A SAS PROCEDURE FOR AFTER TAX INVESTMENT ANALYSIS
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1. Introduction

PROC ROR is described below. This procedure processes the annual costs and revenues associated with a capital asset over the specified life of the asset. A financial report is generated by the procedure. This report computes capital gains and income taxes and produces a tabulation of the cash flows before and after taxes, and allows for a portion of the initial capital to be borrowed at a specified interest rate.

From the cash flow after taxes, a rate of return is computed as well as the net present worth of the after tax cash flow for a range of interest rates.

PROC ROR is implemented using a stand-alone FORTRAN program called ATXROR, developed by the authors at West Virginia University for use in the classroom. The SAS implementation retains the ATXROR program intact. Five parameter cards are used with the procedure to provide parameters in the format expected by ATXROR. Annual revenues and costs are read in using SAS and then converted to a format expected by ATXROR and passed along with the parameter data to ATXROR.

Background discussion of the rate of return method is presented below. This is followed by details on how to run and interpret PROC ROR.

2. A General Model for Rate of Return

After tax rate of return criteria for investment analysis is one of the most popular methods for investment decision making. In this model, the annual gross revenue is known and we compute the rate of return for an investment proposal. The following variables are used in the model:

- \( R \) = The annual gross revenue before taxes and loan payments
- \( d \) = The initial debt ratio. In other words, \( d \times 100\% \) of the capital investment is borrowed at the time of investment.
- \( P \) = Asset first cost
- \( N \) = The investment life.
- \( t \) = Loan repayment period. If the asset is sold before \( t \), i.e. \( N > t \) then the unpaid balance of \( N \) must be repaid.
- \( r \) = The loan rate i.e. the cost of borrowed capital.

For each year \( k, k=1, 2, \ldots, N \), let

\[ I(k) = \text{The interest payment on the loan} \]
\[ UB(k) = \text{The unpaid balance} \]
\[ RP(k) = \text{The total loan repayment} \]
\[ PRIN(k) = \text{The principal part of} \ RP(k). \]

Therefore, \( PRIN(k) = RP(k) - I(k) \).

For a uniform annual end of year repayment plan,

\[ RP(k) = P^d(A/P, r, t) \]

where \((A/P, r, t)\) is the well known capital recovery factor \((1)\), and \(I(k)\) and \(PRIN(k)\) are computed recursively starting from \(UB(0) = P^d\)

\[ I(k) = UB(k-1) \times r \]
\[ PRIN(k) = RP(k) - I(k) \]
\[ UB(k) = UB(k-1) - PRIN(k) \]

For each year \( k, k=1, 2, \ldots, N \), the taxable income is given by

\[ TI(k) = R - OD(k) - D(k) - I(k) \]

where

\[ OD(k) = \text{The operating expenses} \]
\[ D(k) = \text{The depreciation charge, which may be assumed straight line, sum of the years digits or double rate declining balance method} \]

Let \( t \) = The marginal income tax rate. It is assumed that the decision maker pays \( t \times 100 \) dollars tax for every additional \$100 taxable income

Therefore, for every year \( k \), the income tax

\[ IT(k) = t \times TI(k) \]

At the end of year \( N \), the asset is sold. If the resale value of the asset is more than the book value, capital gains tax must be paid at the CGTAX rate. It is assumed that the capital gain cannot be offset by a capital loss during that year. At the end of year \( N \), the book value

\[ BV(N) = P - \sum_{k=1}^{N} D(k) \]

and the resale value is \( Z \). Then the capital gain is given by:

\[ CG = Z - BV(N) \]

Therefore, the capital gain tax is

\[ GAIN_{\text{TAX}} = CG \times CGTAX \]
Notice that negative CG implies a capital loss and consequently negative GAIN TAX implies a tax savings.

For every year \( k \), the cash flow after taxes may be computed as

\[
\text{CFAT}(k) = -P + Pd
\]

and

\[
\text{CFAT}(N) = R - OD(N) - RP(N) - IT(N) + Z - UB(N) = \text{GAIN}_{\text{TAX}}
\]

In order to compute the rate of return on the equity investment, we set up the net present worth (NPW) equation and compute the NPW for various values of interest rate \( i \). Therefore,

\[
\text{NPW}(i) = \sum_{k=1}^{N} \text{CFAT}(k) \cdot (P/F, i, k)
\]

The \( i^* \) that gives \( \text{NPW}(i^*) = 0 \) is the rate of return on the equity investment.

3. Procedure Input

Procedure ROR is invoked as follows

```
PROC ROR R=variable C=variable D=method; PARMCARDS:
```

```
(4 cards)
```

Parameters \( R \) and \( C \) in the PROC card are used to name the SAS variables in the input data set which are to be interpreted as annual revenues (\( R \)) and annual costs (\( C \)). Parameter \( D \) specifies the desired depreciation method. (STL = straight line, SYD = sum of years digits, DDB = double declining balance.) See, for example, reference (1). Parameter \( D \) defaults to STL when not specified. Parameters \( R \) and \( C \) must be provided.

The four required parmcards are set up to be read by the FORTRAN program ATXROR. The appropriate READ and FORMAT statements from ATXROR are given below. Data must be punched on the parmcards as specified by the FORMAT statements.

Parmcard #1 (Asset Card)

```
READ(5,100) FCSTAS, SALVAS, LIFEAS
100 FORMAT(2F10.0, I3)
```

where: FCSTAS = First cost of the asset
SALVAS = Salvage value of the asset
LIFEAS = Length of time the asset is kept (years)

Parmcard #2 (Loan Card)

```
READ(5,102) AMTBOR, APRLN, LIFE LN
102 FORMAT(2F10.0, I3)
```

where: AMTBOR = Amount of the asset first cost which is borrowed.
APR LN = Annual loan interest rate (0.00 - APR - 1.0)
LIFE LN = Years the loan is to run.

