Report on

Actuarial Study in Respect to Active Members as of June 30, 1975 of the Retirement System of the Government of Puerto Rico and Its Instrumentalities, and Supplementary Comments

Prepared by

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ACTUARIAL STUDY IN RESPECT TO ACTIVE MEMBERS AS OF JUNE 30, 1975 OF THE RETIREMENT SYSTEM OF THE GOVERNMENT OF PUERTO RICO AND ITS INSTRUMENTALITIES, AND SUPPLEMENTARY COMMENTS

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Mr. Jose Moran, Administrator
Los Sistemas de Retiro de los Empleados
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Dear Mr. Moran:

We are pleased to present the attached report which describes our actuarial study in respect to active members of the Employees Retirement System of the Government of Puerto Rico on which we have worked during the past year. This study complements previous studies in respect to retired employees and, in fact, brings together a picture of the total costs for the System.

The recommendations presented herein have been made with consideration of what steps are necessary and what are feasible. We believe these recommendations are timely and hope that implementation of them will occur soon.

Respectfully submitted,

Arturo Estrella

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1. INTRODUCTION

This is the fourth in a series of actuarial reports that have been prepared through collaboration of members of the University of Michigan and of staff of the Retirement System of the Government of Puerto Rico. As such it is part of the effort to carry out a Proposal for the Cooperative Development of Actuarial Supervision of the Employees Retirement System of Puerto Rico. Under this proposal, Arturo Estrella completed the requirements for a master's degree in actuarial mathematics at the University of Michigan in 1976, and now is engaged as actuary for the System. He programmed and performed the computations for this report, and was active in all stages of its preparation. A second actuarial trainee, Hector Pacheco graduated from the University of Michigan in May, 1977 and has returned to join the System. In addition, three actuarial studies have been reported to the System (references [1], [2], [3]).

Two of the previous reports ([1], [3]) have been concerned with the present value of benefits for the current beneficiaries, that is, have indicated the fund which if invested at an assumed rate of interest would, together with future investment earnings, be sufficient to provide the future pension payments to those of the current beneficiaries expected to survive year by year according to the mortality table. One test of the financial status of a retirement system is provided by comparison of the actual fund on hand with the present value of benefits in current payment status. Such a test, however, reveals only part of the financial situation as it does not take account of responsibilities accrued by the System in regard to the active members. The main objective of the present report is to supply information about the future costs of the accruing benefits for the active members.

II. SUMMARY OF THE REPORT

Part III of the Report describes the various steps that were followed in order to determine explicit annual costs, expressed as percents of payroll, that if paid by the employers over future years would provide a sound financial basis for the System. These steps are described in Sections 1 to 9 of Part III, and were:

1. Page 6. Preparation of a service table for calculating the probabilities of employees remaining in service or of terminating from service by reason of death, withdrawal from government employment, disability retirement, or age-service retirement. Additional assumptions were required in regard to the valuation interest rate (5 percent), and in regard to a scale for projecting salary increases.

2. Page 6. To be in accord with Article 21 of the System's basic Law 447, which specifies the valuation of benefit rights accumulated up to the end of the fiscal year, the accrued benefit actuarial cost method was selected.

3. Page 7. Consideration was given to classical mathematical valuation procedures versus modern, iterative, numerical processes, with the decision going to the latter.

4. Page 7. A consolidated computer program was developed, adapted to the provisions of the System, which when actuarial data of a participant is inputted, simultaneously computes four principal cost items, in each case by an accrued benefit actuarial cost method, namely:

(i) The annual normal cost for age-service retirement benefit in respect to the current year's service.

(ii) The supplementary present value in respect to age-service retirement. Here supplementary present value denotes the fund which together with future investment earnings would suffice to provide the payment of benefits earned or accrued by service prior to the valuation date.

(iii) The annual normal cost for non-occupational disability retirement.

(iv) The supplementary present value in respect to non-occupational disability retirement.

By means of these four items, plus a few additional items of annual cost, one can visualize the total future costs of the System and can propose steps for funding those costs in an orderly and secure manner.

5. Page 8. Sample computations produced by the program were tested at several stages in its development, and the final program was validated by independent calculations for sample individual participants.

6. Page 8. Actuarial data sources for active participants were reviewed, and a Contributions Tape, showing age, sex, service, and contribution data for 62,180 employees of the Central Government was found to be the most feasible source.

7. Page 9. Two initial runs of the computer program applied to a 5.6% sample and to a 33% sample of the 62,180 records on the Contributions Tape were made, with future non-inflationary salary increases projected on the basis of the selected salary scale. The actuarial cost figures emerging from these two sample runs were highly consistent, and no further runs on this basis were deemed necessary.

8. Page 9. To test the effect of making moderate advance allowance for future inflationary increases in salaries, the program was re-run for the 33% sample with provision for general salary increases at the rate of 3% per year in addition to the non-inflationary increases that are taken into account through the salary scale mentioned previously. There results a substantial increase in the employer share of normal cost as percent of current payroll and in supplementary present values (see Tables 1 and 2).

