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# **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.

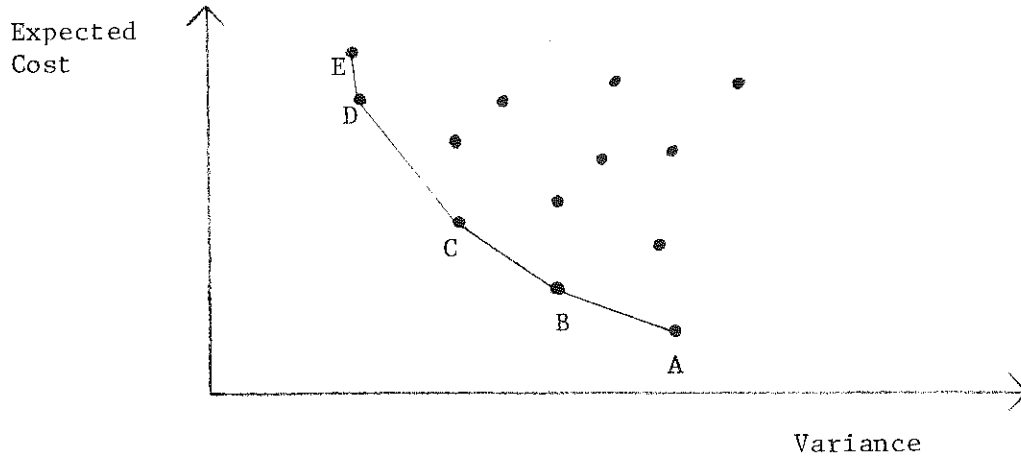
In this two period case, if funding needs increase in the second period, it is necessary to use the one-period bond of the second period to fund that increase. In contrast, if funding needs decrease in the second period, it is necessary to use the one-period bond of the first period in at least the amount 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

Figure 1. Efficient Frontier of Bond Strategies



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

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

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

## Strategy 1

Bond 1	\$ 7,300
Bond 2	\$ 2,700
Bond 3	\$17,300
Expected Cost	\$ 2,720
Variance	\$13,636
Standard Deviation	\$ 117

## Strategy 2

Bond 1	\$10,000
Bond 2	\$ 0
Bond 3	\$20,000
Expected Cost	\$ 2,680
Variance	\$15,600
Standard Deviation	\$ 125

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-

remaining 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)

	Number of Bonds	Term 1	Term 2	Term 3
First Month				
Last Third				
Second Month				
Third Month	1	4.0		
Fourth Month	1	5.0		
Last Third	3	2.0	4.0	7.0
Fifth Month				
Sixth Month				
Seventh Month	1	5.0		
Last Third	3	3.0	6.0	10.0
Eighth Month				
Ninth Month				
Tenth Month				
Last Third	3	4.0	8.0	12.0
Eleventh Month				
Twelfth Month	1	4.5		

FCB DEBT MODEL

Interest Rate Projection # 1  
 Probability = .45

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

	Discount Coefficient Rate	Discount Notes	Six-month Bonds	Nine-month Bonds		Term Bonds	
First Month	<u>0.</u>	<u>0.</u>	<u>0.</u>	<u>0.</u>			
Last Third		<u>0.</u>			<u>0.</u>		
Second Month	<u>12.</u>	<u>12.1</u>	<u>12.05</u>	<u>12.</u>			
Third Month	<u>11.1</u>	<u>11.2</u>	<u>11.35</u>	<u>11.5</u>	<u>11.75</u>		
Fourth Month	<u>11.1</u>	<u>11.2</u>	<u>11.35</u>	<u>11.5</u>	<u>11.75</u>		
Last Third		<u>11.2</u>			<u>11.75</u>	<u>11.8</u>	<u>11.85</u>
Fifth Month	<u>11.1</u>	<u>11.2</u>	<u>11.35</u>	<u>11.5</u>			
Sixth Month	<u>11.3</u>	<u>11.4</u>	<u>11.5</u>	<u>11.6</u>			
Seventh Month	<u>11.5</u>	<u>11.6</u>	<u>11.7</u>	<u>11.75</u>	<u>12.2</u>		
Last Third		<u>11.75</u>			<u>12.4</u>	<u>12.45</u>	<u>12.5</u>
Eighth Month	<u>11.7</u>	<u>11.8</u>	<u>11.9</u>	<u>12.</u>			
Ninth Month	<u>11.6</u>	<u>11.7</u>	<u>11.8</u>	<u>11.9</u>			
Tenth Month	<u>11.5</u>	<u>11.6</u>	<u>11.7</u>	<u>11.8</u>			
Last Third		<u>11.55</u>			<u>12.25</u>	<u>12.3</u>	<u>12.35</u>
Eleventh Month	<u>11.4</u>	<u>11.5</u>	<u>11.6</u>	<u>11.65</u>			
Twelfth Month	<u>11.35</u>	<u>11.45</u>	<u>11.55</u>	<u>11.65</u>	<u>12.2</u>		

Ending Rates

1-month bond	<u>11.4</u>	1-year bond	<u>11.7</u>	6-year bond	<u>12.05</u>
2-month bond	<u>11.4</u>	2-year bond	<u>11.8</u>	7-year bond	<u>12.10</u>
3-month bond	<u>11.4</u>	3-year bond	<u>12.</u>	8-year bond	<u>12.10</u>
4-month bond	<u>11.45</u>	4-year bond	<u>12.</u>	9-year bond	<u>12.10</u>
5-month bond	<u>11.45</u>	5-year bond	<u>12.</u>	10-year bond	<u>12.10</u>
6-month bond	<u>11.5</u>				
7-month bond	<u>11.55</u>				
8-month bond	<u>11.6</u>				

FCB DEBT MODEL

Interest Rate Projection # 2  
 Probability = .30

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

	Discount Coefficient Rate	Discount Notes	Six-month Bonds	Nine-month Bonds	Term Bonds		
First Month	<u>0.</u>	<u>0.</u>	<u>0.</u>	<u>0.</u>	<u>0.</u>		
Last Third		<u>0.</u>					
Second Month	<u>12.</u>	<u>12.1</u>	<u>12.05</u>	<u>12.</u>			
Third Month	<u>12.35</u>	<u>12.45</u>	<u>12.35</u>	<u>13.3</u>	<u>12.15</u>		
Fourth Month	<u>12.7</u>	<u>12.8</u>	<u>12.7</u>	<u>12.6</u>	<u>12.35</u>		
Last Third		<u>13.1</u>			<u>12.55</u>	<u>12.5</u>	<u>12.45</u>
Fifth Month	<u>13.1</u>	<u>13.2</u>	<u>13.1</u>	<u>12.9</u>			
Sixth Month	<u>13.3</u>	<u>13.4</u>	<u>13.25</u>	<u>13.15</u>			
Seventh Month	<u>13.5</u>	<u>13.6</u>	<u>13.5</u>	<u>13.35</u>	<u>12.8</u>		
Last Third		<u>13.75</u>			<u>12.95</u>	<u>12.9</u>	<u>12.85</u>
Eighth Month	<u>13.75</u>	<u>13.85</u>	<u>13.7</u>	<u>13.6</u>			
Ninth Month	<u>13.9</u>	<u>14.</u>	<u>13.85</u>	<u>13.7</u>			
Tenth Month	<u>14.1</u>	<u>14.2</u>	<u>13.95</u>	<u>13.85</u>			
Last Third		<u>14.35</u>			<u>13.25</u>	<u>13.3</u>	<u>13.3</u>
Eleventh Month	<u>14.3</u>	<u>14.4</u>	<u>14.1</u>	<u>14.</u>			
Twelfth Month	<u>14.25</u>	<u>14.35</u>	<u>14.1</u>	<u>14.</u>	<u>13.4</u>		

Ending Rates

1-month bond	<u>14.35</u>	1-year bond	<u>13.95</u>	6-year bond	<u>13.3</u>
2-month bond	<u>14.35</u>	2-year bond	<u>13.25</u>	7-year bond	<u>13.3</u>
3-month bond	<u>14.35</u>	3-year bond	<u>13.35</u>	8-year bond	<u>13.25</u>
4-month bond	<u>14.3</u>	4-year bond	<u>13.35</u>	9-year bond	<u>13.25</u>
5-month bond	<u>14.2</u>	5-year bond	<u>13.35</u>	10-year bond	<u>13.25</u>
6-month bond	<u>14.1</u>				
7-month bond	<u>14.</u>				
8-month bond	<u>13.95</u>				

