A FARM CREDIT DEBT SELECTION MODEL

Description and Application

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FOREWORD

This Farm Credit Debt Selection Model is being made available so that Banks of the Farm Credit System may use it as a tool in making their debt selection decisions. Although the model is operational in its present state of development, most banks will find it convenient to make modifications in the model and programs to meet their individual requirements. The programs are nonproprietary and may be used or modified in any manner.
A Farm Credit Debt Selection Model: Description and Application

Introduction

The primary funding objective of a Farm Credit Bank is to obtain the necessary debt funds for its lending operations at the lowest possible cost. Fulfilling this objective entails decisions of participation in the various Farm Credit System securities. Participation decisions in present and future securities are based upon present and future debt needs and costs. Because future debt needs and costs are not known with certainty, participation decisions are necessarily complex and difficult. Complexity exists because of the numerous debt participation options that are possible. Even if future interest rates could be known with certainty, they often peak and ebb at various times. It is, therefore, a tedious job to determine the future debt participation options that would result in the lowest cost. However, because future interest rates are not known with certainty, participation decisions become very difficult.

Participation decisions are often based upon expected debt needs and costs. Unfortunately, selecting the lowest expected cost participation strategy is no guarantee that the selected strategy will in fact be the lowest cost strategy, since actual costs may deviate greatly from expected costs. This manuscript discusses a technique, called quadratic risk programming, that sorts through all participation possibilities and selects strategies that have low expected costs and low risks, such that actual costs will not deviate greatly from expected costs. The model does not forecast interest
rates or debt needs. Rather, it uses projections provided by the user to generate low expected cost and low risk debt participation strategies. The model is user oriented; it queries the operator for information and data that it needs.

The remainder of this manuscript is divided into sections discussing the details and operation of the debt selection model. The first section covers the basic concepts of the quadratic risk programming model using a simple example. Then, the characteristics of the model for selecting Farm Credit securities are specified. The third section is a user's guide for operating the model. The final section is a technical section which specifies the assumptions and equations used in the model. The Appendices include a sample application as well as a listing of the computer programs.

A Two-Period Quadratic Debt Selection Model

A simple two-period case illustrates the concepts of the debt selection model. In the first period two bonds can be issued. One bond has a duration of one period. The other bond has a duration of two periods. In the second period, there is one bond option that is a one-period duration bond. To meet the funding needs over the two periods, there are only two basic options: either fund with a long-term bond or fund with two short-term bonds. However, it is possible to use some combination of the two options in various proportions.

The selection of a bond issuance strategy depends upon interest rate movements and funding needs during the two periods. Funding needs must be met and may affect the selection of bond activities.
In this two period case, if funding needs increase in the second period, it is necessary to use the one-period bond of the second period to fund that increase. In contrast, if funding needs decrease in the second period, it is necessary to use the one-period bond of the first period in at least the amount of the decrease. (Short-term investment options are not included in the model, but they could be added.)

The expected costs of the three bonds and their cost risks also influence the selection of bonds. The goal is to select the minimum cost bond strategy. Because costs are not known with certainty, we must attempt to select the minimum cost bond strategy using expected bond costs, recognizing that some bond strategies have a greater risk than other bond strategies, such that the actual cost may deviate greatly from expected cost. Cost risk is measured by the variance of cost.

In the model, both expected cost and variance of cost are minimized. The minimum expected cost bond strategy, however, is rarely the minimum variance bond strategy. In fact, there is a tradeoff between expected cost and variance. The lower the expected cost of a bond strategy, the greater is the variance of cost. This relationship is depicted in Figure 1.

In Figure 1, point A is the bond strategy with the lowest expected cost, but that bond strategy has a relatively high variance level (or risk that the actual cost may deviate greatly from the expected cost). In contrast, point E is the bond strategy that has
the lowest variance, but also a high expected cost. Lying between points A and E are bond strategies with various levels of expected cost and variance. What is unique about each of these strategies is that at their respective levels of expected cost, it is not possible to derive any other strategy that has a lower risk. Lying to the right of bond strategies A through E are numerous other bond strategies that could be selected, but should not be chosen because they are undesirable. Regardless of which strategy lying to the right of strategies A through E that you might select, you could always find one of the strategies A through E that has both a lower expected cost and a lower variance. Thus, strategies A through E are efficient bond strategies. Bond strategies lying to the right of strategies A through E are inefficient bond strategies.

In our simple two-period case, let us assume that there are three distinct interest rate scenarios. These three interest rate
projections and their individual probabilities of occurrence are listed in Table 1. The model first converts these interest rates into costs for the duration of each bond. In this example, costs are per $1,000 of debt for a one-year period. The expected cost of each bond is computed by summing the costs multiplied by their respective probabilities. The expected cost of bond 1 is $80(.4)+$70(.3)+$90(.3) = $80. Next, the deviations of each cost projection from the expected costs are calculated. (Cost deviations are also listed in Table 1.) The deviations and the probabilities are used to calculate the variance and covariance coefficients as follows: the deviations are multiplied by themselves (if variance) or by another bond deviation (if covariance) and by the probabilities that the deviation will occur and then summing these values. The variance of bond 1 is $(0)(0)(.4)+(-10)(-10)(.3)+(-10)(10)(.3) = 60$. The covariance of bond 1 and bond 3 is $(0)(6)(.4)+(-10)(6)(.3)+(-10)(-14)(.3) = -60$.

The quadratic programming solution to this simple example is listed in Table 2. There are only two unique bond strategies. In other applications there may be dozens of strategies, especially when more periods and bonds are added to the model. The quadratic programming solution technique is complex and will not be described here. However, it is easy to show how the expected cost and variance of a debt strategy can be computed. The expected cost of a debt strategy is the expected cost of each bond multiplied by the quantity of that bond to be used, summed over all the bonds. For example, in the first strategy the expected cost is 7.3($80) + 2.7($188)+17.3($94) = $2720. The variance is computed by multiply-
Table 1. Input Data for Two Period Model

<table>
<thead>
<tr>
<th>Probability</th>
<th>Bond 1</th>
<th>Bond 2</th>
<th>Bond 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest Rate Projections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.4</td>
<td>.08</td>
<td>.10</td>
<td>.10</td>
</tr>
<tr>
<td>.3</td>
<td>.07</td>
<td>.08</td>
<td>.10</td>
</tr>
<tr>
<td>.3</td>
<td>.09</td>
<td>.10</td>
<td>.08</td>
</tr>
<tr>
<td>Cost Projections</td>
<td>$80</td>
<td>$200</td>
<td>$100</td>
</tr>
<tr>
<td>.4</td>
<td>70</td>
<td>160</td>
<td>100</td>
</tr>
<tr>
<td>.3</td>
<td>90</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>expected cost</td>
<td>80</td>
<td>188</td>
<td>94</td>
</tr>
<tr>
<td>Cost Deviations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.4</td>
<td>0</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>.3</td>
<td>-10</td>
<td>-28</td>
<td>6</td>
</tr>
<tr>
<td>.3</td>
<td>10</td>
<td>12</td>
<td>-14</td>
</tr>
<tr>
<td>Variance - Covariance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bond 1</td>
<td>60</td>
<td>120</td>
<td>-60</td>
</tr>
<tr>
<td>Bond 2</td>
<td>120</td>
<td>336</td>
<td>-72</td>
</tr>
<tr>
<td>Bond 3</td>
<td>-60</td>
<td>-72</td>
<td>84</td>
</tr>
<tr>
<td>Funding Requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period 1</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>Period 2</td>
<td></td>
<td></td>
<td>$20,000</td>
</tr>
</tbody>
</table>

Bond 1 is a one-period, first period bond.
Bond 2 is a two-period, first period bond.
Bond 3 is a one-period, second period bond.
Table 2. Solution to Two-Period Model

<table>
<thead>
<tr>
<th>Strategy 1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond 1</td>
<td>$ 7,300</td>
</tr>
<tr>
<td>Bond 2</td>
<td>$ 2,700</td>
</tr>
<tr>
<td>Bond 3</td>
<td>$17,300</td>
</tr>
<tr>
<td>Expected Cost</td>
<td>$ 2,720</td>
</tr>
<tr>
<td>Variance</td>
<td>$13,636</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>$ 117</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategy 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond 1</td>
<td>$10,000</td>
</tr>
<tr>
<td>Bond 2</td>
<td>$ 0</td>
</tr>
<tr>
<td>Bond 3</td>
<td>$20,000</td>
</tr>
<tr>
<td>Expected Cost</td>
<td>$ 2,680</td>
</tr>
<tr>
<td>Variance</td>
<td>$15,600</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>$ 125</td>
</tr>
</tbody>
</table>

Bond 1 is a one-period, first period bond.
Bond 2 is a two-period, first period bond.
Bond 3 is a one-period, second period bond.
ing the quantity of each bond to be used by itself (if variance) or by another bond quantity (if covariance), and by the variance or covariance value and then summing all terms. The variance of the first strategy is $60(7.3)(7.3)+$336(2.7)(2.7)+$84(17.3)(17.3)+
$120(7.3)(2.7)+(-$60)(7.3)(17.3)+(-$72)(2.7)(17.3)+$120(7.3)(2.7)+
(-$60)(7.3)(17.3)+(-$72)(2.7)(17.3) = $13,636.

The Farm Credit Debt Model

Although the concepts and the solution procedure are the same, there are differences in the above example and the Farm Credit Debt Model. The planning horizon of the Farm Credit Debt Model is one year, so interest rate and debt projections are needed for one year into the future. The model then selects optimal bond and note participations for that year. Bond options include the next 12 monthly six-month and nine-month bonds, and the quarterly long-term bonds. In addition, it is possible to specify long-term bonds for any of the 12 months. For each long-term bond issue date, up to three maturities can be specified. The model also determines the average participation in discount notes between bond dates, but does not determine the participation in specific discount note offerings.

Up to ten separate interest rate projections can be entered. The model uses these projections to compute expected costs and a variance-covariance matrix. The model discounts all interest costs to the present to adjust for differences in the timing of interest payments. This requires 12 monthly discounting rates for each in-
terest rate projection. Projected Treasury Bill rates are suggested as discounting rates.

The model has 16 periods because there are 16 separate bond entry (issue) dates. A debt requirement forecast for each of the 16 periods is required. Eight of the periods are monthly periods, four periods are two-thirds of a month, and four periods are one-third of a month. The eight fraction-month periods occur because of the mid-month quarterly long-term bond issues. A forecast of the average debt needs for each of the periods can be used for the debt requirement forecast under the criterion that any surplus during a period can be invested, and a deficit can be covered by discount notes (or other debt sources) beyond those recommended by the model. As alternatives to the average debt need for the period, it is possible to use the highest debt need, where the surplus is invested, or the lowest debt need, where the deficit is acquired elsewhere, or the debt amount necessary at the start of the period, if all debt is converted into system debt at the start of the period.

Expectation of interest rates and debt needs beyond the one year planning horizon should affect debt selection during the planning horizon. So, to indirectly incorporate interest rates beyond the one year horizon into the model, an ending yield curve is entered for each of the up to ten interest rate projections. The ending yield curve is used to price outstanding bonds at the end of the horizon. The ending prices are used to liquidate all outstanding ending bonds. The result is that only the debt costs during the
planning horizon are computed, but part of that cost is the reflection that the market believes interest rates will move up, move down, or stay constant beyond the planning horizon as reflected in the ending yield curve. The technical section of this manuscript explains the computational procedure in detail.

