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A PRESENT VALUE APPROACH
TO
THE RETIREMENT DECISION

LT COL WILLIAM J. WALSH

DEPARTMENT OF ECONOMICS

MAY 1985

FINAL REPORT

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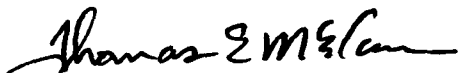
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This paper examines the financial side of the decision to retire from active duty. The methodology is one of computing the present values of two possible streams of income. The first stream of income is that received by someone who opts for immediate retirement. The components are immediate retired pay and, presumably, immediate civilian salary. The second possible stream of income is that received by someone who opts to remain on active duty. The components are current military pay, military retirement beginning at a later date, and civilian salary beginning at a later date. This paper presents the methodology for determining the "breakeven income"--the civilian income which would equate the values of the two alternative streams of income.

The principal tool used is "present value analysis." The methodology allows for differences in age, expected civilian raises, discount rates, possible "capping" of retired pay, rank, and years of service.

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"A PRESENT VALUE APPROACH TO THE RETIREMENT DECISION"

by

Lt. Col. William J. Walsh

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This paper examines the financial side of the decision to retire from active duty. The methodology is one of computing the present values of two possible streams of income. The first stream of income is that received by someone who opts for immediate retirement. The components are immediate retired pay and, presumably, immediate civilian salary. The second possible stream of income is that received by someone who opts to remain on active duty. The components are current military pay, military retirement beginning at a later date, and civilian salary beginning at a later date. This paper presents the methodology for determining the "breakeven income"--the civilian income which would equate the values of the two alternative streams of income.

The principal tool used is "present value analysis". The methodology allows for differences in age, expected civilian raises, discount rates, possible "capping" of retired pay, rank, and years of service.

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SECTION ONE

PRESENTATION OF THE PROBLEM

The principal financial considerations in the retirement decision are the military pay schedule, the retired pay schedule, and civilian pay opportunities. While the military and retired pay schedules are a matter of law, civilian pay opportunities vary significantly from individual to individual. This paper describes a procedure which "custom tailors" a financial criterion to the situation of the individual attempting to make a retirement decision.

The first financial factor mentioned, the military salary schedule, describes the military pay the individual can expect as a function of his rank and years of service. Military pay is an inducement to remain on active duty as there is no military pay once retired. Greater time on active duty generally entitles members to greater pay, up to some maximum for each rank. The maximum is normally reached at about the time the member would be expected to pin on the next higher rank, if selected "on time" for promotion.

The second financial factor mentioned, the retired pay schedule, describes the retired pay the individual can expect as a function of his rank and years of service. Retired pay is both an incentive to retire (because there is no entitlement until retirement) and an incentive to remain on active duty (because the yearly entitlement grows with greater years of service). The minimum service time to be eligible for retirement is currently 20 years. There is no vesting of retirement benefits

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for those with fewer years of service. Members eligible for retirement are paid at the rate of 2.5% of base pay for each year of creditable active duty, up to a maximum of 30 years active duty or 75% of base pay. What this means for the individual is: the retirement check will be larger the longer the individual is on active duty, but the longer the individual is on active duty the number of checks likely to be received gets smaller.

Civilian pay opportunities are an incentive to retire as the civilian pay will not be received until civilian employment begins.

The retirement decision can be seen as a choice between two financial values: the value of all the incomes from "staying in" and the value of all the incomes from "getting out". The word "value" refers to "present discounted value" which will be described below and which is abbreviated as "PV". The present value of something will be denoted by PV{something}. The present value of "staying in" is the sum of the following three items:

PV{military pay for applicable rank and years of service}
plus
PV{retired pay for rank and years of service at ret'mt}
plus
PV{civilian pay from retirement till civilian ret'mt}

The present value of "getting out" is the sum of the following two items:

PV{retired pay for current rank and years of service}
plus
PV{civilian pay from current ret'mt till civilian ret'mt}

This report determines the civilian pay which would equate the two present values of the two alternatives. That is, it determines what civilian salary it would take to make the decision a financial "flip of the coin". If the individual has civilian salary prospects greater that the "breakeven salary", earlier retirement is a financially preferable alternative. If the individual has civilian salary prospects less than the "breakeven salary", then remaining on active duty is the financially preferable alternative. In the form of an algebraic equation, the situation looks like this for a Colonel with 24 years of service who is comparing the alternative of retiring now (1985 as of this writing) or in 2 years:

$$PV(MP,6,24,1985-1986) +$$
$$PV(RP,6,26,1987-die) +$$
$$PV(CP,1987-quit)$$

$$=$$

$$PV(RP,6,24,1985-die) +$$
$$PV(CP,1985-quit)$$

where MP = military pay
      RP = retired pay
      CP = civilian pay

where MP and RP are determined by rank = 6, and by
      years of service = 24 or 26 (as appropriate)

and where PV of each is determined by the years over
      which the pay will be received (till the death
      or till quitting/retiring).

As military pay schedules, retired pay schedules, and the method of finding present value are all known, the only unknown quantity is the "breakeven" civilian pay. In algebraic terms, one equation with one unknown is solvable for the value of the unknown.

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Section Two gives a geometric description of "present discounted value". Section Three is an in-depth look at the formula used in accomplishing this report. Section Four continues with a description of other factors which determine the amount of pay to be received other than rank and years of service.

SECTION TWO

THE GEOMETRY OF PRESENT DISCOUNTED VALUE

Military retirement can be thought of as stacks of money which will be paid out for series of years. A picture of this could be a rectangle with the height representing the number of dollars and the length representing the number of years. (Fig. 1)
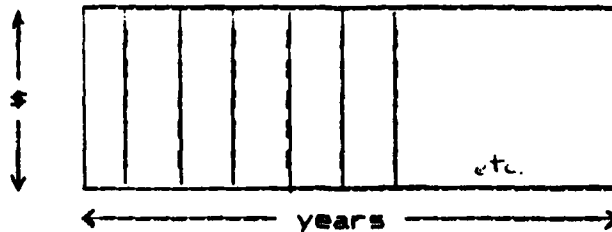
Fig. 1

Each stack represents a FUTURE VALUE of dollars to be received. It is possible, though certainly not current policy, to pay an individual all that money "up front" and then let that individual disburse the regular payments to himself. Would, then, the single big stack have to be as tall as the sum of individual stacks? If the individual were allowed to invest the money and receive an interest rate, then the size of the stack required would clearly be smaller because payments could be made from both the principal and the interest accumulated. The size of the original stack required to allow all the payments to be made is the PRESENT VALUE.

