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ACTUARIAL VALUATION REPORT  
OF  
THE CONTRIBUTORY RETIREMENT SYSTEMS OF  
THE COMMONWEALTH OF MASSACHUSETTS  
AS OF JANUARY 1, 1976

MASSACHUSETTS RETIREMENT LAW COMMISSION

Publication # 9928-34-500-9-77-CR  
Approved by Alfred C. Holland, State Purchasing Agent





# *The Commonwealth of Massachusetts*

## *Retirement Law Commission*

*One Ashburton Place*

*Boston, Massachusetts 02108*

July 22, 1977

To the Honorable Governor, and to the Honorable Senate and House of Representatives.

The Retirement Law Commission submits herewith this report which presents the actuarial valuation of the Contributory Retirement Systems of the Commonwealth of Massachusetts. The report was made possible from the Data Information Bank maintained by the Retirement Law Commission which information was furnished by the Contributory Retirement Systems of the Commonwealth. For convenience, the report has been divided into the following sections:

- I. INTRODUCTION AND SUMMARY
- II. BENEFIT PROVISIONS
- III. ACTUARIAL ASSUMPTIONS
- IV. ACTUARIAL COSTS
- V. EMPLOYEE DATA

The actuarial study was prepared by Martin E. Segal Company, Incorporated. Thomas D. Levy, a Fellow of the Society of Actuaries and a Member of the American Academy of Actuaries, prepared the actuarial calculations. Sherman G. Sass and Matthew J. Ryan also participated in the work of Martin E. Segal Company in the preparation of the report.

Respectfully submitted,

Carmen W. Elio, Chairman  
James W. Callanan, Vice Chairman  
Joel Goober  
Alicia H. Munnell  
Eugene Sullivan  
Patrick D. Sullivan  
Sidney J. Weiner



## I. INTRODUCTION AND SUMMARY

This report presents the second actuarial valuation of the Commonwealth of Massachusetts Contributory Retirement Systems as of January 1, 1976. (The first report was prepared as of January 1, 1974.) The basic employee data and pensioner data for the actuarial studies were drawn from the Data Bank of the Retirement Law Commission which contains records for 100 systems in operation on the valuation date.\* The Commission maintains this Data Bank to provide up-to-date information for continuing actuarial valuations and reports on proposed legislation.

This second actuarial valuation was based on the revised actuarial assumptions recommended by the 1976 Funding Advisory Committee. To reflect the recent experience, the Committee increased the inflation assumption to 4 1/2 per cent per year compared to 3 per cent used in the first report. This change meant that the interest assumption was raised from 6 to 7 1/2 per cent; the salary scale assumes level increases of 4 1/2 per cent (previously 3 per cent) plus merit increases; and the cost-of-living increase assumption was raised from 3 to 4 1/2 per cent.

The new actuarial assumptions lower costs because the higher investment return more than offsets the increased cost from more rapid salary growth and greater cost-of-living increases. This result occurs because the higher wage growth brings the \$6,000 limitation on benefits eligible for cost-of-living adjustments into effect quickly. With a higher rate of inflation, a smaller portion of the retirement allowance receives cost-of-living increases. The change in assumptions lowered the normal cost by \$42 million and the unfunded liability by \$661 million compared to what would have developed on the prior assumptions. (A more detailed reconciliation is presented on page 28 of this report.)

The actuarial costs are presented in Table 1 at the end of Section IV, ACTUARIAL COST. The principal cost factors reported in that Section, for all systems as of January 1, 1976, are as follows:

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\*As of the date of this report, one town had not yet filed the necessary data.



<u>Item</u>	<u>Amount in millions</u>	<u>% of Pay</u>
Normal cost --		
Total	\$ 481	16.7
Estimated employee contributions	149	5.2
Employer normal cost	332	11.5
Actuarial Liability --		
Active members	5,447	
Retired members	3,895	
Total	9,342	
Assets	1,698	
Unfunded actuarial liability	7,644	
Total annual employer cost (employer normal cost plus 40 year amortization of the unfunded actuarial liability) --		
"Traditional" (normal cost is level per cent of pay; amortization is level dollar amount) "Percent of pay"	896	31.1
(normal cost and amortization are level per cents of pay)	647	22.4
Total covered annual payroll	2,886	

The above figures are subject to the notes and qualifications, which are outlined in Section IV of the report.

These costs are presented as the long term, level annual amounts required to be paid by employer contributions in order to meet the ultimate retirement benefits promised by the Contributory Retirement Law. Presenting the costs this way would ordinarily imply a method of funding or budgeting under which the year-to-year appropriations would correspond to these level costs, and would in this way provide advance funding for payments to future pensioners.

Now in fact, the Massachusetts Contributory Retirement Law does not provide (or permit) such advance funding. Rather the law required year-to-year budgetary financing. That is, appropriations are made on a pay-as-you-go basis, equal each year to the amount of expected retirement payments in



that year less that portion of the benefits that is covered by employee contributions. Currently, employee contributions, on the average, finance from 10 to 15 per cent of the annual retirement benefits paid.

In explaining this presentation of level annual actuarial costs, it will be helpful to start with some of the concepts that are described more fully in Section IV. The Actuarial costs include:

Normal cost - the cost for that portion of the retirement benefit earned in a given year:

Actuarial liability - the equivalent of the accumulated costs for all benefits earned in all years before the valuation date.

Unfunded actuarial liability - the accrued liability less the accumulated assets, or simply the accumulated costs for all benefits already earned but not yet paid for.

Level annual payment - an amount sufficient to cover both the normal cost and a payment which will amortize the unfunded actuarial liability over a certain number of years.

The actuarial costs should be identified and reported, independently of whether the financing of the retirement systems provides for current payments or deferred payments of the costs. The actuarial liability is a fair measure of the present value of future benefits already accrued. Again, the normal cost is the measure of the cost attributable to the employee's service in the current year.