FCB DEBT MODEL

Interest Rate Projection # 3

Probability = .25

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

	Discount Coefficient Rate	Discount Notes	Six-month Bonds	Nine-month Bonds		Term Bonds	
First Month	<u>0.</u>	<u>0.</u>	<u>0.</u>	<u>0.</u>			
Last Third		<u>0.</u>			<u>0.</u>		
Second Month	<u>10.2</u>	<u>10.3</u>	<u>10.4</u>	<u>10.45</u>			
Third Month	<u>9.95</u>	<u>10.05</u>	<u>10.15</u>	<u>10.25</u>	<u>10.9</u>		
Fourth Month	<u>9.75</u>	<u>9.85</u>	<u>9.95</u>	<u>10.15</u>	<u>10.65</u>		
Last Third		<u>9.7</u>			<u>10.5</u>	<u>10.55</u>	<u>10.6</u>
Fifth Month	<u>9.55</u>	<u>9.65</u>	<u>9.75</u>	<u>10.05</u>			
Sixth Month	<u>9.65</u>	<u>9.75</u>	<u>9.85</u>	<u>10.15</u>			
Seventh Month	<u>9.8</u>	<u>9.9</u>	<u>9.95</u>	<u>10.25</u>	<u>10.45</u>		
Last Third		<u>10.</u>			<u>10.5</u>	<u>10.55</u>	<u>10.6</u>
Eighth Month	<u>9.95</u>	<u>10.05</u>	<u>10.05</u>	<u>10.35</u>			
Ninth Month	<u>10.</u>	<u>10.1</u>	<u>10.15</u>	<u>10.45</u>			
Tenth Month	<u>10.05</u>	<u>10.15</u>	<u>10.2</u>	<u>10.55</u>			
Last Third		<u>10.2</u>			<u>10.7</u>	<u>10.8</u>	<u>10.85</u>
Eleventh Month	<u>10.15</u>	<u>10.25</u>	<u>10.3</u>	<u>10.6</u>			
Twelfth Month	<u>10.25</u>	<u>10.35</u>	<u>10.45</u>	<u>10.7</u>	<u>10.85</u>		

Ending Rates

1-month bond	<u>10.5</u>	1-year bond	<u>10.75</u>	6-year bond	<u>10.9</u>
2-month bond	<u>10.5</u>	2-year bond	<u>10.8</u>	7-year bond	<u>10.9</u>
3-month bond	<u>10.5</u>	3-year bond	<u>10.85</u>	8-year bond	<u>10.9</u>
4-month bond	<u>10.55</u>	4-year bond	<u>10.85</u>	9-year bond	<u>10.9</u>
5-month bond	<u>10.6</u>	5-year bond	<u>10.85</u>	10-year bond	<u>10.9</u>
6-month bond	<u>10.6</u>				
7-month bond	<u>10.65</u>				
8-month bond	<u>10.75</u>				

FCB DEBT MODEL

Debt Needs

(In Millions of Dollars)

First Month	<u>0.</u>
Last Third	<u>0.</u>
Second Month	<u>17.</u>
Third Month	<u>41.</u>
Fourth Month	<u>52.</u>
Last Third	<u>76.</u>
Fifth Month	<u>92.</u>
Sixth Month	<u>103.</u>
Seventh Month	<u>124.</u>
Last Third	<u>147.</u>
Eighth Month	<u>180.</u>
Ninth Month	<u>188.</u>
Tenth Month	<u>196.</u>
Last Third	<u>209.</u>
Eleventh Month	<u>239.</u>
Twelfth Month	<u>246.540</u>

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

	Discount Notes	Six-month Bonds	Nine-month Bonds		Term Bonds	
First Month	<u>50.</u>	<u>75.</u>	<u>75.</u>			
Last Third						
Second Month						
Third Month				<u>50.</u>		
Fourth Month				<u>50.</u>		
Last Third				<u>25.</u>	<u>25.</u>	<u>25.</u>
Fifth Month						
Sixth Month						
Seventh Month				<u>50.</u>		
Last Third				<u>25.</u>	<u>25.</u>	<u>25.</u>
Eighth Month						
Ninth Month						
Tenth Month						
Last Third				<u>25.</u>	<u>25.</u>	<u>25.</u>
Eleventh Month						
Twelfth Month				<u>50.</u>		



START  
EXECUTION BEGINS...  
THIS IS A GRAND 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  
?

2  
IS THERE A TERM BOND(S) FOR MONTH 2 ? ENTER 1 FOR YES, 2 FOR NO  
?

2  
IS THERE A TERM BOND(S) FOR MONTH 3 ? ENTER 1 FOR YES, 2 FOR NO  
?

1  
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 3, THE LIMIT IS 4  
?

1  
ENTER THE TERM OF TERM BOND 1 FOR MONTH 3  
?

4.0  
IS THERE A TERM BOND(S) FOR MONTH 4 ? ENTER 1 FOR YES, 2 FOR NO  
?

1  
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 4, THE LIMIT IS 4  
?

1  
ENTER THE TERM OF TERM BOND 1 FOR MONTH 4  
?

5.0  
IS THERE A TERM BOND(S) FOR MONTH 5 ? ENTER 1 FOR YES, 2 FOR NO  
?

2  
IS THERE A TERM BOND(S) FOR MONTH 6 ? ENTER 1 FOR YES, 2 FOR NO  
?

2  
IS THERE A TERM BOND(S) FOR MONTH 7 ? ENTER 1 FOR YES, 2 FOR NO  
?

1  
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 7, THE LIMIT IS 4  
?

1  
ENTER THE TERM OF TERM BOND 1 FOR MONTH 7  
?

5.0  
IS THERE A TERM BOND(S) FOR MONTH 8 ? ENTER 1 FOR YES, 2 FOR NO  
?

2

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  
?  
1  
ENTER THE NUMBER OF TERM ISSUES FOR MONTH 12, THE LIMIT IS 4  
?  
1  
ENTER THE TERM OF TERM BOND 1 FOR MONTH 12  
?  
4.5  
ENTER THE NUMBER OF TERM ISSUES FOR QUARTER 1, THE LIMIT IS 4  
?  
0  
ENTER THE TERM OF TERM BOND 1 FOR QUARTER 1  
?  
1.  
ENTER THE NUMBER OF TERM ISSUES FOR QUARTER 2, THE LIMIT IS 4  
?  
3  
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

?

3

ENTER THE PROBABILITY OF FORECAST 1

?

.45

ENTER THE 12 MONTHLY DISCOUNTING RATES FOR FORECAST 1

?

0. 12. 11.1 11.1 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 11.2 11.4 11.6 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. 11.9 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

?

14.35 14.4 14.35  
ENTER THE 12 SIX-MONTH RATES FOR FORECAST 2

?

0. 12.05 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 8-MONTH BONDS, FORECAST 2

?

14.35 14.35 14.35 14.3 14.2 14.1 14. 13.95  
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

?

13.95

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  
?  
10.55  
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  
?  
10.55  
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  
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 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  
?  
10.85  
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. 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.

WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE



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)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 8.207                               |
| FIFTH MONTH    | 24.207              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 0.0                 | 6.000              | 50.000                              |
| NINTH MONTH    | 8.000               | 0.0                | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 37.540              | 0.0                | 42.460                              |
| TWELFTH MONTH  | 0.0                 | 0.0                | 50.000                              |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 15.793 |
| 2-Q              | 7.00     | 0.0    |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.566  
 STANDARD DEVIATION = 0.444

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 3  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 7.875                               |
| FIFTH MONTH    | 23.875              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 0.0                 | 6.000              | 50.000                              |
| NINTH MONTH    | 8.000               | 0.0                | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 37.540              | 0.0                | 42.460                              |
| TWELFTH MONTH  | 0.0                 | 0.0                | 50.000                              |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 16.125 |
| 2-Q              | 7.00     | 0.0    |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.565  
STANDAPD DEVIATION = 0.444

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 6  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 8.842                               |
| FIFTH MONTH    | 24.842              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 6.000               | 0.0                | 50.000                              |
| NINTH MONTH    | 8.000               | 0.0                | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 37.540              | 0.0                | 42.460                              |
| TWELFTH MONTH  | 0.0                 | 0.0                | 50.000                              |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 15.158 |
| 2-Q              | 7.00     | 0.0    |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.561  
STANDARD DEVIATION = 0.444

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

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 16.487                              |
| FIFTH MONTH    | 32.487              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 6.000               | 0.0                | 50.000                              |
| NINTH MONTH    | 8.000               | 0.0                | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 75.000              | 0.0                | 5.000                               |
| TWELFTH MONTH  | 0.0                 | 0.0                | 12.540                              |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 7.513  |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.487  
STANDARD DEVIATION = 0.450