9. Page 12. This next section is devoted to the calculation of total employer annual costs. First, the various components of annual normal cost are brought together (see Table 3, page 12) and appropriate offset is taken for the employee annual contribution. The remainder, which is the employer normal costs, varies from 5.33% of payroll for the case without allowance for inflationary increases in salary, to 9.22% of payroll for the case with allowance for such increases. A similar compilation is made of the supplementary present values and is shown in Table 4, page 14. The remaining supplementary present value to be funded by employer contributions is 184.44% of payroll for the case without allowance for inflationary increases in salaries and is 227.19% of payroll for the case with allowance for such increases.

The interpretation is that in addition to the total reserve ($359,697,880 as of June 30, 1975) there should be on hand further funds approximating <u>two years payroll</u> in order to meet the future costs of the benefits accrued for service up to June 30, 1975. In dollar amounts there is a funding deficiency of $1.1 billion if no advance allowance is made for inflationary increases, and of $1.4 billion if allowance is made for 3% annual inflationary increases. The deficit (unfunded supplementary present value) can be funded by employer contributions determined as a level percent of future payrolls. The total annual employer contribution rate is then the sum of the employer annual normal cost rate (required for funding the year-by-year benefits for future service) and the level percent for funding the deficit. The resulting total employer contribution rates, expressed as percents of payroll, are shown in Tables 5 and 6, page 15, and vary from 14.84% to 22.90% of payroll.

There is an unfortunate tendency for some persons to dismiss 'actuarial costs' as lacking real significance but it is essentially certain that they will have to be paid over future years if the System is to provide the expected retirement benefits. If the System is to continue, these costs will be paid by the present and future generations; and to avoid making intolerable cost burdens for future generations, the present generation should shoulder an equitable portion of the costs. It is clear that the present level (6-7 percent) for employer contributions is less than half of an adequate level, and to improve this situation there is offered

Recommendation 1. Until a future actuarial valuation indicates that an adequate level of income has been reached by the System, it is recommended that yearly increments of at least 2% per year be made in the employer contribution rates.

The next three sections of Part III deal with a variety of topics.

10. Page 16. This section presents some qualifications which should be stated concerning this, our first, valuation of actuarial costs in regard to the active participants.

11. Page 17. Various conservation measures are available to decrease costs of the pension system. A gradual increase of the normal retirement age from age 58 to 62 or 65 years would provide substantial saving. A higher rate of return on reserve funds would also cut employer contribution rates significantly. More effective and up-to-date co-ordination with Social Security is also a source for cost saving. Some of these ideas are gathered in

Recommendation 2. It is recommended that employers be charged interest at a rate of at least 5% per year on any outstanding employer contributions. In addition, studies should be undertaken of ways to increase the rate of investment on funds of the System, and of measures to insure that the combination of benefits from Social Security and from the System are adequate but not redundant.

12. Page 17. This section of the report discusses the necessity of developing an accurate actuarial data base and ends with

Recommendation 3. In coordination with the development of a revised administrative data system, it is recommended that an actuarial data base be developed and maintained on a continuous basis, as indicated in this section.

Part IV of the Report discusses the status of the actuarial study of the present value of benefits for the current beneficiaries as of June 30, 1976. For the Employees Retirement System, the estimated present value

of benefits for the current beneficiaries is $711,000,000, and the reserve on hand equals only 54% of this present value. For the Judiciary System, the estimated present value of benefits for the beneficiaries as of June 30, 1976 is $11,904,000, and the reserve on hand equals only 82% of this present value. From June 30, 1975 to June 30, 1976, there has been some deterioration of the funding status of each System.

Part V, Concluding Comments, aims to provide additional insight into the funding status of the Employees Retirement System and its critical need for substantial increase in income. It points out that in the fiscal year ending June 30, 1976, the effective reserve fund (excluding unpaid employer contributions) remained level at approximately $330 million, which means that the cash disbursements of the System were about equal to the cash income. Cash flow problems will become urgent soon unless the employer contributions are substantially raised. In addition, investment income should be improved and means to conserve on future benefit costs be considered. These measures will be necessary in order for the System to discharge its responsibilities to its current and future beneficiaries.

III. MAIN STUDY

The main study that is reported herein assesses the benefit costs that will emerge over future years in regard to new beneficiaries from among the active participants. This complements previous studies ([1] and [3]) of the present value of benefits for the current beneficiaries. The various steps in this study are described in the following sections.

1. Preparation of a Service Table. Additional Actuarial Assumptions. A service table is a basic actuarial instrument for calculating the probabilities of remaining in service to various attained ages, or of terminating from service in the various age years due to death, withdrawal from employment, disability retirement, or age-service retirement. The initial step in preparing a table is to study what experience is available and then to select appropriate assumptions in regard to the various rates of decrement. We were able to draw upon the experience studies made in preparing previous reports but additional studies were necessary in respect to rates of retirement. The assumptions selected and the resulting service tables are presented in further detail in the Appendix.

In keeping with previous studies, the interest rate has been assumed to be 5% per year. This is more than the System is earning on its reserve but is well within the potential of the System if proper steps are taken.

To recognize future non-inflationary salary increases, an extension of the relative salary scale appearing (for a new entrant age 25) in Table C·2 of [2] was chosen. This scale appears in the Appendix.