No adjustment is made for debt needs beyond the planning horizon. Most banks have experienced at least gradual growth in debt needs in recent years. The growth in debt needs has usually been met when needed so that increases in debt needs beyond the planning horizon are generally met by new issues beyond the horizon, even if those issues may be higher in cost. If a bank believes that interest rates will increase substantially after the end of the planning horizon, and also expects its total debt needs will increase after the end of the planning horizon, a larger debt need for the last period can be entered with the knowledge that the excess will be invested until needed. If debt needs will remain constant beyond the planning horizon, but interest rates are expected to increase, the model will adjust automatically by selecting more longer term bonds. The adjustment occurs via the ending yield curve. Declining total debt needs beyond the planning horizon can be accommodated by the user forcing the model to select sufficient short-term securities that will mature as total debt needs decline.

The user can force the model to participate in any specific bond or note issue at a minimum level, or put a maximum ceiling on that participation. The model is thus able to select participation
strategies within many types of debt policy guidelines that a bank has established.

User Instructions for the Farm Credit Debt Model

The model consists of three separate program sections. The first section is a matrix generator. This computer program queries the operator for data and constructs a data input file for the quadratic program. The second section is the quadratic program. The quadratic program uses the matrix generator data input file to compute optimal debt participation options. These options are then placed into a data file. The final section is a report writer. This computer program takes the quadratic program output and prints it in report format. The matrix generator is the only program section that requires data input from the operator. However, editing commands unique to each computer installation will be required by the operator to route output from one program to another. The editing system used at Cornell is the Conversation Monitor System (CMS).

The matrix generator program queries the user for data as the program requires it. In order to have the data when it is needed, the user should first complete data input forms 1 through 4. Each form begins with the month that a quarterly term bond is available. Thus, the first month must be January, April, July, or October. If the current month is not one of those four months it is necessary to begin at the second month (February, May, August, November), or the
third month (March, June, September, December) of the input forms. Then, when the computer asks for data for the first month (and the second month), it is necessary to enter zeros.

Input form 1 allows the user to specify what term bonds will be available in the upcoming year. Input form 2 is used to enter the interest rates of a specific forecast. One input form 2 is used for each interest rate forecast. Input form 3 is used to specify the debt needs of the bank. Input form 4 is used to specify any constraints to be placed on debt participation. Examples of completed forms are shown in Appendix A. The data on the input forms were used as the input data in the computer application that follows the input forms. The example was completed during late October. Because the next current month was November, the model begins with the second month. Zeros are entered in the first month and the first quarter term bond issue (October). Following is a description of the process.

The matrix generator first asks the user when term bonds are to be issued during the upcoming months, the number of term bonds for each month, and the term of each bond. All entries in this section are made without a decimal point except for the terms of the bonds. Terms are entered in years and part years. Thus, a four-year, six-month bond is entered as 4.50. The program also asks for the number of term bonds and their terms for each quarter.

The program then asks for the number of separate interest rate forecasts the user will enter. The user is asked for the probability of the first forecast along with the interest rate forecast.
Since the model discounts all costs to the present, 12 monthly discounting rates are first entered. These rates might be what the user expects 90-day T-bill bond equivalent rates will be for each of the next 12 months. A rate of 11 1/2 percent would be entered as 11.5. If the user wants the model to minimize nondiscounted expected cost and cost variance rather than the present values of the costs, zeros (with a decimal point) can be entered for the 12 discounting rates.

The model then asks for the 16 discount note rates for the upcoming year. Eight of these rates are the average rates for each of the eight months during which a term bond is not available in the middle of the month. The other eight rates are for the four months that a term bond is available during the month. For each of these four months, a discount note rate for the first part of the month and a discount note rate for the last part of the month are entered.

Next, the 12 six-month bond rates and the 12 nine-month bond rates are entered. Then a rate for each of the term bonds is entered. To assist the user, the model indicates the month or quarter of the bond and the term.

The model then asks if the user wants to use debt termination or salvage activities. A response of 1 for yes will activate questions concerning an ending yield curve for forecast 1. First, ending rates for one to eight-month maturity bonds will be requested. Then, rates for all of the ending term bonds will be requested. If the user states that no salvage activities are to be used, the model computes only actual debt costs that accrue for the duration of the planning horizon.
After the ending yield curve rates for the first forecast are entered, or after the user specifies no debt termination activities, the program will ask for the probability of the second forecast along with interest rates, termination activities, and rates. Then, that same information will be requested for the remaining forecasts. It is important that the probabilities of all forecasts sum to one.

After all forecasts are entered, the user enters the debt needs for each of the 16 periods in millions of dollars. These amounts are accumulated new money needs for the current period. New money needs will occur because of maturing debt issued before the start of the one year planning horizon, and growth in total debt needs since the start of the planning horizon. Two-hundred-forty-six million, fifty-four-hundred thousand dollars is entered as 246.50. In this section it is important that if the first month or the second month is not used because the current month is not the start of a quarter period, zeros with decimals be entered for the initial one to three periods.

The program next asks the user if maximum or minimum constraints should be placed on any bond, or group of bonds, or on the average discount notes outstanding between periods. The constraints are entered in millions of dollars. Extreme care must be exercised when placing constraints on any bond or discount note. It is very easy to place constraints that the model cannot fulfill. If that happens, the model breaks down and no solution is possible. The model does not contain diagnostics that the operator can use to interpret this problem.
Finally, the matrix generator states that the matrix is being generated and the Fortran file number it is placed on. Additional information that is used by the report writer, but not the quadratic program, is placed on a separate file for later use.

The operator then needs to call for the quadratic program which generates optimal debt participation strategies. Those commands are unique to each computer installation. The output from the quadratic program is stored on a file. The user can view that output if desired. However, the output format is not presented in a useful form. Therefore, the report writer should be called to take the quadratic program output and convert it into a report.

The report produced from the example data is attached. There were 31 debt issuance strategies generated in that application but only 11 of those strategies are shown here. The first strategy has the lowest standard deviation and the highest expected cost. The last strategy has the lowest expected cost and the highest standard deviation. The remaining strategies fall between these two extremes.

Each strategy shows the level of nine-month and six-month bond participation for each of the 12 months. The average discount notes outstanding are given for each period. The long-term bonds are also listed for each strategy. (The notation 7-month means the seventh month.) The reader will notice that gradual changes in bond participation occur from strategy to strategy.
Technical Descriptions

The solution procedure is comprised of three separate computer programs—a matrix generator program, a quadratic program, and a report writer program. All three are written in FORTRAN IV except that the quadratic program also uses an assembly routine. The matrix generator requires data input from the user and constructs an input matrix required by the quadratic program. The quadratic program computes an efficient frontier set of debt strategies. The report writer converts the output of the quadratic program into tables. The matrix generator program code and report writer program code are reproduced in Appendix B.

The quadratic program is listed in the publication written by, L. Cutler and D.S. Pass, "A Computer Program for Quadratic Mathematical Models to be Used for Aircraft Design and Other Applications Involving Linear Constraints," R-516-PR, June 1971, published by The Rand Corporation, Santa Monica, California. Necessary changes in the Rand program are listed in Appendix B.

Limitations to the Quadratic Debt Model

The quadratic model generates debt strategies based upon the expected costs and variance-covariance of costs. If the underlying probability of interest rates is normally distributed, then the quadratic model selects the best debt strategies. Bank management, however, must select one of the strategies after assessing its
tradeoff between risk and expected cost. If interest rate probabilities are not normally distributed, then the quadratic model may not select the best strategies. However, the strategies that it does select are better than a strategy based only upon expected cost. (Actually, the lowest expected cost quadratic program strategy is the lowest expected cost strategy. There are no lower cost options.)

The quadratic model will not adjust for interest rates that are projected to be skewed to the right or to the left of the expected interest rates. Skewness can occur, for instance, when the expected interest rate is 20 percent and there is a 50-50 chance that interest rates will be greater or less than 20 percent, but it is believed that the rate will not move above 25 percent but it could move to as low as 10 percent. This is a skewness to lower values. The model would consider that risk to be the same as if the 20 percent expected interest rate could be either 30 percent or 15 percent—a skewness to higher values. Incorporating measures of skewness is not possible with quadratic programming. Alternative solution procedures must be used, none of which are easy to use. Many are impossible to use.

Another difficulty with this debt model is that a limited number of interest rate projections are entered. A limit of ten projections was placed on the model since very few users would even approach ten projections. Many users might use only three or four projections. The small number of interest rate projections means that the normal probability function estimated by expected costs and
variance-covariance will not be based upon observations from a smooth sample surface. Three or four projections may not define the underlying probability distribution very well.

**Discount Factors**

At the option of the user, costs can be discounted to the present by entering non-zero discounting interest rates. A discounting interest rate is entered for each of the 12 months. Because these rates are annual rates, they are divided by 12 to obtain monthly rates. To compute the discount factor for month \( n \), the first \( n \) month rates are multiplied together by the formula:

\[
d_n = \prod_{i=1}^{n} \frac{1}{1+r_i}
\]

where: \( d_n \) = the discount factor for month \( n \)

\( r_i \) = the monthly discounting interest rate

The twelfth month discounting interest rate is used as the monthly discounting rate for months 13 to 30 to compute any discount factor beyond month twelve.

**The Computation of Interest Costs**

All entered interest rates should include both the cost of issuance and interest payment costs. The cost of a discount note is computed by dividing the annual rate by 12, then multiplying by the duration between bond issues, which is either one-third, two-thirds, or one month. The cost is then discounted to the present.

The cost of the first 6, six-month bonds is calculated by converting the annual interest rate into six months' cost which is then multiplied by the discount factor of the month of payment (when the
bond matures). A six-month bond issued during the last six months of the planning horizon will not mature until after the end of the planning horizon. To calculate the interest cost of these bonds, the six months' interest cost is first calculated. Then the interest rate of a bond whose term is the months remaining on the six-month bond at the end of the planning horizon is multiplied by the months remaining, and that cost is subtracted from the six months' interest cost. The concept behind this procedure is that at the end of the planning horizon, a bond of that maturity and rate could be available as a replacement for the original six-month bond. Because the interest payments on both the six-month bond and the replacement bond would occur beyond the planning horizon, the cost difference between the six-month and replacement bond is multiplied by the discount factor of the month when payment will be made. If salvage activities are not indicated by the user, then the initial six-month bond rate is used as the interest rate of the replacement bond, which eliminates any costs beyond the planning horizon. Nine-month bonds are handled in a manner similar to six-month bonds.

Because long-term bonds have an interest payment every six months, a different technique is used to compute their costs. First, any interest payment during the planning horizon is discounted to the present. Then, the first payment beyond the planning horizon is compared to the first payment of a replacement bond to be issued at the end of the planning horizon. This cost difference is discounted to the present using the period discount factor. The re-
maining life of the original and replacement bond is treated as a six-month annuity where the payment is the difference between the interest payment on the original and replacement bond every six months. The value of the annuity is discounted to the first payment period beyond the planning horizon. Then, that value is discounted to the present. Again, if no salvage activities are elected, the initial term bond interest rate is used as the replacement interest rate, resulting in a zero cost beyond the planning horizon. Mathematically, cost is computed on a long-term bond as:

\[
C = (R_o \times 6 \times D_1) - ((R_o \times 6) - (R_r \times M)) \times D_2 + (R_o - R_r) \times 6 \times \frac{(1-1/(1 + d)^n)}{d} \times D_2
\]

where: 

- \( C \) = discounted interest cost
- \( R_o \) = monthly interest rate of original bond
- \( R_r \) = monthly interest rate of replacement bond
- \( D_1 \) = discount factor for the payment during the planning horizon
- \( D_2 \) = discount factor for the payment beyond the planning horizon
- \( M \) = months before first payment past planning horizon
- \( d \) = semi-annual interest rate based upon twelve month discounting interest rate
- \( n \) = number of interest payments beyond the first payment past the planning horizon
The expected cost of each bond and note activity is computed by multiplying the cost of each projection by its probability of occurrence and then summing all of these products. The variance-co-variance is computed as explained in the earlier two-period example.
APPENDIX A

An Application of the Farm Credit Debt Selection Model

Contains:

(1) Completed data input forms.