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

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 9.474                               |
| FIFTH MONTH    | 25.474              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 0.0                 | 6.000              | 50.000                              |
| NINTH MONTH    | 8.000               | 0.0                | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 75.000              | 0.0                | 5.000                               |
| TWELFTH MONTH  | 0.0                 | 0.0                | 12.540                              |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 14.526 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.442  
STANDARD DEVIATION = 0.458

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 15  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 8.002                               |
| FIFTH MONTH    | 24.002              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 0.0                 | 6.000              | 50.000                              |
| NINTH MONTH    | 0.0                 | 8.000              | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 75.000              | 0.0                | 5.000                               |
| TWELFTH MONTH  | 12.540              | 0.0                | 0.0                                 |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 15.998 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.431  
STANDARD DEVIATION = 0.462

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 18  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 0.0                                 |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| FIFTH MONTH    | 16.000              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 7.301               | 0.0                | 48.699                              |
| NINTH MONTH    | 0.0                 | 6.699              | 50.000                              |
| TENTH MONTH    | 21.000              | 0.0                | 37.000                              |
| LAST THIRD     |                     |                    | 50.000                              |
| ELEVENTH MONTH | 75.000              | 0.0                | 5.000                               |
| TWELFTH MONTH  | 12.540              | 0.0                | 0.0                                 |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 41.000 |
| 4-M              | 5.00     | 11.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 24.000 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.366  
STANDARD DEVIATION = 0.495



DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 21  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 10.156                              |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| FIFTH MONTH    | 16.000              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 14.000              | 0.0                | 42.000                              |
| NINTH MONTH    | 0.0                 | 0.0                | 50.000                              |
| TENTH MONTH    | 26.000              | 0.0                | 32.000                              |
| LAST THIRD     |                     |                    | 45.000                              |
| ELEVENTH MONTH | 75.000              | 0.0                | 0.0                                 |
| TWELFTH MONTH  | 7.540               | 0.0                | 0.0                                 |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 30.844 |
| 4-M              | 5.00     | 21.156 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 24.000 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.323  
STANDARD DEVIATION = 0.528

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 24  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 39.000                              |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| FIFTH MONTH    | 16.000              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 40.000              | 0.0                | 16.000                              |
| NINTH MONTH    | 0.0                 | 0.0                | 24.000                              |
| TENTH MONTH    | 0.0                 | 0.0                | 32.000                              |
| LAST THIRD     |                     |                    | 45.000                              |
| ELEVENTH MONTH | 75.000              | 0.0                | 0.0                                 |
| TWELFTH MONTH  | 7.540               | 0.0                | 0.0                                 |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 2.000  |
| 4-M              | 5.00     | 50.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 24.000 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.210  
STANDARD DEVIATION = 0.621

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 27  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 30.000                              |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| FIFTH MONTH    | 16.000              | 0.0                | 0.0                                 |
| SIXTH MONTH    | 11.000              | 0.0                | 0.0                                 |
| SEVENTH MONTH  | 21.000              | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 56.000              | 0.0                | 0.0                                 |
| NINTH MONTH    | 8.000               | 0.0                | 0.0                                 |
| TENTH MONTH    | 8.000               | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 13.000                              |
| ELEVENTH MONTH | 43.000              | 0.0                | 0.0                                 |
| TWELFTH MONTH  | 7.540               | 0.0                | 0.0                                 |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 2.000  |
| 4-M              | 5.00     | 50.000 |
| 7-M              | 5.00     | 0.0    |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 24.000 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

EXPECTED DISCOUNTED COST = 12.175  
STANDARD DEVIATION = 0.657

DEBT ISSUANCE FOR THE NEXT 12 MONTHS STRATEGY NUMBER 31  
(IN MILLIONS OF DOLLARS)

|                | NINE-MONTH<br>BONDS | SIX-MONTH<br>BONDS | DISCOUNT NOTES<br>10, 20, OR 30 DAY |
|----------------|---------------------|--------------------|-------------------------------------|
| FIRST MONTH    | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| SECOND MONTH   | 0.0                 | 0.0                | 17.000                              |
| THIRD MONTH    | 0.0                 | 0.0                | 39.000                              |
| FOURTH MONTH   | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 0.0                                 |
| FIFTH MONTH    | 0.0                 | 0.0                | 16.000                              |
| SIXTH MONTH    | 0.0                 | 0.0                | 27.000                              |
| SEVENTH MONTH  | 0.0                 | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 23.000                              |
| EIGHT MONTH    | 56.000              | 0.0                | 0.0                                 |
| NINTH MONTH    | 8.000               | 0.0                | 0.0                                 |
| TENTH MONTH    | 8.000               | 0.0                | 0.0                                 |
| LAST THIRD     |                     |                    | 13.000                              |
| ELEVENTH MONTH | 43.000              | 0.0                | 0.0                                 |
| TWELFTH MONTH  | 0.0                 | 7.540              | 0.0                                 |

LONG-TERM BONDS

| MONTH OR QUARTER | MATURITY | AMOUNT |
|------------------|----------|--------|
| 3-M              | 4.00     | 2.000  |
| 4-M              | 5.00     | 50.000 |
| 7-M              | 5.00     | 48.000 |
| 12-M             | 4.50     | 0.0    |
| 1-Q              | 1.00     | 0.0    |
| 2-Q              | 2.00     | 0.0    |
| 2-Q              | 4.00     | 0.0    |
| 2-Q              | 7.00     | 24.000 |
| 3-Q              | 3.00     | 0.0    |
| 3-Q              | 6.00     | 0.0    |
| 3-Q              | 10.00    | 0.0    |
| 4-Q              | 4.00     | 0.0    |
| 4-Q              | 8.00     | 0.0    |
| 4-Q              | 12.00    | 0.0    |

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

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DIMENSION R(70,10),DEV(70,10),Z(8,10),CON(70),E(70),S(12,10), QPM00010
$P(20),PROB(10),VC(70,70),DEM(16),CM(70),NT(12),NTM(12),TTM(12,4), QPM00020
$NTQ(4),TTQ(4,4),ITME(12,4),TTQE(4,4),ZIM(20,10),ZIQ(20,10) QPM00030
DATA NIM/12*0/ QPM00040
DATA NTQ/4*0/ QPM00050
DATA NZ,NZ1,NZ2,NZ3,NZ4/5*2/ QPM00060
DATA NY,NY1,NY2,NY3,NY4/5*2/ QPM00070
DATA CM/70*0./ QPM00080
DATA CON/70*0./ QPM00090
NO=2 QPM00100
NT6=12 QPM00110
NT7=13 QPM00120
C QPM00130
WRITE(6,220) QPM00140
220 FORMAT(' THIS IS A QPRAND MATRIX GENERATOR',/) QPM00150
WRITE(6,221) QPM00160
221 FORMAT(' WRITTEN BY',/) QPM00170
WRITE(6,222) QPM00180
WRITE(6,223) QPM00190
WRITE(6,224) QPM00200
222 FORMAT(10X,' LOREN TAUER') QPM00210
223 FORMAT(10X,' DEPT. OF AG. ECON.') QPM00220
224 FORMAT(10X,' CORNELL UNIVERSITY',//) QPM00230
C QPM00240
C THIS SECTION IS WHERE THE DATA IS READ QPM00250
C QPM00260
DO 810 J=1,12 QPM00270
WRITE(6,700)J QPM00280
700 FORMAT(' IS THERE A TERM POND(S) FOR MONTH',I3, QPM00290
$' ? ENTER 1 FOR YES, 2 FOR NO') QPM00300
READ(5,*)NT(J) QPM00310
IF(NT(J).EQ.NO) GO TO 810 QPM00320
WRITE(6,702)J QPM00330
702 FORMAT(' ENTER THE NUMBER OF TERM ISSUES FOR MONTH',I3, QPM00340
$' , THE LIMIT IS 4') QPM00350
READ(5,*)NTM(J) QPM00360
NTMJ=NTM(J) QPM00370
DO 810 J2=1,NTMJ QPM00380
WRITE(6,703)J2,J QPM00390
703 FORMAT(' ENTER THE TERM OF TERM BOND',I3,' FOR MONTH',I3) QPM00400
READ(5,*)TTM(J,J2) QPM00410
WRITE(NT7,860)TTM(J,J2),J,J2 QPM00420
810 CONTINUE QPM00430
DO 811 J=1,4 QPM00440
WRITE(6,200)J QPM00450
200 FORMAT(' ENTER THE NUMBER OF TERM ISSUES FOR QUARTER',I3, QPM00460
$' , THE LIMIT IS 4') QPM00470
READ(5,*)NTQ(J) QPM00480
NTQJ=NTQ(J) QPM00490
DO 811 J2=1,NTQJ QPM00500
WRITE(6,704)J2,J QPM00510
704 FORMAT(' ENTER THE TERM OF TERM BOND',I3,' FOR QUARTER',I3) QPM00520
READ(5,*)TTQ(J,J2) QPM00530
WRITE(NT7,870)TTQ(J,J2),J,J2 QPM00540
811 CONTINUE QPM00550