2. Actuarial Cost Method. Article 21 of the basic Law 447 of the System begins as follows:

El patrono aportará al Sistema una cantidad igual a un porcentaje de las retribución que regularmente reciban los particpantes, debiendo hacerse aportaciones concurrentemente con las aportaciones hechas por éstos según lo dispuesto en otro sitio de esta Ley. El Administrador determinará el porcentaje de retribución, el cual, al aplicarse a la retribución que de ordinario reciben los miembros, será suficiente para proveer las siguientes cantidades:

(a) Para anualidades por retiro y anualidades por incapacidad no ocupacional, los derechos a las cuales se acumulen por razón de servicios posteriores; una cantidad que al sumarse al activo mantenido por el Sistema para estos beneficios y constituido por las aportaciones

anteriormente hechas por el patrono y por los miembros participantes, será igual al valor actual de las obligaciones del Sistema por concepto de las anualidades acreditadas por servicios posteriores; obligaciones acumuladas hasta la terminación del año económico para el cual habrá de fijarse el por ciento de las aportaciones;

In actuarial terminology, this provides for full funding by the traditional accrued benefit cost method with immediate adjustment for experience gains and losses. The System has not maintained such full funding but should take some steps towards that goal. For this purpose, we have devised a pro-rata accrued benefit actuarial cost method (see [4], page 40) which will determine annual normal costs for age-service and non-occupational disability benefits and supplementary present values representing the value of benefits accrued up to date of valuation. As the aggregate supplementary present value for active members is mainly unfunded (except for the offset provided by accumulated employee contributions), various methods of amortizing this unfunded supplementary present value will be proposed. We believe that these procedures for accrued benefit actuarial costing follow the intent of Article 21 as closely as is reasonable under current circumstances of the System.

3. Valuation Procedures. One possible valuation procedure would have been to sort the employee data into valuation cells classified by attained age and service, then to calculate valuation factors for each cell by means of mathematical formulas expressed in terms of classical commutation functions, and finally, to apply these factors to the cell data and aggregate the results. An alternative procedure is to treat the data records serially as they appear on the tape, without sorting into valuation cells, and by year-by-year application of service table and salary scale factors trace out for individual employees the present value of benefits that may be incurred in the successive future years. We refer to this process as the 'iterative procedure' as it iterates from year to year over the potential service of the employee a set of instructions which establish the potential benefits to be incurred in a service year and calculates the present value thereof. Because the System's benefits are determined by a basic formula, and also by a merit plan for long service employees, and because the provision for minimum benefits plays a significant role, any valuation procedure will be complex. The classical procedure would have required a good deal of mathematical, as well as data, preparation; would have been inflexible in recognizing the minimum benefit; and did not lend itself so readily to long term projections (an objective we have in mind when adequate data is available). The iterative procedure required considerable program planning and testing, but was more flexible in recognizing minimum benefits and will easily lend itself to long term projections. For those reasons, the decision was made to develop the iterative procedure.

4. Consolidated Program for the Iterative Procedure. A consolidated computer program was developed, adapted to the provisions of the System, which, when the actuarial data of a participant is inputted, simultaneously computes four principal cost items, in accordance with the accrued benefit actuarial cost method, namely:

(i) The annual normal cost for age-service retirement.

Here annual normal cost represents the present value of the unit of benefit earned by service in the fiscal year ending June 30, 1976.

(ii) The supplementary present value in respect to age-service retirement, that is, the fund which together with future investment earnings, would suffice to provide the payment of benefits accrued for service prior to June 30, 1975.

(iii) The annual normal cost for non-occupational disabilitv retirement.

(iv) The supplementary present value in respect to non-occupational disability.

Items (iii) and (iv) are defined in respect to non-occupational disability retirement in a manner analogous to the definitions of items (i) and (ii) relative to age-service retirement.

By summing over the individual data records that are processed, one obtains aggregate values for items (i), (ii), (iii), and (iv). The values are available in dollar amounts and as percents of current annual payroll of employees represented in the data.

This consolidated program is a powerful and flexible instrument for valuing the System's benefits as they are now constituted. As noted later in Section 10, in the discussion of qualifications of the valuation procedure, this instrument could be further refined but it was considered that the current status of the actuarial data base would not justify such refinement. It will permit ready valuations for subsets of the employees, in particular, valuations for the employee groups of the public corporations and the municipalities when data becomes available.

A supplementary program was developed to take account of the offsets to total costs that are provided by the employee contributions.

5. Tests of the Consolidated Program. At several stages in the development of the program, sample computations produced by the the program were reviewed and tested, and revisions were incorporated as necessary. The final program was validated by comparing full printouts of calculations for sample individual participants with corresponding values obtained by independent calculations.

6. Actuarial Data. The Computing Section of the System had a Contributions Tape, showing age, sex, service, and contribution data for 62,180 employees of the Central Government as of May, 1975. This tape was reprocessed by the Computing Section in preparation for the actuarial calculations.

7. Valuation Runs Recognizing Only Non-inflationary Salary Increases. Two runs of the Consolidated Program were made with samples of data from the Contributions Tape. Since the tape had data in blocks, each containing 3 employee records, a sample was formed by taking the first record from every sixth block, thus obtaining a (1/18)th or 5.6% sample. After satisfactory processing of this small sample, a second run was made with a 33% sample obtained by taking the first record from each data block. In both cases, account is taken of future non-inflationary salary increases based on the selected salary scale. The results, expressed throughout as percents of the corresponding payrolls, are summarized in Table 1.

These results are highly consistent and it was deemed unnecessary to make further runs on this basis. The results from the 33% sample will be used in Section 9 in discussion of total employer costs.

