New Jersey, New York, rest of U.S.).

	Male		Female	
	On	Off	On	Off
California	40	312	12	111
New Jersey	44	389	22	162
New York	136	939	50	292
Rest of U.S.	653	6018	146	1650

The 3 dimensional table is far more difficult to analyze than the 2 dimensional table, from which conclusions can often be made by inspection. Thus there is a temptation, which has been yielded to by many, to "collapse" a multi-dimensional table over one or more of its classifications in order to clarify the relations among the remaining classifications. For example, in the table above, if we are interested principally in the relation between geographical region and claim status, we would collapse (sum) over the classification of sex. This would give us a count of 52 for the California on claim cell, 423 for the California off claim cell, etc.

That this can be a dangerous practice will be illustrated in the next few tables. There are two pitfalls in collapsing over one or more variables. The first is that we may create an apparent relation among the classifications where none really exists. The second is that we may destroy a valid relation among the classifications. The next table illustrates the first pitfall.

	Male On	Male Off	Female On	Female Off		"Collapsed" On	"Collapsed" Off
Sickness	5	10	20	5	Sickness	25	15
Accident	200	400	100	25	Accident	300	425

Look at the "Male" half of the 2x2x2 contingency table. The classifications are claim status and type of disablement. Without knowing the type of disablity, we can estimate the probability of going off claim. It is (10+400)/(5+10+200+400) = 2/3. We ask the question "does knowing the type of disablement give us a more accurate estimate of this probability?" The answer is "no", since the estimate is 10/(5+10) for sickness, and 400/(200+400) for accident, and both fractions are 2/3. The same is true for the "Female" half of the table where the probability is uniformly equal to 1/5. Now look at the 2x2 table at the right which is the result of collapsing over the classification of sex. Here the overall estimate of the probability of termination is (15+425)/(25+15+300+425) = 0.575. The estimates for sickness and accident claims are 15/(25+15) = 0.375, and 425/(300+425) = 0.586 respectively. An apparent relation between type of disablement and claim status has been created by collapsing the table over the classification of sex. The next table shows the opposite condition.

	Male On	Male Off	Female On	Female Off		"Collapsed" On	"Collapsed" Off
Sickness	10	5	15	45	Sickness	25	50
Accident	100	100	500	1100	Accident	600	1200

Here we have a relation between sex and claim status for both male and female claimants. But if we collapse the 3 dimensional table over the classification of sex, the relation is destroyed. There is a theorem which tells us that we are safe in collapsing over a classification only if that classification is independent of at least one other classification in the contingency table.

The next table is a 5 dimensional (2x2x2x2x2) table showing hypothetical experience after the 2nd month of disability. It shows very graphically the impossibility of selecting the important classifications by inspection. It is in just this kind of situation that the use of multivariate statistics, in this case, the log-linear method, is indispensable. My opinion is that multivariate methods are underutilized and, when they are used, are often used incorrectly.

White Collar

	Young				Old			
	0-14 Day		30+ Day		0-14 Day		30+ Day	
	On	Off	On	Off	On	Off	On	Off
Accident	942	757	669	520	1754	1424	759	582
Sickness	807	665	935	683	5313	3786	3720	2553

Blue Collar

	Young				Old			
	0-14 Day		30+ Day		0-14 Day		30+ Day	
	On	Off	On	Off	On	Off	On	Off
Accident	1996	1608	682	530	2556	2026	427	321
Sickness	1381	1182	475	366	5708	3881	985	679

The basic assumption of the log-linear method is that each cell count can be approximated by the product of certain factors. It is quite simple even though the phrase "log-linear" makes it sound complicated. Statisticians favor linear models, namely those which can be represented as sums, so if we have a model which proposes that a cell count can be represented by a product of factors then the log of the cell count can be representated by the sum of the logs of those same factors. Thus, our basic assumption can be stated equivalently as: the log of each cell count can be approximated by the sum of certain factors. Table 1 shows how we apply the log-linear method to a segment of the 5 dimensional table shown above.

If we compute the ratio of "Offs" to "Ons" (called the "odds ratio") for each of "Accident" and "Sickness", we get the values $k_1=0.804$, $k_2=0.824$. One of the questions we might wish to answer is whether the difference between these two values is significant, or whether it is probably due to random fluctuation. We start by representing the log of the count in the Acc-On cell by a sum of factors. The model is written as:

$$\ln a_{11} = \ln 942 = u + u_{1.} + u_{.1} + u_{11}$$

The algebraic values of these factors are shown in the table.

