



**NORTH DAKOTA TEACHERS'
FUND FOR RETIREMENT**

***ACTUARIAL EXPERIENCE STUDY
FOR THE FIVE-YEAR PERIOD
ENDING JUNE 30, 1994***

February 1995

Wyatt

February 23, 1995

Board of Trustees
North Dakota Teachers'
Fund for Retirement
1930 Burnt Boat Road
P.O. Box 7100
Bismarck, ND 58507-7100

Dear Members of the Board:

Results of 1994 Experience Study

We are pleased to present our report containing a summary of the results of the 1994 Experience Study of TFFR. It includes our recommendations for new actuarial assumptions and the resulting actuarial impact produced by these recommendations.

We are recommending changes in several assumptions. This Study covers a five year period for active members and retired members. The period of the Study ends June 30, 1994.

We wish to thank your staff for their assistance in providing data and answering numerous questions which have enabled us to perform our analysis.

With the Board's approval of the recommendations in this report, we believe the actuarial condition of the System will be more accurately portrayed.

Sincerely,



J. Christian Conradi, ASA, MAAA, EA
Actuary



W. Michael Carter, FSA, MAAA, EA
Actuary

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Enclosures

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SECTION I
INTRODUCTION

Section I

Introduction

In determining liabilities, contribution rates and funding periods for retirement plans, actuaries must make assumptions about the future. Among the assumptions that must be made are:

- Retirement rates
- Mortality rates
- Turnover rates
- Disability rates
- Investment return rate
- Salary increase rates

For some of these assumptions, such as the mortality rates, past experience provides important evidence about the future. For other assumptions, such as the investment return rate, the link between past and future results is much weaker. In either case, though, actuaries should review their assumptions periodically and determine whether these assumptions are consistent with actual past experience and with anticipated future experience.

For this purpose, therefore, we have reviewed and analyzed TFFR's data for the period from June 30, 1989, through June 30, 1994. In our view, performing such experience reviews on a five-year interval is reasonable. Sufficient data can be gathered over a five-year period so that the results have statistical significance. Legislation, such as plan improvements or changes in state-wide salary schedules, can sometimes affect the results; using a five-year period prevents giving too much weight to such short-term effects. (We will provide an example of this later, in connection with our discussion of the retirement rates.) Finally, using a much longer period would water down real changes that may be occurring, such as mortality improvement or a change in the ages at which teachers retire.

In an experience study, we first determine the number of deaths, retirements, etc. that occurred during the period. Then we determine the number that were expected, based

on the current actuarial assumptions. Finally we calculate the A/E ratio, where "A" is the actual number (of retirements, for example) and "E" is the expected number. If the current assumptions were "perfect", the A/E ratio would be 100.0%. When it varies much from this figure, it is a sign that new assumptions may be needed.

Of course we not only look at the assumptions as a whole, but we also review how well they fit the actual results by sex, by age, and by service.

Finally, the actuary "graduates" or smooths the results, since the raw results can be quite uneven from age to age or from service to service.

SECTION II

**ANALYSIS OF EXPERIENCE
AND RECOMMENDATIONS**

Section II**Analysis of Experience and Recommendations**

For theoretical reasons, the assumed inflation rate underlies both the investment return assumption and the salary increase assumption. Therefore, we will deal with it first. Then we will cover the other economic assumptions (the investment return rate and the salary increase rates). Finally, we will discuss the demographic assumptions (mortality, disability, termination and retirement).

A. Inflation rate

The assumptions which we inherited from the previous actuary were based on a 4.5% inflation rate.

Over the five-year period from June 1989, through June 1994, the CPI-U has increased at an average rate of 3.6%. The average over the ten-year period beginning June 1984 and ending June 1994, is, coincidentally, also 3.6%. The CPI-U increases for each of the last five years are as follows:

1989/1990	4.8%
1990/1991	4.4%
1991/1992	3.2%
1992/1993	2.8%
1993/1994	2.8%

However, the assumed inflation rate is only weakly tied to past results. While the inflation rate has been decreasing throughout the period, we believe that there will be increasing pressure on the Federal Reserve to inflate the economy, and we do not believe that the current rates, which are as low as at any time since the Kennedy and Johnson administrations, will be sustained in the face of the current budget deficits. We also think that current long-term bond yields support this view; we think they are as high as they are in part because of anticipated increases in the inflation rate. Therefore, we recommend adopting a 4.0% average future inflation assumption.