These actuarial cost methods, applied to estimate the cost of proposed improvements in the benefit or eligibility rules, also provide realistic long term assessments of these costs; whereas studies which just projected benefit



payments on account of the improvements may be misleading in the early years. For example, reducing the minimum service requirement for vesting from 20 years to 10 years will result in a substantial increase in the amount of benefit payments, ultimately. Yet the immediate effect on benefit payments in the early years is negligible because payment of these newly vested benefits is deferred until retirement age, many years in the future. Only the actuarial cost methods will identify the real cost impact.

Following the actuarial valuation of the Contributory Retirement Systems as of January 1, 1974, a Funding Advisory Committee was convened. Based on the report of this Committee, the Commission introduced legislation to mandate funding of public pensions in Massachusetts. The following are the principal provisions of that bill:

- (1) The funding objective requires payment of the Normal Cost each year plus 40 year amortization of the Unfunded Actuarial Liability, with each component calculated so as to remain level as a percentage of projected payroll.
- (2) There should be a five year transition period such that the amortization payment on the Unfunded Actuarial Liability would be multiplied by the following fractions of the amounts otherwise payable:

<u>Fiscal year</u>	<u>Fraction</u>
1977 - 78	1/15
1978 - 79	3/15
1979 - 80	6/15
1980 - 81	10/15
1981 - 82	100%

For some Systems, the above formula produces a funding requirement which is less than the current pay-as-you-go contribution in the first year or two. These Systems must receive income at least equal to the current payouts just to cover their cash requirements. Accordingly, for such Systems the reported funding contribution has been increased so that it equals the pay-as-you-go contribution.

In recognition of the fact that over half of the total unfunded liability is attributable to the State Employees' and



Teachers' Retirement Systems, it was recommended that the funding be implemented more rapidly for them. The fractions in the second, third and fourth year are 2/5, 3/5, and 4/5, respectively. In the first year, the actuaries recommended that the appropriations for each of these large systems be \$5 million in excess of the "pay-as-you-go" contribution.

- (3) Benefit improvements should be funded as above except based on 30 year amortization of the added actuarial liability and without benefit of the transition rules.

It was recognized that the above proposal would result in an increasing unfunded liability for a number of years. However, the Committee felt that it was the best available balance between fiscal responsibility and fiscal reality.

The current actuarial valuation includes projections of the required appropriations under this funding proposal for the next 15 years and compares them with the projected employee contributions based on the present, "pay-as-you-go" scheme. For all systems combined, the results are:

(Amounts in millions)

<u>Fiscal Year</u>	<u>Funding Contribution</u>	<u>Percent of Pay</u>	<u>Pay-as-you-go Contribution</u>	<u>Percent of Pay</u>
1977 - 78	\$ 477	14.8%	\$453	14.1%
1978 - 79	546	16.3	486	14.5
1979 - 80	638	18.2	525	15.0
1980 - 81	770	21.0	572	15.6
1981 - 82	935	24.4	622	16.2
1982 - 83	977	24.4	672	16.8
1983 - 84	1,021	24.4	725	17.3
1984 - 85	1,067	24.4	784	17.9
1985 - 86	1,115	24.4	850	18.6
1986 - 87	1,165	24.4	911	19.1
1987 - 88	1,217	24.4		
1988 - 89	1,272	24.4		
1989 - 90	1,329	24.4		
1990 - 91	1,389	24.4		
1991 - 92	1,451	24.4		

From the above projections, the actuaries estimated that the proposed funding method, if adopted beginning in 1977-78, would cost less than the present arrangement by about 1993-94. (This material is also subject to notes and qualifications in Section IV.) That is, reserves on which investment income was being earned would be such that, by that time, the required contributions from public employers would be less than the pension payments.



## II. BENEFIT PROVISIONS

Public Employees in Massachusetts are not covered by the Federal Social Security System; they receive benefits only under the Contributory Retirement Law. The Main features of that Law are summarized below.

### Employee Contributions

Employees hired before January 1, 1975 contribute 5 per cent of their salary; employees hired after that date contribute 7 per cent.

### Retirement Benefits

Employees covered by the Contributory Retirement Law are classified into one of four groups depending on job classification. Group 1 comprises most positions in state and local government. It is the general category of public employees. Group 4 comprises mainly police and firefighters. Group 2 is for other specified hazardous occupations. Officers and inspectors of the State Police make up Group 3.

The maximum benefit payable is 80 per cent of a member's final three year average salary. The formula for computing the maximum benefit is different for each group according to the following schedule:

<u>Age</u>	<u>Group</u>		
	<u>1</u>	<u>2</u>	<u>4</u>
65	2.5%	2.5%	2.5%
64	2.4	2.5	2.5
63	2.3	2.5	2.5
62	2.2	2.5	2.5
61	2.1	2.5	2.5
60	2.0	2.5	2.5
59	1.9	2.4	2.5
58	1.8	2.3	2.5
57	1.7	2.2	2.5
56	1.6	2.1	2.5
55	1.5	2.0	2.5
54	1.4	1.4	2.4
53	1.3	1.3	2.3
52	1.2	1.2	2.2
51	1.1	1.1	2.1
50	1.0	1.0	2.0
49	0.9	0.9	1.9
48	0.8	0.8	1.8
47	0.7	0.7	1.7
46	0.6	0.6	1.6
45	0.5	0.5	1.5
44	0.4	0.4	0.4
43	0.3	0.3	0.3
42	0.2	0.2	0.2
41	0.1	0.1	0.1



Group 3 members at age 55 receive 50 per cent of final three year average salary after 20 years of service plus one per cent for each additional year.