TABLE 1

Under Age 40

0-14 Day Elimination Period
White Collar Occupation

	ON	OFF	
Acc	$a_{11} = 942$	$a_{12} = k_1 a_{11} = 757$	$k_1 = 0.804$
Sick	$a_{21} = 807$	$a_{22} = k_2 a_{21} = 665$	$k_2 = 0.824$

$$u = \frac{1}{4} \sum_i \sum_j \ln a_{ij} = 6.67$$

$$u_{1.} = \frac{1}{2} \sum_j \ln a_{1j} - u = 0.071$$

$$u_{.1} = \frac{1}{2} \sum_i \ln a_{i1} - u = 0.103$$

$$\ln a_{11} = 6.85 = u + u_{1.} + u_{.1} + u_{11}$$

$$u_{11} = \frac{1}{4} \ln (k_2 \div k_1)$$

$$u_{11} = 6.85 - 6.67 - 0.071 - 0.103 = 0.004$$

We may think of u as an overall effect (called the "grand mean") common to all 4 log cell counts. Then $u_{1.}$ is the effect of a_{11} being in the 1st (Accident) row, $u_{.1}$ is the effect of a_{11} being in the 1st (On) column, and u_{11} is the relation between the classifications of type of disability and claim status, since it is the effect which is not due to either type of disability alone, nor to claim status alone. We compute u_{11} by subtraction, and obtain a numerical value of 0.004 which is not significant. More important is its algebraic value which is

$$u_{11} = \frac{1}{4}\ln(k_2/k_1)$$

This algebraic expression makes sense as a measure of the relation between the two classifications for the following reason. If there is no relation between the two classifications, then k_1 and k_2 will be identical and u_{11} will be zero. Further, the absolute value of u_{11} is a monotonically increasing function of the ratio between k_1 and k_2, so the algebraic expression is a reasonable one for the relation between classifications. This analysis can be extended to higher dimension contingency tables with more than two categories for each classification. Rather than show the algebra for such an analysis, let's look at a numerical illustration which appeared in a recent issue of "The American Statistician". The next table shows a 2 dimensional table with classifications of accident (categories yes, no in accident year 1974) and presence of cardiovascular disease in the driver (categories yes, no).

		Accidents	
		No	Yes
Cardiovascular	Yes	938	102
	No	665	127

A conventional contingency table analysis gives a χ^2 value of 15.94 with 1 degree of freedom. From this, we conclude that there is a strong relation between the two classifications, and that drivers with cardiovascular disease are less likely to have an accident than drivers without cardiovascular disease. This 2x2 table was the result of collapsing the following 3x2x2 table over the classification of age (categories 16-35, 36-55, over 55).

		No Accidents		Some Accidents	
		CV	No CV	CV	No CV
Age	16-35	27	275	8	94
	35-55	245	217	40	18
	56+	666	173	54	15

Applying the log-linear method, we see what the true picture is.

	Log-Linear Relationship Measure	Normal Random Variable
Accident X CV	-.039	-.781
Accident X Age	-.390	-4.969
	.113	1.715
	.277	4.169
Age X CV	-1.093	-13.929
	.333	5.051
	.760	11.444

The relation between accident and cardio is rather small (-0.039). But the relation between accident and age for each of the 3 age groups is much larger (-0.390,0.113,0.277), so we conclude that the real relation is not between accident and cardiovascular disease, but between accident and age. The relation between age and cardio is of secondary interest to us, but is quite large (-1.093,0.333,0.760). Transforming the numerical relation to a normal random variable with mean 0 and variance 1 can be used to decide whether a relation is statistically significant.