Geometrically, the box representing payments could then be

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redrawn.   The new box (Figure 2) has an arcing line crossing it

interest

$

principal

←———————— years ————————→
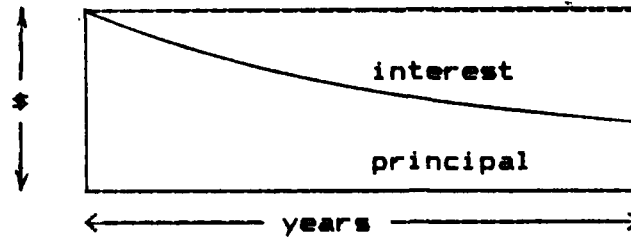
Fig. 2

from left to right.   The area above the line represents the
interest received on the original stack of money.   This interest
supplements the money paid from the principal--the original stack
of money.   The total area is the total money received in the
form of regular, uniform payments.   Another name for regular,
equal payments or receipts is an ANNUITY.   Car payments are one
form of annuity which individuals use to pay principal and
interest on a car loan in regular, equal payments.   A home
mortgage is another form of annuity.   Military pay is an annuity
which is a series of regular, equal payments. Retirement checks
are also an annuity.

Another form of annuity is an allotment to a savings
account.   With this type of annuity, regular deductions are made
from a members paycheck and deposited for him in his bank.   An
annuity of this type would earn interest.   With no withdrawals,
the interest earned in one year would earn interest itself during

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the following year. This is, as you probably know, called
compound interest. The geometric picture of compound interest is
presented below in Figure 3. The principal is the amount
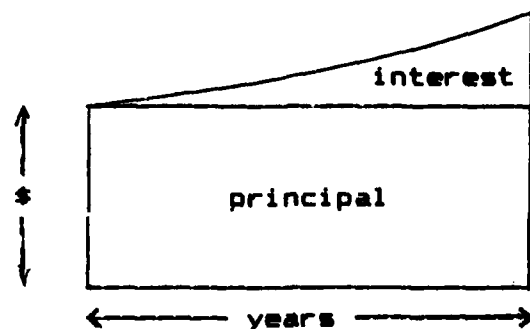
Fig. 3

deposited over the years. The portion above the box is the
interest accrued. Notice that is rises at an increasing rate.
That is because of the compounding of the interest. Now notice
the similarity between Figures 2 and 3. It is often said that
finding present discounted value is like working a compound
interest problem in reverse. This is even more apparent in the
algebraic description of present discounted value in the
following section.

This report is involved with uncovering the number of
dollars of civilian pay which would equate the two streams of
income pictured geometrically below. Note that the military pay
box is taller than the retirement boxes, because military
paychecks are larger than retirement checks. Because we will

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only be discussing short periods of military pay, that box will
not be as long as the retirement or civilian pay boxes. The
boxes of dollars are not drawn to scale.

Fig. 4

MP   +   RP   +   CP   =   RP   +   CP
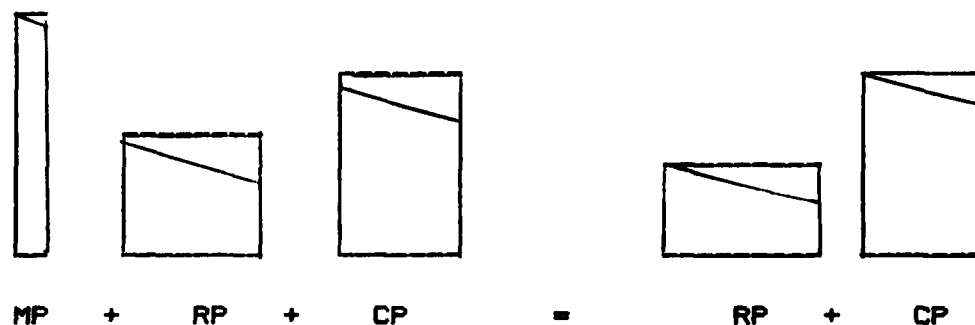
The question to be answered is: how tall (how many dollars) do
the two civilian pay boxes have to be to equate the two present
values. Remember, present value is the size of the "principal"
portion of the boxes.

One thing that will cause our answer to change is a change
in the interest rate used. Figures 5a and 5b show how a box for
equal, regular $1000 payments would look for 20 years of
payments. Interest rates of 3% and 6% are used. This means that

Fig. 5a   Fig. 5b

$1000 {   }$554 $1000 {   } $312

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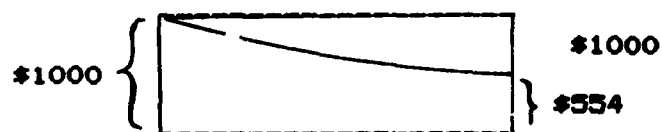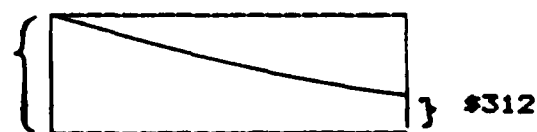
the last $1000 monthly payment could be financed with $554 that earned 3% per year for 20 years, or it could be financed with $312 that earned 6% for 20 years.

The algebra for the calculations is presented next. This section may be skipped without any loss of continuity.

SECTION THREE

THE ALGEBRA OF PRESENT DISCOUNTED VALUE

An amount of money placed in a savings account will earn interest at a particular interest rate. If the amount is not withdrawn, the principal will grow by a compounded amount. The following table shows the compounding of $1000 at 6% interest.