#### Benefits for Group 1

The benefit program provides for voluntary retirement from age 55 to age 70 - the mandatory retirement age for this group. However, members who are younger than age 55 and who have completed 20 years of service are eligible to retire. Veterans receive an extra \$15 per year for each year of employment up to a maximum of \$300 for 20 or more years of employment.

#### Benefits for Groups 2 and 4

Members covered by Groups 2 and 4 are subject to a lower mandatory retirement age - 65. The maximum benefit accrual rate of 2.5 per cent begins at age 60 for Group 2 members and at age 55 for Group 4 members.

#### Disability Benefits

A member who is unable to perform his job due to a non-occupational disability will receive a retirement allowance if he has fifteen years of service (ten if a veteran) and has not reached age 55 of 1.5 per cent of final three year average salary multiplied by years of service. For veterans, there is a minimum benefit of 50 per cent of his most recent year's pay plus an annuity based on his own contributions.

For a job-connected disability the benefit is 72 per cent of the member's most recent annual pay plus additional amounts for surviving children.

#### Death Benefits

In general, the beneficiary of an employee who dies in active service will receive a refund of the employee's own contributions. If the employee was eligible to retire on the date of his death, a spouse's benefit will be paid based on two-thirds of the amount the employee would have received under Option C. There is also a minimum widow's pension of \$140 per month, and there are additional amounts for surviving children.



If an employee's death is job-connected, the spouse will receive 72 per cent of the member's most recent annual pay, plus additional amounts for surviving children.

Options

Members can elect to receive a full retirement allowance under Option A that stops at death. Under Option B a member can elect to receive a lower Monthly allowance in exchange for a guarantee that at death any contributions not expended for annuity payments will be refunded to his beneficiary. Option C allows the member to take a lesser retirement allowance in exchange for providing his survivor with two-thirds of the lesser amount.

Post Retirement Benefits

All of the retirement and survivor benefits are subject to cost-of-living increases. If the consumer price index changes by 3 per cent or more the retirement allowance is adjusted by the amount of the CPI increase. This adjustment only applies to retirement allowances up to \$6,000, and is subject to appropriations.



### III. ACTUARIAL ASSUMPTIONS

The purpose of an actuarial valuation is to determine the employer contributions required to meet the ultimate cost of a retirement system in accordance with a specific funding method. The term "funding method" refers to the budgeting or payment program under which the retirement system is to be financed. Based on the benefit provisions of the system, and on the characteristics of active, inactive and retired members of the system, the actuary makes mathematical calculations to project future benefit payments.

Having determined the liabilities of the retirement system (the current and prospective benefit payments), the actuary then determines the contributions required to accumulate matching assets. The rate at which assets are to be accumulated varies depending on the funding method applied in the actuarial cost calculations.

The term "actuarial valuation" is often used as if it implied a precise and inevitable mathematical result. While it is true that an actuarial valuation involves a good deal of sophisticated mathematics, it also involves a great many variables. The actuary must make his calculations on the basis of a set of actuarial assumptions which have been arrived at following a careful review of the age, service and salary characteristics of active employees; an analysis of hiring and retiring statistics and policies; a full understanding of all of the benefit provisions of the system; and an analysis of past salary increase practices. The actuary also uses an interest rate in his calculations which he believes is likely to be achieved over the long term.

If each of the actuarial assumptions is exactly fulfilled, the actual cost of the retirement system will equal the projected cost. However, this result is rare because of the period of time and the numerous variables involved. Some assumptions may prove to have overestimated the ultimate cost



of the system, while others may understate it. For example, if the investment earnings on the assets of the system are higher than the assumed rate of return, the system will receive investment earnings an accumulated assets that were not taken into account in the actuarial valuation. On the other hand, if salaries increase more rapidly than projected, actual benefit obligations may exceed projected obligations.

At the end of this section of the Report there are tables showing the assumptions used for each of the systems. Here is an explanation of each of the assumptions:

#### Mortality

A mortality table is used to project the number of employees at each age who will die in active service, and also to determine the amount of the reserve required at the time of retirement to pay benefits for the remainder of an employee's lifetime. We have used the most recently published table of pension plan mortality, the Group Annuity Table for 1971, to project the incidence of deaths among active and retired members.

#### Disability Rates

For estimating the incidence of disability among active employees, we have used the tables prepared by the Social Security Administration. For employees other than Group 4 we assumed that one out of every two retirements on account of disability would be "accidental" (service connected). For Group 4 employees the factors in the table have been doubled, and we assumed that nine out of ten disability retirements would be under the "accidental disability" provisions of the law.

#### Withdrawal Rates

The withdrawal or turnover rates used in an actuarial valuation are an important element in the costs of the retirement system because they project the percentage of employees in various age brackets who will leave the system without immediate benefit rights (except for the return of contributions). The employer contributions made to the retirement system during the periods worked by such employees will be available instead for the payment of benefits to other members who meet the system's requirements.



Based on our experience with a number of other large public employee retirement systems, we believe that it is appropriate to use different withdrawal rates for safety employees and for all other employees covered by the System.

The withdrawal rates used for State employees and Teachers assume low turnover; for Boston Group 1 and 2 employees, low to moderate turnover; for Group 1 and 2 "Locals", moderate turnover; and for the State Police and Group 4 employees, no turnover was assumed.

#### Net investment return

Funding a retirement system on an actuarial reserve basis involves the accumulation of substantial reserves in order to guarantee the fulfillment of benefits provided under the system. These reserves are invested and the rate of long-term investment earnings is a major factor in determining the contributions required to support the ultimate cost of benefits.

While the selection of an interest rate (technically the investment return rate or yield rate) is generally the most important actuarial assumption to be made, the assumed interest rate is not an assumption based exclusively on actuarial considerations. This is because the reported rate of investment earnings depends primarily on the investment policies and asset valuation procedures in effect in a particular retirement system.

