ASSESSORS' HANDBOOK
SECTION 582

THE EXPLANATION OF THE DERIVATION OF EQUIPMENT PERCENT GOOD FACTORS

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FOREWORD

Assessors' Handbook Section 581A was written to serve as a permanent supplement to Assessors' Handbook Section 581, *Equipment Index Factors and Inventory Ratios*, which is reissued annually. The sole intent of Assessors' Handbook Section 581A is to provide a technical explanation of the mathematical origin of the percent good factors in Assessors' Handbook Section 581 and to elucidate the usefulness and limitations of those factors.

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January 1981

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CHAPTER 1: INTRODUCTION

Normal percent good tables have long been published in Assessors' Handbook Section 581, *Equipment Index Factors and Inventory Ratios*. The intent of this report is to tell of their derivation, their usefulness, and their limitations. Normal percent good factors help to provide one estimate of value, namely RCLND, which means replacement or reproduction cost new less normal depreciation. RCLND is not the answer to all property appraisals that employ the cost approach to value, but it is a significant aid in the mass appraisal of industrial machinery and equipment. Therefore, it is appropriate that appraisers who regularly compute RCLND, whether by election or by policy, should understand the origin of the percent good factors they are using.

BASIS OF PERCENT GOOD

The value of a property is said to be equal to the present worth of its anticipated future net benefits. Also, it is generally agreed that industrial property is owned primarily for its future net income. It follows, then, that the value of an industrial property is equal to the present worth of its future net income. The major problem with using this rationale in appraising industrial property is the almost impossible task of estimating net income accurately.

We can, however, use this idea in preparing percent good tables and avoid the critical problem of estimating net income. If the only difference between an existing property and a similar new property is age or remaining life expectancy, a relationship between the two properties can be computed using present worth factors. A present worth factor for the total life of the property is proportionate to the value of the new property, and the present worth factor for the remaining life is proportionate to the value of the existing property. By dividing the present worth of one per annum for the remaining life expectancy of a property by the present worth of one per annum for the total life expectancy, the percent good can be calculated.

For example: a property has a 20-year total life expectancy, a 15-year remaining life expectancy, and a proper rate of return is 10 percent. Then:

$$\text{Percent Good} = \frac{\text{PW of 1 for 15 Years at 10 Percent}}{\text{PW of 1 for 20 Years at 10 Percent}} = \frac{7.606}{8.514} = 89.33$$

Usually the remaining life is not the only difference between a new property and an older property. For various reasons the net-income producing capability of property will usually decline with time. This net income decline can be compensated for in our calculations by adjusting the income imputable to the older property to allow for this percentage of decline. By recognizing this income decline in our calculations, we will establish a more proper relationship or percent good.

For example, using the same conditions as in the previous example, 20-year total life, 15-year remaining life, a 10 percent rate of return, and also assuming that the future income to the old property has declined by 5 percent. Then:

$$\text{Percent Good} = \frac{\text{PW of 1 for 15 Years at 10 Percent}}{\text{PW of 1 for 20 Years at 10 Percent}} = \frac{7.606 \text{ x } .95}{8.514 \text{ x } 1} = 84.87$$

The percent good factors in Assessors' Handbook Section 581 use the present worth valuation principle. An example of an income adjustment factor is also used.

CHAPTER 2: MORTALITY STUDIES

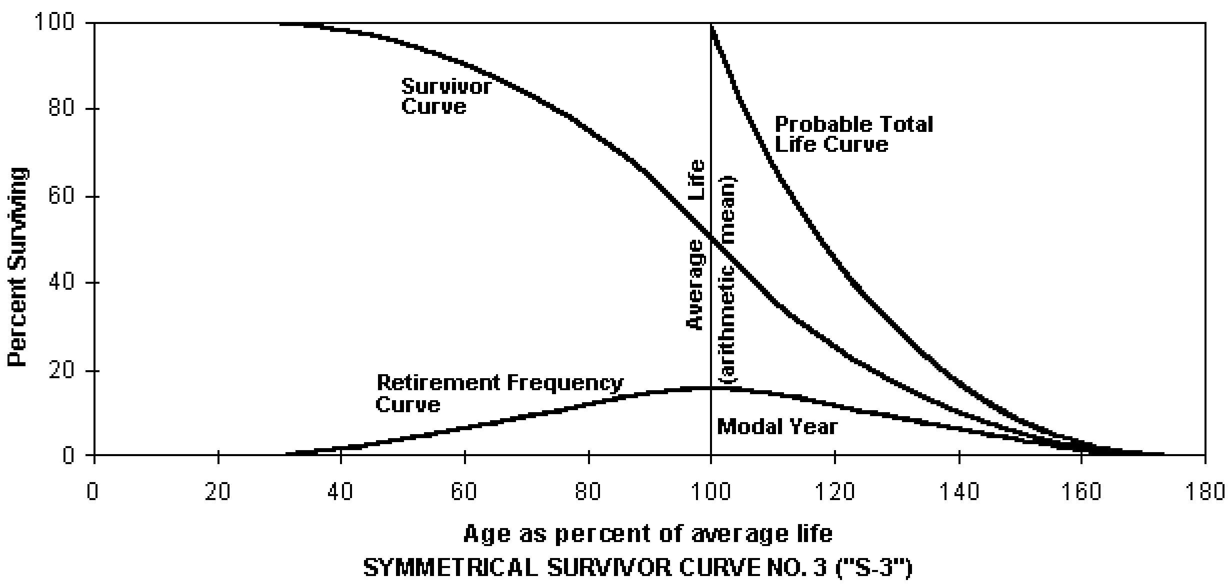
One of the necessary ingredients in computing these percent good factors is the relationship between total life expectancy and probable remaining life expectancy of property items at all stages of their life. It may seem that if an item has a 20-year life expectancy when new that after 20 years its life expectancy would be zero. This is not the case; any forecast of future events is subject to change with time. A new property is usually faced with many uncertainties. As time passes and the property survives the test of time, the forecast of its total life expectancy will increase.