(2) Copy of data input for matrix generator

(3) Debt issuance report (partial set).
### FCB DEBT MODEL

**Terms of Long-Term Bonds**
(In years and fraction of year)

<table>
<thead>
<tr>
<th></th>
<th>Number of Bonds</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Month</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last Third</td>
<td></td>
<td></td>
<td></td>
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FCB DEBT MODEL

Interest Rate Projection # 1

Probability = .45

One of these forms must be filled out for each interest rate projection

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<th>Discount Notes</th>
<th>Six-month Bonds</th>
<th>Nine-month Bonds</th>
<th>Term Bonds</th>
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<td>11.2</td>
<td>11.35</td>
<td>11.5</td>
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<td>11.2</td>
<td>11.35</td>
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</table>

Ending Rates

1-month bond 11.4
2-month bond 11.4
3-month bond 11.4
4-month bond 11.45
5-month bond 11.45
6-month bond 11.5
7-month bond 11.53
8-month bond 11.6
1-year bond 11.7
2-year bond 11.8
3-year bond 12.1
4-year bond 12.2
5-year bond 12.3
6-year bond 12.05
7-year bond 12.10
8-year bond 12.10
9-year bond 12.10
10-year bond 12.10
FCB DEBT MODEL

Interest Rate Projection #2

Probability = 0.30

One of these forms must be filled out for each interest rate projection

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<th>Discount Notes</th>
<th>Six-month Bonds</th>
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<td>12.35</td>
<td>13.3</td>
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<tr>
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<td>10.7</td>
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Ending Rates

1-month bond 14.35  1-year bond 13.95  6-year bond 13.3
2-month bond 14.35  2-year bond 13.25  7-year bond 13.3
3-month bond 14.35  3-year bond 13.35  8-year bond 13.25
4-month bond 14.3  4-year bond 13.35  9-year bond 13.25
5-month bond 14.2  5-year bond 13.35  10-year bond 13.25
6-month bond 14.1
7-month bond 14.1
8-month bond 13.95
FCB DEBT MODEL

Interest Rate Projection \#\#\#\#
Probability = 2.6

One of these forms must be filled out for each interest rate projection

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Ending Rates

1-month bond 10.5
2-month bond 10.5
3-month bond 10.5
4-month bond 10.55
5-month bond 10.6
6-month bond 10.6
7-month bond 10.65
8-month bond 10.75
1-year bond 10.75
2-year bond 10.8
3-year bond 10.85
4-year bond 10.85
5-year bond 10.85
6-year bond 10.9
7-year bond 10.9
8-year bond 10.9
9-year bond 10.9
10-year bond 10.9
FCB DEBT MODEL

Debt Needs
(In Millions of Dollars)

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FCB DEBT MODEL

Constraints - per debt issue (for discount notes - notes outstanding at any time)

Check: Maximum [ ] or Minimum [ ]

(In Millions of Dollars)

A separate form must be completed for maximum and minimum constraints

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<tbody>
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</tr>
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</tbody>
</table>


START
EXECUTION BEGINS...
THIS IS A GAPRAME MATRIX GENERATOR

WRITTEN BY
LOREN TAUER
DEPT. OF AG. ECON.
CORNELL UNIVERSITY

IS THERE A TERM BOND(S) FOR MONTH 1? ENTER 1 FOR YES, 2 FOR NO?
IS THERE A TERM BOND(S) FOR MONTH 2? ENTER 1 FOR YES, 2 FOR NO?
IS THERE A TERM BOND(S) FOR MONTH 3? ENTER 1 FOR YES, 2 FOR NO?
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 3, THE LIMIT IS 4?
ENTER THE TERM OF TERM BOND 1 FOR MONTH 3?
IS THERE A TERM BOND(S) FOR MONTH 4? ENTER 1 FOR YES, 2 FOR NO?
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 4, THE LIMIT IS 4?
ENTER THE TERM OF TERM BOND 1 FOR MONTH 4?
IS THERE A TERM BOND(S) FOR MONTH 5? ENTER 1 FOR YES, 2 FOR NO?
IS THERE A TERM BOND(S) FOR MONTH 6? ENTER 1 FOR YES, 2 FOR NO?
IS THERE A TERM BOND(S) FOR MONTH 7? ENTER 1 FOR YES, 2 FOR NO?
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 7, THE LIMIT IS 4?
ENTER THE TERM OF TERM BOND 1 FOR MONTH 7?
IS THERE A TERM BOND(S) FOR MONTH 8? ENTER 1 FOR YES, 2 FOR NO?
IS THERE A TERM BOND(S) FOR MONTH 9? ENTER 1 FOR YES, 2 FOR NO?
2.
IS THERE A TERM BOND(S) FOR MONTH 10? ENTER 1 FOR YES, 2 FOR NO?
2.
IS THERE A TERM BOND(S) FOR MONTH 11? ENTER 1 FOR YES, 2 FOR NO?
2.
IS THERE A TERM BOND(S) FOR MONTH 12? ENTER 1 FOR YES, 2 FOR NO?
2.
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 12, THE LIMIT IS 4?
4.
ENTER THE TERM OF TERM BOND 1 FOR MONTH 12?
4.
ENTER THE NUMBER OF TERM ISSUES FOR QUARTER 1, THE LIMIT IS 4?
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ENTER THE TERM OF TERM BOND 1 FOR QUARTER 1?
1.
ENTER THE NUMBER OF TERM ISSUES FOR QUARTER 2, THE LIMIT IS 4?
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ENTER THE TERM OF TERM BOND 1 FOR QUARTER 2?
2.
ENTER THE TERM OF TERM BOND 2 FOR QUARTER 2?
4.
ENTER THE TERM OF TERM BOND 3 FOR QUARTER 2?
7.
ENTER THE NUMBER OF TERM ISSUES FOR QUARTER 3, THE LIMIT IS 4?
3.
ENTER THE TERM OF TERM BOND 1 FOR QUARTER 3?
3.
ENTER THE TERM OF TERM BOND 2 FOR QUARTER 3?
6.
ENTER THE TERM OF TERM BOND 3 FOR QUARTER 3?
10.
ENTER THE NUMBER OF TERM ISSUES FOR QUARTER 4, THE LIMIT IS 4?
3.
ENTER THE TERM OF TERM BOND 1 FOR QUARTER 4?
4.
ENTER THE TERM OF TERM BOND 2 FOR QUARTER 4?
8.
ENTER THE TERM OF TERM BOND 3 FOR QUARTER 4?
12.
ENTER THE NUMBER OF INTEREST RATE FORECASTS, THE LIMIT IS 10

ENTER THE PROBABILITY OF FORECAST 1

ENTER THE 12 MONTHLY DISCOUNTING RATES FOR FORECAST 1

0. 12. 11.1 11.3 11.1 11.3 11.5 11.7 11.6 11.5 11.4 11.35

ENTER THE 16 DISCOUNT NOTE RATES FOR FORECAST 1

0. 0. 12.1 11.2 11.2 11.2 11.4 11.6 11.7 11.75 11.8 11.7 11.6

11.55 11.5 11.45

ENTER THE 12 SIX-MONTH RATES FOR FORECAST 1

0. 12.05 11.35 11.35 11.35 11.5 11.7 11.9 11.8 11.7 11.6 11.55

ENTER THE 12 NINE-MONTH RATES FOR FORECAST 1

0. 12. 11.5 11.5 11.5 11.6 11.75 12. 11.5 11.8 11.65 11.65

ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR MONTH 3 FORECAST 1

11.75

ENTER THE RATE FOR THE 5.00 YEAR TERM BOND FOR MONTH 4 FORECAST 1

11.75

ENTER THE RATE FOR THE 5.00 YEAR TERM BOND FOR MONTH 7 FORECAST 1

12.2

ENTER THE RATE FOR THE 4.50 YEAR TERM BOND FOR MONTH 12 FORECAST 1

12.2

ENTER THE RATE FOR THE 1.00 YEAR TERM BOND FOR QUARTER 1, FORECAST 1

99

ENTER THE RATE FOR THE 2.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 1

11.75

ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 1

11.8

ENTER THE RATE FOR THE 7.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 1

11.85

ENTER THE RATE FOR THE 3.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 1

12.4

ENTER THE RATE FOR THE 6.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 1

12.45

ENTER THE RATE FOR THE 10.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 1

12.5

ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 1

12.25

ENTER THE RATE FOR THE 8.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 1

12.3

ENTER THE RATE FOR THE 12.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 1
12.35
Would you like to use DEBT TERMINATION ACTIVITIES?
Enter 1 for yes, 2 for no

? 1
Enter the 8 ending rates for 1- to 8-month bonds, forecast 1

11.4 11.4 11.4 11.45 11.45 11.5 11.55 11.6
Enter the ending rate for a 3.17 year term bond, forecast 1

? 12
Enter the ending rate for a 4.25 year term bond, forecast 1

? 12
Enter the ending rate for a 4.50 year term bond, forecast 1

? 12
Enter the ending rate for a 4.42 year term bond, forecast 1

? 12
Enter the ending rate for a 0.06 year term bond, forecast 1

? 99
Enter the ending rate for a 1.31 year term bond, forecast 1

? 11.7
Enter the ending rate for a 3.31 year term bond, forecast 1

? 12
Enter the ending rate for a 6.31 year term bond, forecast 1

? 12.05
Enter the ending rate for a 2.56 year term bond, forecast 1

? 12
Enter the ending rate for a 5.56 year term bond, forecast 1

? 12.05
Enter the ending rate for a 9.56 year term bond, forecast 1

? 12.1
Enter the ending rate for a 3.81 year term bond, forecast 1

? 12
Enter the ending rate for a 7.81 year term bond, forecast 1

? 12.1
Enter the ending rate for a 11.81 year term bond, forecast 1

? 12.1
Enter the probability of forecast 2

? .30
Enter the 12 monthly discounting rates for forecast 2

0.12.12.35 12.7 13.1 13.3 13.5 13.75 13.9 14.1 14.3 14.25
Enter the 16 discount note rates for forecast 2

0.0.12.1 12.45 12.8 13.1 13.2 13.4 13.6 13.75 13.85 14. 14.2
ENTER THE 12 SIX-MONTH RATES FOR FORECAST 2

0.05 12.35 12.7 13.1 13.25 13.5 13.7 13.85 13.95 14.1 14.1
ENTER THE 12 NINE-MONTH RATES FOR FORECAST 2

0.12 13.3 12.6 12.9 13.15 13.35 13.6 13.7 13.85 14.14
ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR MONTH 3 FORECAST 2

