

PENSION MATHEMATICS **with Numerical Illustrations**

Second Edition

Howard E. Winklevoss, Ph.D., MAAA, EA
President
Winklevoss Consultants, Inc.

Published by

Pension Research Council
Wharton School of the University of Pennsylvania

and

University of Pennsylvania Press
Philadelphia

© Copyright 1977 (first edition) and 1993 (second edition) by the
Pension Research Council of the Wharton School of the University of Pennsylvania

All rights reserved

Library of Congress Cataloging-in-Publication Data

Winklevoss, Howard E.

Pension mathematics with numerical illustrations / Howard E.

Winklevoss. -2nd ed.

p. cm.

Includes bibliographical references and index.

ISBN 0-8122-3196-1

1. Pensions--Mathematics. 2. Pensions--Costs--Mathematics. 3. Pension trusts--Accounting. I. Title.

HD7105.W55 1993

331.25'2--dc20

92-44652

CIP

Printed in the United States of America

Chapter 13

Alternative Plan Benefits

The purpose of this chapter is to consider the financial implications of several alternative plan designs. The analysis is segregated according to benefit category: retirement, vested, disability, and surviving spouse benefits. The effects of various benefit formulas and eligibility requirements within each category are studied.

RETIREMENT BENEFITS

Three separate analyses are performed on the plan's retirement benefits. First, the retirement formula itself is examined, with comparisons being made among final average, career average, and flat dollar unit benefit formulas. Secondly, the benefits payable at early retirement are considered. The model plan provides actuarially equivalent benefits, and the analysis compares the effect of providing full benefits at early retirement. Finally, the benefits provided after retirement are considered. The model plan provides *ad hoc* COLAs every 3 years equal to 25 percent of cumulative inflation, and the analysis considers alternative inflation-based adjustments to retirement benefits.

Alternative Benefit Formulas

The benefit formula is, of course, the most important factor affecting the costs and liabilities of the plan. The model plan has benefits based on the employee's final 5-year average salary, a relatively common formula among corporate pension plans. Table 13-1 shows the financial implications if the averaging pe-

riod is reduced to 3 years, increased to the employee's entire career, or if the formula is equal to a flat dollar unit benefit.

TABLE 13-1
Effect of Alternative Benefit Formulas

Salary Average Period	Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
	NC	AL	NC	AL	NC	AL
FAS (3 Years)	105.5	103.5	105.6	103.7	105.7	103.9
FAS (5 Years)	100.0	100.0	100.0	100.0	100.0	100.0
Career Average	57.8	100.0	71.5	84.2	70.7	79.9
Flat Dollar	56.0	100.0	58.9	79.5	40.0	79.1

FAS = Final Average Salary; Flat Dollar = Flat Dollar Unit Benefit. All formulas are equivalent before salary increase assumption is applied.

Reducing the final average period from 5 to 3 years increases costs and liabilities by about 5 percent. This result is a function of the salary increase assumption which, for the model pension plan, is 5 percent plus the merit scale, the latter having little impact at ages near retirement. A higher salary assumption would increase the cost impact of a 3-year final average period and vice versa.