Mortality studies are statistical studies based upon a sample group of a population. They state the percentage of things which live at any given age and their life expectancy at any age. A group of things is identified, and a record of the life term of each one is made. The average life term or probable life expectancy when new is computed by summing the life terms of all items in the group and dividing by the total number in the group. The probable total life expectancy of survivors of the group is similarly computed by summing their total life expectancies and dividing by the number of survivors at that age.

We are all familiar with the actuarial tables compiled by insurance companies and used to predict the life expectancy of humans at all ages. Similar studies have been conducted with various types of industrial machinery and equipment by the engineering department of Iowa State University. A part of the very useful data published as a result of this research is in the form of several series of graphs and tables which reflect the results of their studies.

Figure I is an example of one set of curves. It illustrates a survivor curve, a probable total life expectancy curve, a retirement frequency curve, average service life, and the modal year.

FIGURE I



AVERAGE SERVICE LIFE

Average service life is the average life term of a group of items. Let us say we have 100 generators installed about the same time and that the sum of their life terms is 1,000 years. Their average service life is 10 years (1,000 years ÷ 100 = 10). Average service life is usually expressed as 100 percent on the horizontal scale of a survivor curve. Any length of time less than or greater than the average life is expressed as a percentage of average life.

PROBABLE TOTAL LIFE

Probable total life is the average life expectancy of survivors of an original group. For the aforementioned group of 100 generators, the average service life expectancy when new is 10 years. If one is retired after the first year, the total life expectancy of the 99 survivors is 999 years divided by 99 equals 10.0909 years or 100.9 percent of average service life. If at the end of the second year two more are retired, the total life expectancy of the 97 survivors is 995 divided by 97 equals 10.2577 years, or 102.577 percent of average service life. As the short-lived items are eliminated from the group, the total life expectancy of the survivors increases.

REMAINING LIFE EXPECTANCY

Remaining life expectancy is simply the total life expectancy of a group at a particular age less the years already in service. If the survivors of a group have a probable total life expectancy of 21 years, at the end of six years then their remaining life expectancy is 15 years (21 - 6 = 15).

SURVIVOR CURVES

A survivor curve or table expresses the percentage or number of survivors of an original group of items for each year of existence of the group. If an item in an original group of 100 items is retired at the end of five years, the percent surviving at the end of five years is 99 percent. These tables are usually expressed in terms of percent surviving on the vertical scale and age as a percent of average life on the horizontal scale.

RETIREMENT FREQUENCY CURVES

A retirement frequency curve shows the percentage of an original group of items that are retired in each year of the existence of the group. If 5 items of an original group of 100 items are retired in the fifth year of their life, the retirement frequency for the fifth year is 5 percent.

The highest point on the retirement frequency curve is represented by the modal year.

THE MODAL YEAR

The modal year is simply the year which has the largest number of retirements of any year in existence of the group.

CHAPTER 3: THE ORGANIZATION OF THE IOWA STATE TABLES

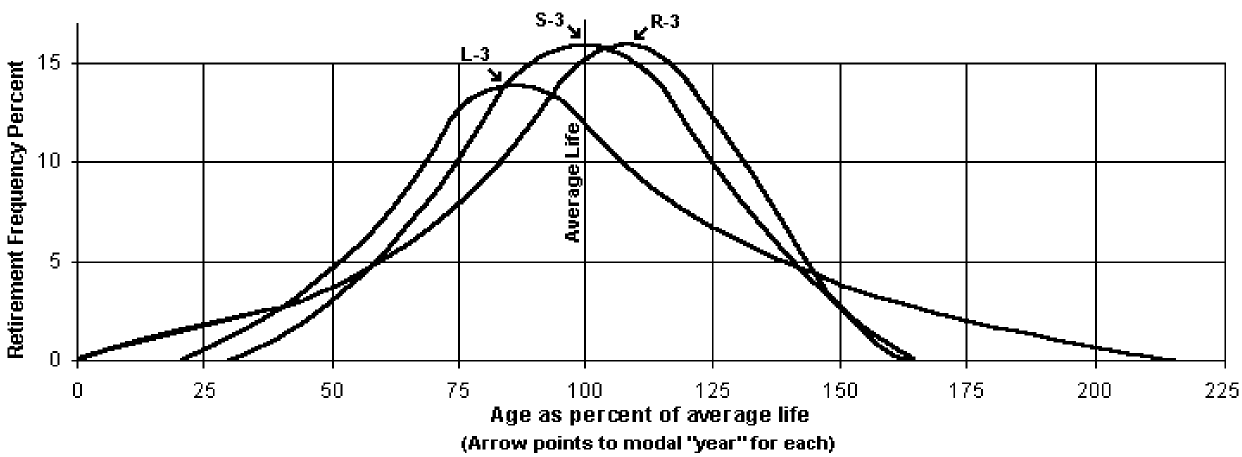
Iowa State University studied large numbers of groups of industrial equipment items, primarily from public utility properties. By identifying large numbers of like property items installed approximately at the same time and recording the date of all retirements, they were able to compile all of the necessary statistical data to formulate a series of equipment mortality tables. These tables were refined, and a series of 18 different sets of curves were developed. These curves were then organized according to variations in retirement frequency and labeled using a two-part designation system.