Investment return rate

For this assumption, past performance, even averaged over a five- or ten-year period, is not a reliable indicator of future performance. There are several reasons for this. First, investment returns, at least theoretically, include an allowance for inflation. Returns achieved in a period of high inflation would not necessarily be achieved in a period of low inflation. Second, the asset allocation of the trust will impact the overall performance. If the allocation changes, older performance figures may become meaningless. Finally, the real rates of return for many asset classes, especially equities, vary so dramatically from year to year that even a ten-year period may not be long enough to provide reasonable guidance. In addition, for most of the last ten years, real returns on equities have been at historical highs.

The current asset allocation for the fund is approximately:

Equities	52%
Fixed income & mortgages	43%
Cash & equivalents	3%
Real estate	2%

Some important historical averages (through 1992) for real rates of return are as follows:

S&P 500 (composite)	
Last 10 years	11.8%
Last 25 years	4.3%
Since 1926	6.7%

Lehman Bros. Gov't/Corp bond index

Last 10 years	7.4%
All available years	3.1%

The wide variation in these figures makes it easy to justify almost any investment return rate, especially if a significant portion of the fund is invested in equities. However, we believe that using a long-term real rate of return of 6.0% for equities and real estate and

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3.0% for bonds and mortgages is justifiable. On this basis, we would compute an expected real rate of return for TFFR of about 4.5%, as shown below:

Equities	52% * 6%	=	3.1%
Fixed income	43% * 3%	=	1.3%
Real estate	2% * 6%	=	0.1%
Cash & equivs.	3% * 0%	=	<u>0.0%</u>
Total			4.5%

When combined with the assumed 4.0% inflation rate, this gives an 8.5% inflation return rate. However, the rate we use in our calculations is the assumed rate of return, *net of expenses*. Combined administrative and investment expenses for TFFR currently amount to about 50 basis points, resulting in a net investment return rate of 8.00%, unchanged from the current assumption.

You should note that 8.00% is still the most common investment return assumption used by public pension plans.

Salary increase rates

The average pay increase for members active in both valuations are as follows:

1989/1990	6.12%
1990/1991	3.64%
1991/1992	6.60%
1992/1993	4.56%
1993/1994	4.08%

The geometric average of these is 4.99%.

The current salary increase rates vary by age. They range from 7.50% for the youngest members to 4.5% for the oldest members. There is also a minimum increase of 7.50% for members with less than five years of service. Our experience, however, is that salary increases are correlated with service much more than they are with age. Therefore, we

have recommended the adoption of a new set of assumed salary increase rates which vary by service.

To determine the new rates, we first determined the average increase over the five-year period for members grouped by service. Next, we backed out the inflation during the period, arriving at the real rates of increase. Finally, we added back our assumed 4.0% inflation rate to arrive at the recommended rates. These new rates include an increase of 12.25% for members after one year, grading down to a 4.25% increase for members with 15 or more years of service. The full schedule is shown in Section VI.

This change in assumptions reduces the average salary increase for the entire active membership from 6.0% to 5.4%.

Post-retirement mortality

The mortality tables currently being used for non-disabled retirees and for beneficiaries receiving benefits are the 1983 Group Annuity Mortality tables (without margins) for males and females. These tables are then adjusted by using a four-year setback for males and a three-year setback for females.

When we reviewed the mortality experience for non-disabled retirees and for beneficiaries, we were somewhat surprised by the results. The actual deaths in this group were:

Males	204
Females	<u>511</u>
Total	715

For females, the actual to expected ratio was 102.4%, and because this is close to 100.0%, we decided not to recommend any changes. However, for males the actual-to-expected ratio was 123.6%, indicating that the current assumed rates are too low. This result was unexpected, because generally as mortality improves over time, and life expectancy increases, the A/E ratio will decrease. Therefore, if a reasonable table had been chosen at the time of the last study, the current A/E ratio should be close to 100%, or even a little below it.

Because of the anomalous results for males, we went back to the prior study and discovered that there were only about 100 male deaths during the period covered by the last study. This is too small of a number on which to base the choice of a mortality table. Based on the experience during the last five years, therefore, we recommend changing the mortality table for non-disabled males by changing the setback from four years to two years. This produces an A/E ratio of 104.6%. Further, the new mortality assumptions are in line with the experience in other state-wide teacher systems for both males and females.

We also looked at mortality among the disabled retirees, but there were only nine deaths in this group. This is far too few to use in setting assumptions, so we recommend no change from the table currently being used. This is a published table derived from Social Security experience and used by the Pension Benefit Guaranty Corporation.