12.15
ENTER THE RATE FOR THE 5.00 YEAR TERM BOND FOR MONTH 4 FORECAST 2

12.35
ENTER THE RATE FOR THE 5.00 YEAR TERM BOND FOR MONTH 7 FORECAST 2

12.8
ENTER THE RATE FOR THE 4.50 YEAR TERM BOND FOR MONTH 12 FORECAST 2

13.4
ENTER THE RATE FOR THE 1.00 YEAR TERM BOND FOR QUARTER 1, FORECAST 2

99
ENTER THE RATE FOR THE 2.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 2

12.55
ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 2

12.5
ENTER THE RATE FOR THE 7.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 2

12.45
ENTER THE RATE FOR THE 3.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 2

12.95
ENTER THE RATE FOR THE 6.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 2

12.9
ENTER THE RATE FOR THE 10.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 2

12.85
ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 2

13.25
ENTER THE RATE FOR THE 8.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 2

13.3
ENTER THE RATE FOR THE 12.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 2

13.3
WOULD YOU LIKE TO USE DEBT TERMINATION ACTIVITIES?
ENTER 1 FOR YES, 2 FOR NO

1
ENTER THE 8 ENDING RATES FOR 1- TO 6-MONTH BONDS, FORECAST 2

ENTER THE ENDING RATE FOR A 3.17 YEAR TERM BOND, FORECAST 2

13.35
ENTER THE ENDING RATE FOR A 4.25 YEAR TERM BOND, FORECAST 2

13.35
ENTER THE ENDING RATE FOR A 4.50 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 4.42 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 0.06 YEAR TERM BOND, FORECAST 2

? 99.
ENTER THE ENDING RATE FOR A 1.31 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 3.31 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 6.31 YEAR TERM BOND, FORECAST 2

? 13.3
ENTER THE ENDING RATE FOR A 2.56 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 5.56 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 9.56 YEAR TERM BOND, FORECAST 2

? 13.25
ENTER THE ENDING RATE FOR A 3.81 YEAR TERM BOND, FORECAST 2

? 13.35
ENTER THE ENDING RATE FOR A 7.81 YEAR TERM BOND, FORECAST 2

? 13.25
ENTER THE ENDING RATE FOR A 11.81 YEAR TERM BOND, FORECAST 2

? 13.25
ENTER THE PROBABILITY OF FORECAST 3

? 25
ENTER THE 12 MONTHLY DISCOUNTING RATES FOR FORECAST 3

? 0. 10.2 9.95 9.75 9.55 9.65 9.8 9.95 10. 10.05 10.15 10.25
ENTER THE 16 DISCOUNT NOTE RATES FOR FORECAST 3

? 0. 0. 10.3 10.05 9.85 9.7 9.65 9.75 9.9 10. 10.05 10.1 10.15

? 10.2 10.25 10.35
ENTER THE 12 SIX-MONTH RATES FOR FORECAST 3

? 0. 10.4 10.15 9.95 9.75 9.85 9.95 10.05 10.15 10.2 10.3 10.45
ENTER THE 12 NINE-MONTH RATES FOR FORECAST 3

? 0. 10.45 10.25 10.15 10.05 10.15 10.25 10.35 10.45 10.55 10.6 10.7
ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR MONTH 3 FORECAST 3

? 10.9
ENTER THE RATE FOR THE 5.00 YEAR TERM BOND FOR MONTH 4 FORECAST 3
10.65
ENTER THE RATE FOR THE 5.00 YEAR TERM BOND FOR MONTH 7 FORECAST 3
?
10.45
ENTER THE RATE FOR THE 4.50 YEAR TERM BOND FOR MONTH 12 FORECAST 3
?
10.85
ENTER THE RATE FOR THE 1.00 YEAR TERM BOND FOR QUARTER 1, FORECAST 3
?
99
ENTER THE RATE FOR THE 2.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 3
?
10.5
ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 3
?
10.65
ENTER THE RATE FOR THE 7.00 YEAR TERM BOND FOR QUARTER 2, FORECAST 3
?
10.6
ENTER THE RATE FOR THE 3.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 3
?
10.5
ENTER THE RATE FOR THE 6.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 3
?
10.65
ENTER THE RATE FOR THE 10.00 YEAR TERM BOND FOR QUARTER 3, FORECAST 3
?
10.6
ENTER THE RATE FOR THE 4.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 3
?
10.7
ENTER THE RATE FOR THE 8.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 3
?
10.8
ENTER THE RATE FOR THE 12.00 YEAR TERM BOND FOR QUARTER 4, FORECAST 3
?
10.85
W OULD YOU LIKE TO USE DEBT TERMINATION ACTIVITIES?
ENTER 1 FOR YES, 2 FOR NO
?
1
ENTER THE 8 ENDING RATES FOR 1- TO 8-MONTH BONDS, FORECAST 3
?
10.5 10.5 10.5 10.55 10.6 10.6 10.65 10.75
ENTER THE ENDING RATE FOR A 3.17 YEAR TERM BOND, FORECAST 3
?
10.85
ENTER THE ENDING RATE FOR A 4.25 YEAR TERM BOND, FORECAST 3
?
10.85
ENTER THE ENDING RATE FOR A 4.50 YEAR TERM BOND, FORECAST 3
?
10.65
ENTER THE ENDING RATE FOR A 4.42 YEAR TERM BOND, FORECAST 3
?
10.85
ENTER THE ENDING RATE FOR A 0.06 YEAR TERM BOND, FORECAST 3
?
99,
ENTER THE ENDING RATE FOR A 1.31 YEAR TERM BOND, FORECAST 3
10.75
ENTER THE ENDING RATE FOR A 3.31 YEAR TERM BOND, FORECAST 3
10.85
ENTER THE ENDING RATE FOR A 6.31 YEAR TERM BOND, FORECAST 3
10.9
ENTER THE ENDING RATE FOR A 2.56 YEAR TERM BOND, FORECAST 3
10.85
ENTER THE ENDING RATE FOR A 5.56 YEAR TERM BOND, FORECAST 3
10.9
ENTER THE ENDING RATE FOR A 9.56 YEAR TERM BOND, FORECAST 3
10.9
ENTER THE ENDING RATE FOR A 3.81 YEAR TERM BOND, FORECAST 3
10.85
ENTER THE ENDING RATE FOR A 7.81 YEAR TERM BOND, FORECAST 3
10.9
ENTER THE ENDING RATE FOR A 11.81 YEAR TERM BOND, FORECAST 3
10.9
ENTER THE DEBT NEEDS FOR THE 16 PERIODS IN MILLIONS $?
0, 0, 17, 41, 52, 76, 92, 103, 124, 147,
180, 188, 196, 209, 239, 246, 540
WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON ANY
NOTE OR BOND GROUP? ENTER 1 FOR YES, 2 FOR NO?
1
WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE
DISCOUNT NOTES? ENTER 1 FOR YES, 2 FOR NO?
1
ENTER THE MAXIMUM FOR EACH OF THE 16 DISCOUNT NOTES?
50, 50, 50, 50, 50, 50, 50.
50, 50, 50, 50, 50, 50, 50.
WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE
SIX-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO?
1
ENTER THE MAXIMUM FOR EACH OF THE 12 SIX-MONTH BONDS?
75, 75, 75, 75, 75, 75, 75, 75, 75, 75, 75, 75.
WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE
NINE-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO?
1
ENTER THE MAXIMUM FOR EACH OF THE 12 NINE-MONTH BONDS?
75, 75, 75, 75, 75, 75, 75, 75, 75, 75, 75, 75.
LONG-TERM BONDS? ENTER 1 FOR YES, 2 FOR NO

1
ENTER THE MAX. FOR THE 4.00 YEAR TERM BOND FOR MONTH 3

50.
ENTER THE MAX. FOR THE 5.00 YEAR TERM BOND FOR MONTH 4

50.
ENTER THE MAX. FOR THE 5.00 YEAR TERM BOND FOR MONTH 7

50.
ENTER THE MAX. FOR THE 4.50 YEAR TERM BOND FOR MONTH 12

50.
ENTER THE MAX. FOR THE 1.00 YEAR TERM BOND FOR QUARTER 1

25.
ENTER THE MAX. FOR THE 2.00 YEAR TERM BOND FOR QUARTER 2

25.
ENTER THE MAX. FOR THE 4.00 YEAR TERM BOND FOR QUARTER 2

25.
ENTER THE MAX. FOR THE 7.00 YEAR TERM BOND FOR QUARTER 2

25.
ENTER THE MAX. FOR THE 3.00 YEAR TERM BOND FOR QUARTER 3

25.
ENTER THE MAX. FOR THE 6.00 YEAR TERM BOND FOR QUARTER 3

25.
ENTER THE MAX. FOR THE 10.00 YEAR TERM BOND FOR QUARTER 3

25.
ENTER THE MAX. FOR THE 4.00 YEAR TERM BOND FOR QUARTER 4

25.
ENTER THE MAX. FOR THE 8.00 YEAR TERM BOND FOR QUARTER 4

25.
ENTER THE MAX. FOR THE 12.00 YEAR TERM BOND FOR QUARTER 4

25.

WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON ANY
NOTE AND BOND GROUP? ENTER 1 FOR YES, 2 FOR NO

2

THE QPRAND MATRIX IS BEING GENERATED
THE QPRAND MATRIX HAS BEEN CREATED ON FILE 12
INFO. FOR THE REPORT WRITER HAS BEEN PLACED ON FILE 13
THE FOLLOWING ARE DEBT ISSUANCE STRATEGIES DERIVED BY A QUADRATIC PROGRAM

THE PROCEDURE WAS WRITTEN BY

LOREN TAUER
DEPT. OF AG. ECON.
CORNELL UNIVERSITY

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 1
(IN MILLIONS OF DOLLARS)

<table>
<thead>
<tr>
<th>NINE-MONTH BONDS</th>
<th>SIX-MONTH BONDS</th>
<th>DISCOUNT NOTES 10, 20, OR 30 DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST MONTH</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>SECOND MONTH</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>THIRD MONTH</td>
<td>0.0</td>
<td>17,000</td>
</tr>
<tr>
<td>FOURTH MONTH</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td>8,207</td>
</tr>
<tr>
<td>FIFTH MONTH</td>
<td>24.207</td>
<td>0.0</td>
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<tr>
<td>SIXTH MONTH</td>
<td>11,000</td>
<td>0.0</td>
</tr>
<tr>
<td>SEVENTH MONTH</td>
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</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td>23,000</td>
</tr>
<tr>
<td>EIGHT MONTH</td>
<td>0.0</td>
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</tr>
<tr>
<td>NINTH MONTH</td>
<td>8,000</td>
<td>50,000</td>
</tr>
<tr>
<td>TENTH MONTH</td>
<td>21,000</td>
<td>37,000</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td>50,000</td>
</tr>
<tr>
<td>ELEVENTH MONTH</td>
<td>37.540</td>
<td>42,460</td>
</tr>
<tr>
<td>TWELETH MONTH</td>
<td>0.0</td>
<td>50,000</td>
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</table>

LONG-TERM BONDS

<table>
<thead>
<tr>
<th>MONTH OR QUARTER</th>
<th>MATURITY</th>
<th>AMOUNT</th>
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</thead>
<tbody>
<tr>
<td>3-M</td>
<td>4.00</td>
<td>41,000</td>
</tr>
<tr>
<td>4-M</td>
<td>5.00</td>
<td>11,000</td>
</tr>
<tr>
<td>7-M</td>
<td>5.00</td>
<td>0.0</td>
</tr>
<tr>
<td>12-M</td>
<td>4.50</td>
<td>0.0</td>
</tr>
<tr>
<td>1-Q</td>
<td>1.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
<td>2.00</td>
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<td>2-Q</td>
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<tr>
<td>3-Q</td>
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<td>8.00</td>
<td>0.0</td>
</tr>
<tr>
<td>4-Q</td>
<td>12.00</td>
<td>0.0</td>
</tr>
</tbody>
</table>