"R," " S," AND "L" CURVES

First, the 18 sets of curves were divided into three categories according to the relationship of the modal year to the average service life of the group. Figure II illustrates typical examples of the three types of curves.

FIGURE II

COMPARISON OF THREE RETIREMENT FREQUENCY CURVES



Seven curves in which the modal year and the average life are the same are labeled "S" and form a symmetrical retirement frequency curve. Six curves have a modal year that is to the left of the average life and are labeled "L." Five more curves are labeled "R" and have a modal year that is to the right of the average life.

The position of the mode relative to the average life is a result of the pattern of retirement frequency over the life of the group of property items. In the "R" curves, the greatest frequency of retirements is after the life term is reached. This causes the retirement frequency curve to be skewed to the right. In other words, the majority of items in this group will last longer than the average life, but most of them will be retired in a short period of time after the average life term is reached.

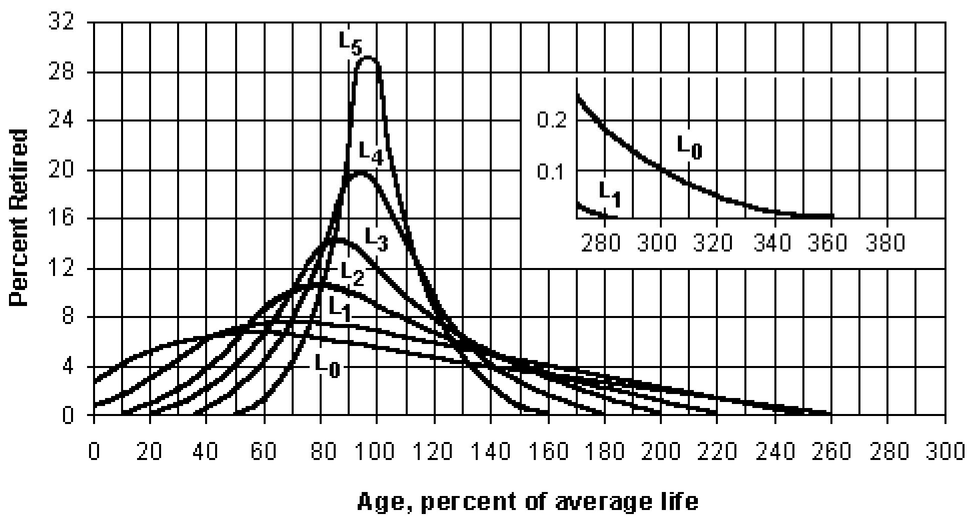
The "L" curves, on the other hand, indicate the greatest frequency of retirements is prior to the average life. Though a minority of items will be in existence for a long time, the majority of units in this case are retired prior to the average life of the group. In other words, more than half do not reach the age of the average of the group. The minority that do last longer than the average survive for a long time and compensate for the early losses.

In the "S" tables, the modal year and the average life are the same thus producing a symmetrical curve. Half of all items are retired prior to the average life, and an equal amount are retired after the average life term is reached. The pattern of retirements prior to the modal year is exactly the reverse of the pattern after the modal year.