The experience of the last several years clearly illustrates that rates of investment earnings can vary widely during relatively short periods. Twenty years ago typical interest rate assumptions used in actuarial valuations were between 2 1/2 per cent and 3 per cent; assumptions of 6 per cent and 7 per cent are common today.

In these calculations we have used 7 1/2 per cent as the long-term effective rate of yield on the assets of the retirement systems. This increase compared to 6 per cent in the prior valuation reflects continuing high inflation levels -- perhaps 4 1/2 per cent per year -- which we have assumed will continue in the future.



At the same time we believe that the assumed interest rate should bear a reasonable relationship to the assumption made with respect to anticipated increased salary.

### Salary Increases

Because the retirement benefits provided by the system are based on an employee's final average salary (three highest years of earnings), increases in salaries have a significant effect on the ultimate cost of the system. For purposes of an actuarial valuation, an assumption is made to estimate the probable salary progression of employees in the future.

The effect of salary increases greater than projected is to produce an actuarial loss, which if not offset by other actuarial gains, results in higher contribution requirements for the future. Selecting a salary increase assumption which approximates actual experience helps to maintain contribution requirements at a level percentage of salary.

The salary scale used in these calculations assumed level increases of 4 1/2 per cent per year plus merit increases ranging from 1.8 per cent per year at younger ages to no increases at older ages.

### Retirement Age

In terms of cost impact, one of the more important actuarial assumptions is the assumption made with respect to the average age at which employees will retire from service. If it is assumed that employees will retire as soon as they become eligible, the projected cost of the retirement system will be substantially higher than if it is assumed that retirements are deferred for a number of years beyond eligibility. Of course, the ultimate cost of the system will depend on the ages at which employees actually retire from service in the future. To estimate the ultimate cost of the system, an actuary must make an assumption as to the probable incidence of retirements.



Here are the retirement ages that were used for the various systems or groups of systems:

State	63
State Police	50
Teachers	63
Boston and Locals:	
Groups 1 and 2	64
Group 4	60

#### Post-Retirement Increases

Cost-of-living increases have been assumed to average 4 1/2 per cent each year up to the \$6,000 ceiling on such increases.

#### Valuation of Assets

The assets of the systems were valued in accordance with the statutory provisions of Chapter 32.

#### Funding Method

The Entry Age Normal Cost method of funding was used. The operation of this method is discussed further in the section on "Actuarial Costs". The basic goal of this method is to spread the cost of each member's benefits as a level percentage of his pay from his date of membership to his projected retirement date.

#### Inflation

We have included in these calculations an assumption of 4 1/2 per cent per year inflation. This is reflected in three of the above assumptions:

Investment yield: Economic studies have indicated a "true underlying interest yield" of about 3 per cent. Adding an inflation allowance, we have used a 7 1/2 per cent investment yield.

Salary scale: We have projected salaries by combining a scale based on merit increases and 4 1/2 per cent across-the-board increases each year. The total payroll is therefore projected to increase 4 1/2 per cent per year, while the number of employees remains stable.



Post-retirement increases: The inflation assumption is reflected directly in this assumption.

#### Effect of changes in assumptions

The prior valuation as of January 1, 1974, assumed that inflation would average 3 per cent per year. After discussions with the Funding Advisory Committee members, the actuaries increased the inflation assumption to 4 1/2 per cent per year. The assumptions which are not related directly to inflation are essentially unchanged from the prior review.

By itself, the higher investment return from higher inflation levels lowers plan costs. That is, more of the cost is paid for by investment income, so less has to be contributed by public employers.

However, salaries go up faster in times of higher inflation. The benefits under the Systems are generally related to salary just prior to retirement. These higher salaries produce higher benefits and therefore higher costs than would be the case at lower inflation levels.

Finally, cost-of-living increases to pensioners will be higher as inflation increases, which also increases costs. This area, however, is subject to an important limit. Pensioner increases are only applied to the first \$6,000 of annual retirement allowance. In times of higher inflation, the effect of this limit is to raise pension benefits by less than the rate of increase in the Consumer Price Index. Perhaps 85 per cent of current payments are subject to cost-of-living increases. If the \$6,000 limit is not changed and inflation continues at 4 1/2 per cent, each year will see a lower percentage of total benefits covered for cost-of-living payments. In a long-term calculation, this limit is quite significant.

The total effect of the changes in inflation-related assumptions is to decrease the required costs from what would be obtained on the prior assumptions. That is, the added investment income more than offsets the added benefit payments attributable to higher inflation.



The higher inflation assumption also has a substantial impact on the rate at which the unfunded actuarial liability is amortized. Since total payroll is assumed to increase at a faster rate, the process of levelling costs as a per cent of payroll causes lower amortization payments in the early years and higher payments in later years.

Group 1, 2 and 3 (Rate 2)

Age	Disability	Death*	Total*
20	0.00	0.00	0.00
25	0.00	0.00	0.00
30	0.00	0.00	0.00
35	0.00	0.00	0.00
40	0.00	0.00	0.00
45	0.00	0.00	0.00
50	0.00	0.00	0.00
55	0.00	0.00	0.00
60	0.00	0.00	0.00

State Police (Rate 2)

Age	Disability	Death*	Total*
20	0.00	0.00	0.00
25	0.00	0.00	0.00
30	0.00	0.00	0.00
35	0.00	0.00	0.00
40	0.00	0.00	0.00
45	0.00	0.00	0.00
50	0.00	0.00	0.00
55	0.00	0.00	0.00
60	0.00	0.00	0.00

Salary Series

Age	Disability	Death*	Total*
20	0.00	0.00	0.00
25	0.00	0.00	0.00
30	0.00	0.00	0.00
35	0.00	0.00	0.00
40	0.00	0.00	0.00
45	0.00	0.00	0.00
50	0.00	0.00	0.00
55	0.00	0.00	0.00
60	0.00	0.00	0.00