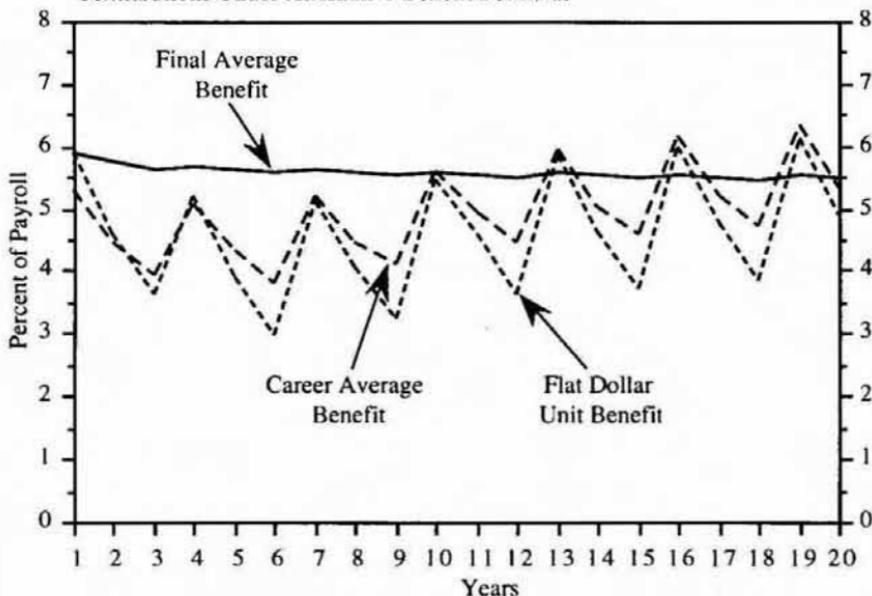
Expanding the salary averaging period to the employee's entire career has a dramatic financial impact. Normal costs are reduced by 40 percent under the accrued benefit method and by 30 percent under the benefit and cost prorate methods. The actuarial liability under the accrued benefit method is not affected, while the other two methods have a 15 to 20 percent reduction. The flat dollar unit benefit formula affects the accrued benefit method by a similar amount; however, the normal costs under the benefit and cost prorate methods are reduced by 40 and 60 percent, respectively, as compared to the costs under the final 5 year average formula.

Many career average plans have benefit updates that, in the long run, make them the equivalent of final average formulas. Similarly, flat dollar unit benefit plans, which are typically associated with collectively bargained employees, often have benefits that are negotiated to keep pace with inflation, with such benefit increases being provided retroactively. These updating processes causes such plans to be less funded than their final average counterparts. In the past, actuaries often used lower-than-expected

interest rates to implicitly fund some portion of the inevitable future benefit increases in advance. This practice is no longer permissible, and the requirement that explicit, best estimate assumptions be used exacerbates the underfunding problem associated with these plans. The underfunding of flat dollar unit benefit plans was part of the motivation for the *deficit reduction contribution* under OBRA '87. However, it may be more appropriate for Congress to allow (or even require) tax deductible contributions to be based on an assumed increase in the unit benefit of such formulas, perhaps limited to 3 or 4 percent.

Figures 13-1 shows the long-term costs of a final 5-year average formula compared to a career average formula and a flat dollar unit benefit formula, where the latter two are updated every 3 years to the benefits provided under the final average plan.¹ As expected, the cost pattern for the two amended plans is quite erratic due to the updating procedure.

FIGURE 13-1
Contributions Under Alternative Benefit Formulas



¹Assets as a percent of the actuarial liability under all three plans were set equal at the outset of the projection in order to have a valid comparison of the long-run costs of the different benefit formulas.

The economic liability is the same for all three plans, since each plan delivers essentially the same final average benefit.² The economic liability funded ratio under the final average benefit formula is approximately 100 percent during the projection; however, the same ratio under the career average plan is in the 75 percent range and for the flat-dollar unit benefit plan is in the 65 percent range. Since the long-run level of assets is lower, the long-run costs of the amended plans eventually will be higher than the costs under the final average plan.

If it is the intention of the plan sponsor to update a career average plan, for example, to mimic a final average plan, it may be better to adopt a final average plan in the first place. Under a periodically updated career average plan, the funded status will be lower, long-run costs will be higher, and the pattern of costs will be erratic. On the other hand, the advantage of periodic updates is that the employer has greater control over the costs and liabilities of the plan.

Alternative Early Retirement Benefits

The benefits provided at early retirement, like the basic benefit formula itself, can have a significant effect on pension costs. In recent years more participants are retiring early and more plans are providing benefits that exceed full actuarial reductions. The cost effect of providing non-reduced early retirement benefits for various early retirement assumptions relative to the cost of retirement at age 65 is given in Table 13-2. The base case early retirement assumption, shown previously in Table 2-9, has an average retirement age of 61.4. This distribution has an increased normal cost of 20 percent for the accrued benefit method and about 10 percent for the other two cost methods as compared to age-65 retirement.