- - - - - - - - - - - -

Table 1

NUMBER OF YEARS	ACCOUNT BALANCE
0	$ 1000
1	1060
2	1123
3	1191
4	1262
5	1338

- - - - - - - - - - - -

The calculations can be written as

$$FV = PV \times (1 + i)^n$$

where FV = future value
PV = present value
i = annual interest rate
n = number of years

So,

$$\$1338 = \$1000 \times (1 + .06)^5$$

and

$$\$1262 = \$1000 \times (1 + .06)^4$$

Present discounted value is very similar. The present value
of $1338 in 5 years (at an interest rate or discount rate of 6%)
is the $1000 that we started with. The general formula for
present discounted value is:

$$PV = FV / (1 + i)^n$$

Or equivalently,

$$PV = FV \times (1 + i)^{-n}$$

Finding the present value of an annuity involves finding the
present value of each of the future payments to be received.
Using summation notation for the same example as on page 5, we
have:

$$\sum_{j=0}^{1} MP_{6,24} \times (1+i)^j$$

$$+ \sum_{j=2}^{DIS} RP_{6,26} \times (1+i)^j$$

$$+ \sum_{j=2}^{QUIT} CP \times (1+i)^j$$

$$=$$

$$\sum_{j=0}^{DIS} RP_{6,24} \times (1+i)^j$$

$$+ \sum_{j=0}^{QUIT} CP \times (1+i)^j$$

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where the subscripts indicate rank, years of service

In abbreviated form, the formula can be rewritten solving for the value of CP which satisfies the equality.

$$CP = \frac{PV\{MP(in)\} + PV\{RP(in)\} - PV\{RP(out)\}}{\sum_{j=0}^{QUIT}(1+i)^j - \sum_{j=2}^{QUIT}(1+i)^j}$$

where (in) and (out) refer to the appropriate values of
of military and retirement pay for each decision

This is, with modifications, the formula used to calculate the "breakeven" civilian salaries for various retirement scenarios. The modifications will be explained below.

A sample present discounted value table is presented in Table 2 for a 6% interest rate and $1000 future value.

- - - - - - - - - - - - -

Table 2

NUMBER OF YEARS	PRESENT VALUE
0	$1000
1	943
2	890
3	840
4	792
5	747

- - - - - - - - - - - - -

The present value table shows the amount of money you would need

to start with to end up with $1000 after the indicated number of
years.

SECTION FOUR

METHODOLOGY AND ASSUMPTIONS

Methodology

As stated above, the focus of the problem is on the amount of civilian pay which it would take to make the present value of the decision to continue on active duty be exactly equal to the present value of the decision to retire. A civilian pay in excess of the amount would tilt the decision toward earlier retirement. A civilian pay less than the amount would tilt the decision toward delayed retirement. The approach is discrete in that only two decision points are compared at a time. The points chosen compare the 20, 22, 24, 26 and 28 years of time in service with the 22, 24, 26, 28, and 30 year points respectively. That is, every decision is whether to retire "now" or "in two years", where "now" means once every two years from 20 to 28 years of service.

The policy issue which is addressed is the consequence of retired pay capping on the retirement decision financial criterion.

Explicit Assumptions

For the calculations performed, it was assumed that the member entered active duty at age 22, will retire at one of the discrete two-year points, will work in the civilian labor force from military retirement until age 65, and will die at age 75. The interactive program attached at Appendix A allows the reader to change the entering age. The program can be modified to allow

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for other civilian retirement ages and expected mortality points.

Implicit Assumptions

A single financial criterion implies that all the "non-financial" aspects of the choice (location, duty hours, commaraderie, familiarity, inertia, etc.) are perfectly offsetting, or that the "non-financial" aspects will be weighed along with the financial criterion in arriving at a final decision.

The single financial criterion implies that the availabilities of civilian employment are neither lessened by greater age nor improved by additional military experience, or that these two factors are offsetting. In terms of the dollar statistic, it means that your chances of getting a job at a given salary neither improve nor regress in two years.

There are no special duty pays included in military pay. Individuals drawing hazardous duty pay or aircrew incentive pay must make a subjective evaluation of how that influences the decision.

Other financial factors (availability of Survivors Benefit Protection, protection from some state taxation, and the non-taxability of some military pay) are not included in this analysis.

Except where specifically included, all factors are considered in real terms, that is, fully adjusted for the effects of inflation. This means that military pay, retired pay, and civilian pay are assumed to adjust for inflation. This assumption can be modified by judicious selection of some of the

choice variables described immediately below.

The opportunity for promotion to the next higher grade/grades has been excluded from consideration, except as noted for Lieutentant Colonels at the 20 year point, but would be expected to have a significant impact on the results, encouraging continued active duty.

The use of discrete increments for computation makes the assumption of unchanged job opportunities more likely to be a reasonable one. As the time period moves beyond 2 years, the assumption become less tenable. The reader would then have to incorporate enhanced or diminished civilian job opportunities into the non-quantified factors influencing the retirement decision.

Choice Variables

Rank. Computations were done for officer paygrades 4 through 6, though the program and input data allow for computations for O-1E through O-7.

Discount Rate. Computations were done for interest rates (real) ranging from 1% to 10% per year in increments of 3%. The programming allows for the use of any interest rate greater than zero percent, including fractional percentages. The choice should be made keeping in mind the following information. The long run real rates of return on investments in U.S. Treasury bills, U.S. government bonds, corporate bonds, and common stocks have averaged approximately 0%, 0.8%, 1.5%, and 6.5% respectively. [1] It is the author's opinion that the future will

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hold marginally better (add 1%) returns because of structural changes in recent years. While these are rates received on lending/investing funds, the rates charged to borrowers are traditionally a few percent higher. Commercial banks often charged borrowers 4% above the bank's cost of funds. Charge cards often charge a real interest rate in excess of 12%. An appropriate interest/discount rate would probably lie between what you expect to pay when borrowing and expect to receive when lending. You should probably lean more towards what you have to pay if you expect to be a net borrower for most of your remaining life. If, however, you expect to be a net lender (saver), then lean more towards the rates you hope to receive (pay).

Civilian Raises. Raises in civilian pay were built into the program with the possibility of using any positive real rate of growth. The program is constrained to allow civilian pay to rise by the same percentage every year for 10 consecutive years from the point of initial civilian employment. Computations were performed in increments of 1% in the range of 0% to 4% compounded annual growth. [Note that compounding causes a 4% growth rate to yield a compounded growth of 48% over 10 years.]