8. Valuation Run With Moderate Advance Allowance for Inflationary Increases in Salaries. To test the effect of making moderate advance allowance for future inflationary increases in salaries, the program was re-run for the 33% sample with provision for general salary increases at the rate of 3% per year in addition to the non-inflationary increases that are taken into account through the relative salary scale untilized for the runs reported in the previous section. It is generally considered that there should be a spread between the interest rate assumption and the inflationary rate of salary increases. The former assumption is 5% per year. A 3% rate for inflationary salary increases leaves a 2% spread.

It is mathematically possible to operate a pension fund without advance recognition of future inflationary salary increases. In such a case, annual normal cost and supplementary present value figures by an accrued benefit actuarial cost method are substantially lower than the corresponding figures which recognize future inflationary salary increases. However, when unfunded supplementary present values are spread as costs over future payrolls, then total annual costs for the case, without advance recognition of inflationary increases may not differ much from those for the case with advance recognition, in fact, in some instances the total annual cost for the inflation case may be lower.

Table 2, which presents annual normal costs and supplementary present values, for the 33% sample with assumption of 3% annual inflationary increases in salaries, has substantially higher figures than the corresponding ones in Table 1. There remains the problem of how to spread these costs reasonably over future payrolls, and that is the question addressed in the following section.

TABLE 1

VALUATION RESULTS FROM SAMPLE RUNS, EXPRESSED AS PERCENTS OF PAYROLL, ALL VALUES AS OF JUNE 30, 1975* AND WITH ALLOWANCE FOR ONLY NON-INFLATIONARY INCREASES IN SALARIES

	5.6% Sample	33% Sample
Annual normal cost for age-service retirement	6.13%	6.28%
Annual normal cost for non-occupational disability retirement	1.75%	1.79%
Supplementary present value for age-service retirement	108.73	108.89
Supplementary present value for non-occupational disability retirement	27.61	27.99
Number of records used	3,474	20,629
Total monthly payroll	$1,570,653	$9,449,786
Average monthly salary	$445	$458

*The values presented are those from the computer run loaded by the factor 1.00144 to take account of refunds after retirement. The loading factor was determined by study of benefit values for new retirees of the fiscal year ending in 1974.

TABLE 2

VALUATION RESULTS FROM RUN OF 33% SAMPLE, EXPRESSED AS PERCENTS OF PAYROLL AND WITH ALLOWANCE FOR 3% INFLATIONARY INCREASES IN SALARIES, COMPARED WITH THOSE WITHOUT SUCH ALLOWANCE. ALL VALUES AS OF JUNE 30, 1975*

	With Allowance For Inflationary Increases	Without Allowance For Inflationary Increases (cf. Table 1)
Annual normal cost for age-service retirement	9.47%	6.28%
Annual normal cost for non-occupational disability retirement	2.49%	1.79%
Supplementary present value for age-service retirement	144.51%	108.89%
Supplementary present value for non-occupational disability retirement	35.12%	27.99%
Number of records	20,629	
Total monthly payroll	$9,449,786	
Average monthly salary	$458	

*See footnote to Table 1

9. Calculation of Total Employer Annual Costs. The first step in compiling employer annual costs was to bring together all the component annual normal costs for the various contingencies of death and retirement. Those for age-service and non-occupational disability retirement were already computed, but additional costs on a current cost basis were calculated for death benefits and for occupational disability. Also, as provided in Article 21, an annual allowance for administrative expense was included. A second step was to take account of the amount of the current employee annual contribution expected to be available at retirement. One cannot offset the full employee contribution as it may be refunded on termination of the employee from service instead of being retained for retirement purposes. The resulting total annual normal costs are tabulated in Table 3.

TABLE 3

ANNUAL NORMAL COSTS EXPRESSED AS PERCENTS OF PAYROLL
(As of June 30, 1975)

Category	Without Allowance For Inflationary Increases in Salaries	With Allowance For Inflationary Increases in Salaries
Age-service retirement	6.28%	9.47%
Non-occupational disability retirement	1.79%	2.49%
Death and Occupational Disability	1.43%	1.43%
Administrative expense	.29%	.29%
Subtotal	9.79%	13.68%
Employee contribution offset	4.46%	4.46%
Employer Annual Normal Cost	5.33%	9.22%

*Calculated by the supplementary program (see end of Section 4) applied to the 62,180 records.

A similar compilation is required for supplementary present values except that for the benefits funded on a current cost basis there is no supplementary present value. However, at this stage the unfunded present value of current benefits is required and is calculated as follows:

Present Value of Current Benefits as of June 30, 1975		$619,944,080 (see [3], Table 1)
Total Reserve	359,697,878	
Less Accumulated Employee Contributions	176,728,642	
		$182,969,236
Unfunded Present Value of Current Benefits as of June 30, 1975		$436,974,844

This represents 70.87% of annual payroll ($616,583,646) as of June 30, 1975.

A final item to be considered is the offset to future retirement costs that is provided by the accumulated employee contributions. By means of the supplementary program, this offset was calculated to be equivalent to 23.31% of payroll.

It should be stated that, in contrast to previous reports [1] and [3], we here regard accumulated employee contributions as an offset to future retirement costs for current active members, rather than as part of the reserve fund for current beneficiaries. To so offset the accumulated employee contributions against costs for active members is a normal and reasonable concept. Of course, in either case, the accumulated employee contributions are considered in the equating of total costs.