The cost of providing non-reduced early retirement benefits relative to the cost of providing actuarially reduced benefits for retirements at the same ages is given in Table 13-3. The cost impact is significant. For example, the age 61.4 early retirement distribution shows a 30 percent increase in costs and about a 20

²The economic liability, which represents management's best-estimate of the true economic obligation of the plan, is discussed in Chapter 14.

TABLE 13-2

Effect of Non-Reduced Benefits at Alternative Retirement Ages as a Percent of Values for Retirement at Age 65

Average Retirement Age	Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
	NC	AL	NC	AL	NC	AL
65.0	100.0	100.0	100.0	100.0	100.0	100.0
63.4	109.0	106.4	105.1	104.3	104.1	103.2
61.4	122.1	115.2	112.0	110.0	109.9	107.1
59.4	137.0	124.4	119.2	115.4	115.9	110.7
57.5	148.7	135.9	123.6	121.5	121.6	114.7

TABLE 13-3

Effect of Non-Reduced Benefits at Alternative Retirement Ages as a Percent of Values of Actuarially Reduced Benefits

Average Retirement Age	Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
	NC	AL	NC	AL	NC	AL
65.0	100.0	100.0	100.0	100.0	100.0	100.0
63.4	112.0	106.7	112.2	108.4	112.3	109.1
61.4	130.1	116.2	131.2	120.1	132.6	121.9
59.4	150.4	126.3	154.0	132.5	159.8	135.5
57.5	176.8	139.1	184.0	148.0	195.5	153.5

percent increase in actuarial liabilities. Thus, the dual effect of early retirements and non-reduced benefits can be significant.

Cost-of-Living Adjustments (COLA)

Some plans, mostly or perhaps exclusively in the public sector, allow the benefits of retired employees to increase automatically, usually according to a rate which is tied to a national inflation index. The purpose of this section is to investigate the cost consequences of an automatic benefit escalator under various rates of inflation versus paying these same benefits on an *ad hoc* basis. Table 13-4 shows that costs and liabilities under all three funding methods are increased by about 8 percent for each one percentage point increase in the COLA assumption. For example, providing an automatic 3 percent COLA increases costs and liabilities by about 25 percent. This, of course, is the long-term

TABLE 13-4
Effect of Automatic Cost-of-Living Adjustments

Automatic COLA Rate*	Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
	NC	AL	NC	AL	NC	AL
0%	100.0	100.0	100.0	100.0	100.0	100.0
1%	107.7	107.3	107.7	107.4	107.7	107.4
2%	116.4	115.4	116.4	115.6	116.5	115.7
3%	126.2	124.6	126.2	124.9	126.4	125.1
4%	137.3	134.9	137.4	135.5	137.6	135.7

*The inflation rate in the salary and interest assumptions also adjusted to this level (from 4% base case).

increase in costs. If a plan without an automatic COLA were to adopt a 3 percent COLA, the near-term costs would be additionally increased by the unfunded liability created at the time of adoption.

Figure 13-2 shows the cost implications of providing these same benefits on a *ad hoc* basis by amending the plan every three years. The base case, it will be recalled, provides 25 percent of cumulative inflation (or 1 percent) every 3 years. After 20 years of *ad hoc* benefit increases, costs are about 1 percentage point of payroll higher (or a change in costs of 15 to 20 percent) for each one percentage point of COLA provided on an *ad hoc* basis.

Nearly all employers provide benefits adjustments to retirees on an *ad hoc* basis, partly because they can control future benefit increases and partly because of the high cost of installing an automatic COLA, even one with a cap of 3 or 4 percent. Most public plans, on the other hand, provide benefit adjustments of 2 to 4 percent on an automatic basis.

VESTED TERMINATION BENEFITS

The minimum required vesting period is 5 years of service. Table 13-5 shows the effects on normal costs and actuarial liabilities of alternative service requirements, ranging from zero years to 20 years. These results indicate that alternative vesting requirements have a rather modest impact on total costs based on the termination rates used in the model pension plan. In fact, eliminating the service requirement completely only increases costs by about 1 percentage point.