EXPECTED DISCOUNTED COST = 12,566
STANDARD DEVIATION = 0.444
DEBT ISSUANCE FOR THE NEXT 12 MONTHS  STRATEGY NUMBER 3  
(IN MILLIONS OF DOLLARS)

<table>
<thead>
<tr>
<th>Month</th>
<th>Nine-Month Bonds</th>
<th>Six-Month Bonds</th>
<th>Discount Notes 10, 20, or 30 Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SECOND MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>17.000</td>
</tr>
<tr>
<td>THIRD MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>FOURTH MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td></td>
<td>7.875</td>
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<tr>
<td>FIFTH MONTH</td>
<td>23.875</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SIXTH MONTH</td>
<td>11.000</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SEVENTH MONTH</td>
<td>21.000</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td></td>
<td>23.000</td>
</tr>
<tr>
<td>EIGHT MONTH</td>
<td>0.0</td>
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<td>NINTH MONTH</td>
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<td></td>
<td>50.000</td>
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<tr>
<td>ELEVENTH MONTH</td>
<td>37.540</td>
<td>0.0</td>
<td>42.460</td>
</tr>
<tr>
<td>TWELFTH MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>50.000</td>
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</tbody>
</table>

LONG-TERM PONDS

<table>
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<tr>
<th>Month or Quarter</th>
<th>Maturity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-M</td>
<td>4.00</td>
<td>41.000</td>
</tr>
<tr>
<td>4-M</td>
<td>5.00</td>
<td>11.000</td>
</tr>
<tr>
<td>7-M</td>
<td>5.00</td>
<td>0.0</td>
</tr>
<tr>
<td>12-M</td>
<td>4.50</td>
<td>0.0</td>
</tr>
<tr>
<td>1-Q</td>
<td>1.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
<td>2.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
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<td>16.125</td>
</tr>
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<td>2-Q</td>
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</tr>
<tr>
<td>3-Q</td>
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</tr>
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<td>4-Q</td>
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<tr>
<td>4-Q</td>
<td>12.00</td>
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</tr>
</tbody>
</table>

EXPECTED DISCOUNTED COST = 12.565
STANDARD DEVIATION = 0.444
DEBT ISSUANCE FOR THE NEXT 12 MONTHS  
STRATEGY NUMBER 6  
(IN MILLIONS OF DOLLARS)

<table>
<thead>
<tr>
<th></th>
<th>NINE-MONTH BONDS</th>
<th>SIX-MONTH BONDS</th>
<th>DISCOUNT NOTES 10, 20, OR 30 DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SECOND</td>
<td>0.0</td>
<td>0.0</td>
<td>17,000</td>
</tr>
<tr>
<td>THIRD</td>
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<td>0.0</td>
</tr>
<tr>
<td>FOURTH</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
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</tr>
<tr>
<td>FIFTH</td>
<td>24,842</td>
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</tr>
<tr>
<td>SIXTH</td>
<td>11,000</td>
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LONG-TERM BONDS

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EXPECTED DISCOUNTED COST = 12.561

STANDARD DEVIATION = 0.444
DEBT ISSUANCE FOR THE NEXT 12 MONTHS  STRATEGY NUMBER 9
(IN MILLIONS OF DOLLARS)

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EXPECTED DISCOUNTED COST = 12.487
STANDARD DEVIATION = 0.450
DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 12
(IN MILLIONS OF DOLLARS)

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<tr>
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LONG-TERM PONDS

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EXPECTED DISCOUNTED COST = 12.442
STANDARD DEVIATION = 0.458
DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 15
(IN MILLIONS OF DOLLARS)

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<tr>
<td>LAST THIRD</td>
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<tr>
<td>THIRD MONTH</td>
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<tr>
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LONG-TERM PONDS

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EXPECTED DISCOUNTED COST = 12.431
STANDARD DEVIATION = 0.462
DEBT ISSUANCE FOR THE NEXT 12 MONTHS  STRATEGY NUMBER 18
(IN MILLIONS OF DOLLARS)

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LONG-TERM BONDS

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EXPECTED DISCOUNTED COST = 12.366
STANDARD DEVIATION = 0.495
DEBT ISSUANCE FOR THE NEXT 12 MONTHS
(IN MILLIONS OF DOLLARS)

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<td>LAST THIRD</td>
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<tr>
<td>SECOND MONTH</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>THIRD MONTH</td>
<td>0.0</td>
<td>17.000</td>
</tr>
<tr>
<td>FOURTH MONTH</td>
<td>0.0</td>
<td>10.156</td>
</tr>
<tr>
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</tr>
<tr>
<td>FIFTH MONTH</td>
<td>16.000</td>
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</tr>
<tr>
<td>SIXTH MONTH</td>
<td>11.000</td>
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</tr>
<tr>
<td>SEVENTH MONTH</td>
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</tr>
<tr>
<td>LAST THIRD</td>
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<tr>
<td>EIGHT MONTH</td>
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<tr>
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<tr>
<td>LAST THIRD</td>
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<td>45.000</td>
</tr>
<tr>
<td>ELEVENTH MONTH</td>
<td>75.000</td>
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</tr>
<tr>
<td>TWELFTH MONTH</td>
<td>7.540</td>
<td>0.0</td>
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</tbody>
</table>

LONG-TERM BONDS

<table>
<thead>
<tr>
<th>MONTH OR QUARTER</th>
<th>MATURITY</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
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<td>4.00</td>
<td>30.844</td>
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<tr>
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<td>5.00</td>
<td>21.156</td>
</tr>
<tr>
<td>7-M</td>
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<td>0.0</td>
</tr>
<tr>
<td>12-M</td>
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</tr>
<tr>
<td>1-Q</td>
<td>1.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
<td>2.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
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<tr>
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<td>0.0</td>
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<tr>
<td>3-Q</td>
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<tr>
<td>4-Q</td>
<td>4.00</td>
<td>0.0</td>
</tr>
<tr>
<td>4-Q</td>
<td>4.00</td>
<td>0.0</td>
</tr>
<tr>
<td>4-Q</td>
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</tr>
</tbody>
</table>

EXPECTED DISCOUNTED COST = 12.323
STANDARD DEVIATION = 0.528
### Debt Issuance for the Next 12 Months

**Strategy Number 24**

*(in millions of dollars)*

<table>
<thead>
<tr>
<th>Month</th>
<th>Nine-Month Bonds</th>
<th>Six-Month Bonds</th>
<th>Discount Notes 10, 20, or 30 Day</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Month</strong></td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Last Third</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second Month</strong></td>
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<td>0.0</td>
<td>17.000</td>
</tr>
<tr>
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<td>39.000</td>
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<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Last Third</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fifth Month</strong></td>
<td>16.000</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Sixth Month</strong></td>
<td>11.000</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Seventh Month</strong></td>
<td>21.000</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Last Third</strong></td>
<td></td>
<td></td>
<td>23.000</td>
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<tr>
<td><strong>Eighth Month</strong></td>
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<td>16.000</td>
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<td>0.0</td>
<td>32.000</td>
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<td><strong>Last Third</strong></td>
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<tr>
<td><strong>Twelfth Month</strong></td>
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### Long-Term Bonds

<table>
<thead>
<tr>
<th>Month or Quarter</th>
<th>Maturity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-M</td>
<td>4.00</td>
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</tr>
<tr>
<td>4-M</td>
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<td>5.00</td>
<td>0.0</td>
</tr>
<tr>
<td>12-M</td>
<td>4.50</td>
<td>0.0</td>
</tr>
<tr>
<td>1-Q</td>
<td>1.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
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<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
<td>7.00</td>
<td>24.000</td>
</tr>
<tr>
<td>3-Q</td>
<td>3.00</td>
<td>0.0</td>
</tr>
<tr>
<td>3-Q</td>
<td>6.00</td>
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<tr>
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<tr>
<td>4-Q</td>
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</tr>
</tbody>
</table>

**Expected Discounted Cost = 12.210**

**Standard Deviation = 0.621**
DEBT ISSUANCE FOR THE NEXT 12 MONTHS  STRATEGY NUMBER 27
(IN MILLIONS OF DOLLARS)

<table>
<thead>
<tr>
<th>MONTH</th>
<th>NINE-MONTH BONDS</th>
<th>SIX-MONTH BONDS</th>
<th>DISCOUNT notes 10, 20, OR 30 DAY</th>
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</thead>
<tbody>
<tr>
<td>FIRST MONTH</td>
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<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SECOND MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>17.000</td>
</tr>
<tr>
<td>THIRD MONTH</td>
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<tr>
<td>FOURTH MONTH</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LAST THIRD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIFTH MONTH</td>
<td>16.000</td>
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<td>0.0</td>
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<tr>
<td>SIXTH MONTH</td>
<td>11.000</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SEVENTH MONTH</td>
<td>21.000</td>
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<td>0.0</td>
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<tr>
<td>LAST THIRD</td>
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<tr>
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<tr>
<td>TWELFTH MONTH</td>
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LONG-TERM BONDS

<table>
<thead>
<tr>
<th>MONTH OR QUARTER</th>
<th>MATURITY</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-M</td>
<td>4.00</td>
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</tr>
<tr>
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<td>50.000</td>
</tr>
<tr>
<td>7-M</td>
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<td>0.0</td>
</tr>
<tr>
<td>1-Q</td>
<td>1.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
<td>2.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2-Q</td>
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</tr>
<tr>
<td>2-G</td>
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</tr>
<tr>
<td>3-Q</td>
<td>6.00</td>
<td>0.0</td>
</tr>
<tr>
<td>3-G</td>
<td>10.00</td>
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<tr>
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<td>0.0</td>
</tr>
<tr>
<td>4-G</td>
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<td>0.0</td>
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</table>

EXPECTED DISCOUNTED COST = 12.175
STANDARD DEVIATION = 0.657
DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 31
(IN MILLIONS OF DOLLARS)

<table>
<thead>
<tr>
<th>MONTH OR QUARTER</th>
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<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-M</td>
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</tr>
<tr>
<td>4-M</td>
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<td>50,000</td>
</tr>
<tr>
<td>7-M</td>
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<td>48,000</td>
</tr>
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</tr>
<tr>
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<td>1.00</td>
<td>0.0</td>
</tr>
<tr>
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</tr>
<tr>
<td>2-Q</td>
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</tr>
<tr>
<td>2-Q</td>
<td>7.00</td>
<td>24,000</td>
</tr>
<tr>
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<tr>
<td>3-Q</td>
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</tr>
<tr>
<td>3-Q</td>
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<tr>
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</tr>
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</table>