Retired Caps. Two government policies were considered regarding the "capping" of retired pay. The first is to cap pay for the next 10 calendar years by some constant percentage. This would probably mean that retired pay would be partially adjusted for inflation for 10 years and fully-indexed after that. Computations were done in 1% increments ranging from 0% (no cap) to 3% per year (a cumulative 26% cap after 10 years). This policy would discourage retirement because the effects of retired

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pay capping could be completely or partially avoided by remaining on active duty for all or part of the 10 year implementation period. The second policy consideration is to cap the retired pay from the date of retirement till age 62 of the retiree, then to fully-index that retiree's payments. This seems a more likely possibility, but because it would be effective for a longer period of time the retiree should hope that the cap is smaller each year. The results of this system of capping are not obvious. Delayed retirement would avoid little of the effects of the capping by rendering the individual subject to it for fewer years. Yet the capping itself reduced the importance of the retirement pay in comparison to the other factors -- the military pay and civilian pays available. Computations were done in increments of 1% from 0% to 3% per year (a cumulative cap of 45% after 20 years). The effects of this capping method fall differently on individuals depending on the age upon entering service and the years of service at retirement.

The Geometry of Pay Raises and Caps

The assumption of regular raises at a given percentage raises the present value of the retirement pay associated with a given starting salary. The raises may partially, completely, or more than completely offset the effects of discounting. A partial offset, as with 6% discounting and 3% pay raises is depicted in Figure 6 below. Note that the raises continue for only 10 of the 20 years shown.

18

with raises

Fig. 6

$

w/o raises

<------ years ------>

- - - - - - - - - - - -
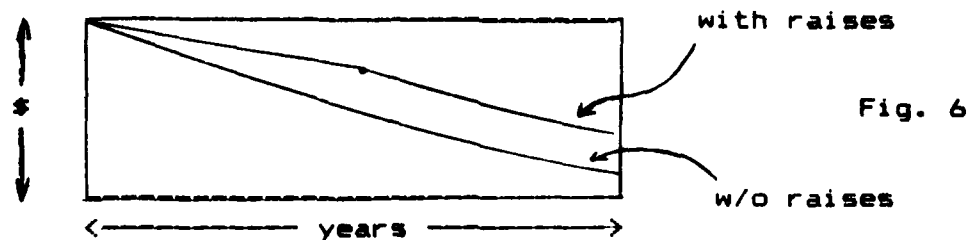
The geometry is similar for "capping" retirement pay, except that the cap reinforces the effects of discounting. Figure 7 below illustrates the reduction in present value from capping.

- - - - - - - - - - - -

w/o capping

$

Fig. 7

with capping

<------ years ------>

- - - - - - - - - - - -
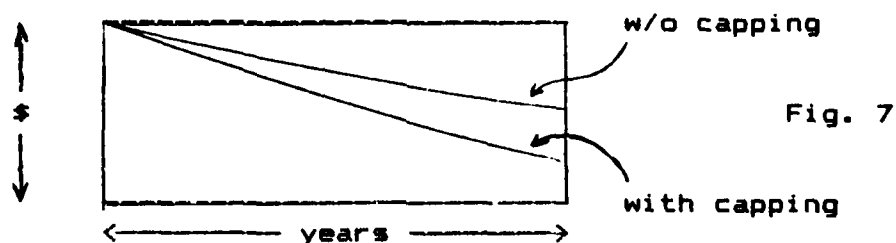
The Algebra of Raises and Capping

For an individual who began civilian employment with civilian pay, CP, and who received salary increases of w% each year, the present value of that salary (if discounted at i% per year for "j" years) is given by the following formula.

$$PV = Salary \times (1+i)^{-j} \times (1+w)^{j}$$

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Note that in discounting to the present, the exponents may be different if the calculation is for the fourth year in the future but only for the second year of civilian salary raises (as would be the case for a two year continuation of active duty).

Similarly, the formula for the present value of retired pay to be received "j" years into the future, with discount rate "i", and with a "c" percentage pay cap is given below.

$$PV = RP \times (1+i)^{-j} \times (1+c)^{-j}$$

A sample problem is shown below in Figure 8. The interrogations are the ones which appear on-screen when the program in Attachment A is run using MBASIC (Microsoft Basic). One possible set of responses are indicated in heavy script. The reader should note that the present discounted values of the two possible streams are equalized. The civilian pay which would cause that to be the case is indicated on the last line of the figure.

An output table from a large program which iterates through myriad combinations of interest rate, pay raise rates, and capping rates is shown for specific choices of those variables and for paygrades of Major through BrigGen. The MIL-PAY column shows current monthly military pay. The next two columns show the "breakeven" monthly and yearly starting civilian salaries. This sample is titled Figure 9.

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What interest rate (discount rate) would you like to use?
Pick a rate which is over and above the inflation rate.   .045
Input as a decimal: e.g. 4% entered as .04

What is your rank?   5
Input your pay grade: e.g. LtCol entered as 5

What is your time in service for pay?   20
Enter one of the following: 20, 22, 24, 26, 28

At what annual rate would you expect your civilian pay to rise?
The same figure will be used for 10 consecutive raises.   .025
Enter as a decimal: e.g. 3.1% as .031

How old were you when you began service?   24
Enter your age to the whole year: e.g. 21

What annual retired pay cap do you expect?
Pay cap chosen will be applied annually from retirement till
you are 62 years of age.   Choose some percentage from 0 to 3%.   .012
Enter your choice as a decimal: e.g. as .02 for two percent.

THE PRESENT VALUE OF TWO MORE YEARS MILITARY INCOME IS $ 95600.3

THE PRESENT VALUE OF RETIRED PAY IN 2 YEARS IS $ 314930

THE PRESENT VALUE OF CIVILIAN PAY STARTED IN 2 YEARS IS $ 577145

        THE VALUE OF DELAYED RETIREMENT IS .... $ 987675

THE PRESENT VALUE OF IMMEDIATE RETIRED PAY IS $ 316495

THE PRESENT VALUE OF IMMEDIATE CIVILIAN PAY IS $ 671180

        THE VALUE OF IMMEDIATE RETIREMENT IS .... $ 987675

THE CIVILIAN PAY WHICH IS YOUR BREAKEVEN POINT IS $ 39398.2

Fig. 8

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Fig. 9

I   is the interest rate (4%)
RAISES are annual raises in civilian pay (2%)
CAP is the annual loss of retired pay to inflation (1%)
GRADE is the officer paygrade (4 - 7)
TIS is the time in service for pay purposes

I	RAISES	CAP	GRADE	TIS	MIL-PAY	MO-CIV-PAY	YR-CIV-PAY
4	2	1	4	20	3565	2747.53	32970.3
4	2	1	5	20	4071	3562.05	42744.6
4	2	1	5	22	4190	3044.14	36529.7
4	2	1	5	24	4190	2861.73	34340.7
4	2	1	5	26	4190	2675.9	32110.8
4	2	1	6	20	4478	4233.51	50802.1
4	2	1	6	22	4697	3407.71	40892.5
4	2	1	6	24	4697	4561.08	54733
4	2	1	6	26	5035	3194.06	38328.7
4	2	1	6	28	5035	2961.64	35539.7
4	2	1	7	24	5695	3864.4	46372.8
4	2	1	7	26	5695	3605.12	43261.5
4	2	1	7	28	5695	3340.6	40087.2

MILPAY is for the given rank and TIS
MO-CIV-PAY & YR-CIV-PAY are the monthly and yearly civilian
    pay which make retirement a "breakeven" proposition.