Parmcard #3 (Tax Rate Card)

```
READ(5,106) IT RATE, CG R AT E
106 FORMAT(2F10.0)
```

where: IT RATE = Marginal income tax rate.
CG RATE = Capital gains tax rate.

Parmcard #4 (Depreciation Card)

```
READ(5,104) FCSTBK, SALV BK, LIFEBK
104 FORMAT(2F10.0, I3)
```

where: FCSTBK = Initial book value
SALV BK = Final book value
LIFEBK = Years from initial to final book value.

To illustrate the input for PROC ROR, consider the following example problem. A piece of rental property is purchased for \( $80,000 \). The down payment is \( $40,000 \) and the remaining \( $40,000 \) is borrowed at 10% (annual interest) for a fifteen year term. The property is to be written off (depreciated) for tax purposes from \( $80,000 \) to \( $20,000 \) over a 20 year term using the DDB method. After 7 years the property is sold for \( $100,000 \). The marginal income tax rate is 35% (of taxable income) and the applicable capital gains tax rate is 30% (of capital gains).

Cross annual income and operating expenses for the 7 years the property is owned are \( $10,000 \) and \( $2,500 \) respectively and are contained in SAS input data set XI with SAS names \( Y \) and \( W \), respectively. (There may be up to 100 records with values of \( Y \) and \( W \), but only the first 7 are used by PROC ROR.) PROC ROR for this example could be used as shown below.

```
DATA XI:
INPUT X Y Z W;
CAR DS;
```

```
PROC ROR R=Y C=W D=DDB;
PARMCARDS:
80000. 10000. 007
60000. .10 025
13 .30
80000. 20000. 020
```

```
4. Procedure Output

The output of PROC ROR is in three sections. The first section provides an echo check printout of the input parameters. The second section provides a tabular listing for each year (7 in this example) of the following items.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>GROSS REVENUE</th>
<th>OPERATING COSTS</th>
<th>LOAN PAYMENT (END OF YEAR)</th>
<th>CFBT (CASH FLOW BEFORE TAXES)</th>
<th>ANNUAL PRINCIPAL</th>
<th>ANNUAL INTEREST</th>
<th>UNPAID DEBT (END OF YEAR)</th>
<th>ANNUAL DEPRECIATION</th>
<th>BOOK VALUE (END OF YEAR)</th>
<th>TOTAL DEDUCTIONS</th>
<th>TAXABLE INCOME</th>
<th>INCOME TAX</th>
<th>CFAT (CASH FLOW AFTER TAXES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR</td>
<td>GROSS REVENUE</td>
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<td>LOAN PAYMENT (END OF YEAR)</td>
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<td>ANNUAL INTEREST</td>
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<td>TAXABLE INCOME</td>
<td>INCOME TAX</td>
<td>CFAT (CASH FLOW AFTER TAXES)</td>
</tr>
</tbody>
</table>

Totals are also printed for each item in the above list except BOOK VALUE and UNPAID DEBT.

The third and final section of the output provides a financial summary report. The report for the example problem is given below.

**FINANCIAL SUMMARY REPORT**

**SALES PRICE - BOOK VALUE = $61736.**

**CAPITAL GAINS TAX = $18521.**

**SALES PRICE OF ASSET = $100000.**

**LESS UNPAID LOAN DEBT = $71944.**

**LESS CAPITAL GAINS TAX = $3423.**

**AFTER TAX RATE OF RETURN: 0.111**

<table>
<thead>
<tr>
<th>INTEREST</th>
<th>NET PRESENT WORTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATE (PCT)</td>
<td>AFTER TAXES</td>
</tr>
<tr>
<td>0.00</td>
<td>34047.</td>
</tr>
<tr>
<td>0.05</td>
<td>15325.</td>
</tr>
<tr>
<td>0.10</td>
<td>2266.</td>
</tr>
<tr>
<td>0.15</td>
<td>-7026.</td>
</tr>
<tr>
<td>0.20</td>
<td>-13762.</td>
</tr>
<tr>
<td>0.25</td>
<td>-18731.</td>
</tr>
<tr>
<td>0.30</td>
<td>-22457.</td>
</tr>
<tr>
<td>0.35</td>
<td>-25294.</td>
</tr>
<tr>
<td>0.40</td>
<td>-27487.</td>
</tr>
<tr>
<td>0.45</td>
<td>-29206.</td>
</tr>
</tbody>
</table>

The capital gains (Sales price-book value) are $61,736; and the capital gains tax is $18,521. When this is paid as well as the unpaid loan debt of $28,056 the net amount realised on the sale is $53,423. The rate of return is computed using this amount as well as the seven values of CFAT and the initial down payment of $40,000. The rate of return is 11.11.

The summary report also lists the net present worth (after taxes) for interest rates from 0% to 45% increasing in 5% increments. The net present worth is zero for an interest rate equal to the rate of return.

The net present worth NPW has a useful interpretation for investment analysis. If an investor knows what interest rate he will be satisfied with, then the NPW can be thought of as a bonus or penalty to him to be paid upon his entry into the investment scheme under consideration, if that scheme were to earn his satisfying interest rate. For the example problem, an investor who would be satisfied earning 5% on his money would find that his 5% would be earned as well as a $15,325 bonus. On the other hand, an investor who wishes to make 15% would find a discouraging $7,026 penalty to be paid.

It should be noted that investments requiring no down payment have an infinite rate of return and positive values of NPW for each finite interest rate. Investments such as these will cause PROC ROR to return an undefined rate of return.

Those persons wishing to obtain copies of PROC ROR are invited to contact the authors at West Virginia University.

**References**