EXPECTED DISCOUNTED COST = 12.078
STANDARD DEVIATION = 1.142

***** END OF THE SOLUTIONS *****
APPENDIX B

Contains:  
(1) Matrix generator program \( QPMAT \)  
(2) Report writer program \( QPRWT \)  
(3) Modification necessary to the Rand Quadratic Program
DIMENSION R(70,10), DEV(70,10), Z(8,10), CON(70), E(70), S(12,10),
SP(20), PROB(10), VC(70,70), DEM(16), CM(70), NT(12), NTH(12), TTM(12,4),
SQ(4), TTQ(4,4), TIME(12,4), TQE(4,4), ZIM(20,10), ZIQ(20,10)
DATA NTM/12*0/
DATA NTQ/4*0/
DATA NZ,NZ1,NZ2,NZ3,NZ4/5*2/
DATA NY,NY1,NY2,NY3,NY4/5*2/
DATA CM/70*0./
DATA CON/70*0./
NO=2
NT6=12
NT7=13
C
WRITE(6,220)
220 FORMAT( ' THIS IS A QPRAND MATRIX GENERATOR', /)
WRITE(6,221)
221 FORMAT( ' WRITTEN BY', /)
WRITE(6,222)
WRITE(6,223)
WRITE(6,224)
222 FORMAT( 10X, ' LOREN TAUER' )
223 FORMAT( 10X, ' DEPT. OF AG. ECON.' )
224 FORMAT( 10X, ' CORNELL UNIVERSITY', /)
C
C THIS SECTION IS WHERE THE DATA IS READ
C
DO 810 J=1,12
WRITE(6,700) J
700 FORMAT( ' IS THERE A TERM BOND(S) FOR MONTH', 'I3,
$' ? ENTER 1 FOR YES, 2 FOR NO' )
READ(5,'*') NT(J)
IF(NT(J).EQ.2) GO TO 810
WRITE(6,702) J
702 FORMAT( ' ENTER THE NUMBER OF TERM ISSUES FOR MONTH', 'I3,
$, THE LIMIT IS 4' )
READ(5,'*') NTM(J)
NTMJ=NTM(J)
DO 810 J2=1,NTMJ
WRITE(6,703) J2
703 FORMAT( ' ENTER THE TERM OF TERM BOND', 'I3,' FOR MONTH', 'I3)
READ(5,'*') TTM(J,J2)
WRITE(NT7,860) TTM(J,J2), J, J2
810 CONTINUE
DO 810 J=1,4
WRITE(6,200) J
200 FORMAT( ' ENTER THE NUMBER OF TERM ISSUES FOR QUARTER', 'I3,
$, THE LIMIT IS 4' )
READ(5,'*') NTQ(J)
NTQJ=NTQ(J)
DO 810 J2=1,NTQJ
WRITE(6,704) J2
704 FORMAT( ' ENTER THE TERM OF TERM BOND', 'I3,' FOR QUARTER', 'I3)
READ(5,'*') TTQ(J,J2)
WRITE(NT7,870) TTQ(J,J2), J, J2
811 CONTINUE
WRITE(6,201)
201 FORMAT(' ENTER THE NUMBER OF INTEREST RATE FORECASTS, THE LIMIT $IS 10$')
   READ(5,*) M
   DC 11 J=1,M
   WRITE(6,203) J
203 FORMAT(' ENTER THE PROBABILITY OF FORECAST',I3)
   READ(5,*) PECE(J)
   WRITE(6,204) J
204 FORMAT(' ENTER THE 12 MONTHLY DISCOUNTING RATES FOR FORECAST',I3)
   READ(5,*) (S(I,J),I=1,12)
   WRITE(6,205) J
205 FORMAT(' ENTER THE 16 DISCOUNT NOTE RATES FOR FORECAST',I3)
   READ(5,*) (B(I,J),I=1,16)
   WRITE(6,206) J
206 FORMAT(' ENTER THE 12 SIX-MONTH RATES FOR FORECAST',I3)
   READ(5,*) (E(I,J),I=17,28)
   WRITE(6,207) J
207 FORMAT(' ENTER THE 12 NINE-MONTH RATES FOR FORECAST',I3)
   READ(5,*) (R(I,J),I=29,40)