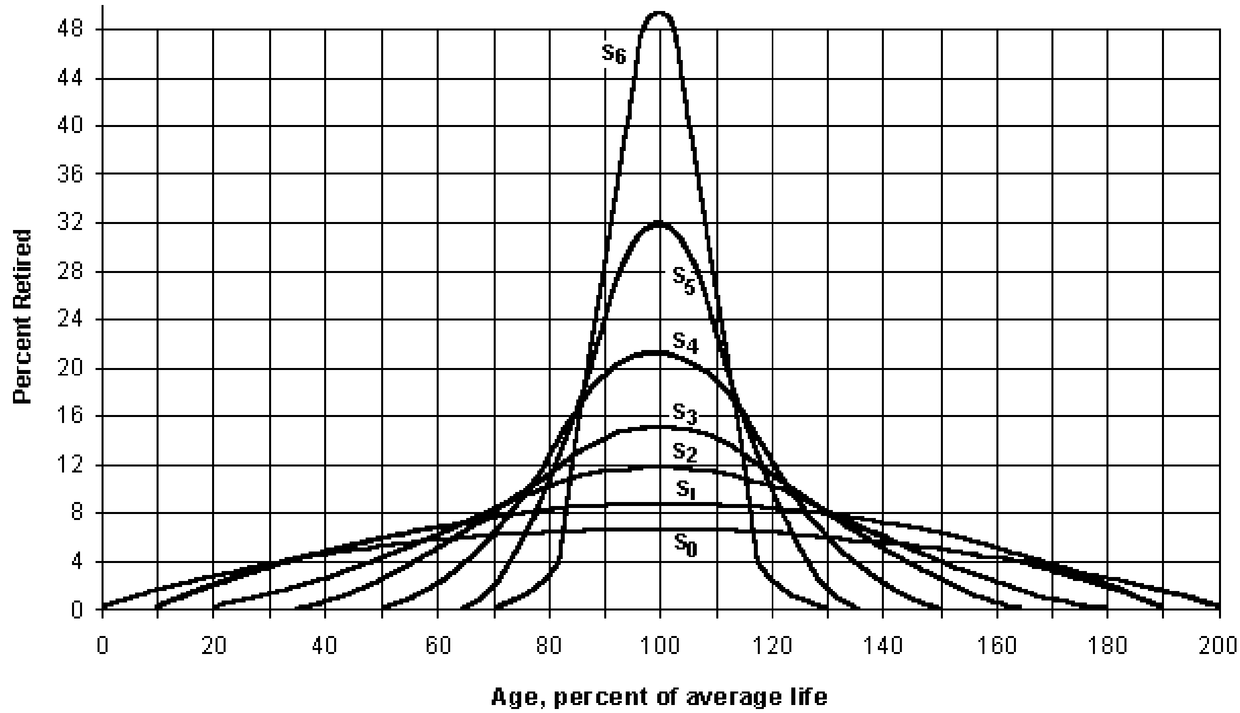
VARIATIONS DUE TO MODAL YEAR RETIREMENT FREQUENCY

Each set of the three types of frequency contains curves that vary with the height of the curve in the modal year. Figure III illustrates the three sets of curves.

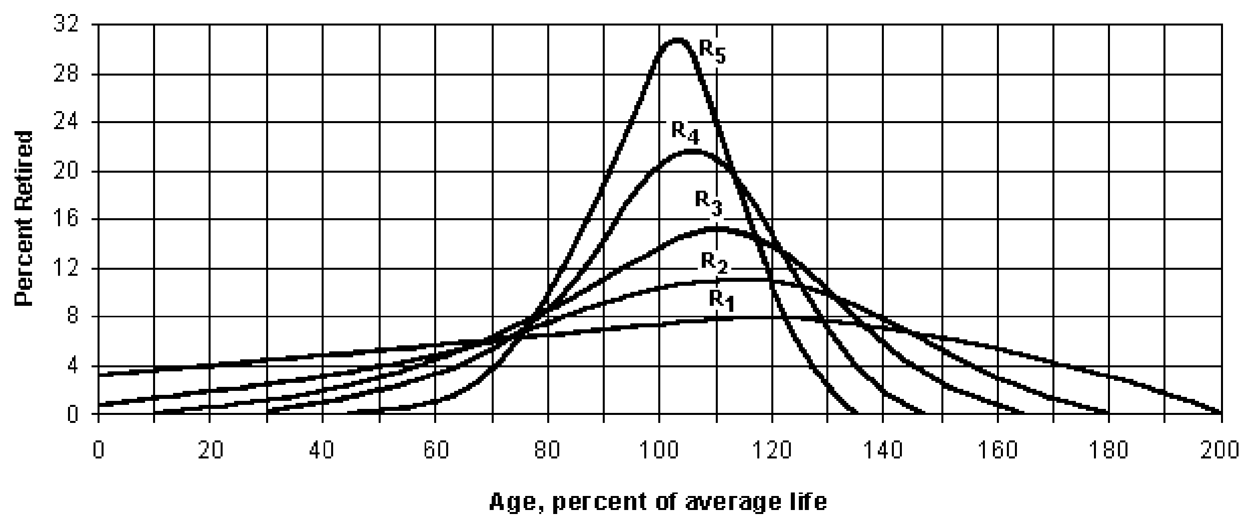
FIGURE III



Left mode type survivor, probable life, and frequency curves



Symmetrical type survivor, probable life, and frequency curves.



Right mode type survivor, probable life, and frequency curves

As you can see, curves are numbered with the lowest number having the lowest frequency of retirement at the modal year, and the highest number has the greatest frequency of retirements in the modal year. An “S-1” curve is a symmetrical curve with a low frequency of retirements in the modal year, and an “R-5” is a curve which is skewed to the right and has a high frequency of retirements in the modal year.

THE SCOPE OF THE IOWA CURVES

The 18 curves published by Iowa State University cover the full spectrum of typical variations in retirement patterns . These curves range from sets where the greatest number of retirements are early in life to sets where the most frequent retirements are late in the life term and from sets with low retirement frequencies in the modal year to sets with high modal year frequencies.

The curves contain the necessary relationships to compute percent good tables; namely, average service life, probable total life expectancy at all ages, and retirement frequencies. To compute a table for a particular property type, the appraiser must consider the retirement pattern of the property in question and select the curve that most nearly fits this pattern.

CHAPTER 4: COMPUTING PERCENT GOOD

As previously stated on page 1, the computation of percent good in its simplest form is the present worth of one per annum for the remaining life expectancy discounted at an appropriate yield rate and divided by a similarly discounted income of one per annum for the total life expectancy of the item. This method is called the individual method of computing percent good. A more complex method of computing percent good, called the group method, is also often used and will be discussed later.