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                WRITE(6,201)
201  FORMAT( ' ENTER THE NUMBER OF INTEREST RATE FORECASTS, THE LIMIT
$IS 10')
        READ(5,*) M
        DO 11 J=1,M
                WRITE(6,203) J
203  FORMAT( ' ENTER THE PROBABILITY OF FORECAST',I3)
        READ(5,*) PRCB(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,*) (R(I,J),I=1,16)
        WRITE(6,206) J
206  FORMAT( ' ENTER THE 12 SIX-MONTH RATES FOR FORECAST',I3)
        READ(5,*) (R(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 (NT(K).EQ.NO) GO TO 812
        NIMK=NTM(K)
        DO 812 K2=1,NIMK
        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
        NTQK=NTQ(K)
        DO 814 K2=1,NTQK
        I=I+1
        WRITE(6,815) TIQ(K,K2),K,J
815  FORMAT( ' ENTER THE RATE FOR THE',F6.2,' YEAR TERM BOND FOR QUARTE
$R',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, FORECA
$ST',I3)
        READ(5,*) (Z(N,J),N=1,8)
        I=40
        DO 816 K=1,12
        IF (NT(K).EQ.NO) GO TO 816
        NIMK=NTM(K)
        DO 816 K2=1,NIMK
        I=I+1

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QPM00560  
 QPM00570  
 QPM00580  
 QPM00590  
 QPM00600  
 QPM00610  
 QPM00620  
 QPM00630  
 QPM00640  
 QPM00650  
 QPM00660  
 QPM00670  
 QPM00680  
 QPM00690  
 QPM00700  
 QPM00710  
 QPM00720  
 QPM00730  
 QPM00740  
 QPM00750  
 QPM00760  
 QPM00770  
 QPM00780  
 QPM00790  
 QPM00800  
 QPM00810  
 QPM00820  
 QPM00830  
 QPM00840  
 QPM00850  
 QPM00860  
 QPM00870  
 QPM00880  
 QPM00890  
 QPM00900  
 QPM00910  
 QPM00920  
 QPM00930  
 QPM00940  
 QPM00950  
 QPM00960  
 QPM00970  
 QPM00980  
 QPM00990  
 QPM01000  
 QPM01010  
 QPM01020  
 QPM01030  
 QPM01040  
 QPM01050  
 QPM01060  
 QPM01070  
 QPM01080  
 QPM01090  
 QPM01100





|     |  |          |
|-----|--|----------|
|     | WRITE (6,826)  | QPM01660 |
| 826 | FORMAT ( ' WOULD YOU LIKE TO PLACE MAX. CONSTRAINTS ON THE',/,<br>\$' LONG-TERM BONDS? ENTER 1 FOR YES, 2 FOR NO')     | QPM01670 |
|     | READ (5,*) NY4   | QPM01680 |
|     | IF (NY4.EQ.NO) GO TO 79  | QPM01690 |
|     | DO 827 K=1,12  | QPM01700 |
|     | IF (NT(K).EQ.NO) GO TO 827   | QPM01710 |
|     | NIMK=NIM(K)  | QPM01720 |
|     | DO 827 K2=1,NTMK   | QPM01730 |
|     | I=I+1  | QPM01740 |
|     | WRITE (6,828) ITM(K,K2),K  | QPM01750 |
| 828 | FORMAT ( ' ENTER THE MAX. FOR THE',F6.2,' YEAR TERM BOND FOR MONTH'<br>\$,I3)  | QPM01760 |
|     | READ (5,*) CON(I)  | QPM01770 |
| 827 | CONTINUE   | QPM01780 |
|     | DO 829 K=1,4   | QPM01790 |
|     | NTQK=NTQ(K)  | QPM01800 |
|     | DO 829 K2=1,NTQK   | QPM01810 |
|     | I=I+1  | QPM01820 |
|     | WRITE (6,830) ITQ(K,K2),K  | QPM01830 |
| 830 | FORMAT ( ' ENTER THE MAX. FOR THE',F6.2,' YEAR TERM BOND FOR QUARTE<br>\$R',I3)  | QPM01840 |
|     | READ (5,*) CON(I)  | QPM01850 |
| 829 | CONTINUE   | QPM01860 |
| 79  | CONTINUE   | QPM01870 |
|     | WRITE (6,225)  | QPM01880 |
| 225 | FORMAT ( ' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON ANY',/,<br>\$' NOTE AND BOND GROUP? ENTER 1 FOR YES, 2 FOR NO') | QPM01890 |
|     | READ (5,*) NZ  | QPM01900 |
|     | IF (NZ.EQ.NO) GO TO 80   | QPM01910 |
|     | WRITE (6,831)  | QPM01920 |
| 831 | FORMAT ( ' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,<br>\$' DISCOUNT NOTES? ENTER 1 FOR YES, 2 FOR NO')      | QPM01930 |
|     | READ (5,*) NZ1   | QPM01940 |
|     | IF (NZ1.EQ.NO) GO TO 832   | QPM01950 |
|     | WRITE (6,226)  | QPM01960 |
| 226 | FORMAT ( ' ENTER THE MINIMUM FOR EACH OF THE 16 DISCOUNT NOTES')   | QPM01970 |
|     | READ (5,*) (CM(I),I=1,16)  | QPM01980 |
| 832 | CONTINUE   | QPM01990 |
|     | WRITE (6,833)  | QPM02000 |
| 833 | FORMAT ( ' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,<br>\$' SIX-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO')     | QPM02010 |
|     | READ (5,*) NZ2   | QPM02020 |
|     | IF (NZ2.EQ.NO) GO TO 834   | QPM02030 |
|     | WRITE (6,227)  | QPM02040 |
| 227 | FORMAT ( ' ENTER THE MINIMUM FOR EACH OF THE 12 SIX-MONTH BONDS')  | QPM02050 |
|     | READ (5,*) (CM(I),I=17,28)   | QPM02060 |
| 834 | CONTINUE   | QPM02070 |
|     | WRITE (6,835)  | QPM02080 |
| 835 | FORMAT ( ' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,<br>\$' NINE-MONTH BONDS? ENTER 1 FOR YES, 2 FOR NO')    | QPM02090 |
|     | READ (5,*) NZ3   | QPM02100 |
|     | IF (NZ3.EQ.NO) GO TO 836   | QPM02110 |
|     | WRITE (6,228)  | QPM02120 |
| 228 | FORMAT ( ' ENTER THE MIN. FOR EACH OF THE 12 NINE-MONTH BONDS')  | QPM02130 |
|     |  | QPM02140 |
|     |  | QPM02150 |
|     |  | QPM02160 |
|     |  | QPM02170 |
|     |  | QPM02180 |
|     |  | QPM02190 |
|     |  | QPM02200 |

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836 READ(5,*) (CM(I),I=29,40) QPM02210
      CONTINUE QPM02220
      I=40 QPM02230
      WRITE(6,837) QPM02240
837 FORMAT(' WOULD YOU LIKE TO PLACE MIN. CONSTRAINTS ON THE',/,
$' LONG-TERM BONDS? ENTER 1 FOR YES, 2 FOR NO') QPM02250
      READ(5,*) NZ4 QPM02260
      IF(NZ4.EQ.NO) GO TO 80 QPM02270
      DC 838 K=1,12 QPM02280
      IF(NT(K).EQ.NO) GO TO 838 QPM02290
      NIMK=NTM(K) QPM02300
      DO 838 K2=1,NIMK QPM02310
      I=I+1 QPM02320
      WRITE(6,839) TIM(K,K2),K QPM02330
839 FORMAT(' ENTER THE MIN. FOR THE',F6.2, QPM02340
$' YEAR TERM BOND FOR MONTH',I3) QPM02350
      READ(5,*) CM(I) QPM02360
838 CONTINUE QPM02370
      DC 840 K=1,4 QPM02380
      NICK=NTQ(K) QPM02390
      DO 840 K2=1,NICK QPM02400
      I=I+1 QPM02410
      WRITE(6,841) TIC(K,K2),K QPM02420
841 FORMAT(' ENTER THE MIN. FOR THE',F6.2, QPM02430
$' YEAR TERM BOND FOR QUARTER',I3) QPM02440
      READ(5,*) CM(I) QPM02450
840 CONTINUE QPM02460
80 CONTINUE QPM02470
      WRITE(6,216) QPM02480
216 FORMAT(' THE QPRAND MATRIX IS BEING GENERATED') QPM02490
C QPM02500
C THIS SECTION IS WHERE THE COSTS ARE COMPUTED QPM02510
C QPM02520
C THE DISCOUNT FACTORS ARE COMPUTED HERE QPM02530
      DO 20 J=1,M QPM02540
      P(1)=(1.+S(1,J)/1200.) QPM02550
      DO 81 K=2,12 QPM02560
      P(K)=P(K-1)*(1.+S(K,J)/1200.) QPM02570
81 CONTINUE QPM02580
      DISAD=1.+S(12,J)/1200. QPM02590
      DO 2100 K=13,20 QPM02600
      P(K)=P(K-1)*DISAD QPM02610
2100 CONTINUE QPM02620
      K=0 QPM02630
      N=1 QPM02640
C DISCOUNT NOTES QPM02650
      DO 12 I=1,4 QPM02660
      R(K+1,J)=(R(K+1,J)*.55555556)/P(N) QPM02670
      R(K+2,J)=(R(K+2,J)*.27777778)/P(N) QPM02680
      R(K+3,J)=(R(K+3,J)*.83333333)/P(N+1) QPM02690
      R(K+4,J)=(R(K+4,J)*.83333333)/P(N+2) QPM02700
      K=K+4 QPM02710
      N=N+3 QPM02720
12 CONTINUE QPM02730
C SIX-MONTH BONDS QPM02740
      QPM02750