I=40
   DO 812 K=1,12
   IF(MT(K).EQ.NC) GC TC 812
   NTK=NTM(K)
   DO 812 K2=1,NTK
   I=I+1
   WRITE(6,813) TIM(K,K2),K,J
813 FORMAT(' ENTER THE RATE FOR THE ',F6.2,' YEAR TERM BOND FOR MONTH',I3,' , FORECAST',I3)
   READ(5,*) R(I,J)
812 CONTINUE
   DO 814 K=1,4
   NTK=NTQ(K)
   DO 814 K2=1,NTK
   I=I+1
   WRITE(6,815) TQC(K,K2),K,J
815 FORMAT(' ENTER THE RATE FOR THE ',F6.2,' YEAR TERM BOND FOR QUARTER',I3,' , FORECAST',I3)
   READ(5,*) R(I,J)
814 CONTINUE
   WRITE(6,1209)
1209 FORMAT(' WOULD YOU LIKE TO USE DEBT TERMINATION ACTIVITIES?',/$', ' ENTER 1 FOR YES, 2 FOR NO$)
   READ(5,*) KL
   IF(KL.EQ.2) GO TO 11
   WRITE(6,209) J
209 FORMAT(' ENTER THE 8 ENDING RATES FOR 1- TO 8-MONTH BONDS, FORECAST',I3)
   READ(5,*) (Z(N,J),N=1,8)
   I=40
   DO 816 K=1,12
   IF(MT(K).EQ.NO) GO TO 816
   NTK=NTM(K)
   DO 816 K2=1,NTK
   I=I+1
TIME(K,K2) = TIME(K,K2) - (13 - K) / 12.
WRITE(6,017) TIME(K,K2), J
817 FORMAT( * ENTER THE ENDING RATE FOR A', F6.2,' YEAR TERM BOND, FORECAST, I3)
READ(5,*), ZIN(I,J)
816 CONTINUE
DO 818 K=1,4
NTCK = NTQ(K)
DO 818 K2=1, NTCX
I = I + 1
TQCK(K,K2) = TQC(K,K2) - (4.7777778 - K) / 4.
WRITE(6,819) TQCK(K,K2), J
819 FORMAT( * ENTER THE ENDING RATE FOR A', F6.2,' YEAR TERM BOND, FORECAST, I3)
READ(5,*), ZIQ(I,J)
11 CONTINUE
NCCI = I
NS10E = 1000 + NCCI
WRITE(6,211)
211 FORMAT( * ENTER THE DEBT NEEDS FOR THE 16 PERIODS IN MILLIONS $')
READ(5,*), (DEM(KK), KK=1,16)
WRITE(6,218)
218 FORMAT( * WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON ANY',/,
$' NOTE OR BOND GROUP? ENTER 1 FOR YES, 2 FOR NO')
READ(5,*), NY
IF (NY.EQ.0) GO TO 79
WRITE(6,820)
820 FORMAT( * WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE',/,
$' DISCOUNT NOTES? ENTER 1 FOR YES, 2 FOR NO')
READ(5,*), NY1
IF (NY1.EQ.0) GO TO 821
WRITE(6,212)
212 FORMAT( * ENTER THE MAXIMUM FOR EACH OF THE 16 DISCOUNT NOTES')
READ(5,*), (CON(I), I=1,16)
821 CONTINUE
WRITE(6,822)
822 FORMAT( * WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE',/,
$' SIX-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO')
READ(5,*), NY2
IF (NY2.EQ.0) GO TO 823
WRITE(6,213)
213 FORMAT( * ENTER THE MAXIMUM FOR EACH OF THE 12 SIX-MONTH BONDS')
READ(5,*), (CON(I), I=17,28)
823 CONTINUE
WRITE(6,824)
824 FORMAT( * WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE',/,
$' NINE-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO')
READ(5,*), NY3
IF (NY3.EQ.0) GO TO 825
WRITE(6,214)
214 FORMAT( * ENTER THE MAXIMUM FOR EACH OF THE 12 NINE-MONTH BONDS')
READ(5,*), (CON(I), I=29,40)
825 CONTINUE
I = 40
WRITE (6, 826)
826 FORMAT (' WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE',/,$' LONG-TERM BONDS? ENTER 1 FOR YES, 2 FOR NO')
READ (5, *) NT4
IF (NT4.EQ. NO) GO TO 79
DO 827 K=1,12
NTMK=NTM(K)
DO 827 K2=1,NTMK
I=I+1
WRITE (6, 828) TTM(K,K2), K
READ (5, *) CON(I)
CONTINUE
DO 829 K=1,4
NTCK=NTQ(K)
DO 829 K2=1,NTCK
I=I+1
WRITE (6, 830) TIC(K,K2), K
830 FORMAT (' ENTER THE MAX. FOR THE', F6.2, ' YEAR TERM BOND FOR QUARTER', $',I3)
READ (5, *) CON(I)
CONTINUE
79 CONTINUE
WRITE (6, 225)
225 FORMAT (' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON ANY',/,$' NOTE AND BOND GROUP? ENTER 1 FOR YES, 2 FOR NO')
READ (5, *) NZ
IF (NZ.EQ. NO) GO TO 80
WRITE (6, 831)
831 FORMAT (' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,$' DISCOUNT NOTES? ENTER 1 FOR YES, 2 FOR NO')
READ (5, *) NZ1
IF (NZ1.EQ. NO) GO TO 832
WRITE (6, 226)
226 FORMAT (' ENTER THE MINIMUM FOR EACH OF THE 16 DISCOUNT NOTES')
READ (5, *) (CM(I), I=1,16)
832 CONTINUE
WRITE (6, 833)
833 FORMAT (' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,$' SIX-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO')
READ (5, *) NZ2
IF (NZ2.EQ. NO) GO TO 834
WRITE (6, 227)
227 FORMAT (' ENTER THE MINIMUM FOR EACH OF THE 12 SIX-MONTH BONDS')
READ (5, *) (CM(I), I=17,28)
834 CONTINUE
WRITE (6, 835)
835 FORMAT (' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,$' NINE-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO')
READ (5, *) NZ3
IF (NZ3.EQ. NO) GO TO 836
WRITE (6, 228)
228 FORMAT (' ENTER THE MIN. FOR EACH OF THE 12 NINE-MONTH BONDS')
READ(5,*) (CM(I),I=29,40)
I=40
WRITE(6,837)
837 FORMAT('WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,
$'LONG-TERM BONDS? ENTER 1 FOR YES, 2 FOR NO')
READ(5,*) N24
IF(N24.EQ.NO) GO TO 80
DC 838 K=1,12
IF(NK.EQ.NC) GC TO 838
NTMK=NMK(K)
DO 838 K2=1,NMK
I=I+1
WRITE(6,839) TIM(K,K2),K
839 FORMAT('ENTER THE MIN. FOR THE',F6.2,
$'YEAR TERM BOND FOR MONTH',I3)
READ(5,*) CM(I)
CONTINUE
DC 840 K=1,4
NTCK=NTQ(K)
DO 840 K2=1,NTCK
I=I+1
WRITE(6,841) TIM(K,K2),K
841 FORMAT('ENTER THE MIN. FOR THE',F6.2,
$'YEAR TERM BOND FOR QUARTER',I3)
READ(5,*) CM(I)
CONTINUE
WRITE(6,216)
216 FORMAT('THE QPRAND MATRIX IS BEING GENERATED')
C THIS SECTION IS WHERE THE COSTS ARE COMPUTED
C THE DISCOUNT FACTORS ARE COMPUTED HERE
DO 80 J=1,M
  P(J)=(1.0+S(1,J)/1200.0)
DO 81 K=2,12
  F(K)=P(K-1)*(1.0+S(K,J)/1200.0)
81 CONTINUE
DISAD=1.0+S(12,J)/1200.0
DO 2100 K=13,20
  F(K)=P(K-1)*DISAD
2100 CONTINUE
K=0
N=1
C DISCOUNT NOTES
DO 12 L=1,4
  R(K+1,J)=(R(K+1,J)*.05555556)/P(N)
  B(K+2,J)=(B(K+2,J)*.27777778)/P(N)
  R(K+3,J)=(R(K+3,J)*.83333333)/P(N+1)
  R(K+4,J)=(R(K+4,J)*.83333333)/P(N+2)
  K=K+4
  N=N+3
12 CONTINUE
C SIX-MONTH BONDS
DO 13 I = 17, 23
  B(I, J) = (B(I, J) * 5.) / P(I - 11)
13  CONTINUE
IF (K(1, 2) = R(24, J))
R(24, J) = (R(24, J) * 5. - Z(1, J) * 6333333) / P(13)
IF (K(2, 2) = R(25, J))
R(25, J) = (R(25, J) * 5. - Z(2, J) * 1.6666667) / P(14)
IF (K(3, 2) = R(26, J))
R(26, J) = (R(26, J) * 5. - Z(3, J) * 2.5) / P(15)
IF (K(4, 2) = R(27, J))
R(27, J) = (R(27, J) * 5. - Z(4, J) * 3.333333) / P(16)
IF (K(5, 2) = R(28, J))
C NINE-MONTH BONDS
DO 14 I = 29, 32
  R(I, J) = (R(I, J) * 7.5) / P(I - 20)
14  CONTINUE
DO 15 I = 33, 40
IF (K(1, 32) = R(I, J))
15  CONTINUE
C LONG-TERM BONDS
RTN = (S(12, J) / 1200. + 1.) ** 6. - 1.
RTE = RTN
IF (S(12, J) = E.E. 0.) RTE = 1.
I = 40
DO 842 K = 1, 6
IF (T(K) = E.E. 0.) GO TO 842
NTMK = NTM(K)
DO 842 K2 = 1, NTMK
I = I + 1
IF (K(1, 2) = R(I, J))
R(I, J) = (R(I, J) * 5.) / P(K + 5) + (R(I, J) * 5. - Z(I, J) * 8333333 ** (K - 1)) /$
  $E(K + 11) + (R(I, J) - Z(I, J)) * 5. * (1. - 1. / (1. + RTN) ** ((TIME(K, K2) -$
  $. 0833333 ** (K - 1)) * 2)) / RTE / P(K + 11)
842  CONTINUE
DO 843 K = 7, 12
IF (T(K) = E.E. 0.) GO TO 843
NTMK = NTM(K)
DO 843 K2 = 1, NTMK
I = I + 1
IF (K(1, 2) = R(I, J))
R(I, J) = (R(I, J) * 5. - Z(I, J) * 8333333 ** (K - 7)) / P(K + 5) + (R(I, J) -$
  $Z(I, J)) * 5. * (1. - 1. / (1. + RTN) ** ((TIME(K, K2) - 0.0833333 ** (K - 7))$
  *.2)) / RTE / P(K + 5)
843  CONTINUE
NTQ = NTQ(1)
DO 844 K2 = 1, NTQ
I = I + 1
IF (K(1, 2) = R(I, J))
  $(1. - 1. / (1. + RTN) ** ((TQE(K, K2) * 2)) / RTE / P(12)
844  CONTINUE
NTQ = NTQ(2)
DO 845 K2 = 1, NTQ
I=I+1
IF(KL.EQ.2) ZTQ(I,J)=R(I,J)
R(I,J)=R(I,J)*5./E(9)+(R(I,J)*5.-ZTQ(I,J)*2.5)/P(15)+(R(I,J)-
$ZTQ(I,J)*5.*(1.-1./(1.+RTN)**((TTQE(2,K2)-.25)*2))/RTE/P(15)"
845 CONTINUE
RTQ3=RTQ(3)
DO 846 K2=1,RTQ3
I=I+1
IF(KL.EQ.2) ZTQ(I,J)=R(I,J)
R(I,J)=(R(I,J)*5.)/P(12)+(R(I,J)-ZTQ(I,J))*5.*(1.-1./(1.+RTN)**
$((TTQE(3,K2)*2))/RTE/P(12)
846 CONTINUE
RTQ4=RTQ(4)
DO 1847 K2=1,RTQ4
I=I+1
IF(KL.EQ.2) ZTQ(I,J)=R(I,J)
R(I,J)=(R(I,J)*5.-ZTQ(I,J)*2.5)/P(15)+(R(I,J)-ZTQ(I,J))*5.*(1.-1./
$((TTQE(4,K2)-.25)*2))/RTE/P(15)
1847 CONTINUE
20 CONTINUE
C THIS SECTION COMPUTES THE EXPECTED VALUES AND DEVIATIONS
C
DO 19 I=1,NCOL
E(I)=0.
DO 17 J=1,M
E(I)=E(I)+R(I,J)*PROB(J)
17 CONTINUE
DO 18 J=1,M
DEV(I,J)=R(I,J)-E(I)
18 CONTINUE
19 CONTINUE
C THIS SECTION CREATES THE VARIANCE-COVARIANCE
C
DO 66 I=1,NCOL
DO 67 J=1,NCOL
VC(I,J)=0.
DO 68 K=1,M
VC(I,J)=VC(I,J)+DEV(I,K)*DEV(J,K)*PROB(K)*VC(I,J)
68 CONTINUE
67 CONTINUE
66 CONTINUE
C THIS SECTION IS WHERE THE RAND OF MATRIX IS GENERATED
C
WRITE(NT6,501)
FORMAT(4Horows)
WRITE(NT6,502)
FORMAT(11x,4H$GEJ)
DO 71 I=1001,1016
WRITE(NT6,503) I
503 FORMAT(12x,1HE,4I)
71 CONTINUE
C WRITE BOWS FOR ANY CONSTRAINTS
NC=NCOL+1200
NI=NCOL+1100
IF(NY.EQ.NO) GO TO 72
504 FORMAT (11X,2H+R,I4)
   IF(NY1.NE.NO) WRITE(NT6,504) (I,I=1101,1116)
   IF(NY2.NE.NO) WRITE(NT6,504) (I,I=1117,1128)
   IF(NY3.NE.NO) WRITE(NT6,504) (I,I=1129,1140)
   IF(NY4.NE.NO) WRITE(NT6,504) (I,I=1141,NI)
72 CONTINUE
   IF(NZ.EQ.NO) GC TC 74
505 FORMAT (11X,2H-R,I4)
   IF(NZ1.NE.NO) WRITE(NT6,505) (I,I=1201,1216)
   IF(NZ2.NE.NO) WRITE(NT6,505) (I,I=1217,1228)
   IF(NZ3.NE.NO) WRITE(NT6,505) (I,I=1229,1240)
   IF(NZ4.NE.NO) WRITE(NT6,505) (I,I=1241,NC)
74 CONTINUE
   WRITE(NT6,405)
C WRITE THE MATRIX SECTION
   WRITE(NT6,401)
401 FORMAT (6HMATRIX)
C WRITE THE DISCOUNT NOTES
   DO 31 I=1001,1016
   WRITE(NT6,402) I,E(I-1000)
402 FORMAT (6X,1HE,I4,1X,3HOBJ,3X,F12.6)
   WRITE(NT6,403) I,I
403 FORMAT (6X,1HE,I4,1X,1HR,I4,1X,'1',1X)
   I2=I+100
   I3=I+200
   IF(NY1.NE.NO) WRITE(NT6,403) I,I2
   IF(NZ1.NE.NO) WRITE(NT6,403) I,I3
   DO 32 J=I,NSICE
   WRITE(NT6,404) I,J,VC(I-1000,J-1000)
32 CONTINUE
31 CONTINUE
C WRITE THE SIX-MONTH BONDS
   I=1017
   WRITE(NT6,402) I,E(I-1000)
   DO 34 J=1001,1008
   WRITE(NT6,403) I,J
34 CONTINUE
   I2=I+100
   I3=I+200
   IF(NY2.NE.NO) WRITE(NT6,403) I,I2
   IF(NZ2.NE.NO) WRITE(NT6,403) I,I3
   DO 35 J=I,NSICE
   WRITE(NT6,404) I,J,VC(I-1000,J-1000)
35 CONTINUE
   N=1003
   DO 36 I=1018,1026
   WRITE(NT6,402) I,E(I-1000)
   NN=NN+7
   DC 37 J=NN,NN
   WRITE(NT6,403) I,J
CONTINUE
I2=I+100
I3=I+200
IF (NY2 .NE. NO) WRITE (NT6,403) I, I2
IF (NZ2 .NE. NO) WRITE (NT6,403) I, I3
DO 38 J=1, NSTOF
WRITE (NT6,404) I, J, VC (I-1000, J-1000)
38 CONTINUE
N=N+1
CONTINUE
N=1007
DO 39 I=1021, 1023
WRITE (NT6,402) I, E (I-1000)
39 CONTINUE
NN=N+7
DO 40 J=NN, N
WRITE (NT6,403) I, J
40 CONTINUE
I2=I+100
I3=I+200
IF (NY2 .NE. NO) WRITE (NT6,403) I, I2
IF (NZ2 .NE. NO) WRITE (NT6,403) I, I3
DO 41 J=1, NSTOF
WRITE (NT6,404) I, J, VC (I-1000, J-1000)
41 CONTINUE
N=N+1
CONTINUE
N=1011
DO 42 I=1024, 1026
WRITE (NT6,402) I, E (I-1000)
42 CONTINUE
J=N, 1016
WRITE (NT6,403) I, J
CONTINUE
I2=I+100
I3=I+200
IF (NY2 .NE. NO) WRITE (NT6,403) I, I2
IF (NZ2 .NE. NO) WRITE (NT6,403) I, I3
DO 43 J=1, NSTOF
WRITE (NT6,404) I, J, VC (I-1000, J-1000)
43 CONTINUE
N=N+1
CONTINUE
N=1015
DO 45 I=1027, 1028
WRITE (NT6,402) I, E (I-1000)
45 CONTINUE
J=N, 1016
WRITE (NT6,403) I, J
CONTINUE
I2=I+100
I3=I+200
IF (NY2 .NE. NO) WRITE (NT6,403) I, I2
IF (NZ2 .NE. NO) WRITE (NT6,403) I, I3
DO 47 J=1, NSTOF
WRITE (NT6,404) I, J, VC (I-1000, J-1000)
47 CONTINUE
N=N+1
CONTINUE
C WRITE THE NINE-MONTH ECNDS
I=1029
WRITE(NT6,402)I,E(I-1000)
DO 48 J=1001,1012
WRITE(NT6,403)I,J
48 CONTINUE
I2=I+100
I3=I+200
IF(NY3.NE.NO) WRITE(NT6,403)I,I2
IF(NZ3.NE.NO) WRITE(NT6,403)I,I3
DO 49 J=I,NSTIP
WRITE(NT6,404)I,J,VC(I-1000,J-1000)
49 CONTINUE
N=1003
DO 50 I=1030,1032
WRITE(NT6,402)I,E(I-1000)
NN=N+11
DO 51 J=NN,NN
WRITE(NT6,403)I,J
51 CONTINUE
I2=I+100
I3=I+200
IF(NY3.NE.NO) WRITE(NT6,403)I,I2
IF(NZ3.NE.NO) WRITE(NT6,403)I,I3
DO 52 J=I,NSICE
WRITE(NT6,404)I,J,VC(I-1000,J-1000)
52 CONTINUE
N=N+1
50 CONTINUE
N=1007
DO 53 I=1033,1035
WRITE(NT6,402)I,E(I-1000)
DO 54 J=N,1016
WRITE(NT6,403)I,J
54 CONTINUE
I2=I+100
I3=I+200
IF(NY3.NE.NO) WRITE(NT6,403)I,I2
IF(NZ3.NE.NO) WRITE(NT6,403)I,I3
DO 55 J=I,NSICE
WRITE(NT6,404)I,J,VC(I-1000,J-1000)
55 CONTINUE
N=N+1
53 CONTINUE
N=1011
DO 56 I=1036,1038
WRITE(NT6,402)I,E(I-1000)
DO 57 J=N,1016
WRITE(NT6,403)I,J
57 CONTINUE
I2=I+100
I3=I+200
IF(NY3.NE.NO) WRITE(NT6,403)I,I2
IF(NZ3.NE.NO) WRITE(NT6,403)I,I3
FILE: QPNAT  FORTRAN A  CORNELL VM/SP CMS LEVEL 104