Table 1a

## ACTUARIAL ASSUMPTIONS - STATE RETIREMENT SYSTEM

Mortality rates -- 1971 Group Annuity Mortality Table.  
Termination rates before retirement:

Groups 1, 2 and 4 (Rate %)

<u>Age</u>	<u>Death*</u>	<u>Disability</u>	<u>Withdrawal</u>	<u>Total*</u>
20	.05	.06	5.44	5.55
25	.06	.09	4.89	5.04
30	.08	.11	3.70	3.89
35	.11	.15	2.35	2.61
40	.16	.22	1.13	1.52
45	.29	.36	.27	.92
50	.53	.61	--	1.14
55	.85	--	--	.85
60	1.31	--	--	1.31

50% of the disability rates shown represent accidental disability.

State Police (Rate %)

<u>Age</u>	<u>Death*</u>	<u>Disability</u>	<u>Withdrawal</u>	<u>Total*</u>
20	.05	.06	--	.11
25	.06	.09	--	.15
30	.08	.11	--	.19
35	.11	.15	--	.26
40	.16	.22	--	.38
45	.29	.36	--	.65

90% of the disability rates shown represent accidental disability.

Detail figures may not add to totals shown due to rounding.

\*Rates shown are for men; rates for women are slightly lower.

Salary scale:

<u>Age</u>	<u>Present salary as a percent of salary at 65</u>	<u>Annual increases rate (%)</u>
20	9.11	6.36
25	12.38	6.27
30	16.73	6.11
35	22.43	5.91
40	29.73	5.59
45	38.76	5.23
50	49.73	4.96
55	63.15	4.84
60	80.07	4.67

Includes allowance for inflation of 4½% per year.

Post-retirement increases -- 4½% per year.

Retirement age -- 63, except 50 for State Police.

Investment Return -- 7½%.

Valuation of assets -- At statutory values.



Table 1b

## ACTUARIAL ASSUMPTIONS - TEACHERS RETIREMENT SYSTEM

Mortality rates -- 1971 Group Annuity Mortality Table.  
Termination rates before retirement:

Age	(Rate %)				Total*
	Death*	Disability	Withdrawal		
20	.05	.06	5.44		5.55
25	.06	.09	4.89		5.04
30	.08	.11	3.70		3.89
35	.11	.15	2.35		2.61
40	.16	.22	1.13		1.52
45	.29	.36	.27		.92
50	.53	.61	--		1.14
55	.85	--	--		.85
60	1.31	--	--		1.31

50% of the disability rates shown represent accidental disability.

Detail figures may not add to totals shown due to rounding.

\*Rates shown are for men; rates for women are slightly lower.

## Salary scale:

Age	Present salary as a percent of salary at 65	Annual increases rate (%)
20	9.11	6.36
25	12.38	6.27
30	16.73	6.11
35	22.43	5.91
40	29.73	5.59
45	38.76	5.23
50	49.73	4.96
55	63.15	4.84
60	80.07	4.67

Includes allowance for inflation of  $4\frac{1}{2}\%$  per year.

Post-retirement increases --  $4\frac{1}{2}\%$  per year.

Retirement age -- 63.

Investment Return --  $7\frac{1}{2}\%$ .

Valuation of assets -- At statutory values.



Table 1c

## ACTUARIAL ASSUMPTIONS - BOSTON RETIREMENT SYSTEM

Mortality rates -- 1971 Group Annuity Mortality Table.  
Termination rates before retirement:

Groups 1 and 2 (Rate %)

<u>Age</u>	<u>Death*</u>	<u>Disability</u>	<u>Withdrawal</u>	<u>Total*</u>
20	.05	.06	6.58	6.69
25	.06	.09	5.27	5.42
30	.08	.11	4.83	5.02
35	.11	.15	4.47	4.73
40	.16	.22	3.84	4.22
45	.29	.36	3.21	3.87
50	.53	.61	1.52	2.66
55	.85	--	--	.85
60	1.31	--	--	1.31

50% of the disability rates shown represent accidental disability.

Group 4 (Rate %)

<u>Age</u>	<u>Death*</u>	<u>Disability</u>	<u>Withdrawal</u>	<u>Total*</u>
20	.05	.12	--	.17
25	.06	.17	--	.23
30	.08	.22	--	.30
35	.11	.29	--	.40
40	.16	.44	--	.60
45	.29	.72	--	1.01
50	.53	1.21	--	1.74
55	.85	--	--	.85

90% of the disability rates shown represent accidental disability.

Detail figures may not add to totals shown due to rounding.

\*Rates shown are for men; rates for women are slightly lower.

Salary scale:

<u>Age</u>	<u>Present salary as a percent of salary at 65</u>	<u>Annual increases rate (%)</u>
20	9.11	6.36
25	12.38	6.27
30	16.73	6.11
35	22.43	5.91
40	29.73	5.59
45	38.76	5.23
50	49.73	4.96
55	63.15	4.84
60	80.07	4.67

Includes allowance for inflation of 4½% per year.

Post-retirement increases -- 4½% per year.

Retirement age -- 64, except for Group 4.

Investment Return -- 7½%.

Valuation of assets -- At statutory values.



Table 1d

## ACTUARIAL ASSUMPTIONS - LOCAL RETIREMENT SYSTEMS

Mortality rates -- 1971 Group Annuity Mortality Table.

Termination rates before retirement:

Groups 1 and 2 (Rate %)

<u>Age</u>	<u>Death*</u>	<u>Disability</u>	<u>Withdrawal</u>	<u>Total*</u>
20	.05	.06	7.94	8.05
25	.06	.09	7.72	7.87
30	.08	.11	7.22	7.41
35	.11	.15	6.28	6.54
40	.16	.22	5.15	5.53
45	.29	.36	3.98	4.63
50	.53	.61	2.56	3.69
55	.85	--	--	.85
60	1.31	--	--	1.31

50% of the disability rates shown represent accidental disability.