For those who are mathematically inclined, a formula for computing percent good using the individual method may be developed as follows:

Let r = Rate of Return
Let n = Probable Total Life Expectancy at Age a
Let a = Age

$$\text{Percent Good} = \frac{\text{PW 1 Per Annum for n-a Years at r Percent}}{\text{PW 1 Per Annum for n Years at r Percent}}$$

$$\text{Percent Good} = \frac{(1+r)^{n-a} - 1}{r(l+r)^{n-a}} \div \frac{(1+r)^{n} - 1}{r(1+r)^{n}}$$

$$\text{Percent Good} = \frac{(1+r)^{n-a} - 1}{r(l+r)^{n-a}} \times \frac{r(1+r)^{n}}{(1+r)^{n} - l} \quad \text{(Invert \& Multiply)}$$

$$\text{Percent Good} = \frac{(1+r)^{n-a} - 1}{(1+r)^{n-a}} \times \frac{(1+r)^{n}}{(1+r)^{n} - 1} \quad \text{(Cancel ``r'')}$$

$$\text{Percent Good} = \frac{(1+r)^{a-n}\ [(1+r)^{n-a} - 1]\ (1+r)^{n}}{(1+r)^{a-n}\ (1+r)^{n-a}\ [(1+r)^{n} - 1]} \quad \text{Multiply by } \frac{(1+r)^{a-n}}{(1+r)^{a-n}}$$

$$\text{Percent Good} = \frac{[(1+r)^{a-n+n-a} - (1+r)^{a-n}]\ (1+r)^{n}}{(1+r)^{a-n+n-a}\ [(1+r)^{n} - 1]}$$

$$\text{Percent Good} = \frac{[(1 - (1+r)^{a-n}]\ (1+r)^{n}}{1\ (1+r)^{n} - 1} \quad \text{(Multiply out numerator \& denominator)}$$

$$\text{Percent Good} = \frac{(1+r)^{n} - (1+r)^{a}}{(1+r)^{n} - 1}$$

The use of the final formula greatly simplifies the arithmetic in computing factors. As you can see, it is consistent with the basic principle of using present worth factors for computing percent good as described on page 1.

INCOME ADJUSTMENT FACTORS

A new, modern functionally efficient plant will usually earn a larger net income than a similar older plant. The simple percent good calculation demonstrated previously considers the relationship between two constant income streams. There are several procedures for compensating for decreasing net income in older industrial property. Compensating for decreasing net income can be done by simply assigning an income of one per annum to the income stream for the new property and something less than one as the income for the old property.

The percent good factors in Assessors' Handbook Section 581, *Equipment Index Factors and Inventory Ratios*, utilize an income adjustment factor that amounts to a reduction of income equal to 1 percent for every 10 percent of average life expectancy. If the average life expectancy is 20 years and the property is 2 years old, the income reduction is 1 percent, and the income adjustment factor is .99 (1.00 -.01 = .99). This factor is then applied to the income stream that is discounted over the remaining life term of the property.

Then:

$$\text{Percent Good} = \frac{\text{PW of 1 Per Annum for n-a Years x .99}}{\text{PW of 1 Per Annum for n Years x 1}}$$

Note that in calculating the income adjustment factor, we always use the average life expectancy of a new item as its total life term. On the other hand, when we calculate a percent good factor, we always use the total life expectancy at its current age as its total life term.

A formula for calculating the income decline factor can be derived as follows:

Let A = Average Service Life Expectancy New
Let a = Age

Then:

$$\text{Income Adjustment Factor} = 1 - \frac{a}{A} \times \frac{.01}{.10}$$

$$\text{Income Adjustment Factor} = 1 - \frac{.01a}{.10A}$$

$$\text{Income Adjustment Factor} = 1 - \frac{.1a}{A}$$

We can then incorporate this formula into the percent good computation formula on Page 10 as follows:

$$\text{Percent Good} = \frac{(1 + r)^n - (1 + r)^a \left(1 - \frac{.1a}{A}\right)}{(1 + r)^n - 1}$$

Percent good factors in Assessors' Handbook 581 use the present worth relationship principle. As indicated above, they are also adjusted for a constant rate of net income decline. If additional net income decline over and above that included in the tables occurs and can be demonstrated, recomputation should be made by adjusting the income adjustment factors. This in turn will alter the percent good factors to be used.

THE GROUP METHOD

The group method is a very complex method of computing percent good tables that considers average retirement age within one year intervals and weights each year in proportion to its retirement frequency.

Each factor requires the computation of a series of individual percent good factors for each subsequent year and the formulation of a weighted average using the retirement frequency of each group as a weight. Figure IV is an example of the computation of a percent good factor for the fourth year of a table with a five-year average service life expectancy. This computation is also based upon an "R-3" retirement frequency curve and a 10-percent discount rate.

In the group method, all items are separated into smaller groups of units that have been retired within each one year age interval. Column one of Figure IV designates the age interval of each group. The average retirement age of each group is then computed. As shown in the table, the average age of retirement of the group of units retired in the fifth year of the life of the group is 4.54135 years.

A percent good is then computed for each age interval group for each year of the remaining existence of the group. This is done by dividing the present worth of one per annum for the remaining life expectancy of the group by similarly discounted factor for the total life expectancy of the group.

FIGURE IV

COMPUTATION OF PERCENT GOOD OF SURVIVORS
WITH A FIVE-YEAR AVERAGE SERVICE LIFE
AT FOUR YEARS OF AGE USING AN
"R-3" SURVIVOR CURVE AND A 10 PERCENT DISCOUNT RATE

Age Interval	**Life Expectancy Total**	**Life Expectancy Remaining**	**Present Worth of One Per Annum For Remaining Life**	**Present Worth of One Per Annum For Total Life**	**Percent Good of Group**	**Retirement Frequency Percent**	**Weighted Amount**
1/	2/	3/	4/	5/	6/	7/	8/
0-1	.47360						
1-2	1.58795						
2-3	2.56750						
3-4	3.55900						
4-5	4.54135	.54135	.5141	3.5546	14.46	23.28606	336.716427
5-6	5.49670	1.49670	1.3292	4.0776	32.60	29.96181	976.755006
6-7	6.42765	2.42765	2.0654	4.6083	44.82	19.44731	871.628434
7-8	7.33795	3.33795	2.7246	5.0308	54.16	5.19658	281.446772
8-9	8.10745	4.10745	3.2391	5.3827	60.18	.13638	8.207348
				Sum of Weighted Amounts			2,474.753987
				÷ Percentage of Survivors			78.02814
				= Percent Good			31.716172