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|     |  |          |
|-----|--|----------|
|     | DO 13 I=17,23  | QPM02760 |
|     | R(I,J) = (R(I,J) * 5.) / P(I-11)   | QPM02770 |
| 13  | CONTINUE   | QPM02780 |
|     | IF (KL.EQ.2) Z(1,J) = R(24,J)  | QPM02790 |
|     | R(24,J) = (R(24,J) * 5. - Z(1,J) * .83333333) / P(13)                            | QPM02800 |
|     | IF (KL.EQ.2) Z(2,J) = R(25,J)  | QPM02810 |
|     | R(25,J) = (R(25,J) * 5. - Z(2,J) * 1.66666667) / P(14)                           | QPM02820 |
|     | IF (KL.EQ.2) Z(3,J) = R(26,J)  | QPM02830 |
|     | R(26,J) = (R(26,J) * 5. - Z(3,J) * 2.5) / P(15)                                  | QPM02840 |
|     | IF (KL.EQ.2) Z(4,J) = R(27,J)  | QPM02850 |
|     | R(27,J) = (R(27,J) * 5. - Z(4,J) * 3.33333333) / P(16)                           | QPM02860 |
|     | IF (KL.EQ.2) Z(5,J) = R(28,J)  | QPM02870 |
|     | R(28,J) = (R(28,J) * 5. - Z(5,J) * 4.16666667) / P(17)                           | QPM02880 |
| C   | NINE-MONTH BONDS   | QPM02890 |
|     | DO 14 I=29,32  | QPM02900 |
|     | R(I,J) = (R(I,J) * 7.5) / P(I-20)  | QPM02910 |
| 14  | CONTINUE   | QPM02920 |
|     | DO 15 I=33,40  | QPM02930 |
|     | IF (KL.EQ.2) Z(I-32,J) = R(I,J)  | QPM02940 |
|     | R(I,J) = (R(I,J) * 7.5 - Z(I-32,J) * (I-32) * .83333333) / P(I-20)               | QPM02950 |
| 15  | CONTINUE   | QPM02960 |
| C   | LONG-TERM BONDS  | QPM02970 |
|     | RIN = (S(12,J) / 1200. + 1.) ** 6. - 1.  | QPM02980 |
|     | RTE = RTN  | QPM02990 |
|     | IF (S(12,J) .EQ. 0.) RTE = 1.  | QPM03000 |
|     | I = 40   | QPM03010 |
|     | DO 842 K=1,6   | QPM03020 |
|     | IF (NT(K) .EQ. NO) GO TO 842   | QPM03030 |
|     | NIMK = NIM(K)  | QPM03040 |
|     | DO 842 K2=1, NIMK  | QPM03050 |
|     | I = I + 1  | QPM03060 |
|     | IF (KL.EQ.2) ZTM(I,J) = R(I,J)   | QPM03070 |
|     | R(I,J) = (R(I,J) * 5.) / P(K+5) + (R(I,J) * 5. - ZTM(I,J) * .83333333 * (K-1)) / | QPM03080 |
|     | \$P(K+11) + (R(I,J) - ZTM(I,J)) * 5. * (1. - 1. / (1. + RTN)) ** ((TIME(K,K2) -  | QPM03090 |
|     | \$.08333333 * (K-1)) * 2)) / RTE / P(K+11)                                       | QPM03100 |
| 842 | CONTINUE   | QPM03110 |
|     | DO 843 K=7,12  | QPM03120 |
|     | IF (NT(K) .EQ. NO) GO TO 843   | QPM03130 |
|     | NIMK = NIM(K)  | QPM03140 |
|     | DO 843 K2=1, NIMK  | QPM03150 |
|     | I = I + 1  | QPM03160 |
|     | IF (KL.EQ.2) ZIM(I,J) = R(I,J)   | QPM03170 |
|     | R(I,J) = (R(I,J) * 5. - ZIM(I,J) * .83333333 * (K-7)) / P(K+5) + (R(I,J) -       | QPM03180 |
|     | \$ZIM(I,J)) * 5. * (1. - 1. / (1. + RTN)) ** ((TIME(K,K2) - .08333333 * (K-7))   | QPM03190 |
|     | \$/ RTE / P(K+5)   | QPM03200 |
| 843 | CONTINUE   | QPM03210 |
|     | NIQ1 = NIQ(1)  | QPM03220 |
|     | DO 844 K2=1, NIQ1  | QPM03230 |
|     | I = I + 1  | QPM03240 |
|     | IF (KL.EQ.2) ZIQ(I,J) = R(I,J)   | QPM03250 |
|     | R(I,J) = R(I,J) * 5. / P(6) + R(I,J) * 5. / P(12) + (R(I,J) - ZIQ(I,J)) * 5. *   | QPM03260 |
|     | \$(1. - 1. / (1. + RTN)) ** (ITQE(1,K2) * 2)) / RTE / P(12)                      | QPM03270 |
| 844 | CONTINUE   | QPM03280 |
|     | NIQ2 = NIQ(2)  | QPM03290 |
|     | DO 845 K2=1, NIQ2  | QPM03300 |

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      I=I+1
      IF (KL.EQ.2) ZTQ(I,J)=R(I,J)
      R(I,J)=R(I,J)*5./P(9)+(R(I,J)*5.-ZTQ(I,J)*2.5)/P(15)+(R(I,J)-
845 $ZTQ(I,J))*5.*(1.-1./(1.+RTN)**((TTQE(2,K2)-.25)*2))/RTE/P(15)
      CONTINUE
      NTQ3=NTQ(3)
      DO 846 K2=1,NTQ3
      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)**
846 $(TTQE(3,K2)*2))/RTE/P(12)
      CONTINUE
      NTQ4=NTQ(4)
      DO 1847 K2=1,NTQ4
      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./
1847 $(1.+RTN)**((TTQE(4,K2)-.25)*2))/RTE/P(15)
      CONTINUE
20 20 CONTINUE
C
C THIS SECTION COMPUTES THE EXPECTED VALUES AND DEVIATIONS
C
      DO 19 I=1,NCOL
      E(I)=0.
      DO 17 J=1,M
      E(I)=E(I)+R(I,J)*PROB(J)
17 17 CONTINUE
      DO 18 J=1,M
      DEV(I,J)=R(I,J)-E(I)
18 18 CONTINUE
19 19 CONTINUE
C
C THIS SECTION CREATES THE VARIANCE-COVARIANCE
C
      DO 66 I=1,NCOL
      DO 67 J=I,NCOL
      VC(I,J)=0.
      DO 68 K=1,M
      VC(I,J)=DEV(I,K)*DEV(J,K)*PROB(K)+VC(I,J)
68 68 CONTINUE
      IF (I.NE.J) VC(I,J)=2.*VC(I,J)
67 67 CONTINUE
66 66 CONTINUE
C
C THIS SECTION IS WHERE THE RAND QF MATRIX IS GENERATED
C
      WRITE(NT6,501)
501 501 FORMAT(4HROWS)
      WRITE(NT6,502)
502 502 FORMAT(11X,4H$OBJ)
      DO 71 I=1001,1016
      WRITE(NT6,503) I
503 503 FORMAT(12X,1HR,I4)
71 71 CONTINUE