Group 4 (Rate %)

<u>Age</u>	<u>Death*</u>	<u>Disability</u>	<u>Withdrawal</u>	<u>Total*</u>
20	.05	.12	--	.17
25	.06	.17	--	.23
30	.08	.22	--	.30
35	.11	.29	--	.40
40	.16	.44	--	.60
45	.29	.72	--	1.01
50	.53	1.21	--	1.74
55	.85	--	--	.85

90% of the disability rates shown represent accidental disability.

Detail figures may not add to totals shown due to rounding.

\*Rates shown are for men; rates for women are slightly lower.

Salary scale:

<u>Age</u>	<u>Present salary as a percent of salary at 65</u>	<u>Annual increases rate (%)</u>
20	9.11	6.36
25	12.38	6.27
30	16.73	6.11
35	22.43	5.91
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45	38.76	5.23
50	49.73	4.96
55	63.15	4.84
60	80.07	4.67

Includes allowance for inflation of 4½% per year.

Post-retirement increases -- 4½% per year.

Retirement age -- 64, except for Group 4.

Investment Return -- 7½%.

Valuation of assets -- At statutory values.



#### IV. ACTUARIAL COSTS

Based on the data provided and the assumptions and methods discussed previously, we performed actuarial calculations to determine the long-term level cost of the Contributory Retirement Law. The results of our study are shown in Table 1. We calculated costs and factors separately for each of the following Systems.

- (a) State
- (b) Teachers
- (c) Boston
- (d) Local. The 12 counties, 83 cities and towns, and two authorities which submitted data for the Data Bank. (One town did not submit such data and is excluded from these studies.)

The costs are shown in millions of dollars. Because of deficiencies in the data (discussed in Section V), we have referred to the results as "estimated," within about five per cent above or below the figures shown.

The "Normal Cost" is the level percentage of salary required to fund each person's expected retirement benefits from the age at hire (or "entry age") to the assumed retirement age. It is approximately the value of retirement benefits earned this year on account of service rendered this year. The normal cost for a retirement system is the sum of the normal costs for all the covered active employees.

Statewide\*, the normal cost is 16.7 per cent of covered payroll -- about \$481 million as of January 1, 1976. The employees themselves contribute 5.2 per cent of their salaries, leaving 11.5 per cent for the various public employers to pay.

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\*As used here, "statewide" means all retirement systems which were in operation on January 1, 1976.



The "Actuarial Liability" is customarily described as the value of retirement benefits earned by present employees, retirees, and their beneficiaries on account of service prior to the valuation date. Technically, it is the excess of the present value of all future benefits for all active and retired members (whether or not accrued to date) over the present value of future normal costs.

Statewide, the actuarial liability is \$5.447 billion for active members and \$3.895 billion for retired members and beneficiaries a total of \$9.342 billion.

Against this actuarial liability, there are assets totalling \$1.698 billion, principally representing accumulated employee contributions.

The "Unfunded Actuarial Liability" is simply the difference between the actuarial liability and the assets. It can be thought of as the value of retirement benefits earned but not yet paid for.

Statewide, the unfunded actuarial liability is \$7.644 billion.

At this point, it should be mentioned that it is very uncommon to find a "fully funded plan", i.e., one with no unfunded actuarial liability.

An unfunded actuarial liability generally arises from one of several sources, such as:

- (a) Past service benefits. If credit is given for service prior to the existence of a pension plan, then clearly such benefits will not have been funded when they were earned.
- (b) Plan amendments. If a change in benefits affects service prior to the date of change, the added benefits will not have been funded when they were earned.
- (c) Actuarial losses. If actual experience is less favorable than assumed, then either the liabilities will be greater than anticipated or the assets will be lower, causing an unfunded liability to develop.



(d) Underfunding. If the actuarial costs are not paid as they accrue, assets will be lower than anticipated and there will be an unfunded liability.

While all of these have occurred in Massachusetts, it is the last one which distinguishes the Commonwealth's pension position from other public and private systems.

The following analogy to buying a house may simplify understanding of pension costs.

<u>Terminology</u>	
<u>Pension plan</u>	<u>House</u>
Normal Cost	Maintenance and taxes
Initial Actuarial Liability	Purchase price
Added Actuarial Liability Due to Amendment	Cost of home improvements
Amortization of Actuarial Liability	Mortgage payment
Unfunded Actuarial Liability	Unpaid principal on mortgage

The plan is set up and credit is given for past service, establishing an initial actuarial liability. (A house is purchased.) A schedule is set up to amortize that liability. (A mortgage is acquired, to be paid off over a fixed number of years). Each year the normal cost (maintenance and taxes) and amortization payment (mortgage payment) are paid. After a period of time, the initial accrued liability has been partially paid off, leaving the balance as an unfunded actuarial liability (unpaid principal on mortgage). Benefit improvements (home improvements) are made and an added actuarial liability is established. This is paid off by increasing the amortization payment (increasing the mortgage payment). Of course, the normal cost (maintenance and taxes) also increases. Eventually the plan is fully funded. (The mortgage is paid off.) Then the cost drops to the normal cost (maintenance and taxes) only.

With this as a background, we come to the total annual employer cost -- the actuarial requirement to maintain the systems.



The first decision required is the amortization period (length of the mortgage). We chose forty years -- the longest period acceptable for private pension plans under the Employee Retirement Income Security Act of 1974 (ERISA).