All our log-linear computations were done using the ECTA (Everyman's Contingency Table Analysis) deck which is available for $35.00 from the Statistics Department of the University of Chicago, 5734 University Avenue, Chicago, IL 60637. In addition, I have found the following books very useful:

The Analysis of Contingency Table, by B. S. Everitt; Chapman & Hall (John Wiley in the U.S.) (1977)

The Analysis of Cross-Classified Categorical Data, by S. E. Fienberg; MIT Press (1977)

Discrete Multivariate Analysis: Theory and Practice, by Y. M. M. Bishop, S. E. Fienberg, and P. W. Holland; MIT Press (1975)

MR. FRANK KNORR: I became involved in the work of this Committee because Aetna has such massive computer facilities. Our timesharing system is able to store about 200,000 numbers while a program is being run. This ability to store a large number of values is very important when you consider the method of analysis that Ed Seligman has just outlined. Even in the early stages of the termination rate study before we knew what the log-linear method was, we were already aware of the dangers of summing across variables. For example, if we tried to determine the impact of sex by simply comparing male termination rates with female termination rates, we were not really certain whether we were measuring the effect of sex or the effect of occupational class (since there is virtually no female data for high risk occupational classes). We also felt that the differences we had found among occupational classes may have been influenced by differences in elimination period (since the higher occupational classes tend to have greater elimination periods).

Table 2 shows the 15 variables that are available on the data records in our termination study. There are other variables that may influence termination rates that we cannot identify, for example: replacement ratio, geographic region, and disease code. Ideally we should consider all 15 of these variables at the same time by constructing an array with 15 dimensions. However, we would have a definite size problem because storing this array requires about 1 trillion cells. In addition to this size problem we also have a density problem: Of the trillion cells only about 100,000 would have values other than zero. That is, if the 15 dimensional array were stretched uniformly from coast to coast we would see non-zero numbers for only the first 5 meters.

To solve the problems of both size and density without distorting the data too much, we decided to study male and female data separately beginning with male data and study each month of disablement separately starting with month 2 (because this would give us the largest volume of data to work with). The remaining variables were each reduced to 2 levels. For example, class was reduced to white collar or blue collar and age was reduced to under 40 or over 40. With the data in this form the log-linear method could be used to determine the important variables.

Determining which variables are important is only the first step; the second step is determining which relationships among the variables are important. To help explain this step I'll use the relationship between age and type (accident or sickness) as an example. Termination rates are different for accident claims than for sickness claims yet this difference is not constant, it depends on the age at disablement. Therefore, we say that there is a 2 way interaction between age and type. After the important relationships are determined, the third step is to calculate the termination rate and factors. The ECTA program that Ed mentioned is used in these first 3 steps. The fourth step is to test the results.

We have been studying month 2, male data and have gone through all 4 of these steps. The table below shows preliminary results to illustrate step 1 of this process.

TABLE 2

15 Available Variables in Termination Study

Duration of Disablement:	1-24 months (by month) 3-50 years (by year)
Sex:	Male, Female
Elimination Period:	0, 7, 14, 30, 60, 90, 180, 360 days
Age at Disablement:	20-24, 25-29, 30-34, ---, 75-79
Years of "Own Occupation" Specified:	0 (any occupation) 1 - 10 years to 55, to 60, to 65 no limit
Indemnity Provision:	10 levels from "no benefits payable if insured has earnings from a new occupation for which he is reasonable fitted" to "no reduction in indemnity payable and no offset by reason of actual earnings in new occupation".
Type:	Accident, Sickness, or Unknown
Benefit Period:	1 - 12 months 13 - 24 months 25 - 60 months to 65 Life Other
Occupation Class:	8 Classes plus unknown 0 - 3 are white collar (Society of Actuaries Class I) 4 - 7 are blue collar
Renewal Provision:	Noncancellable, Guaranteed Renewable, etc.
Impairment:	Standard, Substandard, or Unknown
Time to Expiration of Benefit Period:	1 - 2 months 2 - 3 months 3 - 4 months 4 - 5 months Over 5 months
Age at Expiration of Coverage:	55, 60, 65, 99, other (a policy provision such as Guaranteed Renewable to age 60)
Company:	21 Contributors
Observation Year:	1973 through 1978

Importance of 13 of the Available Variables to Termination Rates

Males in the second month of disablement

Most Important:	Elimination Period
Important:	Age at Disablement
Less Important:	Own Occ Indemnity Provision Type (Accident, Sickness) Benefit Period Occupation Class
Little Importance	Renewal Provision Impairment
Not Applicable for Month 2	Time to Expiration of Benefit Period
Thrown Out	Age at Expiration of Coverage
Not Studied	Company Observation Year

Duration is already known to be important. The importance of sex will be determined later. Elimination period and age were found to be most important. There were some coding errors for Age at Expiration of Coverage and there was agreement that this variable could not influence termination rates. Company and Observation Year have not yet been studied mainly because we don't intend to publish tables by Company or Observation Year. We will be looking at variations by company to avoid the mistake of ignoring distortions that result from summing across companies.