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QPM03310  
 QPM03320  
 QPM03330  
 QPM03340  
 QPM03350  
 QPM03360  
 QPM03370  
 QPM03380  
 QPM03390  
 QPM03400  
 QPM03410  
 QPM03420  
 QPM03430  
 QPM03440  
 QPM03450  
 QPM03460  
 QPM03470  
 QPM03480  
 QPM03490  
 QPM03500  
 QPM03510  
 QPM03520  
 QPM03530  
 QPM03540  
 QPM03550  
 QPM03560  
 QPM03570  
 QPM03580  
 QPM03590  
 QPM03600  
 QPM03610  
 QPM03620  
 QPM03630  
 QPM03640  
 QPM03650  
 QPM03660  
 QPM03670  
 QPM03680  
 QPM03690  
 QPM03700  
 QPM03710  
 QPM03720  
 QPM03730  
 QPM03740  
 QPM03750  
 QPM03760  
 QPM03770  
 QPM03780  
 QPM03790  
 QPM03800  
 QPM03810  
 QPM03820  
 QPM03830  
 QPM03840  
 QPM03850

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C WRITE ROWS FOR ANY CCNSTRAINTS
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,1HP,I4,1X,3HOBJ,3X,F12.6)
      WRITE(NT6,403) I,I
403  FORMAT ( 6X,1HP,I4,1X,1HR,I4,1X,'1. ')
      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,NSTCE
      WRITE(NT6,404) I,J,VC(I-1000,J-1000)
404  FORMAT ( 6X,1HP,I4,1X,1HP,I4,1X,F12.6)
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,NSTOP
      WRITE(NT6,404) I,J,VC(I-1000,J-1000)
35   CONTINUE
      N=1003
      DO 36 I=1018,1020
      WRITE(NT6,402) I,E(I-1000)
      NN=N+7
      DO 37 J=N,NN
      WRITE(NT6,403) I,J

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QPM03860
QPM03870
QPM03880
QPM03890
QPM03900
QPM03910
QPM03920
QPM03930
QPM03940
QPM03950
QPM03960
QPM03970
QPM03980
QPM03990
QPM04000
QPM04010
QPM04020
QPM04030
QPM04040
QPM04050
QPM04060
QPM04070
QPM04080
QPM04090
QPM04100
QPM04110
QPM04120
QPM04130
QPM04140
QPM04150
QPM04160
QPM04170
QPM04180
QPM04190
QPM04200
QPM04210
QPM04220
QPM04230
QPM04240
QPM04250
QPM04260
QPM04270
QPM04280
QPM04290
QPM04300
QPM04310
QPM04320
QPM04330
QPM04340
QPM04350
QPM04360
QPM04370
QPM04380
QPM04390
QPM04400

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| 37 | CONTINUE                               | QPM04110 |
|    | I2=I+100                               | QPM04120 |
|    | I3=I+200                               | QPM04130 |
|    | IF (NY2.NE.NO) WRITE (NT6,403) I,I2    | QPM04440 |
|    | IF (NZ2.NE.NO) WRITE (NT6,403) I,I3    | QPM04450 |
|    | DO 38 J=I,NSTOP                        | QPM04460 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM04470 |
| 38 | CONTINUE                               | QPM04480 |
|    | N=N+1                                  | QPM04490 |
| 36 | CONTINUE                               | QPM04500 |
|    | N=1007                                 | QPM04510 |
|    | DO 39 I=1021,1023                      | QPM04520 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM04530 |
|    | NN=N+7                                 | QPM04540 |
|    | DO 40 J=N,NN                           | QPM04550 |
|    | WRITE (NT6,403) I,J                    | QPM04560 |
| 40 | CONTINUE                               | QPM04570 |
|    | I2=I+100                               | QPM04580 |
|    | I3=I+200                               | QPM04590 |
|    | IF (NY2.NE.NO) WRITE (NT6,403) I,I2    | QPM04600 |
|    | IF (NZ2.NE.NO) WRITE (NT6,403) I,I3    | QPM04610 |
|    | DO 41 J=I,NSTOP                        | QPM04620 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM04630 |
| 41 | CONTINUE                               | QPM04640 |
|    | N=N+1                                  | QPM04650 |
| 39 | CONTINUE                               | QPM04660 |
|    | N=1011                                 | QPM04670 |
|    | DO 42 I=1024,1026                      | QPM04680 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM04690 |
|    | DO 43 J=N,1016                         | QPM04700 |
|    | WRITE (NT6,403) I,J                    | QPM04710 |
| 43 | CONTINUE                               | QPM04720 |
|    | I2=I+100                               | QPM04730 |
|    | I3=I+200                               | QPM04740 |
|    | IF (NY2.NE.NO) WRITE (NT6,403) I,I2    | QPM04750 |
|    | IF (NZ2.NE.NO) WRITE (NT6,403) I,I3    | QPM04760 |
|    | DO 44 J=I,NSTOP                        | QPM04770 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM04780 |
| 44 | CONTINUE                               | QPM04790 |
|    | N=N+1                                  | QPM04800 |
| 42 | CONTINUE                               | QPM04810 |
|    | N=1015                                 | QPM04820 |
|    | DO 45 I=1027,1028                      | QPM04830 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM04840 |
|    | DO 46 J=N,1016                         | QPM04850 |
|    | WRITE (NT6,403) I,J                    | QPM04860 |
| 46 | CONTINUE                               | QPM04870 |
|    | I2=I+100                               | QPM04880 |
|    | I3=I+200                               | QPM04890 |
|    | IF (NY2.NE.NO) WRITE (NT6,403) I,I2    | QPM04900 |
|    | IF (NZ2.NE.NO) WRITE (NT6,403) I,I3    | QPM04910 |
|    | DO 47 J=I,NSTOP                        | QPM04920 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM04930 |
| 47 | CONTINUE                               | QPM04940 |
|    | N=N+1                                  | QPM04950 |

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|----|--|----------|
| 45 | CONTINUE                               | QPM04960 |
| C  | WRITE THE NINE-MONTH BCNDS             | QPM04970 |
|    | I=1029                                 | QPM04980 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM04990 |
|    | DO 48 J=1001,1012                      | QPM05000 |
|    | WRITE (NT6,403) I,J                    | QPM05010 |
| 48 | CONTINUE                               | QPM05020 |
|    | I2=I+100                               | QPM05030 |
|    | I3=I+200                               | QPM05040 |
|    | IF (NY3.NE.NO) WRITE (NT6,403) I,I2    | QPM05050 |
|    | IF (NZ3.NE.NO) WRITE (NT6,403) I,I3    | QPM05060 |
|    | DO 49 J=I,NSIOF                        | QPM05070 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM05080 |
| 49 | CONTINUE                               | QPM05090 |
|    | N=1003                                 | QPM05100 |
|    | DO 50 I=1030,1032                      | QPM05110 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM05120 |
|    | NN=N+11                                | QPM05130 |
|    | DO 51 J=N,NN                           | QPM05140 |
|    | WRITE (NT6,403) I,J                    | QPM05150 |
| 51 | CONTINUE                               | QPM05160 |
|    | I2=I+100                               | QPM05170 |
|    | I3=I+200                               | QPM05180 |
|    | IF (NY3.NE.NO) WRITE (NT6,403) I,I2    | QPM05190 |
|    | IF (NZ3.NE.NO) WRITE (NT6,403) I,I3    | QPM05200 |
|    | DO 52 J=I,NSTIOF                       | QPM05210 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM05220 |
| 52 | CONTINUE                               | QPM05230 |
|    | N=N+1                                  | QPM05240 |
| 50 | CONTINUE                               | QPM05250 |
|    | N=1007                                 | QPM05260 |
|    | DO 53 I=1033,1035                      | QPM05270 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM05280 |
|    | DO 54 J=N,1016                         | QPM05290 |
|    | WRITE (NT6,403) I,J                    | QPM05300 |
| 56 | CONTINUE                               | QPM05310 |
|    | I2=I+100                               | QPM05320 |
|    | I3=I+200                               | QPM05330 |
|    | IF (NY3.NE.NO) WRITE (NT6,403) I,I2    | QPM05340 |
|    | IF (NZ3.NE.NO) WRITE (NT6,403) I,I3    | QPM05350 |
|    | DO 55 J=I,NSTIOF                       | QPM05360 |
|    | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM05370 |
| 55 | CONTINUE                               | QPM05380 |
|    | N=N+1                                  | QPM05390 |
| 53 | CONTINUE                               | QPM05400 |
|    | N=1011                                 | QPM05410 |
|    | DO 56 I=1036,1038                      | QPM05420 |
|    | WRITE (NT6,402) I,E (I-1000)           | QPM05430 |
|    | DO 57 J=N,1016                         | QPM05440 |
|    | WRITE (NT6,403) I,J                    | QPM05450 |
| 57 | CONTINUE                               | QPM05460 |
|    | I2=I+100                               | QPM05470 |
|    | I3=I+200                               | QPM05480 |
|    | IF (NY3.NE.NO) WRITE (NT6,403) I,I2    | QPM05490 |
|    | IF (NZ3.NE.NC) WRITE (NT6,403) I,I3    | QPM05500 |