SECTION FIVE

RESULTS

The Present Value of the Retired Pay

The first step in the analysis was to determine the present value of the retirement streams of income for different paygrades, different years of service, different interest rates, and different annual retired pay caps. Were the decision of the individual to rest solely on receiving the most valuable retirement package, at relatively low interest and capping rates, a Major would remain till mandatory retirement at 22 years time in service. A Lieutenant Colonel would remain till 26 years, retiring two years prior to the mandatory point. A Colonel would remain till 26 years and separate after receiving the significant "fogey" at 26. A Brigadier General would retire at 26 -- the increasing percentage of base pay having finally been more than offset by the fewer years of retirement left.

At a relatively low interest rate and high cap, the Major retires at 20, the LtCol at 22 (unless promoted), the Col at 26 again, and the BrigGen at 24. No earlier possible retirement was allowed for BrigGen's due to the rarity of 20 year promotees to that rank. Nor were promotion possibilities calculated for any rank.

At relatively moderate interest rates (4%) with no capping O-4 thru O-7's retired at 20, 22, 26, and 24 respectively. High rates of capping (3%) led all but Col's to retire as early as possible. The 26 year point remained optimal for O-6's.

At high interest rates, even O-6's exited at 20 years of
service with as little as a 1% annual cap. Selected data is
contained in Appendix B. Figure 10 shows how to read that data.

— — — — — — — — — — — — —

Fig. 10

The information at the top shows choices of interest
rate, capping rate, and age on entering service.

G	TIS	PV FOR TIS	PV FOR TIS+2	EXTRA PV FOR +2
5	20	517,378	542,796	+25,418

where   G is officer paygrade (5 = LtCol/Commander)
        TIS is "time in service" for pay
        PV FOR TIS is the present value of retirement
            pay for immediate retirement w/ 20 years
        PV FOR T+2 is the present value of retirement
            pay w/ 22 years TIS
        EXTRA PV FOR +2 is the numerical difference

Note that for some years a minus "EXTRA" means that
there is less PV for more years of service.

— — — — — — — — — — — — —

Level versus Increasing Civilian Pay

Level civilian pay means that a retiree would assume
civilian employment immediately upon retirement from active duty
and remain at the same salary till civilian retirement at age 62.
No civilian retirement checks are included, so the relevant
civilian pay for decision makers should consider that as value to
be added to the gross monthly pay.

One choice variable mentioned above is the rate of annual
growth of civilian pay. The functional restriction is placed

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that civilian pay would grow at that rate and immediately level off after 10 years of civilian employment. The growth of pay is expected to allow the civilian break-even starting salary to decrease because lower initial salary is offset by greater salary later. The sensitivity of the breakeven salary was isolated for moderate interest and cap rates (4% and 2%) for a LtCol at 20 years and for a Col at 24 years. The breakeven salary decreased by approximately $1600 for each 0.5% increase in raises. Selected data is presented in Appendix C.

The Influence of Age

Age played a very minor factor, partially because of its real influence and partially because of simplifying constraints. For an entry age onto active duty between 21 and 26, the breakeven salary for a LtCol varied by $600 per year; for a Col, by $1700 per year. The imposed constraint was an expected age of death of 75. The mortality tables [2] indicate ages from 74-76 for retirement ages between 21 and 54. Selected data is presented in Appendix D.

The Influence of the Interest Rate Choice

Changes in the discount rate were expected to cause significant changes in the breakeven income. Greater discount rates cause near-term income to be weighted much heavier than income to be received further into the future. The relative weights are shown in Fig. 5. The difference between 0% and 10% discounting caused the LtCol, 20 year breakeven salary to range between $46,000 and $33,000. For a Col at 24, the salary ranged

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from $61,000 to $39,000. This should emphasize the importance of the choice of discount rate to match individual circumstances. Selected data is presented in Appendix E.

Capping Retired Pay

Capping of retired pay lowers the breakeven civilian salary more the greater is the size of the cap (for caps levied to age 62). For the 20 year LtCol, no cap yields a salary of $41,000, but a 4% cap yields a $35,000 salary. Thus the influence of such a policy option is to reduce the attractiveness of military service to the retirement eligible member. The value of uncapped income rises in proportion to the capped income. This occurs despite the ability to avoid part of the application of the cap by remaining on active duty longer. Similar results, though for a greater dollar range, exist for the Colonel. The range is from $53,000 to $43,000 as the cap rises from 0% to 4% per annum.

The opposite results appear from an inspection of data when the pay cap policy is a "one shot affair" to run for a set number of calendar years. The data was computed for 10 years application of capping. The incentive was to stay on active duty longer (leave only for a higher salary) to avoid the years that the cap was scheduled to exist. Such a cap is a "full career incentive" to senior members even if it would not be a "career incentive" to junior service members. Selected data is presented in Appendix F.

SECTION SIX

INCORPORATING PROMOTION POSSIBILITIES

This section considers the effects of promotion chances on the decision of a Lieutenant Colonel with 20 years of service. The analysis was based on some simplifying assumptions. The assumed behavior was that the individual would remain in the military to the 26 year point if selected for promotion to Colonel and would retire at the 22 year point if "passed over". The structure of the programming required some explicit behavioral assumptions and these were chosen for a number of reasons. Most individuals selected to Colonel receive word of the selection between 20 and 22 years of service. Acceptance requires service of a minimum of two years in grade. Retirement in grade requires a minimum of three additional years service following "pin on". This puts most Colonels past the 24 year point. Earlier results indicate that most incentives are to remain until the 26 year point. The absence of pay increases past the 22 year point for LtCol's led to that as the choice of separation point for non-selectees.