1/ Age interval of each group.
2/ Total probable life expectancy of items in each group.
3/ Remaining life expectancy of each group after the fourth year.
4/ Present worth of one per annum for remaining life (column 4) divided by present worth of one per annum for total life expectancy (column 5).
5/ Retirement frequency percent or percent of total group retired in each age interval.
6/ Weighted amount is percent good of group (column 6) times retirement frequency (column 7).
7/ Percentage of survivors after four years from R3 table equals to the sum of column 7.
8/ Percent good equals percentage of survivors divided into sum of weighted amount.

In Figure IV on the line for the five- to six-year age interval, the total life expectancy is 5.49670 years. The remaining life expectancy is 1.49670, which is computed by deducting four from 5.49670. We deduct four from the total life expectancy because we are computing percent good at the end of four years.

The present worth of one for the remaining life of 1.49670 years is 1.3292 which is divided by 4.0776 (the present worth of one per annum for the total life expectancy of the group) to arrive at 32.60 percent, the percent good of the group.

A percent good for each group still in existence is then computed. A weighted amount is computed by multiplying the percent good by the retirement frequency or the percent retired during the age interval. All weighted amounts for survivors are summed and divided by the percentage of survivors to arrive at the percent good.

THE GROUP FORMULA

Again for those who are interested in the mathematics of this procedure, here is how the group formula is derived.

Let r = Rate of Return
Let n = Total Probable Life Expectancy at Age "a"
Let a = Age
Let P = Number of Survivors at Any Age
Let M = Maximum Age of Last Survivor
Let f = Retirement Frequency

$\sum$ means to sum up or summation

$\sum_{a}^{M}$ Means to sum calculations from current age to maximum age of last survivor

$\sum_{a}^{M} f$ Means the sum of all retirement frequencies from the current age to the maximum age of last survivor

P_a Means number of survivors remaining at current age

$\sum_{a}^{M} f$ and P_a are the same thing

Then:

$$\text{Percent Good} = \frac{\sum_{a}^{M} \dfrac{100 \text{ PW 1 Per Annum at r Rate for n-a Years}}{\text{PW 1 Per Annum at r Rate for n Years}} (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \left[\frac{(1+r)^{n-a} - 1}{r(1+r)^{n-a}} \div \frac{(1+r)^{n} - 1}{r(1+r)^{n}} \right] (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \left[\frac{(1+r)^{n-a} - 1}{r(1+r)^{n-a}} \times \frac{r(1+r)^{n}}{(1+r)^{n} - 1} \right] (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \frac{[(1+r)^{n-a} - 1)]\ (1+r)^{n}}{(1+r)^{n-a}\ [(1+r)^{n} - 1)]} (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \frac{(1+r)^{a-n}\ [(1+r)^{n-a} - 1]\ (1+r)^{n}}{(1+r)^{a-n}\ (1+r)^{n-a}\ [(1+r)^{n} - 1]} (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \frac{[(1+r)^{a-n+n-a} - (1+r)^{a-n}]\ (1+r)^{n}}{(1+r)^{a-n+n-a}\ [(1+r)^{n} - 1]} (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \, \frac{[1 - (1 + r)^{a-n}] \; (1 + r)^{n}}{1 - 1 + r^{n} - 1} \; (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \, \frac{(1 + r)^{n} - (1 + r)^{a-n+n}}{(1 + r)^{n} - 1} \; (f)}{\sum_{a}^{M} f = P_a}$$

$$\text{Percent Good} = \frac{\sum_{a}^{M} 100 \, \frac{(1 + r)^{n} - (1 + r)^{a}}{(1 + r)^{n} - 1} \; (f)}{\sum_{a}^{M} f = P_a}$$

CHAPTER 5: THE EFFECT OF THE FOUR VARIABLES

There are four variables that have an effect on percent good calculations. They are: the rate of return, the method of calculation, the survivor curve, and the income adjustment factor. While the effect of any one variable on the final results is not a major significance, the cumulative effect of all four variables could be devastating. It is important for the users of these tables to understand the effect of each variable.

THE EFFECT OF THE YIELD RATE

The first variable in computing percent good factors is the rate of return or yield rate. It is a factor that cannot be calculated precisely because of a lack of data. The best way of estimating a proper return on real property is to analyze the relationship between selling price and anticipated future income. This is done by finding the relationship between the selling price of a recently sold property and the buyer's anticipation of the future income of the property. A relationship is expressed in terms of a yield rate or capitalization rate that considers a return on outstanding capital as well as a rate of return of the current value of the wasting assets. It is important that the future income projection is in terms of current dollars. It will be usually level or declining and is free of future inflation. (The Property Taxes Department's objective is to achieve a rate of return that matches an income stream, both being virtually free of inflation.) The sales analysis method is not often available because industrial properties that are "going" concerns are seldom sold.