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|-----|--|----------|
|     | DO 58 J=I,NSTOP                                    | QPM05510 |
|     | WRITE (NT6,404) I,J,VC (I-1000,J-1000)             | QPM05520 |
| 58  | CONTINUE   | QPM05530 |
|     | N=N+1  | QPM05540 |
| 56  | CONTINUE   | QPM05550 |
|     | N=1015   | QPM05560 |
|     | DO 59 I=1039,1040                                  | QPM05570 |
|     | WRITE (NT6,402) I,E (I-1000)                       | QPM05580 |
|     | DO 60 J=N,1016                                     | QPM05590 |
|     | WRITE (NT6,403) I,J                                | QPM05600 |
| 60  | CONTINUE   | QPM05610 |
|     | I2=I+100   | QPM05620 |
|     | I3=I+200   | QPM05630 |
|     | IF (NY3.NE.NO) WRITE (NT6,403) I,I2                | QPM05640 |
|     | IF (NZ3.NE.NO) WRITE (NT6,403) I,I3                | QPM05650 |
|     | DO 61 J=I,NSTOP                                    | QPM05660 |
|     | WRITE (NT6,404) I,J,VC (I-1000,J-1000)             | QPM05670 |
| 61  | CONTINUE   | QPM05680 |
|     | N=N+1  | QPM05690 |
| 59  | CONTINUE   | QPM05700 |
|     | C WRITE THE LONG-TERM BONDS                        | QPM05710 |
|     | KM=1000  | QPM05720 |
|     | I=1040   | QPM05730 |
|     | DO 64 K=1,12                                       | QPM05740 |
|     | IF (K.EQ.2.OR.K.EQ.5.OR.K.EQ.8.OR.K.EQ.11) KM=KM+1 | QPM05750 |
|     | KM=KM+1  | QPM05760 |
|     | IF (NT(K).EQ.NO) GO TO 64                          | QPM05770 |
|     | NTMK=NTM(K)  | QPM05780 |
|     | DO 64 K2=1,NTMK                                    | QPM05790 |
|     | I=I+1  | QPM05800 |
|     | WRITE (NT6,402) I,E (I-1000)                       | QPM05810 |
|     | DO 63 J=KM,1016                                    | QPM05820 |
|     | WRITE (NT6,403) I,J                                | QPM05830 |
| 63  | CONTINUE   | QPM05840 |
|     | I2=I+100   | QPM05850 |
|     | I3=I+200   | QPM05860 |
|     | IF (NY4.NE.NO) WRITE (NT6,403) I,I2                | QPM05870 |
|     | IF (NZ4.NE.NO) WRITE (NT6,403) I,I3                | QPM05880 |
|     | NAB=NCOL+1000                                      | QPM05890 |
|     | DO 64 J=I,NAB                                      | QPM05900 |
|     | WRITE (NT6,404) I,J,VC (I-1000,J-1000)             | QPM05910 |
| 64  | CONTINUE   | QPM05920 |
|     | N=998  | QPM05930 |
|     | DO 62 K=1,4  | QPM05940 |
|     | N=N+4  | QPM05950 |
|     | NTQK=NTQ(K)  | QPM05960 |
|     | DO 62 K2=1,NTQK                                    | QPM05970 |
|     | I=I+1  | QPM05980 |
|     | WRITE (NT6,402) I,E (I-1000)                       | QPM05990 |
|     | DO 847 J=N,1016                                    | QPM06000 |
|     | WRITE (NT6,403) I,J                                | QPM06010 |
| 847 | CONTINUE   | QPM06020 |
|     | I2=I+100   | QPM06030 |
|     | I3=I+200   | QPM06040 |
|     | IF (NY4.NE.NO) WRITE (NT6,403) I,I2                | QPM06050 |



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|      | IF (NZ4.EQ.NO) WRITE (NT6,403) I,I3    | QPM06060 |
|      | NAD=NCOL+1000                          | QPM06070 |
|      | DO 848 J=I,NAD                         | QPM06080 |
|      | WRITE (NT6,404) I,J,VC (I-1000,J-1000) | QPM06090 |
| 848  | CONTINUE                               | QPM06100 |
| 62   | CCONTINUE                              | QPM06110 |
|      | WRITE (NT6,405)                        | QPM06120 |
| 405  | FORMAT (3HEND)                         | QPM06130 |
| C    | WRITE THE RHS                          | QPM06140 |
|      | WRITE (NT6,406)                        | QPM06150 |
| 406  | FORMAT (3HRHS)                         | QPM06160 |
|      | DO 65 I=1001,1016                      | QPM06170 |
|      | WRITE (NT6,407) I,DEM (I-1000)         | QPM06180 |
| 407  | FORMAT (6X,'E',5X,1HR,I4,1X,F12.6)     | QPM06190 |
| 65   | CONTINUE                               | QPM06200 |
|      | IF (NY.EQ.NO) GO TO 1070               | QPM06210 |
|      | IF (NY1.EQ.NO) GO TO 1850              | QPM06220 |
|      | DO 850 I=1101,1116                     | QPM06230 |
|      | WRITE (NT6,407) I,CCN (I-1100)         | QPM06240 |
| 850  | CCONTINUE                              | QPM06250 |
| 1850 | CONTINUE                               | QPM06260 |
|      | IF (NY2.EQ.NO) GO TO 1851              | QPM06270 |
|      | DO 851 I=1117,1128                     | QPM06280 |
|      | WRITE (NT6,407) I,CON (I-1100)         | QPM06290 |
| 851  | CONTINUE                               | QPM06300 |
| 1851 | CONTINUE                               | QPM06310 |
|      | IF (NY3.EQ.NO) GO TO 1852              | QPM06320 |
|      | DO 852 I=1129,1140                     | QPM06330 |
|      | WRITE (NT6,407) I,CCN (I-1100)         | QPM06340 |
| 852  | CONTINUE                               | QPM06350 |
| 1852 | CONTINUE                               | QPM06360 |
|      | IF (NY4.EQ.NO) GO TO 1070              | QPM06370 |
|      | DO 70 I=1141,NI                        | QPM06380 |
|      | WRITE (NT6,407) I,CON (I-1100)         | QPM06390 |
| 70   | CONTINUE                               | QPM06400 |
| 1070 | CONTINUE                               | QPM06410 |
|      | IF (NZ.EQ.NO) GO TO 1069               | QPM06420 |
|      | IF (NZ1.EQ.NO) GO TO 1854              | QPM06430 |
|      | DO 854 I=1201,1216                     | QPM06440 |
|      | WRITE (NT6,407) I,CM (I-1200)          | QPM06450 |
| 854  | CONTINUE                               | QPM06460 |
| 1854 | CONTINUE                               | QPM06470 |
|      | IF (NZ2.EQ.NO) GO TO 1855              | QPM06480 |
|      | DO 855 I=1217,1228                     | QPM06490 |
|      | WRITE (NT6,407) I,CM (I-1200)          | QPM06500 |
| 855  | CONTINUE                               | QPM06510 |
| 1855 | CCONTINUE                              | QPM06520 |
|      | IF (NZ3.EQ.NO) GO TO 1856              | QPM06530 |
|      | DO 856 I=1229,1240                     | QPM06540 |
|      | WRITE (NT6,407) I,CM (I-1200)          | QPM06550 |
| 856  | CONTINUE                               | QPM06560 |
| 1856 | CONTINUE                               | QPM06570 |
|      | IF (NZ4.EQ.NO) GO TO 1069              | QPM06580 |
|      | DO 69 I=1241,NC                        | QPM06590 |
|      | WRITE (NT6,407) I,CM (I-1200)          | QPM06600 |