The breakeven point was again calculated for varying interest rates, civilian pay raises, and retired pay caps. The additional variable was the chances of promotion to Colonel. As the probability of promotion varies greatly by individual, calculations were done over the range of no chance (0%) to surety (100%) in increments of 10%. For a moderate discount rate (4%), moderate civilian raises (2%), and moderate retired pay cap (2)

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the breakeven salary moved from $43,000 to $50,000 to $53,000 as the promotion expectation varied from 0% to 50% to 100% respectively. At a 7% discount rate, the breakeven salaries drop by $5000, $6000, and $7000 respectively, even though the other variables are held constant. Lower discount rates indicate a greater value is placed on the income associated with promotion and retirement at a higher grade. With moderate assumptions, then, an O-5 requires 70-80% of his active duty salary as an inducement to retire at 20 years without "looking at the board". Higher discounts reduce the civilian salary required by about 10% for each 2% change in discount rate.

SECTION SEVEN

WHAT THIS ANALYSIS DOES AND DOESN'T DO

This analysis is presented acknowledging the following limitations. It does not include any measure of employment sensitivity to the breakeven salaries computed. It considers only discrete two year choices; and does not, for example, compare the 20 year point with the 26 year point. It does not adjust expected mortality for the decision point, though this is believed to cause minimal damage to the conclusions. It does not consider promotion possibilities for any of the decision points. It does not consider all the financial aspects or any of the non-financial aspects of the retirement decision.

This analysis does, however, combine the major financial factors influencing the decision to give the individual a precise rule of action matched to personal circumstances. The individual can base the personal decision on a tailored decision rule: If the anticipated salary is greater than the breakeven points, then retirement is the financially preferred option.

REFERENCES

[1] Roger B. Ibbotson and Rex A. Sinquefield, "Stocks, Bonds, Bills and Inflation: Updates", _Financial Analysts Journal_, July-August 1979, pp. 40-44.

[2] 1980 Commissioners Standard Ordinary Mortality Table _1984 Best's Flitcraft Compend_, pg. 662.

```
10 'PROGRAM = ONETIME
20 PRINT "++++++++++++++++++++ PROGRAM  =  ONETIME.BAS ++++++++++++++++++++++++++"
30 PRINT: PRINT
50 PRINT: PRINT
60 '
70 '
80 '
90 '======= QUERIES FOR SPECIFIC VARIABLE CHOICES ==================
100 'I IS THE REAL RATE OF INTEREST TO BE USED FOR DISCOUNTING
110 PRINT "What interest rate (discount rate) would you like to use?"
120 PRINT "Pick a rate which is over and above the inflation rate."
130 PRINT "Input as a decimal: e.g. 4% entered as .04     "
140 INPUT I
150 IF I<0 THEN GOTO 100
160 IF I>.2 THEN GOTO 100
170 PRINT
180 PRINT "What is your rank?
190 PRINT "Input your pay grade: e.g. LtCol entered as 5     "
200 INPUT GRADE
210 IF GRADE<1 THEN GOTO 180
220 IF GRADE>7 THEN GOTO 180
230 PRINT
240 PRINT "What is your time in service for pay?"
250 PRINT "Enter one of the following: 20, 22, 24, 26, 28"
260 INPUT S2
270 IF S2 = 20 THEN GOTO 320
280 IF S2 = 22 THEN GOTO 320
290 IF S2 = 24 THEN GOTO 320
```

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```
300 IF S2 = 26 THEN GOTO 320
310 IF S2 = 28 THEN GOTO 320 ELSE GOTO 250
320 PRINT
330 PRINT "At what annual rate would you expect your civilian pay to rise?"
340 PRINT "The same figure will be used for 10 consecutive raises."
350 PRINT "Enter as a decimal:  e.g. 3.1% as .031  "
360 INPUT RAISES
370 IF RAISES < 0 THEN GOTO 320
380 IF RAISES > .06 THEN GOTO 320
390 PRINT
400 PRINT "How old were you when you began service?"
410 PRINT "Enter your age to the whole year: e.g. 21   "
420 INPUT AGE
430 IF AGE < 17 THEN GOTO 400
440 IF AGE > 24 THEN GOTO 400
450 PRINT
460 PRINT "What annual retired pay cap do you expect?"
470 PRINT "Pay cap chosen will be applied annually from retirement till"
480 PRINT "you are 62 years of age.  Choose some percentage from 0 to 3%."
490 PRINT "Enter your choice as a decimal: e.g. as .02 for two percent."
500 INPUT CAP
510 IF CAP < 0 THEN GOTO 460
520 IF CAP > .035 THEN GOTO 460
530 PRINT
540 '
550 '
560 '
570 '========= DIMENSION AND FUNCTION STATEMENTS ================
580 DIM B(8,11)          'B IS BASE PAY FOR PAYGRADE=G AND SERVICE=S
590 DIM Q(8)             'Q IS QUARTERS ALLOWANCE FOR PAYGRADE
```