Active mortality

Although the mortality assumption for active members can differ from the assumption for retired members, our recommendation in this case is to use the same tables for both purposes. There were only 70 active member deaths during the five-year period. The A/E ratio for males and females combined, based on the recommended assumptions for retirees, is 107.7%. We think this is reasonable, especially given the small number of deaths during the period.

Disability

There were only 30 new disabilities approved during the period. Again this is too few to provide much useful information. The A/E ratio is 87.0%. Therefore, because of the small numbers involved, we are recommending no change to the current disability assumption.

Termination

Termination rates reflect members who leave for any reason other than death, disability or service retirement. They apply whether the termination is voluntary or involuntary,

and whether the member takes a refund or keeps his/her account balance on deposit in the Fund.

The current assumptions consist of two tables of rates based on age, one for males and one for females. Termination rates, however, are correlated both with age and service. If a termination table is a function of age only, even if it produces an A/E ratio of about 100.0% in total, it can result in an understatement of the liabilities. This occurs because the table will predict too few terminations occurring among shorter-service members, who may be numerous but represent only a small portion of the total liabilities, while the table will predict too many terminations among long-service members, who account for most of the liabilities.

The current assumptions in the aggregate produce an A/E ratio for males of 126.7% and an A/E ratio for females of 153.4%. This makes the current rates look too low. However, if we focus only on employees with 10 or more years of service, we find that the current tables produce A/E ratios of 70.8% (males) and 86.4% (females).

For this reason, we have recommended the adoption of new termination rates which reflect both age and service. Such tables are called "select-and-ultimate" tables. There are still separate tables for males and females. The recommended tables produce an aggregate A/E ratio of 105.1% (males) and 104.8% (females), and the recommended rates also track actual experience for each service duration much more closely than the current rates.

Retirement rates

The current retirement rates were set by the prior actuary based on data gathered during 1985-1989, before the Rule of 85 was adopted for TFFR. Therefore, it was no surprise that the actual number of retirements (903) was much greater than the expected number under the current assumptions (498). For males the A/E ratio was 139.5%, while for females it was 215.6%.

Further, the number of retirements varied dramatically by year, as shown below:

1989/1990	255
1990/1991	176
1991/1992	157
1992/1993	64
1993/1994	251

We believe the large number of retirements in 1989-90 was an after-effect of the adoption of Rule of 85. The small number in 1992-93 was due, we suspect, to the fact that many members who were ready to retire were aware that the benefit formula was going to change as of July 1, 1993, and elected to postpone their retirement in consequence. This also would account for the large number of retirements in 1993-94.

Further, we checked the experience to determine how many of the retirements were for members who were not eligible for an unreduced benefit, i.e., members who were below age 65 and had not met the Rule of 85. Only about 50 retirements occurred among this group; so most members are delaying retirement until they are eligible for an unreduced benefit. Further, the members who are retiring with a reduced benefit appear to have a very different pattern of retirement than the others, with most retirements clustered around age 62.

We are therefore recommending that the retirement rate table be split into two new tables, one for reduced retirement, applicable to members who are age 55 and vested, but are not yet eligible for unreduced retirement, and a second table for members who meet the Rule of 85 or who are over age 65. There would still be separate tables for males and females.

The new tables produce A/E ratios as follows:

Males, unreduced retirement	105.7%
Males, reduced retirement	115.8%
Females, unreduced retirement	104.9%
Females, reduced retirement	116.7%

Other assumptions

There are other assumptions made in the course of a valuation, such as the percentage of members who are married, the age difference between husbands and wives, the likelihood that a terminating employee will take a refund, etc. We reviewed these, and decided to recommend no changes to these other assumptions.

SECTION III

**ACTUARIAL IMPACT
OF RECOMMENDATIONS**

Section III

Actuarial Impact of Recommendations

Shown below is a table which compares key statistics from the July 1, 1994 actuarial valuation with these same statistics remeasured with the recommended new assumptions. As you can see, the changes are minor, but produce a decrease of 37 basis points in the margin.

	<i>Current Assumptions</i>	<i>Recommended Assumptions</i>
Normal cost	7.72%	8.15%
UAAL (millions)	\$157.4	\$154.9
Funding period (years)	18.3	21.4
21-year contribution rate	6.42%	6.79%
Margin	0.33%	-0.04%

The UAAL is the unfunded actuarial accrued liability. This is the portion of the total present value of future benefits which is assigned to past years. The funding period is the number of years which will be required to amortize the UAAL, assuming that the employer contribution rate remains at 6.75%. The amortization calculations are made assuming level payments. I.e., future payroll growth is ignored. The 21-year funding rate is the Board's target rate. It is the amount required to pay the normal cost and to amortize the UAAL in level payments over 40 years from July 1, 1975 (21 years from July 1, 1994). The margin is the difference excess (shortfall) between the actual employer contribution rate of 6.75% and the target rate.