Supplementary present values are gathered together in Table 4.

TABLE 4

SUPPLEMENTARY PRESENT VALUES EXPRESSED AS PERCENTS OF PAYROLL
(As of June 30, 1975)

Category	Without Allowance For Inflationary Increases in Salaries	With Allowance For Inflationary Increases in Salaries
For Active Members		
Age-service retirement	108.89%	144.51%
Non-occupational disability retirement	27.99%	35.12%
Subtotal	136.88%	179.63%
Unfunded Present Value of Current Benefits	70.87%	70.87%
Total Supplementary Present Value to be Funded	207.75%	250.50%
Offset provided by Accumulated Employee Contributions	23.31%	23.31%
Remaining Supplementary Present Value to be funded by Employer Contributions on Future Payrolls	184.44%	227.19%

These are significant figures and require serious consideration. The interpretation is that in addition to the total reserve ($359,697,880 as of June 30, 1975) there should be on hand further funds approximating two years payroll in order to meet the future costs of the benefits accrued for service up to June 30, 1975. In dollar amounts, there is a funding deficiency (unfunded supplementary present value) of $1.1 million if no advance allowance is made for inflationary increases in salaries, and of $1.4 billion if allowance is made for 3% annual inflationary increases, all in respect to retirement benefits accrued for service up to June 30, 1975. The deficit (unfunded supplementary present value) can be funded by employer contributions determined as a level percent of future payrolls. The percent required depends on the number of future payrolls considered and on whether payrolls increase according to an inflation assumption. The total annual employer contribution rate is then the sum of the employer annual normal cost rate (required for funding the year-by-year benefits for future service) and the level percent for funding the deficit (unfunded supplementary present value). The resulting total employer contribution rates, expressed as percents of payrolls, are given in Table 5 for the case without inflationary increases and in Table 6 for the case where 3% inflationary increases are assumed.

TABLE 5

TOTAL ANNUAL EMPLOYER COSTS EXPRESSED AS PERCENTS OF PAYROLLS ASSUMED STATIONARY

(As of June 30, 1975)

	Supplementary Present Value Funded Over				
	20 Payrolls	30 Payrolls	40 Payrolls	50 Payrolls	60 Payrolls
Annual Normal Cost	5.33%	5.33%	5.33%	5.33%	5.33%
Funding of Supplementary Present Value	14.44%	11.71%	10.49%	9.86%	9.51%
Total Annual Cost	19.77%	17.04%	15.82%	15.19%	14.84%

TABLE 6

TOTAL ANNUAL EMPLOYER COSTS EXPRESSED AS PERCENTS OF PAYROLLS ASSUMED TO INCREASE ANNUALLY AT 3% PER YEAR

(As of June 30, 1975)

	Supplementary Present Value Funded Over				
	‹20 Payrolls›	‹30 Payrolls›	‹40 Payrolls›	‹50 Payrolls›	‹60 Payrolls›
Annual Normal Cost	9.22%	9.22%	9.22%	9.22%	9.22%
Funding of Supplementary Present Value	13.68%	9.97%	8.14%	7.07%	6.38%
Total Annual Cost	22.90%	19.19%	17.36%	16.29%	15.60%

It should be emphasized that actuarial cost figures are estimates based on the data and circumstances existing at the time of valuation. Periodically, these estimates should be re-calculated to take account of new data and circumstances, and by utilization of experience studies, the estimates become increasingly valid. Be that as it may, from the present estimates, it is clear that substantial costs lie ahead for the System, and these will not be met by the present level (6 to 7 percent) of employer contributions. This leads to

Recommendation 1. Until a future actuarial valuation indicates that an adequate level of income has been reached by the System, it is recommended that yearly increments of at least 2% per year be made in the employer contribution rates.

10. Qualifications Concerning the Valuation. In this our first valuation of actuarial costs in regard to the active participants, we have made two simplifications to facilitate completion of the work.

(1) It is assumed that both the benefits and the employee contribution rates for all employees are in accordance with the Full Supplementation Plan, and we have not attempted to separate the data into Full Supplementation and Coordinated Plan categories. There are a number of reasons for doing so. As noted in a previous report ([3], page 6) there is only modest evidence that reductions at age 65 of benefits of those on the Coordinated Plan are being effectuated. In many cases, the minimum benefit provision overrides the coordination provision. Assumption of Full Supplementation benefits for all participants may overvalue future benefits but offsetting this is the higher level assumed for employee contributions. The data is often not clear as to whether the participant is on the Coordinated Plan or the Full Supplementation Plan, and it is possible for a participant on the Coordinated Plan to switch to the Full Supplementation Plan by making up the difference in contributions (i.e. by providing additional contributions at 2 1/2% of salary up to $6,600 for prior years from July 1, 1968).

(2) As in the 1975 Report [3], no attempt was made to provide a special valuation for police and fire participants. Assumptions have been determined as applicable to the whole group and are not classified by category. The police and firemen have more liberal early retirement, and the police are on the Full Supplementation Plan. Whereas qualification (1) may or may not overvalue costs, this second qualification will undervalue costs.