For this purpose we must consider several indications and make the most reasonable estimate we can. One indicator of a yield rate for industrial property can be obtained from the stock and bond market. It is called the band of investment method and uses the average rate of return on common stocks and the average yield on corporate bond to formulate a rate of return. A good reference for this data is Standard and Poors Statistical Reference. This publication contains an average yield for common stocks and an average yield for 400 "A" rated industrial bonds. The August 31, 1979 average yield for common stocks was 12.5 percent. At the same time the average yield on 400 "A" rated bonds was 9.10 percent. A 50-50 weighted average for these two indicators is 10.8 percent. It is also important when using the band of investment method that future income projections are based upon current dollars, are constant or declining, and therefore reflect inflation free rates of return.

The band of investment method is criticized from the point of view that while it may be applicable to very large, publicly owned corporations it is probably not a good indicator of a proper yield for small, singly or closely owned properties. It does, however, provide an indication that if combined with other evidence it is possible to make an intelligent estimate of a reasonable yield rate.

Rates of return derived by the band of investment method reflect a relationship of the net income after all taxes and the value of the fee simple interest in real property. They, therefore, represent a rate of return after taxes and do not require a further adjustment.

Interest rates on loans to finance industrial property may also be used. While this does not give us a precise answer, it does give us a general idea of a proper rate. Interest rates on loans are not the same thing as a rate of return on real property. Loans are secured by a promise to pay while a rate of return is secured only by the real property and its earning ability.

Normally, it is expected that interest rates on promissory notes will yield at a lower rate than equity return. During times of rapid inflation, however, this relationship may be different. Investors may be willing to invest at lower rates in equity positions than they will in fixed positions. They may feel that inflation will improve their position over time.

While the rate of return is an important factor in percent good calculations, it is not critical. Here are two examples of differences that arise when an 8 percent and a 10 percent rate are used for computing a table. In all cases, an "R-3" survivor curve and the individual method of computation were used.

20-YEAR AVERAGE LIFE

Age	Percent Good At 8 Percent	Percent Good At 10 Percent	Numerical Difference	Percent Difference
5	85.22	87.32	2.10	2.46
10	67.06	70.70	3.64	5.43
15	47.00	51.12	4.12	8.77
20	28.51	31.97	3.46	12.14
25	15.67	18.03	2.36	15.06

10-YEAR LIFE

Age	Percent Good At 8 Percent	Percent Good At 10 Percent	Numerical Difference	Percent Difference
5	58.54	60.67	2.13	3.64
10	21.45	23.09	1.64	7.60

Notice that when the yield rate is increased the percent good is increased. This is just the opposite effect of increasing the capitalization rate in applying the income approach. In the income approach, the higher the rate of return the lower the value. Here the higher the rate of return the higher the percent good.

It must be remembered that percent good is dependent upon the relationship between the present worth of one per annum for the total life expectancy and a similar factor for the remaining life expectancy. Present worth factors discounted at low rates are greater than factors discounted at higher rates for the same period of time. For example, the present worth of one per annum for 20 years discounted at 8 percent is 9.8181, and the present worth of one per annum for 20 years discounted at 10 percent is 8.5135. Because the starting point of the income stream discounted at 8 percent is higher than the factor arrived at using a 10 percent discount rate, it must decline faster to reach zero in the same length of time. This more rapid decline pattern produces lower percent good factors at the same point in time.

It is interesting to note that variances that will arise from the use of different yield rates in the income capitalization process will be greater than variances reflected in percent good factor calculations.

Here is a table showing the differences that arise when an 8 percent yield rate is used as opposed to a 10 percent rate. In both cases, a constant income premise and an income of one are used. Probable remaining life estimates are based upon those derived from an "R-3" survivor curve and a 20-year average service life.

Age	Probable Remaining Life Expectancy	PW Factor At 8 Percent	PW Factor At 10 Percent	Percent Difference
5	15	8.559	7.606	12.5
10	11	7.139	6.495	9.9
15	7	5.206	4.868	6.9
20	4	3.312	3.170	4.5

THE EFFECT OF THE METHOD OF COMPUTATION

The example below shows differences between the individual or average life method and the group or unit summation method of computation. It assumes a 20-year life, a 10 percent discount rate, an "R-3" survivor curve, and a 10 percent decline in income over the average life term. As you can see, the individual method will produce a slightly higher percent good in the beginning years. It reaches a peak of 4.51 percent difference at 11 years of age.

DIFFERENCES BETWEEN GROUP AND INDIVIDUAL METHODS

Age	Percent Good Group Method	Percent Good Individual Method	Difference in Percent Good Factor	Percent Difference in Factors
1	97.01	97.77	.76	.8
2	93.97	95.39	1.42	1.5
3	90.83	92.86	2.03	2.2
4	87.58	90.17	2.59	3.0
5	84.24	87.32	3.08	3.7
6	80.79	84.31	3.52	4.4
7	77.26	81.13	3.87	5.0
8	73.65	77.80	4.15	5.6
9	69.97	74.32	4.35	6.2
10	66.23	70.70	4.47	6.7
11	62.45	66.96	4.51	7.2
12	58.62	63.11	4.49	7.7
13	54.77	59.16	4.39	8.0
14	50.92	55.16	4.24	8.3
15	47.09	51.12	4.03	8.6
16	43.30	47.08	3.78	8.7
17	39.61	43.10	3.49	8.8
18	36.04	39.22	3.18	8.8
19	32.64	35.49	2.85	8.7
20	29.45	31.97	2.52	8.6
21	26.50	28.68	2.18	8.2
22	23.78	25.65	1.87	7.9
23	21.31	22.88	1.57	7.4
24	19.06	20.36	1.30	6.8
25	16.99	18.03	1.04	6.1

The reason for the difference is a difference in concept which results in a different calculation. In the individual method, the percent good is simply a relationship of the present worth of an income for the probable remaining life expectancy and one for the total life expectancy. It assumes that the best estimate of the future life expectancy of survivors of a group of items is the average of the group. All weight is assigned to this single calculation.