DO 58 J=I,NSTCF
WRITE(NT6,404) I,J,VC(I-1000,J-1000)
58 CONTINUE
N=N+1
56 CONTINUE
N=1015
DO 59 I=1039,1040
WRITE(NT6,402) I,VC(I-1000)
DO 60 J=N,1016
WRITE(NT6,403) I,J
60 CONTINUE
I2=I+100
I3=I+200
IF(NY3.NE.NO) WRITE(NT6,403) I,I2
IF(NZ3.NE.NO) WRITE(NT6,403) I,I3
DO 61 J=1,NSTCF
WRITE(NT6,404) I,J,VC(I-1000,J-1000)
61 CONTINUE
N=N+1
59 CONTINUE
C WRITE THE LONG-TERM FONDS
KM=1000
I=1040
DO 64 K=1,12
IF(K.EQ.2.OR.K.EQ.5.OR.K.EQ.8.OR.K.EQ.11) KM=KM+1
KM=KM+1
IF(NT(K).NE.NC) GO TO 64
NNTK=NTM(K)
DO 64 K2=1,NNTK
I=I+1
WRITE(NT6,402) I,VC(I-1000)
DO 63 J=KM,1016
WRITE(NT6,403) I,J
63 CONTINUE
I2=I+100
I3=I+200
IF(NY4.NE.NO) WRITE(NT6,403) I,I2
IF(NZ4.NE.NO) WRITE(NT6,403) I,I3
NAF=NCOL+1000
DO 64 J=1,NAF
WRITE(NT6,404) I,J,VC(I-1000,J-1000)
64 CONTINUE
N=998
DO 62 K=1,4
N=N+4
NTCK=NTQ(K)
DO 62 K2=1,NTCK
I=I+1
WRITE(NT6,402) I,VC(I-1000)
DO 847 J=N,1016
WRITE(NT6,403) I,J
847 CONTINUE
I2=I+100
I3=I+200
IF(NY4.NE.NO) WRITE(NT6,403) I,I2
FILE: QPMAT FORTRAN A CORNELL VA/SP CMS LEVEL 104

IF(NZ4.NE.NO) WRITE(NT6,403) I,I3
NAD=NAD+1000
DO 848 J=I,NAD
WRITE(NT6,404) I,J,VC(I-1000,J-1000)
848 CONTINUE
62 CONTINUE
WRITE(NT6,405)
405 FORMAT (3HEND)
C WRITE THE RHS
WRITE(NT6,406)
406 FORMAT (3HHS)
DO 65 I=1001,1016
WRITE(NT6,407) I,LEM(I-1000)
407 FORMAT (6X,'E',5X,1HE,F12.6)
65 CONTINUE
IF(NY.EQ.NC) GO TO 1070
IF(NY1.EQ.NC) GO TO 1850
DO 850 I=1101,1116
WRITE(NT6,407) I,CCN(I-1100)
850 CONTINUE
1850 CONTINUE
IF(NY2.EQ.NO) GO TO 1851
DO 851 I=1117,1128
WRITE(NT6,407) I,CON(I-1100)
851 CONTINUE
1851 CONTINUE
IF(NY3.EQ.NO) GO TO 1852
DO 852 I=1129,1140
WRITE(NT6,407) I,CCN(I-1100)
852 CONTINUE
1852 CONTINUE
IF(NY4.EQ.NO) GO TO 1070
DO 70 I=1141,NI
WRITE(NT6,407) I,CON(I-1100)
70 CONTINUE
1070 CONTINUE
IF(NZ.EQ.NO) GO TO 1069
IF(NZ1.EQ.NC) GO TO 1854
DO 854 I=1201,1216
WRITE(NT6,407) I,CM(I-1200)
854 CONTINUE
1854 CONTINUE
IF(NZ2.EQ.NO) GO TO 1855
DO 855 I=1217,1228
WRITE(NT6,407) I,CM(I-1200)
855 CONTINUE
1855 CONTINUE
IF(NZ3.EQ.NO) GC 1856
DO 856 I=1229,1240
WRITE(NT6,407) I,CM(I-1200)
856 CONTINUE
1856 CONTINUE
IF(NZ4.EQ.NO) GO TO 1069
DO 69 I=1241,NC
WRITE(NT6,407) I,CM(I-1200)
FILE: QFMAT FORTRAN A

CONTINUE
1069 CONTINUE
WRITE(NT6,405)
WRITE(NT6,408)
408 FORMAT(3HEOF)
860 FORMAT(1HM,2X,F6.2,I3,I3)
870 FORMAT(1HQ,2X,F6.2,I3,I3)
WRITE(6,217) NT6
217 FORMAT(1 THE QRAND MATRIX HAS BEEN CREATED ON FILE',I3)
WRITE(6,2) NT7
2 FORMAT(1 INFO. FOR THE REPORT WRITER HAS BEEN PLACED ON FILE',I3)
STOP
END
DIMENSION S(70), M(30), TQM(30), M1(30), M2(30)
REAL V(12)
DATA V(1), V(2), V(3), V(4), V(5), V(6), V(7), V(8), V(9), V(10), V(11),
S(12) /'FIRST', 'SECOND', 'THIRD', 'FOURTH', 'FIFTH',
'SIXTH', 'SEVENTH', 'EIGHT', 'NINTH', 'TENTH',
'ELEVENTH', 'TWELFTH' /
DATA CK/ 'NEAR'/
DATA AK/ 'P10'/
ALI=0.
ISCI=1.
NT5=5
NT7=13
AQUAI=0.
WRITE (6, 201)
201 FORMAT (' THE FOLLOWING ARE DEBT ISSUANCE STRATEGIES DERIVED BY A ')
$QUADRATIC PROGRAM'/)
WRITE (6, 202)
WRITE (6, 203)
WRITE (6, 204)
WRITE (6, 205)
202 FORMAT (' THE PROCEDURE WAS WRITTEN BY ')
203 FORMAT ( 10X, 'LOREN TAUR')
204 FORMAT ( 10X, 'DEPT. OF AG. ECON.')
205 FORMAT ( 10X, 'CORNELL UNIVERSITY' )
N4=0
300 CONTINUE
N4=N4+1
READ (NT7, 301, END=302) M(Q(N4), TTHM(N4), M1(N4), M2(N4)
301 FORMAT ( A1, 2X, F6.2, I3, 13)
GO TO 300
302 N4=N4-1
N5=N4*40
C READ FILE UNTIL LINEAR TERM IS REACHED
30 CONTINUE
READ (NT5, 10, END=99) BCK
10 FORMAT ( 61X, A4)
IF (BCK.NE.CK) GO TO 30
CONTINUE
READ (NT5, 11, END=99) ALIN, AQUA
11 FORMAT ( 54X, F17.6, 5X, F19.6)
IF (AQUA.LT.0.) AQUA=0.
AQUA=SQRT (AQUA) *. 001
ALIN=ALIN*. 001
IF (ALIN.EQ. ALINL.AND. AQUA.EQ. AQUAL) GO TO 30
READ (NT5, 16) B1, B2, B3, B4
16 FORMAT (A4/A4/A4/A4)
DC 23 J=1, N5
S(J)=0.
23 CONTINUE
24 CONTINUE
READ (NT5, 12, END=41, ERR=99) ACK, M, B
12 FORMAT ( 3X, A3, I2, 1X, F20.6)
IF (ACK.NE.ACK) GO TO 41
DO 22 J=1, N5
IF (J.EQ.M) GO TO 50
CONTINUE
S(J) = F
GO TO 24
CONTINUE
WRITE (6,101) ISCI
101 FORMAT ('1',18X,'DEBT ISSUANCE FOR THE NEXT 12 MONTHS',2X,'$','STRATEGY NUMBER',I3)
WRITE (6,87)
87 FORMAT (25X,'(IN MILLIONS OF DOLLARS)',//)
WRITE (6,102)
102 FORMAT (22X,'NINE-MONTH',4X,'SIX-MONTH',4X,'DISCOUNT NOTES')
WRITE (6,103)
103 FORMAT (24X,'BONDS',9X,'BONDS',7X,'$10, 20, OR 30 DAY',//)
104 FORMAT (2X,A8,1X,'MONTH',5X,F11.3,2X,F11.3,5X,F11.3)
105 FORMAT (4X,'LAST THIRD',36X,F11.3)
WRITE (6,104) V(1),S(29),S(17),S(1)
WRITE (6,105) S(2)
WRITE (6,104) V(2),S(30),S(18),S(3)
WRITE (6,104) V(3),S(31),S(19),S(4)
WRITE (6,104) V(4),S(32),S(20),S(5)
WRITE (6,105) S(6)
WRITE (6,104) V(5),S(33),S(21),S(7)
WRITE (6,104) V(6),S(34),S(22),S(8)
WRITE (6,104) V(7),S(35),S(23),S(9)
WRITE (6,105) S(10)
WRITE (6,104) V(8),S(36),S(24),S(11)
WRITE (6,104) V(9),S(37),S(25),S(12)
WRITE (6,104) V(10),S(38),S(26),S(13)
WRITE (6,105) S(14)
WRITE (6,104) V(11),S(39),S(27),S(15)
WRITE (6,104) V(12),S(40),S(28),S(16)
WRITE (6,401)
401 FORMAT (,//,30X,'LONG-TERM BONDS',//)
WRITE (6,402)
402 FORMAT (15X,'MONTH OR QUARTER',5X,'MATURETY',10X,'AMOUNT')
DO 769 J=1,N4
WRITE (6,303) A1(J),MQ(J),ITGM(J),S(J+40)
303 FORMAT (20X,I2,1H-,A1,14X,F6.2,5X,F11.3)
769 CONTINUE
WRITE (6,106) ALIN
106 FORMAT (,//,25X,'EXPECTED DISCOUNTED COST = ',F11.3)
WRITE (6,107) AQUA
107 FORMAT (31X,'STANDARD DEVIATION = ',F11.3,//)//
ALIN=ALIN
AQUA=AQUA
ISC=ISC+1
GO TO 30
99 CONTINUE
WRITE (6,108)
108 FORMAT (20X,'***** END OF THE SOLUTIONS *****')
STOP
END
Changes in Rand QP

The following changes are necessary in the Rand Quadratic Program to make it operable as part of the Farm Credit Debt Selection Model.

```
2 A(30000)
DATA MINDM1,MINDM2,MINDM3 /15000,500,500/
2 A(30000)
DO 350 I=5, 13, 2
KBCD(NTAL+1)=KM2(21)
```