Besides the above two items, we should also note:

(3) The actuarial data for the current study has been maintained on a fairly but not fully reliable basis. A test of the data on the Contributions Tape against written records indicated some understatement (about 8%) of accrued service. Steps to improve the actuarial data base are outlined in Section 12.

(4) Investment return at the rate of 5% per annum has been assumed as reasonable for the valuation even though it is not being earned on the full reserve currently because a substantial amount of employer contributions ($53 million as of June 30, 1976) were withheld. Steps have been taken to improve this situation. An offsetting effect is provided by the calculations allowing for accumulation of employee contributions at the valuation rate although the current accumulation rate is 2 1/2%. The calculations allow for possible narrowing of the gap in the future between the earnings rate and the accumulation rate.

11. Conservation Measures. Analogous to how the world wide energy supply problem may be partly solved by conservation measures such as cutting consumption and more efficient utilization of fuels, and by exploitation of alternative sources, so also can the problem of meeting actuarial costs be made more manageable. A conservation measure would be to gradually increase the normal retirement age from its present level of 58 to age 62 or 65. A more efficient utilization measure would be to seek a higher rate of investment return, and, in particular, to obtain interest at the rate of at least 5% on unpaid employer contribution. Achievement of a 6% rate of investment return on the funds of the System could lower total employer costs to perhaps 13% of payroll, as compared to the 15% and higher contribution rates shown in Tables 5 and 6. The alternative source for retirement benefits is Social Security, and more effective and up-to-date coordination with Social Security benefits should be sought. These suggestions are incorporated into our second recommendation.

Recommendation 2. It is recommended that employers be charged interest at a rate of at least 5% per year on any outstanding employer contributions. In addition, studies should be undertaken of ways to increase the rate of investment return on funds of the System, and of measures to insure that the combination of benefits from Social Security and from the System are adequate but not redundant.

12. Construction of an Actuarial Data Base. In order to attain a good measure of actuarial control for the System through successive actuarial studies, it is essential that an accurate actuarial data base be developed and be maintained on a continuous basis. Some aspects of this matter are touched on in the February, 1975 report prepared under the direction of Dr. James C. Emery [5], and it is now timely to proceed on implementation. An outline of major steps in developing an actuarial data base are indicated below.

(1) Electronic data processing (EDP) facilities.

A. Design of EDP files to store all of the necessary actuarial data.

B. Design and implementation of EDP procedures and programs to create and to update files.

(ii) Pensioners data

A. Preparation of forms and procedures for transmitting data from sources (Pensioners Section, Claims Section, etc.) to EDP center.

B. Setting up of effective controls to monitor the data flow.

(iii) Active participants data

A. Obtain actuarial data from municipalities and public corporations, and whatever data is unknown with regard to Central Government employees.

B. Establishment of procedures and controls for the maintenance of the active participant data, as for the pensioners data.

The inauguration of the System's own computer should greatly facilitate the maintenance of an accurate actuarial data base.

While our concern here is with the actuarial data base, we realize that its development must be coordinated with the development of the data for management, statistical, and loan functions of the System. The report [5] bears on this point. To summarize, we present

Recommendation 3. In coordination with the development of a revised administrative data system, it is recommended that an actuarial data base be developed and maintained on a continuous basis, as outlined in (1), (ii), and (iii).

IV. PRESENT VALUE OF BENEFITS FOR THE CURRENT BENEFICIARIES AS OF JUNE 30, 1976.

1. Status of the Study. Work has been underway to calculate the present value of benefits for the current beneficiaries, as of June 30, 1976, for both the Employees Retirement System and the Judiciary System. Former studies as of June 30, 1974 and June 30, 1975 are reported in [1] and [3]. The programs used for these studies were adapted to the University of Michigan computer system, and it has been found advisable to rewrite the programs in a form that is readily useable in Puerto Rico. It will take time to rewrite the programs. In the meanwhile, preliminary estimates have been prepared of the present values and these are discussed in the following section.

2. Preliminary Estimates of the Present Values. On the basis of the October, 1976 payroll it is estimated that the annual amount of pensions in effect as of June 30, 1976 was $63,361,196 for the Employees Retirement System. In the June 30, 1975 Report, the average present value per $1 of annual pension was $11.22 ([3], Table 2, page 5]). Application of this factor to the $63,361,196 pension roll yields $711,000,000 as the estimated present value of benefits for beneficiaries of the Employees Retirement System as of June 30, 1976.

The reserve on hand as of June 30, 1976 (including $53,000,000 of unpaid employer contributions) was $382,445,471 or 54% of the present value of benefits. The corresponding ratios for June 30, 1974 and June 30, 1975 were 62% and 58%, respectively. Thus the ratio has been decreasing by 4% per year.

For the Judiciary System, the annual pension amount was calculated as $1,180,961 as of June 30, 1977. Application of the average present value per $1 of annual pension of $10.08 ([3], Table 4, page 10) to the $1,180,961 pension roll gives $11,904,000 as the estimated present value of benefits for beneficiaries of the Judiciary System as of June 30, 1976. The reserve on hand for the Judiciary System as of June 30, 1976 (including $2,230,540 of unpaid employer contributions) was $9,731,814, or 82% of the present value of benefits. The corresponding ratios for June 30, 1974 and June 30, 1975 were 97%. There has thus been a substantial deterioration in the funding status of the Judiciary System.