Traditionally (and under ERISA), the unfunded actuarial liability is amortized by level dollar payments (as a house mortgage is paid off by equal monthly payments). The normal cost, however, is a level per cent of payroll, tending to rise with inflation as payrolls rise (just as taxes and maintenance on a house increase with inflation). On this basis, the annual employer cost as of January 1, 1976 is \$896 million or 31.1 per cent of payroll. Over time the amount will rise, but as a per cent of payroll the cost will decline. This is because one component, the amortization payment, does not increase with payroll.

A few public systems use a variation on this procedure. They pay off the actuarial liability by payments which are a level percentage of payroll. Under our assumptions, each year's amortization payment would be four and one half per cent higher than the previous payment. On this basis, the initial annual cost is less -- \$647 million or 22.4 per cent of payroll. However, the total cost as a per cent of payroll remains constant (rather than decreasing as in the traditional method), ultimately rising to a higher dollar cost as a result. That is, the "traditional" method costs 31.1 per cent of payroll in the first year, but declines over time; while the "per cent of pay" method costs 22.4 per cent of payroll throughout the forty year period. The recommendations of the Funding Advisory Committee are based on this latter approach.

#### Notes and qualifications on reported results

There are a number of important things to keep in mind when using the results of this report.



- (1) Uniform actuarial assumptions were used for all local systems. Actual experience may be significantly different for individual systems.
- (2) Data was reviewed for consistency with that reported in the Annual Statement to the Commissioner of Insurance by each System. Apparent inconsistencies were resolved in favor of the Commissioner's records, since these are audited and reconciled from year to year. For example, if the apparent annual payroll of a system based on the Data Bank was higher than would be projected from the total contributions reported to the Commissioner, then the calculated costs were reduced proportionately to reproduce the contributions reported in the Annual Statement.
- (3) The "pay-as-you-go" projections may have a bias towards higher numbers than may be experienced in the early years, for two reasons:
  - a. Employees who are at least the assumed retirement age were all projected to retire on January 1, 1976. In fact, many may postpone their retirement for a few years, thus deferring the commencement of pension payments.
  - b. Based on discussions with staff members in the Division of Insurance, it appears that retirement patterns in the past year or so have changed drastically. Principally, fewer retirements among older, longer service employees are taking place than was previously the case. This may be a temporary phenomenon, or may indicate a



permanent change. For the moment, we are not changing the retirement assumption, and expect that most such employees will retire shortly. If this does not occur, then our pay-as-you-go contribution projections may continue to be higher than actual experience.

Any System where the age and/or service data is missing for large numbers of employees may show unreasonable results, especially for the pay-as-you-go contributions.

(4) Because dollar amounts are subject to significant variation over time due to economic and inflationary conditions, the pay-as-you-go projections are quite volatile. The most stable figure in the report is the "per cent of pay" for the funding proposal.

(5) Projections to later years should be viewed in the context of a declining value of the dollar over that period. In particular, the projections for 1992 presume a dollar with half the purchasing power of a 1977 dollar.

(6) Given the magnitude of the data used in this report the Commission was unable to review the data on each individual. However, the combined data for each System was reviewed for reasonableness and consistency. In addition, substantial missing or out-of-date data (discussed in Section V) had to be replaced with average data. This is especially true for the State and Teachers' Systems. Therefore, for level funding costs, we put the costs within a 5% range; for pay-as-you-go contributions, the potential range is 10% or more above or below the figures shown; and, for any individual system, the variation may be somewhat greater.



- (7) The Boston Retirement System is the only local system covering teachers. Under current procedures, the portion of Boston's cost allocable to teachers is reimbursed from State appropriations. Thus the obligations of the Boston Retirement System exceed the obligations of the City of Boston, with the difference coming from State funds.
- (8) The report indicates that in the first year or two the pay-as-you-go contribution may exceed the contribution under the funding bill for some systems. Since each Retirement System must have enough money on hand to pay its retired employees, and since there is no accumulated reserves available, it should be apparent that the contribution each year during the transition period must at least equal the actual total of pension payments.
- (9) In the absence of funding legislation, the pay-as-you-go projections here are advisory only. Actual appropriation requirements will continue to be furnished on a year-to-year basis by the Division of Insurance.
- (10) The crossover points shown are rough estimates by the actuary as to the date when appropriations under the funding bill will be less than under current funding practices. They are subject to significant variation, as changes in the economy and in hiring patterns affect level funding costs and cash payouts in substantially different ways.
- (11) Any delay in implementing the Funding Advisory Committee proposals will defer the crossover dates and increase the contribution levels ultimately required, because there will be one or more additional years of unmet costs to be added to future contributions.



### Comparison to prior actuarial report

Our previous actuarial study as of January 1, 1974 showed costs which are higher as a percent of payroll (and in some cases higher as a dollar amount) than this report presents. The Normal Cost decreased from \$347 million (13.8 per cent of payroll) in 1974 to \$332 million (11.5 per cent of payroll) in 1976. The Unfunded Actuarial Liability increased, but only from \$7.4 billion to \$7.6 billion. This increase in the unfunded liability is less than expected based on the prior valuation. These changes are the result of two major factors.

First, over the two years there have been variations in the group of covered employees from that predicted by the assumptions. It appears that salaries have risen faster than assumed (increasing costs) but that investment income has been higher than was projected and more terminations have occurred than were anticipated (lowering costs). Also, the data is more complete now than for 1974. Items that were estimated in 1974 are known now, thus increasing the accuracy of the data.

Second, the actuarial assumptions have been revised. As discussed in the previous section, the assumption as to the future inflation rate has been increased from 3 per cent to 4 1/2 per cent per year. This has the effect of lowering costs, principally because of the \$6,000 limit on cost-of-living increases after retirement. In times of higher inflation, relatively less of each person's benefit is eligible for cost-of-living increases.