```
600  DIM M(8,11)                    'M IS MILITARY PAY = B+Q+F
610  DIM R(8,11)                    'R IS RETIRED PAY FOR GRADE,SERVICE
620  DEF FNPV(INTEREST,TERM) = (1/(1+INTEREST)^TERM)
630  DEF FNBUMPS(ANNUAL,TERMS) = ((1+ANNUAL)^TERMS)
640  DEF FNRETCAP(CAP,TIME) = (1/(1+CAP)^TIME)
650  DIM FACTOR(39)        'PRESENT VALUE FACTOR FOR YEARS O THRU 33
660  DIM BUMP(11)              'PAY RAISES FOR O THRU 10 YEARS AS CIVILIAN
670  DIM FCAP(26)              'RETD PAY CAP FACTOR FROM NOW FOR 10/25 YEARS
680  '
690  '
700  '
710  '======== INPUT CURRENT PAY DATA (A/O 1 JAN 85)  =========================
720  LET F=106              'F IS FOOD ALLOWANCE
730  '
740  FOR G=1 TO 7
750  READ Q(G)
760       DATA 324,361,421,505,552,599,661
770  NEXT G
780  '
790  FOR G=1 TO 7
800  FOR S1=20 TO 30 STEP 2       'S1 IS SERVICE TIME
810  LET S = S1-20               'S  IS SERVICE TIME OVER 20 YEARS
820  READ B(G,S)
830       DATA 1857,1857,1857,1857,1857,1857
840       DATA 2195,2195,2195,2195,2195,2195
850       DATA 2592,2592,2592,2592,2592,2592
860       DATA 2954,2954,2954,2954,2954,2954
870       DATA 3413,3532,3532,3532,3532,3532
880       DATA 3773,3992,3992,4330,4330,4330
890       DATA 4928,4928,4928,4928,4928,4928
```

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```
900       LET M(G,S) = B(G,S) + Q(G) + F           'TOTALING MILITARY PAY
910       LET R(G,S) = B(G,S) * (.5 + .025*S)       'CALCULATE RETIRED PAY
920  NEXT S1
930  NEXT G
940  .
950  .
960  .
970  G=GRADE
980  '======== SET INTEREST/DISCOUNT RATE =================================
990  FOR YEARS = 0 TO 33 STEP 1 : LET FACTOR(YEARS)=FNFV(I,YEARS)
1000 NEXT YEARS
1010 .
1020 .
1030 .
1040 '======== SET CIVILIAN PAY RAISE RATE  ==============================
1050 FOR YEARS = 0 TO 10 STEP 1 : LET BUMP(YEARS)=FNBUMPS(RAISES,YEARS)
1060 NEXT YEARS
1070 .
1080 .
1090 .
1100 '======== SET RETIRED PAY CAP TILL AGE 62 ===========================
1110 FOR YEARS = 0 TO 25 STEP 1 : LET FCAP(YEARS)=FNRETCAP(CAP,YEARS)
1120 NEXT YEARS
1130 .
1140 .
1150 .
1160 '====== CALCULATE PRESENT VALUES ====================================
1170 'NOTE: COMPUTED VALUES ARE ZEROED BECAUSE OF ITERATIVE ADDITIONS
1180 LET PMISUM=0 : PRISUM=0 : FROSUM=0 : FCOSUM=0 : PCISUM=0
1190 LET S = S2 - 20
```

A-4

```
1200 LET DIE = 75 - AGE - S2
1210 'NOTE THAT MORTALITY TABLES SHOW DIE AGE FROM 74 TO 76
1220 ' FOR (AGE + S2) BETWEEN 41 AND 54
1230 LET CRET = DIE - 10
1250 .
1260 FOR YMI = 0 TO 1 STEP 1
1270 PMISUM = PMISUM + FACTOR(YMI)
1280 NEXT YMI
1290 PMISUM = PMISUM * M(G,S)
1300 .
1310 FOR YRI = 2 TO DIE STEP 1
1320 IF YRI<CRET THEN YRICAP=YRI ELSE YRICAP=CRET
1330 LET PRISUM = PRISUM + FACTOR(YRI) * FCAP(YRICAP)
1340 NEXT YRI
1350 LET PRISUM = PRISUM * R(G,S+2)
1360 .
1370 FOR YRO = 0 TO DIE STEP 1
1380 IF YRO<CRET THEN YROCAP=YRO  ELSE  YROCAP=CRET
1390 PROSUM = PROSUM + FACTOR(YRO) * FCAP(YROCAP)
1400 NEXT YRO
1410 LET PROSUM = PROSUM * R(G,S)
1420 .
1430 FOR YCO = 0 TO CRET STEP 1
1440 IF YCO<10.1 THEN PCO=FACTOR(YCO)*BUMP(YCO) ELSE  PCO=FACTOR(YCO)*BUMP(10)
1450 LET PCOSUM = PCOSUM + PCO
1460 NEXT YCO
1470 .
1480 FOR YCI = 2 TO CRET STEP 1
1490 LET YCI2 = YCI - 2
```

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```
1500 IF YCI2<10.1 THEN PCI=FACTOR(YCI)*BUMP(YCI2) ELSE PCI=FACTOR(YCI)*BUMP(10)
1510 PCISUM = PCISUM + PCI
1520 NEXT YCI
1530
1540 LET C = ( (PMISUM + PRISUM - PROSUM) / (PCOSUM - PCISUM) )
1550 LET CYR=C*12
1560 .
1570 .
1580 .
1590 '========= PRINTOUT ============================================
1600 PRINT CHR$(12)
1610 MY = PMISUM * 12
1620 PRINT "THE PRESENT VALUE OF TWO MORE YEARS MILITARY INCOME IS      $";MY
1630 PRINT
1640 RYI = PRISUM * 12
1650 PRINT "THE PRESENT VALUE OF RETIRED PAY IN 2 YEARS IS            $";RYI
1660 PRINT
1670 PCISUMM = PCISUM * CYR
1680 PRINT "THE PRESENT VALUE OF CIVILIAN PAY STARTED IN 2 YEARS IS   $";PCISUMM
1690 PRINT
1700 INN = MY + RYI + PCISUMM
1710 PRINT "   THE VALUE OF DELAYED RETIREMENT IS ...............    $";INN
1720 PRINT:PRINT:PRINT
1730 RYO = PROSUM * 12
1740 PRINT "THE PRESENT VALUE OF IMMEDIATE RETIRED PAY IS            $";RYO
1750 PRINT
1760 PCOSUMM = PCOSUM * CYR
1770 PRINT "THE PRESENT VALUE OF IMMEDIATE CIVILIAN PAY IS           $";PCOSUMM
1790 OUTT = PCOSUMM + RYO
```

A-6

```
1800 PRINT
1810 PRINT "      THE VALUE OF IMMEDIATE RETIREMENT IS ........... $";OUTT
1820 PRINT:PRINT:PRINT
1830 PRINT "THE CIVILIAN PAY WHICH IS YOUR BREAKEVEN POINT IS $";CYR
1850 PRINT
1860 PRINT "To rerun this program type: RUN, then hit the RETURN key."
1870 END
```