After trying a number of different models I came up with a relatively simple model and calculated a termination rate and applicable factors for that model. Table 3 contains 63 factors that generate 18,144 termination rates that are specific according to 7 variables. If we know the elimination period, class, benefit period, type, age, own occupation specification, and indemnity provision, we can derive a very specific termination rate. This Table illustrates that, in addition to an interaction between age and type, we also found an interaction between own occupation and indemnity provision. If you notice, all groups of factors average to 1. This implies that the "average" rate is a true termination rate if claims are uniformly distributed among all levels of all variables (just as many claims in each cell).

TABLE 3

Model M

Males in second month of disablement

"Average Rate" .425

Elimination Period	
0 day	1.101
7 day	1.057
14 day	1.017
30 day	.823

Occupation Class	
Preferred	1.185
1(no preferred)	1.030
1	1.041
2	1.020
3	.994
4	.984
5,6	.746

Benefit Period	
1-12 mos.	.987
13-24 mos.	.992
Other	1.021

Type	
Accident	.988
Sickness	1.012

Age	
20-24	1.162
25-29	1.113
30-34	1.066
35-39	1.024
40-44	.986
45-49	.953
50-54	.923
55-59	.897
60-64	.876

Age and Type	A	S
20-24	.923	1.099
25-29	.920	1.092
30-34	.929	1.077
35-39	.945	1.054
40-44	.968	1.027
45-49	.995	.997
50-54	1.026	.966
55-59	1.063	.929
60-64	1.108	.882

Own Occupation	
Any Occ.	1.067
1 Year	.935
2 Years	.991
Over 2 Years	1.007

Indemnity Provision	
Full Reduction	1.039
Partial Reduction	.991
No Reduction	.970

Indemnity Prov. and Own Occ.	Full	Partial	No.
Any Occ.	1.115	1.046	.964
1 Year	1.005	.989	.979
2 Years	.938	.996	1.018
Over 2 Years	.909	1.001	1.040

MR. JOHN HAYNES MILLER: The Subcommittee on an Ultimate Disabled Life Termination Table; Bob Shapland, Jim Olsen, Rich Ostuw and myself; was asked to fill the gaps at the longer durations where the new data for the Disability Termination Study (DTS) were too scant for acceptable credibility. With a solid footing provided by the DTS data for the early durations of disablement, it seemed desirable to tie down the tail end of the full table by establishing the ultimate termination rates. We necessarily turned to other information; existing tables and also the raw data from inter-company studies of group long-term disability (GLTD). George Pollino of the Group Committee made available the experience for 1973-77 which is adequate for the first 5 years of disablement and sketchy for years 6, 7 and 8. These rates were projected from the fifth year to an ultimate level by reference to the Benefit 2 Table, the group waiver of premium table, and the Social Security DI experience. The GLTD data for preceding observation periods (1972 - 1976 and earlier) had presented a problem, viz. that the deferment period selection evidenced by the excess of termination rates for policies with three month elimination periods over those with longer deferment did not appear to be phasing out. Happily, the newest data indicated convergence in the second year. The deferment period selection could be accounted for by selection factor averaging about 1.5 in year 1 and 1.1 in year 2. Using these factors, the 3 month and 6 month elimination periods could be combined, making a more substantial data base.

The Social Security DI data cover the full gamut of occupational risk without any separation into strata according to relative hazard. The GLTD data present a more select body of risks, highly concentrated in the white collar sector and affected also by group underwriting selection. The new DTS data cover virtually the full spectrum of occupational risk but are separable by occupational classification. They also reflect individual underwriting. Thus it is not surprising that Social Security disabled life mortality is higher and recoveries lower than those of insured risks. Moreover, there is reason to believe that high replacement ratios, especially for women, tend to depress the recovery rates under DI. Our extrapolation of the GLTD termination rates pointed to the suitability of a 10-year select period. This was confirmed by a study of the Social Security DI experience at the longer durations made possible by Frank Bayo, Deputy Chief Actuary, who provided some unpublished termination rates for the longer duration of disability for the use of the Committee. The Committee is indebted also to other members of Dwight Bartlett's staff: John Wilkins and Steve McKay made available the EDP program for their extension of the Whittaker-Henderson graduation formula to a 2-dimensional matrix of crude rates, i.e. age and duration of disablement. This powerful formula expedited the analysis of innumerable subdivisions of the experience.