The figures above were calculated as of July 1, 1994, using the same benefit provisions and the same member and financial data that was used to prepare the regular July 1, 1994 valuation report.

SECTION IV

SUMMARY OF RECOMMENDATIONS

Section IV

Summary of Recommendations

Our recommendations may be summarized as follows:

- Change the inflation rate from 4.5% to 4.0%
- Leave the investment return rate unchanged at 8.0%
- Change the salary increase assumption to the table shown in Section VI (with the rates a function of service only)
- Change the male (non-disabled) mortality assumption to the rates in the 1983 Group Annuity Table for males, without margins, setback two years
- Make no change to the female mortality assumption
- Make no change to the disability assumption
- Make no change to the disabled mortality assumption
- Change the termination assumptions for males and females to the rates in the tables shown in Section VI, with rates a function of sex, age, and service
- Change the retirement rates to new tables which are shown in Section VI, with rates a function of sex, age, and type of retirement (reduced or unreduced)

SECTION V

**SUMMARY OF ASSUMPTIONS
AND METHODS INCORPORATING
THE RECOMMENDED ASSUMPTIONS**

Section V

**Summary of Assumptions and Methods
Incorporating the Recommended Assumptions**

ACTUARIAL ASSUMPTIONS

1. Investment Return Rate 8.00% per annum, compounded annually, composed of an assumed 4.00% inflation rate and a 4.00% real rate of return.

2. Mortality Rates
 - a. Non-Disabled 1983 Group Annuity Mortality Table (without margins) set back two years for males and three years for females.

 - b. Disabled Pension Benefit Guaranty Corporation Disabled Life Mortality Tables Va and VIa.

Age	Deaths per 100 Lives			
	Male Participants		Female Participants	
	Non-Disabled	Disabled	Non-Disabled	Disabled
20	.0392	4.83	.0177	2.63
25	.0471	4.83	.0236	2.63
30	.0602	3.62	.0315	2.37
35	.0815	2.78	.0431	2.14
40	.1154	2.82	.0595	2.09
45	.1905	3.22	.0861	2.24
50	.3487	3.83	.1374	2.57
55	.5778	4.82	.2165	2.95
60	.8577	6.03	.3448	3.31
65	1.3768	6.78	.5789	3.70
70	2.4699	7.39	.9646	4.11

3. Retirement Rates The following rates of retirement are assumed for members eligible to retire.

Age	Retirements Per 100 Members			
	Unreduced Retirement		Reduced Retirement	
	Male	Female	Male	Female
50	17.0%	5.0%	0.0%	0.0%
51	17.5%	5.0%	0.0%	0.0%
52	18.0%	5.0%	0.0%	0.0%
53	18.5%	5.0%	0.0%	0.0%
54	19.0%	10.0%	0.0%	0.0%
55	19.5%	18.0%	1.0%	1.5%
56	20.0%	20.0%	1.0%	1.5%
57	20.5%	22.0%	1.0%	1.5%
58	21.0%	24.0%	1.0%	1.5%
59	21.5%	27.0%	1.0%	1.5%
60	25.0%	29.0%	2.0%	1.5%
61	37.5%	34.0%	8.0%	2.0%
62	85.0%	55.0%	15.0%	25.0%
63	60.0%	30.0%	8.0%	10.0%
64	60.0%	40.0%	8.0%	10.0%
65	60.0%	65.0%	--	--
66	40.0%	40.0%	--	--
67	40.0%	40.0%	--	--
68	40.0%	40.0%	--	--
69	40.0%	40.0%	--	--
70	100.0%	100.0%	--	--

4. Disability Rates As shown below for selected ages.

Age	Disabilities Per 100 Members
20	0.01
25	0.01
30	0.01
35	0.01
40	0.03
45	0.05
50	0.08
55	0.14
60	0.27
65	0.00

5. Termination Rates

(for causes other than death, disability, or retirement)

The following withdrawal rates are used based on age.