```
INTEREST RATE = .01
 RETD PAY CAP = .01
 ENTERING AGE = 22
```

G	TIS	PV FOR TIS	PV FOR TIS+2	EXTRA PV FOR +2
4	20	447798	453969	6171.19
5	20	517378	542796	25417.9
5	22	564836	565825	989
5	24	588799	583309	-5489.88
5	26	606994	594933	-12061.2
6	20	571951	613489	41537.9
6	22	638398	639516	1117.75
6	24	665483	715099	49615.9
6	26	744134	729348	-14786.3
6	28	758962	736002	-22960.5
7	24	821518	813858	-7659.56
7	26	846904	830076	-16828.3
7	28	863780	837649	-26131.3

INTEREST RATE = .01
RETD PAY CAP = .03
ENTERING AGE = 22

G	TIS	PV FOR TIS	PV FOR TIS+2	EXTRA PV FOR +2
4	20	347926	344481	-3444.91
5	20	401987	411884	9897
5	22	445751	436398	-9352.78
5	24	472280	457605	-14675.3
5	26	495231	475137	-20093.6
6	20	444388	465527	21138.7
6	22	503804	493233	-10570.9
6	24	533789	560994	27204.7
6	26	607121	582487	-24633.4
6	28	630381	598978	-31403.1
7	24	658946	638470	-20475.6
7	26	690968	662932	-28035.6
7	28	717441	681701	-35740.1

INTEREST RATE = .04
RETD PAY CAP = .01
ENTERING AGE = 22

G	TIS	PV FOR TIS	PV FOR TIS+2	EXTRA PV FOR +2
4	20	302293	294465	-7828.06
5	20	349264	352081	2817.94
5	22	388465	374140	-14325.6
5	24	412803	393426	-19377.1
5	26	434083	409560	-24523.1
6	20	386104	397936	11832.2
6	22	439058	422867	-16191.4
6	24	466566	482315	15748.8
6	26	532157	502093	-30063.8
6	28	553980	517479	-36500.2
7	24	575961	548926	-27035.7
7	26	605651	571436	-34215.7
7	28	630488	588946	-41541.1

```
INTEREST RATE = .07
 RETD PAY CAP = .01
 ENTERING AGE = 22
```

G	TIS	PV FOR TIS	PV FOR TIS+2	EXTRA PV FOR +2
4	20	221388	205990	-15398.1
5	20	255788	246295	-9492.55
5	22	287651	264840	-22811.7
5	24	309309	282043	-27266.2
5	26	329402	297618	-31783.5
6	20	282768	278372	-4395.84
6	22	325114	299332	-25782.6
6	24	349593	345766	-3826.75
6	26	403825	364860	-38964.5
6	28	426125	381532	-44592.5
7	24	431562	393519	-38042.9
7	26	459595	415250	-44345.8
7	28	484975	434224	-50750.9

```
DISCOUNT RATE      .04
RAISES             ### TESTING THIS VARIABLE ###
CAP                .02
AGE ENTERED        22
RANK               5
YRS SERVICE        20
RET POLICY         2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
0	48852	47867.4
.005	48852	45963.9
.01	48852	44134.3
.015	48852	42376
.02	48852	40686.7
.025	48852	39063.7
.03	48852	37505
.035	48852	36008.2
.04	48852	34570.9
.045	48852	33191.2
.05	48852	31866.8
.055	48852	30595.6
.06	48852	29375.6

```
DISCOUNT RATE      .04
RAISES             ### TESTING THIS VARIABLE ###
CAP                .02
AGE ENTERED        22
RANK               6
YRS SERVICE        24
RET POLICY         2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
0	56364	60702.3
.005	56364	58288.5
.01	56364	55968.3
.015	56364	53738.4
.02	56364	51596.1
.025	56364	49538
.03	56364	47561.4
.035	56364	45663.2
.04	56364	43840.6
.045	56364	42090.8
.05	56364	40411.3
.055	56364	38799.3
.06	56364	37252.2

```
DISCOUNT RATE      .04
RAISES             .03
CAP                .02
AGE ENTERED        ### TESTING THIS VARIABLE ###
RANK               5
YRS SERVICE        20
RET POLICY         2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
21	48852	37458.7
22	48852	37505
23	48852	37357.4
24	48852	37200.8
25	48852	37034.8
26	48852	36858.6

```
DISCOUNT RATE      .04
RAISES             .03
CAP                .02
AGE ENTERED        ### TESTING THIS VARIABLE ###
RANK               6
YRS SERVICE        24
RET POLICY         2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
21	56364	47874.2
22	56364	47561.4
23	56364	47229.4
24	56364	46877.4
25	56364	46503.9
26	56364	46107.7

```
DISCOUNT RATE     ### TESTING THIS VARIABLE ###
RAISES            .03
CAP               .02
AGE ENTERED       22
RANK              5
YRS SERVICE       20
RET POLICY        2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
0	48852	46195
.01	48852	43288.5
.02	48852	40947.6
.03	48852	39050.9
.04	48852	37505
.05	48852	36237.7
.06	48852	35192.4
.07	48852	34325.5
.09	48952	33602.2
.09	48852	32995.2
.1	48852	32463.1

```
DISCOUNT RATE     ### TESTING THIS VARIABLE ###
RAISES            .03
CAP               .02
AGE ENTERED       22
RANK              6
YRS SERVICE       24
RET POLICY        2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
0	56364	61127.4
.01	56364	56760.9
.02	56364	53133.4
.03	56364	50104.2
.04	56364	47561.4
.05	56364	45415.6
.06	56364	43595.3
.07	56364	42042.9
.08	56364	40712.1
.09	56364	39565.2
.1	56364	38571.7

```
DISCOUNT RATE     .04
RAISES            .03
CAP               ### TESTING THIS VARIABLE ###
AGE ENTERED       22
RANK              5
YRS SERVICE       20
RET POLICY        2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
0	48852	41681
.005	48852	40488.6
.01	48852	39402
.015	48852	38410.6
.02	48852	37505
.025	48852	36676.7
.03	48852	35918.2
.035	48852	35222.9
.04	48852	34584.6

```
DISCOUNT RATE     .04
RAISES            .03
CAP               ### TESTING THIS VARIABLE ###
AGE ENTERED       22
RANK              6
YRS SERVICE       24
RET POLICY        2
```

VARIABLE	YR-MIL-PAY	YR-CIV-PAY
0	56364	53843.9
.005	56364	52080.2
.01	56364	50452.9
.015	56364	48950.3
.02	56364	47561.4
.025	56364	46276.6
.03	56364	45087
.035	56364	43984.7
.04	56364	42962.4

F-1

END

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