Our eclectic approach to the creation of a comprehensive table of termination rates necessitated an assessment of the distribution by occupational risk of each sector of the experience. The DTS experience within the white collar sector, i.e. occupational class codes 0-3, can be combined with the GLTD experience and with our proposed ultimate table producing essentially a white collar table. Thus, one or more additional tables will be required to cover risks with greater occupational hazard. Alternatively, these termination rates representative of white collar risks could be systematically reduced to make the table applicable to all insured risks in the aggregate, without regard to occupational hazard.

Through the tentative ultimate rates, based on extrapolation of the GLTD termination rates to the ultimate level and consideration of existing tables, a Gompertz curve was passed with log C=.04. Although the Gompertz formula was based on experience for ages less than 65, it produced reasonable termination rates for ages 65 to 100. Comparisons of the ultimate termination rates with corresponding population mortality indicated an advance in age of approximately 25 years for a disabled life aged 37, an advance of 16 years for age 47, 12 years for age 57, and 9 years for age 67.

The results of the Society's recent study of termination rates on ordinary waiver of premium benefits had not been published at the time the ultimate table I've described was completed and the preliminary draft of the report did not provide ultimate rates with which our table could be compared. However, John Cook, Chairman of the Committee in charge, assisted us by furnishing ultimate experience data for the elective benefits. Compared to our developed rates the actual waiver experience was slightly over 100% for ages under 60 but 127% for ages 60-64. A comparison of age-incidence trends with Benefit 2, with the Group Waiver of Premium table, and with the Social Security DI experience, reinforced the credibility of our original Gompertized rates at ages 60-64.

It should be mentioned that, from a practical viewpoint, there is a distinct shift in importance vis-a-vis the two discount factors, termination rates and the interest rates, as we move into longer durations. In disability year one, with termination rates as high as 90%, interest is clearly subordinate to termination rates; but as the duration of disablement increases, termination rates fall to 5% or less and become subordinate, in financial impact, to the interest rate.

Having identified three components, (1) the DTS data for the early years, (2) the GLTD data for years through 5, and (3) the Gompertized ultimate values, the next step was to connect these parts and fill in the gaps. For this we made use of the "coefficient of selection" (C/S) defined by the late John S. Thompson in his paper for the 10th International Congress of Actuaries, as $1 - (q_{[x]+n} \div q_{x+n})$.

Since, for disabled life termination rates, this expression yields negative values, we used its complement instead. With all termination rates expressed as C/S's it is a simple matter to fill the gaps by interpolation. The complete table of C/S values can then be graduated by the two-way Whittaker-Henderson formula to assure smoothness, both vertically and horizontally.

With so many factors contributing to the level of termination rates, viz., sex, age, duration, elimination period, and occupational class, as a minimum, one can visualize the need for at least 32 separate two-dimensional tables. Even then, important differences between individual insurers and the inter-company averages would not be recognized.

Perhaps a new philosophy of valuation ought to be considered. In Canada the tendency has been to place the responsibility for adequate reserves squarely on the actuary, whereas in the States rather rigid and specific valuation standards have been relied upon. Could we draw something from each system? Specified valuation tables in the United States have generally been considered minimum standards. In principle the actuary has the responsibility of strengthening the resulting reserves if he judges them not to be entirely adequate. This may create a conflict of interest if the corporate policy is to maximize reported earnings. Also, concern that a conservative valuation not based on a recognized table may result in sanctions from IRS should redundancy result, may further inhibit voluntary reserve strengthening.

As an alternative to the traditional approach for disabled lives, a new termination table for valuation recognizing only sex, age, and duration could be set at a conservative level by reflecting the experience according to the longest elimination period and the most hazardous occupational hazard. The actuary could then create a unique table for the particular mix of business of his company; all based on officially recognized tables and values and permissible or prescribed modifications. For the insurer with a credible volume of mature business a different form of deviation might be permitted, more like the Canadian. The insurer's actual experience could be measured by reference to the single conservative valuation standard and then an appropriate valuation table could be expressed in terms of a precisely defined modification of the single standard.

The philosophy discussed in the above two paragraphs has been presented for consideration, but the Committee has not yet discussed this concept.