Males											
Years of Service											
Age	0	1	2	3	4	5	6	7	8	9	10+
25	0.1420	0.1379	0.1366	0.1339	0.1220	0.1067	0.0896	0.0878	0.0860	0.0842	0.0598
30	0.1416	0.1376	0.1363	0.1336	0.1210	0.1053	0.0907	0.0889	0.0871	0.0853	0.0470
35	0.1359	0.1321	0.1308	0.1282	0.1141	0.0988	0.0867	0.0849	0.0832	0.0815	0.0343
40	0.1317	0.1280	0.1267	0.1243	0.1074	0.0928	0.0824	0.0808	0.0791	0.0775	0.0252
45	0.1282	0.1246	0.1234	0.1210	0.1002	0.0868	0.0777	0.0761	0.0746	0.0730	0.0196
50	0.1246	0.1211	0.1199	0.1176	0.0916	0.0809	0.0725	0.0710	0.0696	0.0681	0.0188
55	0.1444	0.1403	0.1390	0.1362	0.0974	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60	0.1588	0.1544	0.1529	0.1499	0.1071	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
65	0.1747	0.1698	0.1681	0.1648	0.1178	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Females											
Years of Service											
Age	0	1	2	3	4	5	6	7	8	9	10+
25	0.1654	0.1607	0.1592	0.1560	0.1307	0.1119	0.0952	0.0806	0.0790	0.0774	0.0352
30	0.1373	0.1334	0.1321	0.1295	0.1107	0.0964	0.0836	0.0738	0.0723	0.0708	0.0312
35	0.1143	0.1110	0.1100	0.1078	0.0926	0.0820	0.0732	0.0672	0.0658	0.0645	0.0275
40	0.0978	0.0951	0.0941	0.0923	0.0779	0.0695	0.0637	0.0607	0.0595	0.0583	0.0242
45	0.0910	0.0885	0.0876	0.0859	0.0686	0.0593	0.0553	0.0545	0.0535	0.0524	0.0220
50	0.0967	0.0940	0.0931	0.0912	0.0670	0.0519	0.0480	0.0484	0.0475	0.0465	0.0227
55	0.1455	0.1414	0.1400	0.1373	0.0742	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60	0.1885	0.1831	0.1814	0.1778	0.0907	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
65	0.2498	0.2428	0.2404	0.2357	0.1167	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

6. Salary Increase Rates . . . Inflation rate of 4.00% plus step-rate/promotional increase as shown:

<u>Years of Service</u>	<u>Annual Step-Rate /Promotional Component</u>	<u>Annual Total Salary Increase</u>
0	8.25%	12.25%
1	3.50%	7.50%
2	3.25%	7.25%
3	3.00%	7.00%
4	2.75%	6.75%
5	2.50%	6.50%
6	2.25%	6.25%
7	2.00%	6.00%
8	1.75%	5.75%
9	1.50%	5.50%
10	1.25%	5.25%
11	1.25%	5.25%
12	1.25%	5.25%
13	1.00%	5.00%
14	0.50%	4.50%
15 or more	0.25%	4.25%

7. Percent Married For valuation purposes 75% of members are assumed to be married. Male members are assumed to be three years older than their spouses, and female members are assumed to be three years younger than their spouses.
8. Percent Electing a Deferred Termination Benefit . . . Terminating members are assumed to elect the most valuable benefit at the time of termination. Termination benefits are assumed to commence at the first age at which unreduced benefits are available.
9. Provision for Expense . . . The assumed investment return rate represents the anticipated net rate of return after payment of all administrative expenses.

ASSET VALUATION METHOD

The actuarial value of assets is calculated as follows. First, the preliminary asset value is determined as the beginning of year actuarial assets, increased to reflect plan year revenue and expenditures, but excluding realized and unrealized gains and losses. To this preliminary value is added 20% of the realized and unrealized gains and losses for the five preceding years. The method begins by setting the actuarial value for June 30, 1990 equal to the market value, and ignores gains and losses prior to that date.

ACTUARIAL COST METHOD

The funding period required to amortize the unfunded actuarial accrued liability (UAAL) is determined using the Entry Age Normal actuarial cost method. This method assigns the plan's total actuarial present value of future benefits to various periods. The actuarial accrued liability is assigned to years prior to the valuation, and the normal cost is assigned to the year following the valuation. The remaining costs are assigned to future years.

The normal cost is determined for a hypothetical group of new entrants, based on actual new entrants in the June 30, 1994 valuation. The actuarial accrued liability is the difference between the total present value of future benefits and the actuarial present value of future normal costs. The unfunded actuarial accrued liability (UAAL) is the excess of the actuarial accrued liability over the actuarial value of assets.