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| 69   | CONTINUE  | QPM06610 |
| 1069 | CONTINUE  | QPM06620 |
|      | WRITE(NT6,405)  | QPM06630 |
|      | WRITE(NT6,408)  | QPM06640 |
| 408  | FORMAT(3HEOF)   | QPM06650 |
| 860  | FORMAT(1HM,2X,F6.2,I3,I3)   | QPM06660 |
| 870  | FORMAT(1HQ,2X,F6.2,I3,I3)   | QPM06670 |
|      | WRITE(6,217)NT6   | QPM06680 |
| 217  | FORMAT(' THE QPRAND MATRIX HAS BEEN CREATED ON FILE',I3)          | QPM06690 |
|      | WRITE(6,2)NT7   | QPM06700 |
| 2    | FORMAT(' INFO. FOR THE REPORT WRITER HAS BEEN PLACED ON FILE',I3) | QPM06710 |
|      | STOP  | QPM06720 |
|      | END   | QPM06730 |

|     |   |          |
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|     | DIMENSION S(70),MQ(30),TTQM(30),M1(30),M2(30)                     | QPR00010 |
|     | REAL*8 V(12)  | QPR00020 |
|     | DATA V(1),V(2),V(3),V(4),V(5),V(6),V(7),V(8),V(9),V(10),V(11),    | QPR00030 |
|     | \$V(12)/'FIRST ','SECOND ','THIRD ','FOURTH ','FIFTH ',           | QPR00040 |
|     | ,\$'SIXTH ','SEVENTH ','EIGHT ','NINTH ','TENTH ',                | QPR00050 |
|     | ,\$'ELEVENTH ','TWELFTH'/'  | QPR00060 |
|     | DATA CK/'NEAR'/'  | QPR00070 |
|     | DATA AK/'P10'/'   | QPR00080 |
|     | ALINL=0.  | QPR00090 |
|     | ISCI=1  | QPR00100 |
|     | NT5=5   | QPR00110 |
|     | NT7=13  | QPR00120 |
|     | AQUAI=0.  | QPR00130 |
|     | WRITE(6,201)  | QPR00140 |
| 201 | FORMAT( ' THE FOLLOWING ARE DEBT ISSUANCE STRATEGIES DERIVED BY A | QPR00150 |
|     | \$QUADRATIC PROGRAM',/)   | QPR00160 |
|     | WRITE(6,202)  | QPR00170 |
|     | WRITE(6,203)  | QPR00180 |
|     | WRITE(6,204)  | QPR00190 |
|     | WRITE(6,205)  | QPR00200 |
| 202 | FORMAT( ' THE PROCEDURE WAS WRITTEN BY',/)                        | QPR00210 |
| 203 | FORMAT( 10X,' LOREN TAUER')                                       | QPR00220 |
| 204 | FORMAT( 10X,' DEPT. OF AG. ECON.')                                | QPR00230 |
| 205 | FORMAT( 10X,' CORNELL UNIVERSITY'/////)                           | QPR00240 |
|     | N4=0  | QPR00250 |
| 300 | CONTINUE  | QPR00260 |
|     | N4=N4+1   | QPR00270 |
|     | READ(NT7,301,END=302)MQ(N4),TTQM(N4),M1(N4),M2(N4)                | QPR00280 |
| 301 | FORMAT( A1,2X,F6.2,I3,I3)   | QPR00290 |
|     | GO TO 300   | QPR00300 |
| 302 | N4=N4-1   | QPR00310 |
|     | N5=N4+40  | QPR00320 |
|     | C READ FILE UNTIL LINEAR TERM IS REACHED                          | QPR00330 |
| 30  | CONTINUE  | QPR00340 |
|     | READ(NT5,10,END=99)BCK  | QPR00350 |
| 10  | FORMAT( 61X,A4)   | QPR00360 |
|     | IF(BCK.NE.CK) GO TO 30  | QPR00370 |
| 31  | CONTINUE  | QPR00380 |
|     | READ(NT5,11,END=99)ALIN,AQUA                                      | QPR00390 |
| 11  | FORMAT( 54X,F17.6,5X,F19.6)                                       | QPR00400 |
|     | IF(AQUA.LE.0.) AQUA=0.  | QPR00410 |
|     | AQUA=SQRT(AQUA)*.001  | QPR00420 |
|     | ALIN=ALIN*.001  | QPR00430 |
|     | IF(ALIN.EQ.ALINL.AND.AQUA.EQ.AQUAL) GO TO 30                      | QPR00440 |
|     | READ(NT5,16)B1,B2,B3,B4   | QPR00450 |
| 16  | FORMAT(A4/A4/A4/A4)   | QPR00460 |
|     | DO 23 J=1,N5  | QPR00470 |
|     | S(J)=0.   | QPR00480 |
| 23  | CONTINUE  | QPR00490 |
| 24  | CONTINUE  | QPR00500 |
|     | READ(NT5,12,END=41,ERR=99)ACK,M,B                                 | QPR00510 |
| 12  | FORMAT( 3X,A3,I2,1X,F20.6)  | QPR00520 |
|     | IF(ACK.NE.AK) GO TO 41  | QPR00530 |
|     | DO 22 J=1,N5  | QPR00540 |
|     | IF(J.EQ.M) GO TO 50   | QPR00550 |

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22    CONTINUE                                QPR00560
50    CONTINUE                                QPR00570
      S(J)=E                                  QPR00580
      GO TO 24                                QPR00590
41    CONTINUE                                QPR00600
      WRITE(6,101) ISCL                       QPR00610
101   FORMAT('1',18X,' DEBT ISSUANCE FOR THE NEXT 12 MONTHS',2X,
      $'STRATEGY NUMBER',I3)                 QPR00620
      WRITE(6,87)                             QPR00630
87    FORMAT(25X,' (IN MILLIONS OF DOLLARS)',//) QPR00640
      WRITE(6,102)                             QPR00650
102   FORMAT(22X,'NINE-MONTH',4X,'SIX-MONTH',4X,'DISCOUNT NOTES') QPR00660
      WRITE(6,103)                             QPR00670
103   FORMAT(24X,'BONDS',9X,'BONDS',7X,
      $'10, 20, OR 30 DAY',//)              QPR00680
104   FORMAT(2X,A8,1X,'MONTH',5X,F11.3,2X,F11.3,5X,F11.3) QPR00690
105   FORMAT(4X,'LAST THIRD',36X,F11.3)      QPR00700
      WRITE(6,104) V(1),S(29),S(17),S(1)     QPR00710
      WRITE(6,105) S(2)                       QPR00720
      WRITE(6,104) V(2),S(30),S(18),S(3)     QPR00730
      WRITE(6,104) V(3),S(31),S(19),S(4)     QPR00740
      WRITE(6,104) V(4),S(32),S(20),S(5)     QPR00750
      WRITE(6,105) S(6)                       QPR00760
      WRITE(6,104) V(5),S(33),S(21),S(7)     QPR00770
      WRITE(6,104) V(6),S(34),S(22),S(8)     QPR00780
      WRITE(6,104) V(7),S(35),S(23),S(9)     QPR00790
      WRITE(6,105) S(10)                     QPR00800
      WRITE(6,104) V(8),S(36),S(24),S(11)    QPR00810
      WRITE(6,104) V(9),S(37),S(25),S(12)    QPR00820
      WRITE(6,104) V(10),S(38),S(26),S(13)   QPR00830
      WRITE(6,105) S(14)                     QPR00840
      WRITE(6,104) V(11),S(39),S(27),S(15)   QPR00850
      WRITE(6,104) V(12),S(40),S(28),S(16)   QPR00860
      WRITE(6,401)                             QPR00870
401   FORMAT('//,30X,'LONG-TERM BONDS',//)    QPR00880
      WRITE(6,402)                             QPR00890
402   FORMAT(15X,'MONTH OR QUARTER',5X,'MATURITY',10X,'AMOUNT') QPR00900
      DO 769 J=1,N4                             QPR00910
      WRITE(6,303) M1(J),MQ(J),TTQM(J),S(J+40) QPR00920
303   FORMAT(20X,I2,1H-,A1,14X,F6.2,5X,F11.3) QPR00930
769   CONTINUE                                QPR00940
      WRITE(6,106) ALIN                       QPR00950
106   FORMAT(/,25X,'EXPECTED DISCOUNTED COST = ',F11.3) QPR00960
      WRITE(6,107) AQUA                       QPR00970
107   FORMAT(31X,'STANDARD DEVIATION = ',F11.3,///) QPR00980
      ALINI=ALIN                               QPR00990
      AQUA=AQUA                               QPR01000
      ISOL=ISOL+1                             QPR01010
      GO TO 30                                 QPR01020
99    CONTINUE                                QPR01030
      WRITE(6,108)                             QPR01040
108   FORMAT(20X,'***** END OF THE SOLUTIONS *****') QPR01050
      STOP                                     QPR01060
      END                                     QPR01070
                                           QPR01080
                                           QPR01090

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## 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)                 |                 | MAIN0120 |
|   | DATA MINDMI,MINDM2,MINDM3 | /15000,500,500/ | MAIN0350 |
| 2 | ,A(30000)                 |                 | BGN 0050 |
|   | DO 350 I=5, 13, 2         |                 | CAP 1680 |
|   | KBCD(NTAL+1)=KM2(21)      |                 | OUP 0440 |