Since I am not a member of the Taylor/Kidwell Committee I feel free to commend it and its co-chairmen, not only for an exhibition of tremendous industry, but also for the painstaking and innovative study and experimentation respecting the difficult problems of analysing interactive factors. Multivariate contingencies are encountered in most areas of experience analysis; including morbidity, mortality and persistency; but not often properly dealt with. The techniques employed in this study can be used in the future to the improvement of actuarial analysis in general.

MR. SELIGMAN: Table 4 shows some preliminary numeral results from the incidence study which was conducted by Don Pearsall and Barbara Posnick of the John Hancock. The Five Company Study refers to experience gathered for our Committee from Metropolitan, Monarch, Prudential, John Hancock, and Provident Life and Accident for years 1974-1977, while the New York Study was based on the experience of 21 companies licensed in New York for years 1968-1973. Log-linear analysis demonstrates that in both studies, elimination period was the most important classification in deciding whether a policyholder would become a claimant. Positive numbers indicate that a cell was less likely to go on claim. What is even more interesting is the number at the bottom of the table. It is the coefficient of determination (square of the correlation coefficient) between the numbers in the Five Company Study and the New York Study. It is really more of a figure of merit than anything else, but its size is very comforting since it shows a very strong relationship between the two sets of data drawn from different sources in different time periods. It tells us that although the incidence rates change in various studies, the order of importance of our classifications does not shift greatly from company group to company group, nor from time period to time period.

MR. TAYLOR: We had far fewer problems with incidence rates than with termination rates. Once we solve the problems with termination rates, we then plan to develop a set of incidence rates in a consistent manner.

We obviously have a lot of technical work to do to build a complete multidimensional table from the various pieces, blending them together into a consistent whole. When we do this, we would have a table with so many cells that it would be enormous. However, it would be represented by a relatively few numbers. We would thus be able to generate both active life and disabled life reserves for any combination of variable values. We would plan to next test the sensitivity of reserves to each of those variables to see if there are any we can eliminate. A variable might be statistically significant but not produce a financially significant difference in reserves. Having reduced the number of variables and ignoring the subject of margins, we have at least two options for the form of our recommendations. Furthermore, each form presents options to the individual company. We would like to describe these two approaches and hope to get some feedback.

TABLE 4

Incidence Rates

Log - Linear Relationship Measures

		Five Company Study (1974-77)	N.Y. Study (1968-73)
Age:	20	1.206	0.613
	30	0.543	0.618
	40	-0.427	-0.402
	50	-0.526	-0.291
	60	-0.765	-0.553
Occ:	11	1.239	2.586
	21	0.554	0.802
	31	-1.186	-1.193
	41	-0.210	-0.769
Cause:	Accident	2.319	1.830
	Sickness	-2.319	-1.830
Elim:	7 Day	-3.522	-3.024
	14 Day	-1.874	-1.561
	30 Day	-0.007	0.788
	90 Day	3.255	3.087

Coeficient of Determination

$r^2 = 0.913$

At Banff, we described one of these approaches which might be called the direct approach. This approach gets us away from the traditional published tables. It would give the company three options as follows:

(1) Direct application of the table - you could carry all of the variables in your valuation record and generate reserves from basic values on a seriatim method.

(2) Generation of company tables - a company could periodically get a distribution of its in force by all of the variables and interactions contained in the table. By weighting all of the factors by such a distribution, you could generate a table in the same format as the 1964 CDT which would be appropriate for the mix of business for that company.

(3) A third option might be simply a very conservative table not involving any additional variables except perhaps sex.

The other approach which we have thought of would retain the published tables concept. The basic idea of the second approach would be to produce a small number, such as three to five, of tables similar to the 64 CDT. The tables would be varying degrees of conservatism and would be generated by the experience table for some particular combination of variable values. Each table would be described in terms of the mix of business for which it would be appropriate. Then each company would have 2 options. They could either make a determination as to which table was appropriate for their use, or segment their business and use a different table for each segment.

MR. E. PAUL BARNHART: If a company was using the factor approach to modify a basic table, do you anticipate a problem justifying required interest for federal income tax purpose?

MR. OLSEN: A required interest deduction for federal income tax purposes for non-cancellable or guaranteed renewable policies necessitates that the reserves be required by law, based on a recognized table, and an assumed rate of interest. The key question is: would this be a recognized table?

MR. TAYLOR: Even though it is represented by factors and not explicitly set down on paper, I think a multidimentional table should still be considered one table.