FIGURE 13-2
Effect of Ad Hoc Cost-of-Living Adjustments

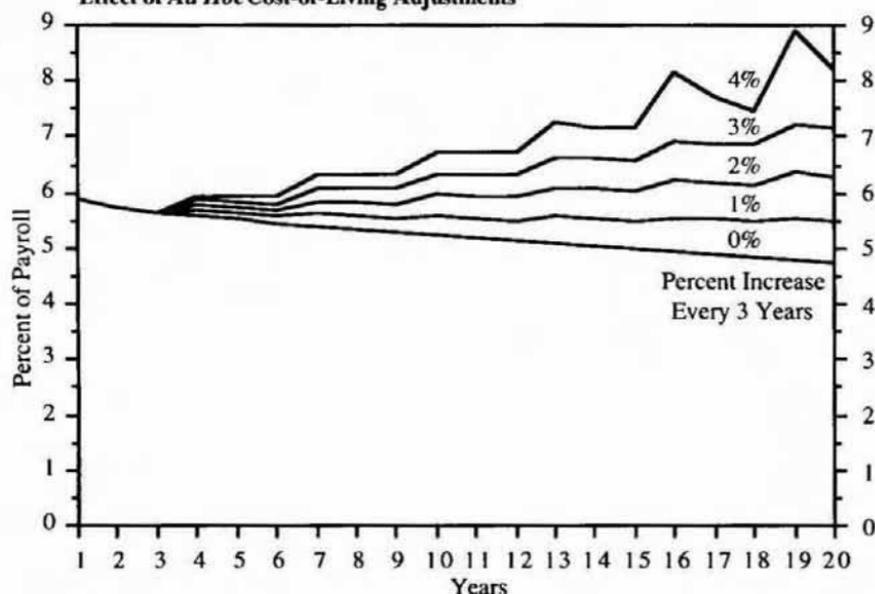


TABLE 13-5
Effect of Alternative Service Requirements for Vesting

Vesting Service Requirement	Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
	NC	AL	NC	AL	NC	AL
20 Years	92.8	97.7	92.2	97.6	90.1	99.2
15 Years	95.3	98.7	94.8	98.7	93.2	100.0
10 Years	97.8	99.5	97.5	99.6	96.6	100.2
5 Years	100.0	100.0	100.0	100.0	100.0	100.0
0 Years	101.1	100.1	101.3	100.1	101.9	99.6

DISABILITY BENEFITS

The disability provision used in the model pension plan requires 10 years of service and age 40. Table 13-6 shows the financial implications of alternative age and service requirements. As noted, there is little impact on costs of such changes, based on the disability rates and benefits for the model pension plan.

TABLE 13-6

Effect of Alternative Age and Service Requirements for Disability Benefits

Disability Requirements:			Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
			NC	AL	NC	AL	NC	AL
Age	Service							
55	10 Yrs		97.6	99.0	97.5	98.8	97.3	98.9
40	10 Yrs		100.0	100.0	100.0	100.0	100.0	100.0
None	10 Yrs		100.1	100.0	100.1	100.0	100.1	100.0
40	0 Yrs		100.6	100.1	100.7	100.1	101.0	100.0
None	0 Yrs		100.9	100.2	101.0	100.2	101.3	100.0

SURVIVING SPOUSE BENEFITS

The surviving spouse benefit for the model pension plan provides 50 percent of the employee's accrued benefit commencing when the employee would have been eligible for early retirement, generally age 55 for most employees. Table 13-7 shows the financial impact of several alternatives with respect to the amount of the benefit and the commencement date.

TABLE 13-7

Effect of Alternative Surviving Spouse Benefits

Survivor Benefit	Accrued Benefit		Constant Dollar Benefit Prorate		Constant Percent Cost Prorate	
	NC	AL	NC	AL	NC	AL
50% Deferred	100.0	100.0	100.0	100.0	100.0	100.0
100% Deferred	104.3	102.1	104.5	102.6	104.8	102.6
50% Immediate	100.8	100.6	100.9	100.5	101.0	100.4
100% Immediate	105.9	103.0	106.2	103.5	106.8	103.2