V. CONCLUDING COMMENTS

In Tables 5 and 6, it has been indicated that total employer contributions of at least 15% of payroll will be required if pension costs of the System are to be funded by a level percent of future payrolls. The unfunded supplementary present value of accrued benefits, that is, the deficit in the funding for benefits earned by service to date, will grow larger as long as such a contribution level is not met. Then future employer contributions will have to rise above 15 percent of payroll, or serious cash flow problems will emerge for the System in the not-so-distant future.

For the fiscal year ending June 30, 1976, the total income of the System was $94 million but over $20 million of this was charged to but not paid by the employers. As a result, during the fiscal year, the reserve fund for retirement benefits remained at an effective level of approximately $330 million, although the reserve, as of June 30, 1976, including amounts owed by employers is shown as $382 million in the financial statements. That the effective reserve fund remained level instead of increasing means that the cash disbursements of the System were about equal to the cash income, and the System narrowly avoided having to draw down its reserve. This illustrates again that cash flow will become urgent soon unless the employer contribution rates are substantially raised.

A moderate funding goal is to have on hand a reserve equal to the sum of the accumulated employer contributions and the present value of benefits in current payment status. As of June 30, 1975, this would have required a reserve of approximately $800 million ($177 million for employee contributions and $620 million for current benefits). The actual effective reserve was approximately $330 million so that the System has a long way to go to meet such a goal.

It has been recommended in the Report that employer contribution rates be raised substantially over the next few years, that investment income be improved, and that means to decrease or conserve on future benefits costs be considered. All three of these measures will be necessary in order for the System to discharge its responsibilities to its current and future beneficiaries.

APPENDIX

The assumptions for males, together with their rationales, are indicated below:

Mortality rates -	1971 Individual Annuity Mortality Table with 2-year set-forward in age. This is based on studies of the mortality experience of age-service beneficiaries observed over the fiscal years ending in 1973 and 1974.
Withdrawal rates -	Piecewise linear (slope - .003 $\pm$ .0005) from 10% at age 20 to 0 at age 55. These rates give moderate numbers of withdrawals consistent with an observed overall turnover rate of 7% for males and females.
Non-occupational disability retirement rates -	75% of 1974 Social Security disability incidence rates (supplied by the Social Security Administration). No exposure was available on active members subject to disability or age-service retirement but there was data on disability and age-service new retirements in the fiscal year 1974. It was decided to start with the 1974 Social Security rates and to infer age-service retirement rates by applying ratios of the numbers (by age-groups) of 1974 age-service retirements to the numbers of 1974 disability retirements. This produced reasonable distributions of disability and age-service retirements for females, but gave a low average age for age-service retirement for males. To correct this, the 1974 Social Security rates for males were reduced by the factor .75, and the ratio at age 57 of age-service to disability retirements for males was limited to twice that ratio for females.
Age-service retirement rates -	Developed from the disability retirement rates as indicated above.

The assumptions for females were:

Mortality rates -	1971 Individual Annuity Mortality rates without adjustment. Again, this was based on pensioner experience in the fiscal years ending in 1974 and 1975.
Withdrawal rates -	Same as for males.
Non-occupational disability retirement rates -	1974 Social Security disability incidence rates with adjustment at age 62.
Age-service retirement rates -	See description of the male rates.

The resulting service tables are shown in Table A (Males), Table B (Females).

The salary scale used for projecting non-inflationary salary increases is given in Table C.

For calculations making advance allowance for inflationary increases in salaries, the rate of such increases was taken as 3% per year. The valuation rate of interest was 5% per year.

TABLE A

SERVICE TABLE FOR MALES

Age	$1{,}000q_x^d$	$1{,}000q_x^w$	$1{,}000q_x^i$	$1{,}000q_x^r$	$1{,}000q_x^T$
~~20~~ 22	.54	100.0			100.54
21	.57	97.5			98.07
22	.59	95.0			95.59
23	.62	92.5			93.12
24	.65	90.0			90.65
25	.68	87.5			88.18
26	.72	85.0			85.72
27	.76	82.5	1.19		84.45
28	.81	80.0	1.29		82.10
29	.86	77.0	1.39		79.25
30	.92	74.0	1.48		76.40
31	.98	71.0	1.58		73.56
32	1.05	68.0	1.67		70.72
33	1.12	65.0	1.84		67.96
34	1.20	62.0	2.00		65.20
35	1.30	59.0	2.16		62.46
36	1.40	56.0	2.32		59.72
37	1.51	53.0	2.48		56.99
38	1.63	50.0	2.74		54.37
39	1.79	46.5	2.99		51.28
40	2.00	43.0	3.24		48.24
41	2.26	39.5	3.50		45.26
42	2.57	36.0	3.75		42.32
43	2.92	32.5	4.24		39.66
44	3.32	29.5	4.72		37.54
45	3.75	26.5	5.21		35.46
46	4.23	23.5	5.69		33.42
47	4.74	20.5	6.17	2.16	33.57
48	5.29	17.5	7.11	5.30	35.20
49	5.86	15.0	8.04	8.44	37.34
50	6.46	12.5	8.98	11.58	39.52
51	7.09	10.0	9.91	14.72	41.72
52	7.74	7.5	10.85	17.87	43.96
53	8.42	5.0	12.65	32.88	58.95
54	9.12	2.5	14.45	47.88	73.95
55	9.85		16.25	62.89	88.99
56	10.61		18.05	77.89	106.55
57	11.41		19.85	92.90	124.16
58	12.25		19.75	124.41	156.41
59	13.13		19.65	155.92	188.70
60	14.07		19.55	187.43	221.05
61	15.08		19.45	218.94	253.47
62	16.18		19.35	250.45	285.98
63	17.40		12.90	371.04	401.34
64	18.77		6.45	491.63	516.85
65	20.29			612.21	632.50
66	21.99			732.81	754.80
67	23.89			853.40	877.29
68	26.00			974.00	1,000.00