The group method assumes that a portion of the group will be retired each year until all are retired. A percent good is calculated for each year, and a weight is assigned for each group according to the number in each group.

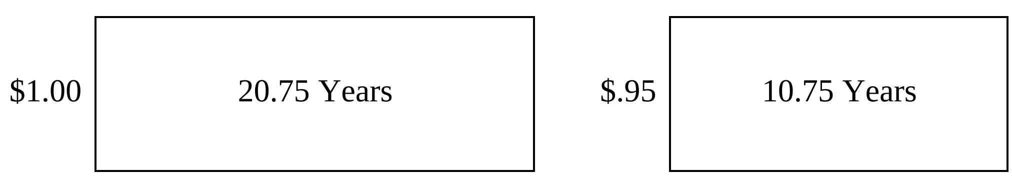
THE EFFECT OF THE INCOME ADJUSTMENT FACTOR

The least controversial of the four factors that influence percent good calculations is the income adjustment factor. It is generally agreed that income to property tends to decline with time. The income adjustment factor used in Assessors' Handbook Section 581, *Equipment Index Factors and Inventory Ratios*, recognizes one adjustment for this factor. The table below shows the effect of this adjustment when a 20-year life, an 8 percent rate, an "R-3" survivor curve, and the individual method are used to compute the percent good.

Age	Percent Good No Income Adjustment	Percent Good With Income Adjustment	Numerical Difference	Percentage Difference
5	89.56	87.32	2.24	2.57
10	74.43	70.71	3.72	5.26
15	55.26	51.12	4.14	8.10
20	35.52	31.97	3.55	11.10
25	20.61	18.03	2.58	14.31

In making this calculation, we are saying that a new property will have an income of one per year for its entire life. At the same time, we are saying that the older property will have an income of something less than one for its entire life. To be correct, the income of the newer property should equal the income of the older property when it reaches the present age of the older property.

The figures below illustrate the relationship between the income projected for a new property and that of a 10-year property with a 20-year average service life.



New Property **10-Year-Old Property**

The above is one method of making an adjustment for declining income. Should the net income decline at a different rate than indicated by the tables, alterations should be made to the income adjustment factors.

THE EFFECT OF THE SURVIVOR CURVE

Here is a table comparing the difference that arises when an "R-3" curve is used as opposed to an "S-3" curve. In both cases, a 10 percent rate of return, a 20-year average service life, the individual method of computation, and a 10 percent income decline factor are used for computation.

Age	Percent Good Using "R-3" Curve	Percent Good Using "S-3" Curve	Percent Difference	Percent Error
5	85.08	84.88	.20	.24
10	66.98	65.53	1.45	2.21
15	46.97	44.67	2.30	5.15
20	28.42	27.96	.46	1.65
25	15.46	16.63	[1.17]	[7.04]

The use of the "R-3" survivor curve has been controversial for some time. The table above indicates it has the least effect on the final answer of the variables.

The "R-3" curve was selected because of the pattern of retirements that it reflected. It seemed reasonable to assume that retirements of new items would be few at first; but as machinery and equipment grew older, the effect of wear and tear as well as obsolescence would cause more frequent retirements. It was felt that the majority of items in any group would reach the average service life of the group and possibly survive a little longer, but after this point in time there would be a large number of retirements.

We can probably make an argument that is reasonably valid for using the "S-3" curve. In any case it seems reasonable that the frequency of retirements is going to be much greater on or near the average service life. It follows, then, that an appropriate curve would be an "R-3" or "R-4" rather than an "R-1" or "R-2."

THE USE OF THE PERCENT GOOD FACTORS

Percent good factors contained in Assessors' Handbook Section 581, *Equipment Index Factors and Inventory Ratios*, are based upon a logical premise and follow accepted appraisal practices. They are intended to reflect the average loss in value that commercial and industrial properties, in general, will suffer over a period of time. The factors are based upon averages and represent a reasonable estimate of percent good for the majority of this type property.

In any group of property items, however, there are individual items that deviate from the norm. For example, in the model group that forms the basis for the R-3 survivor curve, 5.5 percent are retired at 50 percent of the average life of the group, and on the other extreme, 3 percent are retired after 145 percent of the average life term of the total group. Items such as these, whose life terms significantly deviate from the norm, obviously do not closely follow the typical value loss pattern. Therefore, it is necessary for appraisers to analyze the situation of all property when percent good factors are applied. If it is likely that certain property is deviating from the norm, adjustments should be made in the percent good factors.

At the same time, arbitrary deviations from the tables without adequate evidence of deviations from the norm, such as minimum percent good adjustments, are not good appraisal practices. As survivors of an original group reach older age, there may be less reliability in percent good factors applicable to these items. When property items reach this latter stage of their life and the tables indicate very low or zero percent good factors for property that is still functioning, special consideration should be given in assigning percent good factors.

If for administrative reasons the assessor has established a policy of using minimum percent good adjustments, he should be prepared to make readjustments if evidence is presented indicating that the minimum percent good adjustments are inappropriate.

Since percent good factors are not computed according to causes of depreciation, it is impossible to quantify the portion of the indicated value loss that is due to the various causes. However, we can say that the factors include a normal amount of physical deterioration, normal functional obsolescence, and, to the extent that it is normal, normal economic obsolescence.