We have estimated the effect of each of these items on the cost factors as follows:

	(Amounts in millions)	
	<u>Normal cost</u>	<u>Unfunded liability</u>
Amount as of January 1, 1974	\$347	\$7,396
Increase for changes in data and actuarial experience	+ 27	+ 909
Decrease for changes in assumptions	- 42	- 661
Amount as of January 1, 1976	<u>\$332</u>	<u>\$7,644</u>



Table 1

MASSACHUSETTS CONTRIBUTORY RETIREMENT LAW  
 ESTIMATED ACTUARIAL COSTS AS OF JANUARY 1, 1976  
 (In millions of dollars. Amounts should be considered to  
 be within a range of  $\pm 5\%$  from values shown)

ITEM	TOTAL		STATE		TEACHERS		BOSTON		LOCAL	
	Amount	% of Pay	Amount	% of Pay	Amount	% of Pay	Amount	% of Pay	Amount	% of Pay
Normal Cost --										
Total	\$ 481	16.7%	\$ 138	17.6%	\$ 127	14.3%	\$ 53	15.7%	\$ 163	18.5%
Estimated employees contributions	149	5.2	40	5.1	47	5.2	17	5.1	45	5.1
Employer normal cost	332	11.5	98	12.5	81	9.1	36	10.6	117	13.3
Actuarial Liability --										
Active members	5,447		1,100		1,609		798		1,940	
Retired members	3,895		947		1,197		579		1,172	
Total	9,342		2,046		2,806		1,377		3,113	
Assets	1,698		424		516		225		533	
Unfunded actuarial liability	7,644		1,622		2,291		1,152		2,579	
Total annual employer cost (employer normal cost plus 40 year amortization of unfunded actuarial liability) -- "Traditional" (normal cost is level percent of pay; amortization is level dollar amount)	896	31.1	217	27.8	250	28.1	121	36.0	308	35.0
"Percent of pay" (normal cost and amortization are level percents of pay)	647	22.4	164	21.1	175	19.7	83	24.7	225	25.5
Total covered annual payroll	2,886		781		889		335		881	

NOTE: Detail figures may not add to totals due to rounding.



## V. EMPLOYEE DATA

The information for this study came from the new Retirement Law Commission Data Bank - and the studies could not have been done without that information. The data was more complete and more reliable than was available for all earlier studies of this type.

The Commission adopted forms and procedures for each Board to furnish pertinent data for all pensioners and beneficiaries and for all active members. This body of actuarial employee and pensioner data was first analyzed as of January 1, 1974. The current data is substantially more complete than for the prior study. Moreover, this Data Bank is being maintained as a perpetual inventory of employee and pensioner information, making it possible to update the actuarial studies and valuations. Finally, the Commission will be able to report separately to each of the Boards participating in the Data Bank the actuarial cost factors calculated for that Board for the specific data pertinent to that system.

Any new operation of this magnitude can be expected to turn up unforeseen problems. These are outlined below. It should be remembered, however, that in our judgement these are relatively minor. That is, we are satisfied that a 5% margin in the reported figures is sufficient to cover any possible errors introduced by incomplete data.

Category by category, the problems were as follows:

- (a) State. We began by reviewing records on 33,000 new employees and terminated employees since 1974. It appeared, however, that the age and service characteristics of these employees were not typical of State Employees in general. We therefore, turned to alternate data. Employees are paid from several sources. While many pay checks come directly from the State Treasurer, a significant number come from other sources, such as the state colleges and institutions. We received our data from the Treasurer's Data Center. It included age and service data on only those employees who were members of the State Retirement System as of January 1, 1973 and who were paid by the State Treasurer's office. This included 42,707 employees. Age and service data was missing for 19,151 of



these employees; sex data was missing for virtually all of them. As a result, it was necessary to adjust for missing employees and data, and we also had to project changes from January 1, 1973 to January 1, 1976. Missing age and service data was presumed to be similar to the known data. Sex was assigned by reviewing the known data on pensioners who retired in a recent period. Missing employees were assumed to have the same per cent of salary cost factors as the included employees. Salaries for individuals were increased by the ratio of 1975 payroll to 1972 payroll. We then reviewed the complete contribution records as of December 31, 1975. Based on this, we were able to determine a total participating payroll. Since almost all benefits are a direct function of salary, we increased each cost factor by the ratio of the total payroll to the payroll included in our data. Complete current data was available for retired employees and their beneficiaries.

(b) Teachers. Fairly complete data was available as of January 1, 1971. However, employees who were members as of January 1, 1971 but who left teaching in 1971 or 1972 (by death, retirement, resignation, etc.) were not included. Thus we were left with 58,916 employees. The only significant missing information was salary for 3,632 members and sex for a substantial number. The adjustments were essentially the same as for the State System. Current data was available for retired teachers, but not for beneficiaries of teachers.

(c) Boston. Data was generally good for the 33,770 members (including 4,316 Group 4 members) as of January 1, 1976. The adjustments followed those for State employees. Current complete data was available for retired employees and beneficiaries.



(d) Local. Data was submitted on preprinted forms for 12 counties, 83 cities and towns, and two authorities as of January 1, 1976. There was no significant missing active employee data. The data showed 123,378 active employees of whom 24,920 were in Group 4. Individual pension amounts had not been collected since January 1, 1972; changes since then were reflected based on total benefits as reported in annual reports.

Notwithstanding the data problems described, we are satisfied that there are no drastic errors introduced thereby. That is, we judge that the missing data is not "biased" in such a way that it is likely to include a disproportionate number of very low cost or very high cost employees. Therefore, we have confidence that the results reported reflect, within a reasonable range, the actuarial position of the various systems under the Contributory Retirement Law.

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We would like to thank the members and staffs of the participating retirement boards for their help in assembling the data for these studies.

We would also like to thank the staffs of the Treasurer's Data Center and the Division of Insurance for their assistance.