.000974

TABLE B

SERVICE TABLE FOR FEMALES

Age	$1{,}000q_x^d$	$1{,}000q_x^w$	$1{,}000q_x^i$	$1{,}000q_x^r$	$1{,}000q_x^T$
20	.26	100.0			100.26
21	.28	97.5			97.78
22	.29	95.0			95.29
23	.31	92.5			92.81
24	.33	90.0			90.33
25	.35	87.5			87.85
26	.37	85.0			85.37
27	.39	82.5	1.02		83.91
28	.41	80.0	1.21		81.62
29	.44	77.0	1.41		78.85
30	.47	74.0	1.60		76.07
31	.50	71.0	1.80		73.30
32	.53	68.0	1.99		70.52
33	.57	65.0	2.23		67.80
34	.61	62.0	2.46		65.07
35	.65	59.0	2.70		62.35
36	.70	56.0	2.93		59.63
37	.75	53.0	3.17		56.92
38	.81	50.0	3.46		54.27
39	.87	46.5	3.75		51.12
40	.94	43.0	4.03		47.97
41	1.01	39.5	4.32		44.83
42	1.09	36.0	4.61		41.70
43	1.19	32.5	5.14		38.83
44	1.29	29.5	5.68		36.47
45	1.40	26.5	6.21		34.11
46	1.52	23.5	6.75		31.77
47	1.65	20.5	7.28	1.32	30.75
48	1.80	17.5	8.22	2.70	30.22
49	1.97	15.0	9.16	4.08	30.21
50	2.15	12.5	10.11	5.46	30.22
51	2.37	10.0	11.05	6.84	30.26
52	2.64	7.5	11.99	8.22	30.35
53	2.97	5.0	13.74	16.29	38.00
54	3.35	2.5	15.49	24.36	45.70
55	3.79		17.24	32.42	53.45
56	4.28		18.99	40.49	63.76
57	4.83		20.74	48.56	74.13
58	5.41		20.64	94.76	120.81
59	6.02		20.53	140.96	167.51
60	6.63		20.43	187.16	214.22
61	7.22		20.32	233.36	260.90
62	7.77		20.22	279.56	307.55
63	8.29		13.48	397.71	419.48
64	8.78		6.74	515.86	531.38
65	9.29			634.01	643.30
66	9.89			752.16	762.05
67	10.62			870.31	880.93
68	11.54			988.46	1,000.00

TABLE C

RELATIVE SALARY SCALE FOR THE CALCULATION OF NON-INFLATIONARY SALARY INCREASES

Age	Salary Factor	Age	Salary Factor
20	0.45000	45	0.76250
21	0.46250	46	0.77500
22	0.47500	47	0.78750
23	0.48750	48	0.80000
24	0.50000	49	0.81250
25	0.51250	50	0.82500
26	0.52500	51	0.83750
27	0.53750	52	0.85000
28	0.55000	53	0.86250
29	0.56250	54	0.87500
30	0.57500	55	0.88750
31	0.58750	56	0.90000
32	0.60000	57	0.91250
33	0.61250	58	0.92500
34	0.62500	59	0.93750
35	0.63750	60	0.95000
36	0.65000	61	0.96250
37	0.66250	62	0.97500
38	0.67500	63	0.98750
39	0.68750	64	1.00000
40	0.70000	65	1.00000
41	0.71250	66	1.00000
42	0.72500	67	1.00000
43	0.73750	68	1.00000
44	0.75000		

REFERENCES

[1] Actuarial Study of Liabilities for the Current Beneficiaries of the Retirement System of the Government of Puerto Rico and Its Instrumentalities and of the Retirement System of the Judiciary as of June 30, 1974, by D. A. Jones and C. J. Nesbitt, January, 1975.

[2] Actuarial Review and Preliminary Cost Estimates of the Proposed Retirement System for Public Employees of the Commonwealth of Puerto Rico, by D. A. Jones and C. J. Nesbitt, September, 1975.

[3] Actuarial Study of the Present Value of Benefits for the Current Beneficiaries of the Retirement System of the Government of Puerto Rico and Its Instrumentalities and of the Retirement System of the Judiciary as of June 30, 1975, by C. J. Nesbitt and A. Estrella, March, 1976.

[4] The Theory and Practice of Pension Funding by C. L. Trowbridge and C. E. Farr, Richard D. Irwin, Inc. Publisher, 1976.

[5] An Administrative Data Processing System for the Retirement System of the Employees of the Central Government of the Commonwealth of Puerto Rico and Its Instrumentalities, by Dr. James C. Emery, Dr. Howard L. Morgan, Ing. J. Ramon Palacios, Sra. Ruth J. Zowader, February, 1975.